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Second Edition

Second Language Acquisition Research Series

THEORIES IN SECOND LANGUAGE ACQUISITION

AN INTRODUCTION

Edited by
Bill VanPatten and Jessica Williams

ROUTLEDGE

THEORIES IN SECOND LANGUAGE ACQUISITION

The second edition of the best-selling *Theories in Second Language Acquisition* builds on the strengths of the first edition by surveying the major theories currently used in second language acquisition (SLA) research, serving as an ideal introductory text for undergraduate and graduate students in SLA and language teaching. Each chapter focuses on a single theory, written by a leading scholar in the field in an easy-to-follow style—a basic foundational description of the theory, relevant data or research models used with this theory, common misunderstandings, and a sample study from the field to show the theory in practice. This text is designed to provide a consistent and coherent presentation for those new to the field who seek basic understanding of theories that underlie contemporary SLA research but will also be useful to researchers as a "quick guide" to theoretical work outside their respective domains.

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An Introduction

Second Edition

Edited by Bill VanPatten and Jessica Williams

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PREFACE

This book focuses on a number of contemporary mainstream theories in second language acquisition (SLA) research that have generated attention among scholars. For several decades, the field of SLA has struggled with the nature of theories, what they are, and what would be an "acceptable" theory of SLA. Indeed, the present volume draws on one particular publication by Michael Long in a special issue of the *TESOL Quarterly* from 1990 devoted to the construction of a theory in SLA. In that article, Long discussed the nature of what a theory needs to be in SLA and also summarized the research to establish "the least" a theory of SLA needs to explain. We borrow from Long's article in our first chapter to outline the challenges to contemporary theories and list 10 observations that need to be accounted for on theoretical grounds.

One might ask why there are so many "competing" theories in SLA at this point. Why isn't there just one theory that accounts for SLA? What is it about SLA that invites a diffusion of theoretical perspectives? To understand this, one might consider the parable about the four blind men and the elephant. These sightless men chance upon a pachyderm for the first time and one, holding its tail, says, "Ah! The elephant is very much like a rope." The second one has wrapped his arms around a giant leg and says, "Ah! The elephant is like a tree." The third has been feeling alongside the elephant's massive body and says, "Ah! The elephant is very much like a wall." The fourth, having seized the trunk, cries out, "Ah! The elephant is very much like a snake." For us, SLA is a big elephant that researchers can easily look at from different perspectives. SLA is, after all, an incredibly complex set of processes, and if you have been introduced to the field via any of the excellent overviews of SLA, this most likely is your conclusion. Thus, researchers have grabbed onto different parts of the elephant as a means of coming to grips with the complex phenomenon. This does not mean, however, that researchers and scholars have

gone poking around SLA blindly and without thought; the present chapters should convince you otherwise. Unlike the blind men of our fable, researchers grasp that to understand the whole of SLA, they may need to concentrate on the smaller parts first. In the end, we may even need multiple complementary theories to account for different observed phenomena of SLA. As you complete the readings in your book, you might ask yourself, "Just what part of the elephant is each theory examining?"

The present book came about as a perceived need to have a comprehensive yet readily accessible set of readings for the beginning student of SLA. Each of us has taught introductory courses on SLA to students in TESOL and applied linguistics, and we have felt that a good introduction to theories is beneficial. At the same time, we know that it is easy for authors who don't work in a particular theory to reduce the theory to the point of students misinterpreting it or to misinterpret the theory themselves and pass on this misinterpretation to students. To this end, we decided that a collection of chapters written by the experts who work in the theories would best suit our needs as well as those of our students. We are pleased to present this volume for the beginning student of SLA.

Since the publication of the first edition of this book, the field has continued to develop, incorporating insights from theories and research methods from other fields. In response to some of these developments, we have added two new theories to the original set in the first volume. However, it is important to be clear that this book does not cover *all theories* of SLA. Notably, it does not cover theories that take "a social turn." The focus of the original book was on linguistic, psycholinguistic, and cognitive perspectives in SLA, and the second volume has maintained this focus. Since the publication of the first edition, there have been several fine books exploring alternative and, in particular, more social perspectives on SLA. We believe that they complement the current volume.

ACKNOWLEDGMENTS

Since its inception, this volume has been developed with the novice reader in mind—the beginning student of SLA who may not have much background in linguistics or SLA. Keeping that novice reader in mind has been a challenge for us and no less for the various contributors whose theories you will read here. The process of getting this volume into final form was long and demanded considerable effort on the part of the contributors to present some very complex notions in an accessible and consistent format. We know this often tried the patience of our authors. We took them away from their research and teaching duties to answer our numerous queries and revise their chapters, not once but, for most of the authors, now twice for the second edition. That they stuck with us to the end is a demonstration of their commitment and dedication to the profession and to its newest members. They have our heartfelt thanks. We also thank Megan Smith, who worked to format and finalize the manuscript before it went to the publisher. Finally, we thank the folks at Routledge for bringing this volume into the hands of the reader.

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1

INTRODUCTION

The Nature of Theories

Bill VanPatten and Jessica Williams

Almost everyone has heard of Einstein's Theory of Relativity. People have also heard of things such as the "Theory of Evolution" and "Atomic Theory." What is common to all these theories is that they are theories about what scientists call *natural phenomena*: things that we observe everyday. Theories are a fundamental staple in science, and all advances in science are, in some way or another, advances in theory development. If you asked scientists, they would tell you that the sciences could not proceed without theories. And if you ask applied scientists (such as those who develop medicines or attempt to solve the problem of how to travel from Earth to Mars), they would tell you that a good deal of their work is derived from theoretical insights.

Theories are also used in the social and behavioral sciences, such as psychology, sociology, and economics. As in the natural sciences, social sciences attempt to explain observed phenomena, such as why people remember some things better than others under certain conditions or why the stock market behaves the way it does.

In the field of second language acquisition (hereinafter SLA) research, theories have also come to occupy a central position. Some researchers, though by no means all, would even say that the only way SLA can advance as a research field is if it is *theory driven*. The purpose of the present book is to introduce the reader to certain current theories in SLA and provide a background for continued in-depth reading of the same. As a starting point, we will need to examine the nature of theories in general.

What Is a Theory?

At its most fundamental level, a **theory** is a set of statements about natural phenomena that explains why these phenomena occur the way they do. In the sciences, theories are used in what Kuhn (1996) calls the job of "puzzle solving."

By this Kuhn means that scientists look at observable phenomena as puzzles or questions to be solved. Why does the earth revolve around the sun and not fly off into space? Why are humans bipedal but gorillas knuckle-walkers? These are all questions about things that confront us every day, and it is the job of scientists to account for them.

In short, then, the first duty of a theory is to *account for* or *explain* observed phenomena. But a theory ought to do more than that. A theory also ought to make predictions about what would occur under specific conditions. Let's look at three examples: one familiar, the other two perhaps less so. In the early part of the 19th century, scientists were already aware of the presence of microorganisms in the air and water, and they had an idea about the connection between the organisms and disease. However, they had no idea of how they came into existence; indeed, belief in the spontaneous generation of these organisms was widespread. Disease was thought to be caused by "bad air." Careful experimentation by Louis Pasteur and other scientists demonstrated that microbes, though carried by air, are not created by air. Living organisms come from other living organisms. These discoveries led to the development of the *germ theory of disease,* which proposed that disease was caused by microorganisms. The acceptance of this theory had obvious important applications in public health, such as the development of vaccines, hygienic practices in surgery, and the pasteurization of milk. It not only could *explain* the presence and spread of disease, it could also *predict,* for example, that doctors who delivered babies without washing their hands after performing autopsies on patients who had died from childbirth fever would transmit the disease to new patients. Even more important, the same theory could be used to *connect* phenomena that, on the surface, appeared unrelated, such as the transmittal of disease, fermentation processes in wine and beer production, and a decline in silkworm production.

Now let's take an example from psychology. It is an observed phenomenon that some people read and comprehend written text faster and better than others. As researchers began to explore this question, a theory of individual differences in working memory evolved. That theory says that people vary in their ability to hold information in what is called working memory (defined, roughly, as that mental processing space in which a person performs computations on information at lightening speed). More specifically, the theory says that people vary in their working memory *capacity*: Some have greater capacity for processing incoming information compared with others, but for everyone, capacity is limited in some way. Initially used to account for individual differences in reading comprehension ability in a person's first language, the theory also accounts for a wide range of seemingly unrelated phenomena, such as why people remember certain sequences of numbers and not others, why they recall certain words that have been heard, why people vary on what parts of sentences they remember best, why certain stimuli are ignored and others attended to, and why some students are good note takers and others are not. A theory of working

memory, then, allows psychologists to unify a variety of behaviors and outcomes that on the surface level do not necessarily appear to be related. There are even attempts to apply the theory of SLA to explain why some people learn faster and better than others.

Let's take a final example, this time from language. In one theory of syntax (sentence structure), a grammar can allow movement of elements in the sentence. This is how we get two sentences that essentially mean the same thing, as in the following:

(1) Mary said what?
(2) What did Mary say?

In this particular theory, the *what* is said to have moved from its position as an object of the verb *said* to occupy a place in a different part of the sentence. At the same time, this theory also says that when something moves, it leaves a hidden *trace.* Thus, the syntactician would write (2) like (3):

(3) What$_i$ did Mary say t_i?

In (3) the *t* stands for the empty spot that the *what* left and the *i* simply shows that the *what* and the *t* are "co-indexed"; that is, if there happens to be more than one thing that moves, you can tell which trace it left behind.

To add to the picture, the theory also says that *t*s, although hidden, are psychologically real and occupy the spot left behind. Thus, nothing can move into that spot and no contractions can occur across it. Armed with this, the syntactician can make a variety of predictions about grammatical and ungrammatical sentences in English. We might predict, for example, that (4) is a good sentence but (5) is bad and not allowed by English grammar:

(4) Should I have done it?
(5) Should I've done it?

The reason for this is that *should* has moved from its original spot and left a *t* behind, as illustrated in (6):

(6) I should have done it. → Should$_i$ I t_i have done it?

At the same time, the syntactician would predict restrictions on the contraction of *want to* to *wanna*. Thus, (7) is fine because there is no trace intervening where a contraction wants to happen:

(7) Who$_i$ do you want to invite t_i to dinner? → Who do you wanna invite to dinner?

All English speakers would agree, however, that (8) is awful:

(8) *Who do you wanna take Susie to the prom next month?

You could probably work this out yourself, but the reason (8) sounds bad is that the *who* has moved and has left behind a *t* that blocks a possible contraction. Compare (7) and (8) redone here as (9) and (10):

(9) Who$_i$ do you want to invite t_i to dinner? → Who do you wanna invite to dinner?
(10) Who$_i$ do you want t_i to take Susie to the prom next month? → *Who do you wanna take Susie to the prom next month?

Be careful not to pronounce *wanna* like *want tuh*; *want tuh* is not a contraction and is merely the schwawing of the vowel sound in *to. Want tuh* sounds OK in sentence (8) precisely because it is not a contraction.

Thus, the theory unifies constraints on contractions with modals (*should, would, will, may, might*), with auxiliaries (*do, have*), with copular verbs (*be*), with the verb *want,* and with pronouns (*I, you, he,* and so on). It makes predictions about good and bad sentences that perhaps we have never seen or heard, some of which—like silkworms and beer—don't seem to have much in common.

To summarize so far, a theory ought to account for and explain observed phenomena and also make predictions about what is possible and what is not. In addition, most theories—good ones, that is—when accounting for and predicting things, also tend to unify a series of generalizations about the world or unify a series of observations about the world. In the brief view we had of syntactic theory, the few generalizations made about how syntax works unify a variety of observations about contractions and not just contractions with *should*. All contractions conform to the generalizations.

For SLA, then, we will want a theory that acts like a theory should. We will want it to account for observable phenomena (something to which we turn our attention later in this chapter). We want it to make predictions. And, ideally, we want it to unify the generalizations we make as part of the theory. In other words, we want a single theory to bring all of the observed phenomena under one umbrella. Whether this is possible at this time has yet to be determined and is something that this book will explore.

What Is a Model?

Many people confuse theories and models. A **model** describes processes or sets of processes of a phenomenon. A model may also show how different components of a phenomenon interact. The important word here is *how.* A model does not need to explain *why.* Whereas a theory can make predictions based on generalizations,

this is not required of a model. The problem is that in the real world—and in SLA as a research discipline—this distinction is not always maintained. You will find as you read further in the field that researchers often use *model* and *theory* interchangeably. Thus, although in principle it would be a good idea to distinguish between these two terms as they do in the natural sciences, in practice many of us in SLA do not do so.

What Is a Hypothesis?

Distinct from a theory, a **hypothesis** does not unify various phenomena; it is usually an idea about a single phenomenon. Some people use theory and hypothesis interchangeably, but in fact, they are distinct and should be kept separate. In science, we would say that a theory can generate hypotheses that can then be tested by experimentation or observation. In psychology, for example, there are theories regarding memory. You may recall the theory about working memory and capacity discussed earlier. The theory says (among many other things) that working memory is limited in capacity. This means that people can pay attention to only so much information at a given time before working memory is overloaded. The theory also says that there are individual differences in working memory and how people use what they have. Some people have *X* amount of working memory capacity as they attend to incoming information, whereas others have more or less. A hypothesis that falls out of this, then, is that working memory differences among individuals should affect reading comprehension: Those with greater working memory capacity should be faster readers or should comprehend more. This is a testable hypothesis. We ought to add here that the only valuable hypotheses for a theory are those that are testable, meaning some kind of experiment can be run or some kinds of data can be examined to see if the hypothesis holds up. Another example of a hypothesis comes from SLA: the Critical Period Hypothesis. This is a theory in neurolinguistics that states that at an early age, the brain begins to specialize; specific brain functions become increasingly associated with specific areas of the brain. In addition, some functions may be developmentally controlled; that is, they turn on and, more important for language learning, turn off at specific points in development. The Critical Period Hypothesis is a direct consequence of this theory. It states that the ability to attain native-like proficiency in a language is related to the initial age of exposure. If language learning begins after a certain age (and there is a considerable controversy over what this age is as well as whether there even is a critical period—see the various papers in Birdsong, 1999), the learners will never reach a level of proficiency or competence comparable to a native speaker's. A corollary to this hypothesis is that language learning ability declines with age after this point. Again, both of these are testable hypotheses. Recall that earlier we said we wanted a theory to make predictions. Predictions are actually hypotheses. When we make a prediction based on a theory, we are in effect making a hypothesis.

These definitions about theories, models, and hypotheses are important because in everyday speech, we may use the term *theory* in a way not intended in science. For example, one might hear in a disparaging tone that something is "just a theory." In science, the phrase "just a theory" makes no sense, as all work is theoretically driven. What is more, the term *theory* has often been politicized to denigrate particular theories (e.g., evolution) so that "just a theory" becomes a way of dismissing something that has scientific rigor but runs against some other set of beliefs. Finally, in movies and other nonscientific situations, one often hears the term *theory* used to mean "an idea" or a "hypothesis." A detective trying to solve a crime might say, "I have a theory about the killer," when that detective means, "I have an idea about the killer." We cannot, of course, rid everyday speech of how it uses certain words. Our point in bringing up the everyday use of *theory* is to make sure that the reader understands the term as it is used in this book.

Constructs

All theories have what are called **constructs**. Constructs are key features or mechanisms on which the theory relies; they must be definable in the theory. In the theory about disease transmission, *germ* is a construct. In the theory about working memory, *capacity* is a construct; and in the theory about syntax, a *trace* is a construct.

In evaluating any theory, it is important to understand the constructs on which the theory relies; otherwise, it is easy to judge a theory one way or another—that is, as a good or bad theory—without a full understanding of the underpinnings of the theory. For example, without an understanding of the construct *germ,* it would have been easy to dismiss germ theory. But given that the construct *germ* was easily definable and identifiable, dismissal of germ transmission and diseases was not so facile. To fully understand something like Relativity, one must have a thorough grasp of the constructs *time, space,* and others.

In SLA, we find an abundance of constructs that are in need of definitions. For example, take the term *second language acquisition* itself. Each word is actually a construct, and you can ask yourself, "What does *second* mean?" "What does *language* mean?" and "How do we define *acquisition*?" In SLA theorizing, most people use the term *second* to mean any language other than one's first language. It makes no difference what the language is, where it is learned, or how it is learned. This suggests, then, that any theorizing about SLA ought to apply equally to the person learning Egyptian Arabic in Cairo without the benefit of instruction as to the person learning French in a foreign language classroom in the United States. By defining *second* in an all-encompassing way, it has an effect on the scope of the theory. If the construct *second* were not defined this way, then it would have limited scope over the contexts of language learning. For example, some people define *second* language to refer to a language learned where it is spoken (e.g., immigrants learning English in this country, an American learning Japanese in Osaka), whereas *foreign* is used to refer to situations in which the language is not

spoken outside of the classroom (e.g., German in San Diego, California). Thus, if *second* were defined in the more restricted way, a theory of SLA would be limited to the first context of learning.

The term *language* is deceptively simple as a construct, but have you ever tried to define it? Does it mean speech? Or does it mean the rules that govern speech production? Or does it mean the unconscious knowledge system that contains all the information about language (e.g., the sound system, the mental dictionary, syntactic constraints, rules on word formation, rules on use of language in context)? Thus, any theory about SLA needs to be clear on what it means by *language*. Otherwise, the reader may not fully grasp what the theory claims, or worse, misinterpret it.

In summary, here are key issues discussed so far:

- Theories ought to explain observable phenomena.
- Theories ought to unify explanations of various phenomena where possible.
- Theories are used to generate hypotheses that can be tested empirically.
- Theories may be explanations of a *thing* (such as language) or explanations of *how* something comes to be (such as the acquisition of language).
- Theories have constructs, which in turn are defined in the theory.

Why Are Theories and Models Either Good or Necessary for SLA Research?

We have explored what theories are but only obliquely addressed why they might be useful. Certainly, they help us to understand the phenomena that we observe. Consider again the Critical Period Hypothesis. It has often been observed that speakers who begin the process of SLA later in life usually have an accent. A theory about the loss of brain plasticity during natural maturation may help explain this phenomenon. The same theory might predict that learners who begin foreign language study in high school will be less likely to approach a native-like standard of pronunciation than those learners who have access to significant amounts of target-language input much earlier in life. These kinds of predictions have clear practical applications; for example, they suggest that foreign language learning should begin at a young age.

Let's look at another concrete example. In one theory of SLA, producing language (usually called *output*) is considered an important element in structuring linguistic knowledge and anchoring it in memory. In another theory, in contrast, output is considered unimportant in developing second language knowledge. Its role is limited to building control over knowledge that has already been acquired. These differences in theory would have clear and important consequences for second language instruction. In the first case, output practice would have a significant role in all aspects of instruction. In the second case, it would be most prominent in fluency practice.

So far we have explored the utility of theories from a practical, real-world perspective. Theories are also useful in guiding research, which may not always have immediate practical purposes related to, say, instruction. If we step back for a moment and consider the theories previously mentioned, we have looked at the following:

1. a theory that explains/predicts constraints on contraction in English
2. a theory that explains/predicts foreign accents in adult learners
3. theories that predict the role of output in the second language acquisition process

You may notice that they are not all the same. The first is a theory of *what* is to be acquired, that is, the unconscious mental representation of constraints on language. It is not enough to say, for example, that learners are acquiring English, for this begs the question, "What is English? How is it different from Spanish or Chinese?" Clearly, a dictionary of the English language is not the language itself, and so memorizing a dictionary is not equivalent to acquiring English. Nor would it be sufficient to study a big grammar book and commit all its rules to memory. It is very unlikely that any grammar book includes the *wanna/'ve* rule that appeared earlier in this chapter, for example. And what about the sound system and constraints on syllable formation (e.g., no syllable in English can start with the cluster *ru,* but such a syllable-initial cluster is possible in French)? In short, English, like any other language, is complex and consists of many components. You may recall that we touched on this issue when we noted that *language* itself is a construct that a theory needs to define. Once the theory defines what it means by *language,* it can better guide the questions needed to conduct research.

The second two items on the preceding list are not really about the target of acquisition; rather, they address the factors that affect learning outcomes (e.g., the Critical Period position) or they address *how* learning takes place, in other words, processes learners must undergo. These processes may be internal to the learner (such as what might be happening in working memory as the learner is attempting to comprehend language and how this impacts learning) or they may be external to the learner (such as how learners and native speakers engage in conversation and how this impacts learning). Theories regarding factors or processes are clearly different from theories about the *what* of acquisition, but they, too, can guide researchers conducting empirical research.

Finally, research can return the favor to theorists by evaluating competing theories. For example, one theory of learning, including language learning, maintains that humans are sensitive to the frequency of events and experiences and that this sensitivity shapes their learning. Within this theory, linguistic elements are abstracted from exposure to language and from language use. What look like rules in a learner's grammar are really just the result of repeated exposure to regularities in the input. A competing theory maintains that language learning takes place

largely by the interaction of innate knowledge (i.e., human-specific and universal linguistic knowledge) and data gathered from the input. Within this theory, frequency may have some role in making some aspects of language more "robust," but it is not a causal factor as it is in the first theory. Each of these two theories can generate predictions, or hypotheses, about how language acquisition will take place under specific conditions. These hypotheses can then be tested against observations and the findings of empirical studies.

What Needs to Be Explained by Theories in SLA?

As we mentioned at the outset of this chapter, one of the roles of theories is to explain observed phenomena. Examples we gave from the sciences were the observation that the Earth revolves around the sun and doesn't fly off into space and that humans are bipedal while our closest relatives are knuckle-walkers. Theories in science attempt to explain these observations, that is, tell *why* they exist.

In the field of SLA research, a number of observations have been cataloged (e.g., Long, 1990), and what follows is a condensed list of them. At the end of the chapter are references for more detailed accounts of these observations.

Observation 1: Exposure to input is necessary for SLA. This observation means that acquisition will not happen for learners of a second language unless they are exposed to input. Input is defined as language the learner hears (or reads) and attends to for its meaning. For example, when a learner hears "Open your books to page 24" in a second language, the learner is expected to comprehend the message and open his or her book to page 24. Language the learner does not respond to for its meaning (such as language used in a mechanical drill) is not input. Although everyone agrees that input is necessary for SLA, not everyone agrees that it is sufficient.

Observation 2: A good deal of SLA happens incidentally. This captures the observation that various aspects of language enter learners' minds/brains when they are focused on communicative interaction (including reading). In other words, with incidental acquisition, the learner's *primary* focus of attention is on the message contained in the input, and linguistic features are "picked up" in the process. Incidental acquisition can occur with any aspect of language (e.g., vocabulary, syntax, morphology [inflections], phonology).

Observation 3: Learners come to know more than what they have been exposed to in the input. Captured here is the idea that learners attain unconscious knowledge about the L2 that could not come from the input alone. For example, learners come to know what is ungrammatical in a language, such as the constraints on *wanna* contraction that we saw earlier in this chapter. These constraints are not taught and are not evident in the samples of language learners hear. Another kind of unconscious knowledge that learners attain involves ambiguity. Learners come to know, for example, that the sentence *John told Fred that he was going to sing* can mean that either John will sing or Fred will sing.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. Learners' speech shows evidence of what are called "developmental sequences." One example involves the acquisition of negation in English. Learners from all language backgrounds show evidence of the following stages:

Stage 1: *no* + phrase: *No want that.*
Stage 2: subject + *no* + phrase: *He no want that.*
Stage 3: *don't, can't, not* may alternate with *no: He can't/don't/not want that.*
Stage 4: Negation is attached to modal verbs: *He can't do that.*
Stage 5: Negation is attached to auxiliaries: *He doesn't want that.*

In addition to developmental sequences, there are such things as "acquisition orders" for various inflections and small words. For example, in English, *-ing* is mastered before regular past tense, which is mastered before irregular past tense forms, which in turn are mastered before third-person (present tense) *-s.* These stages of development also capture the observation that learners may pass through "U-shaped" development. In such a case, the learner starts out doing something correctly then subsequently does it incorrectly and then "reacquires" the correct form. A classic example comes from the irregular past tense in which learners begin with *came, went* (and similar forms), then may begin to produce *camed, goed/wented,* and then later produce the correct *went, came* and other irregular forms.

Observation 5: Second language learning is variable in its outcome. Here we mean that not all learners achieve the same degree of unconscious knowledge about a second language. They may also vary on speaking ability, comprehension, and a variety of other aspects of language knowledge and use. This may happen even under the same conditions of exposure. Learners under the same conditions may be at different stages of developmental sequences or be further along than others in acquisition orders. What is more, it is a given that most learners do not achieve native-like ability in a second language.

Observation 6: Second language learning is variable across linguistic subsystems. Language is made up of a number of components that interact in different ways. For example, there is the sound system (including rules on what sound combinations are possible and impossible as well as rules on pronunciation), the lexicon (the mental dictionary along with word-specific information such as verb "X" cannot take a direct object or it requires a prepositional phrase or it can only become a noun by addition of *-tion* and not *-ment,* for example), syntax (what are possible and impossible sentences), pragmatics (knowledge of what a speaker's intent is, say, a request versus an actual question), and others. Learners may vary in whether the syntax is more developed compared with the sound system, for example.

Observation 7: There are limits on the effects of frequency on SLA. It has long been held that frequency of occurrence of a linguistic feature in the input correlates with whether it is acquired early or late, for example. However, frequency is not

an absolute predictor of when a feature is acquired. In some cases, something very frequent takes longer to acquire than something less frequent.

Observation 8: There are limits on the effect of a learner's first language on SLA. Evidence of the effects of the first language on SLA has been around since the beginning of contemporary SLA research (i.e., the early 1970s). It is clear, however, that the first language does not have massive effects on either processes or outcomes, as once thought. (We will review one particular theory in Chapter 2.) Instead, it seems that the influence of the first language is somehow selective and also varies across individual learners.

Observation 9: There are limits on the effects of instruction on SLA. Teachers and learners of languages often believe that what is taught and practiced is what gets learned. The research on instructed SLA says otherwise. First, instruction sometimes has no effect on acquisition. As one example, instruction has not been shown to cause learners to skip developmental sequences or to alter acquisition orders. Second, some research has shown that instruction is detrimental and can slow down acquisition processes by causing stagnation at a given stage. On the other hand, there is also evidence that in the end, instruction may affect how fast learners progress through sequences and acquisition orders and possibly how far they get in those sequences and orders. Thus, there appear to be beneficial effects from instruction, but they are not direct and not what many people think.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. Although it may seem like common sense that "practice makes perfect," this adage is not entirely true when it comes to SLA. There is evidence that having learners produce language has an effect on acquisition, and there is evidence that it does not. What seems to be at issue, then, is that whatever role learner production (i.e., using language to speak or write) plays in acquisition, there are constraints on that role, as there on other factors, as noted earlier.

Again, the role of a theory is to explain these phenomena. It is not enough for a theory to say they exist or to predict them; it also has to provide an underlying explanation for them. For example, natural orders and stages exist. But why do they exist and why do they exist in the form they do? Why do the stages of negation look the way they do? As another example, why is instruction limited? What is it about language acquisition that puts constraints on it? Why can't stages of acquisition be skipped if instruction is provided for a structure? And if instruction can speed up processes, why can it?

As you read through the various theories in this volume, you will see that current theories in SLA may explain close to all, some, or only a few of the phenomena. What is more, the theories will differ in their explanations as they rely on different premises and different constructs.

The Explicit/Implicit Debate

Of concern and considerable controversy in the field of SLA are the roles of explicit and implicit learning and knowledge. These concepts are notoriously

difficult to define, in part because they rest on constructs such as consciousness and awareness, which themselves have been the subject of extended scholarly debate.

Hulstijn (2005) defines the distinction in learning as follows:

> Explicit learning is input processing with the conscious intention to find out whether the input information contains regularities and, if so, to work out the concepts and rules with which these regularities can be captured. Implicit learning is input processing without such an intention, taking place unconsciously. (p. 131)

Hulstijn's definition of explicit learning appears to include both awareness of what is to be learned and the intention to learn it. Not all researchers agree. DeKeyser (2003) counts only the former as a hallmark of explicit learning and its absence as a defining feature of implicit learning, which he calls "learning without awareness of what is being learned" (p. 314). Elsewhere, Hulstijn (2003) also provides a more fine-grained distinction, noting that whereas explicit learning involves awareness at the point of learning, intentional learning additionally involves a "deliberate attempt to commit new information to memory" (p. 360). Ellis (2009a) offers a definition of explicit learning that includes intentionality, demands on attentional resources, and awareness of what is being learned and a definition of implicit learning as learning that takes place when all of these features are absent.

What is important to note about all of these definitions is the absence of instruction; that is, they present explicit/implicit learning from the viewpoint of what the learner thinks and does, not from the perspective of what the environment is doing to the learner. Thus, the issue that confronts us here is not the role of instruction (that is handled by Observation 9). Instead, the focus is on what is going on in the mind/brain of the learner when that learner is exposed to L2 input (with or without instruction). Thus, the reader is cautioned not to confuse explicit/implicit learning with explicit/implicit teaching.

As we mentioned, the relative roles (or contributions) of explicit and implicit learning are debated in SLA. Does SLA fully or largely involve explicit learning? Does it fully or largely involve implicit learning? Or does SLA somehow engage both explicit and implicit learning, and if so, how, under what conditions, and for what aspects of language? On one hand, some scholars have questioned whether learning without awareness is even possible. On the other hand, others have questioned whether explicit learning can ever provide the basis for spontaneous and automatic retrieval of knowledge.

Indeed, embedded within these questions about learning is the distinction between explicit and implicit knowledge. Ellis (2009b) asserts both a behavioral and neurobiological basis for this distinction. For the first, he offers "the well-attested fact that speakers of a language may be able to use a linguistic feature accurately and fluently without any awareness of what the feature consists of and vice versa" (p. 335), and for the second, "whereas implicit knowledge involves

widely divergent and diffuse neural structures . . . explicit knowledge is localized in more specific areas of the brain" (p. 335). Implicit and explicit learning and knowledge are clearly related yet distinct concepts (Schmidt, 1994). Ellis (2009a) connects them by referring to the resulting representations of the two types of learning. Specifically, he claims that implicit learning leads to subsymbolic knowledge representations, whereas explicit learning results in symbolic representations, allowing learners to verbalize what they have learned.

Regardless of the how one defines the two types of knowledge, the major question that has challenged researchers is the nature of any interface between them. Although most scholars agree that implicit knowledge is the goal of acquisition, how does implicit knowledge develop? Can explicit knowledge become implicit? Does explicit knowledge somehow aid the acquisition of implicit knowledge? Or are they completely separate systems, which, under most conditions of SLA, do not interact?

Because the field has not yet arrived at a consensus on these questions, and because there is conflicting evidence on the relative roles of explicit and implicit learning, we cannot offer an observation like those that have preceded this section. Therefore, we are asking the contributors to this volume to address explicit and implicit learning and knowledge in a special section in each chapter, asking them to discuss what each theory or framework would claim about the two types of learning and the development of the two types of knowledge.

About This Volume

In this volume, we have asked some of the foremost proponents of particular theories and models to describe and discuss them in an accessible manner to the beginning student of SLA theory and research. As they do so, the various authors address particular topics and questions so that the reader may compare and contrast theories more easily:

- The Theory and Its Constructs
- What Counts as Evidence for the Theory
- Common Misunderstandings
- An Exemplary Study
- How the Theory Addresses the Observable Phenomena of SLA
- The Explicit/Implicit Debate

Our own interests and areas of expertise have led us to the linguistic and cognitive aspects of SLA. Thus, the theories and perspectives taken in the present volume—for the most part—reflect such orientations. To be sure, there are social perspectives that can be brought to bear on SLA (see Atkinson, 2011; Block, 2003). These perspectives are often offered as "alternatives" to the linguistic and cognitive orientations that are said to dominate L2 research, but in our view, they

are simply looking at different phenomena (see, e.g., the discussion in Rothman & VanPatten, 2013). In excluding such perspectives from the present volume, we do not suggest that they are unimportant for the field of SLA research as a whole. Instead, our intention is to gather those approaches that currently compete to explain the acquisition of a linguistic system (with primary emphasis on syntax, morphology, and, to a lesser degree, the lexicon). For those who seek socially oriented frameworks used in L2 research, we suggest using something like Atkinson's (2011) edited volume (or parts of it) as an accompaniment to the present volume.

Discussion Questions

1. In what ways do theories affect our everyday lives? Try to list and discuss examples from politics, education, and society.
2. Discuss a theory from the past that has been disproved. Also discuss a theory from the past that has stood the test of time. Do you notice any differences between these theories in terms of their structures? Is one simpler than the other? Does one rely on nonnatural constructs for explanation?
3. Theories are clearly useful in scientific ventures and may have practical applications. They have also become useful, if not necessary, in the behavioral and social sciences. In what way is the study of SLA a scientific venture rather than, say, a humanistic one?
4. Reexamine the list of observable phenomena. Are you familiar with all of them and the empirical research behind them? You may wish to consult some basic texts on this topic listed in the "Suggested Further Reading" section (e.g., Ellis, Gass, Long).
5. Is there an observable phenomenon in particular you would like to see explained? Select one and, during the course of the readings, keep track of how each theory accounts for this phenomenon.

Suggested Further Reading

Atkinson, D. (Ed.). (2011). *Alternative approaches to second language acquisition*. New York, NY: Routledge.

This volume presents six approaches to SLA that complement or contrast with cognitive approaches to the field. Two of the approaches are represented in this volume.

Ellis, R. (2008). *The study of second language acquisition* (2nd ed.). Oxford, England: Oxford University Press.

This volume is a comprehensive overview of the field that continues to be an excellent resource on many topics in the field.

Gass, S. (2013). *Second language acquisition: An introductory course* (4th ed.). New York, NY: Routledge.

This is a basic introduction to the field in a form that is accessible to readers new to the field. It includes authentic data-based problems at the end of each chapter that help readers grapple with issues typical of SLA research.

Hustijn, J. (2005). Theoretical and empirical issues in the study of implicit and explicit second language learning. *Studies in Second Language Acquisition, 27,* 129–140.
This article is the introduction to a special issue on implicit and explicit learning and knowledge in SLA. As such, it provides a good overview of the issues on this topic.

Lightbown, P., & Spada, N. (2013). *How languages are learned* (4th ed.). Oxford, England: Oxford University Press.
This volume is aimed at teachers and focuses on language acquisition in classroom settings.

Long, M. H. (1990). The least a second language acquisition theory needs to explain. *TESOL Quarterly, 24,* 649–666.
The observations listed in this chapter are based, in part, on this seminal article.

Rothman, J., & VanPatten, B. (2013). On multiplicity and mutual exclusivity: The case for different theories. In M. P. García Mayo, M. J. Gutierrez-Mangado, & M. Martínez Adrián (Eds.), *Contemporary approaches to second language acquisition* (pp. 243–256). Amsterdam, Netherlands: John Benjamins.
This chapter, while taking a generative perspective on language, argues that different theories exist because of the complexity of acquisition, suggesting that multiple theories may be necessary to understand acquisition in its entirety.

VanPatten, B. (2003). *From input to output: A teacher's guide to second language acquisition.* New York, NY: McGraw-Hill.
This is an introductory volume for teachers with little background in SLA. It focuses on how input data are processed, what the linguistic system looks like and how it changes, and how learners acquire the ability to produce language, among other aspects of acquisition.

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Block, D. (2003). *The social turn in second language acquisition.* Edinburgh, Scotland: Edinburgh University Press.

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Ellis, R. (2009b). Retrospect and prospect. In R. Ellis, S. Loewen, C. Elder, R. Erlam, J. Philp, & H. Reinders (Eds.), *Implicit and explicit knowledge in second language learning, testing and teaching* (pp. 335–353). Bristol, England: Multilingual Matters.

Hulstijn, J. (2003). Incidental and intentional learning. In C. Doughty & M. Long (Eds.), *The handbook of second language acquisition* (pp. 349–381). Cambridge, England: Cambridge University Press.

Hulstijn, J. (2005). Theoretical and empirical issues in the study of implicit and explicit second language learning. *Studies in Second Language Learning, 27,* 129–140.

Kuhn, T. S. (1996). *The structure of scientific revolutions* (3rd ed.). Chicago, IL: University of Chicago Press.

Rothman, J., & VanPatten, B. (2013). On multiplicity and mutual exclusivity: The case for different theories. In M. P. García Mayo, M. J. Gutierrez-Mangado, & M. Martínez Adrián (Eds.), *Contemporary approaches to second language acquisition* (pp. 243–256). Amsterdam, Netherlands: John Benjamins.

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2

EARLY THEORIES IN SLA

Bill VanPatten and Jessica Williams

Prior to the 1990s, explanation of second language acquisition (SLA) fell into two basic periods. The first period is marked by the use of behaviorism—a theory taken from psychology—to account for both first and second language acquisition and by structuralist approaches to the study of language. Subsequently, as empirical research on both first and second language acquisition demonstrated some major problems with the structuralist-behaviorist account of language learning, the field of SLA entered a period in which multiple theories emerged, attempting to account for SLA. There were many competing accounts and explanations of various aspects of SLA at that time (see the suggested readings for further information on these). Some of these have evolved and remain influential; others have faded from prominence. The dominant theory in this early period, however, is one that retains considerable influence today: the Monitor Theory of Stephen Krashen. In this chapter, we explore both the structuralist-behaviorist approach and Monitor Theory, both of which have had lasting impact on SLA, particularly for classroom instruction.

Behaviorism and Structural Linguistics

Since its beginnings, the field of SLA has drawn theoretical inspiration from other fields. Indeed its origins lie in a practical orientation to language teaching. Before the field of SLA theory and research was established, notions of how people acquired nonprimary languages (those not learned as a first language in childhood) were closely tied to pedagogical concerns. An outgrowth of the U.S. "Army Method," the Audio-Lingual Method emerged in the 1950s, based in part on ideas from behavioral psychology (see Castagnaro, 2006, for an alternative account) and most significantly on ideas from structural linguistics. These two

fields of scholarship, though they developed separately, came to be closely associated during this period.

The Theory and Its Constructs

Behaviorism is a theory of animal and human behavior. It attempts to explain behavior without reference to mental events or internal processes. Rather, all behavior is explained solely with reference to external factors in the environment. You may be familiar with Pavlov's experiments with dogs. Many date the origins of modern behaviorism to this research. In one experiment, a tone sounded whenever the dogs were fed. Thus, when the dogs heard the sound (the *stimulus*), they anticipated a meal, and they would begin salivating (the *response*). What Pavlov demonstrated was that when the dogs heard the sound, yet no food appeared, they salivated anyway. Because of the repeated association of the sound with food, after a series of trials, the sound alone caused the dogs to salivate. This is called *classical conditioning.* Specifically, this means that in a given context, two events are naturally connected (eating and salivating), and then a third event (the sound) is introduced. After a series of repetitions, the association of the third event alone can trigger the response. Salivating in the presence of food is a natural response for dogs; it is a reflex action. Behaviorists believed the same to be true for human behavior: They reasoned, for instance, that if a child cries and then is picked up by a caregiver, he will develop the habit of crying to summon the caregiver. If his cry brings no response, he will abandon this strategy. This reliance on association to explain behavior is the hallmark of behaviorism.

In addition, there is a significant role for *frequency.* Each time a response is made to the stimulus, the association between them is strengthened. If the organism no longer receives the stimulus, the response behavior is expected to diminish, a process referred to as *extinction.* Repeated exposure, therefore, is an important factor in developing new behaviors. Finally, behaviorists claimed there could be an association among the responses themselves, which initially could be triggered by the external stimulus. For example, a mouse moving through a maze would respond to the initial stimulus of a piece of cheese. However, after several trials, the mouse's motor movements (e.g., first turn left, then right, then right again) would soon become associated with one another. In the same way, typists would associate certain letters with one another in a predictable sequence: *th* is more likely to be followed by *e* than *l*. Simply by typing the sequence *th,* the typist may end up typing a word like *the* without even thinking about it. Similarly, in language learning, after repeated "trials," a learner might come to associate the pronoun *nous* with the verb form *faisons* even after drilling has ceased.

Behaviorists took this idea a step further, with the concept of *operant* or *behavioral conditioning.* This is a feedback system, in which reinforcement and punishment can induce an organism to engage in new behaviors: Chickens can learn to dance, pigeons to bowl, and people to speak new languages. In operant conditioning,

an organism can be conditioned to engage in a behavior even when the stimulus is no longer present if it has learned the relevant association through consistent feedback. For example, if a chicken is conditioned to dance in response to food, but the provision of food is also accompanied by a flashing light, eventually, the chicken will dance in response to the flashing light, even if no food is provided.

Behaviorists contended that mental processes were not involved in this process; it was purely a result of the association of events, a response to environmental stimuli and subsequent *reinforcement* or *punishment*. In effect, these are both responses to the response. Reinforcement encourages continuation of the response behavior whereas punishment discourages continuation of the response. A rat that engages in a behavior (e.g., running on a wheel) and then receives food is more likely to engage in this behavior again. If, conversely, it receives a shock, it is more likely to stop the behavior. These ideas were soon applied to human behavior, along with the notion that thoughts, feelings, and intentions were not necessarily involved in human behavior, which, like animal behavior, was seen as set of responses to external stimuli. This concept is central to behaviorism and contrasts sharply with approaches to learning that followed it.

Within behaviorism, all learning—including language learning—is seen as the acquisition of a new behavior. The environment is the most important factor in learning. Learning consists of developing responses to environmental stimuli. If these responses receive positive reinforcement, they will be repeated. If the responses receive punishment (in the case of language learning, error correction), they will be abandoned. A child learns a language by imitating sounds and structures that she hears in the environment. If she produces an utterance that brings a positive response, she is likely to do so again. If there is no response or a negative response, repetition is less probable. Thus, language learning is seen as similar to any other kind of learning, from multiplication to yodeling: imitation of models in the input, practice of the new behavior, and the provision of appropriate feedback.

According to this theory, SLA occurs in a similar fashion. To learn a second language (L2), one must imitate correct models repeatedly. Learning of novel forms can also occur through *analogy;* for example, learners of English can acquire plural marking on nouns by analogy to previously learned forms: duck:ducks → cat:cats. Positive reinforcement of accurate imitations and correction of inaccurate imitation facilitates the learning process. It is important to note the important role for output in this theory. Learning requires repeated engagement in the target behavior, in this case, the production of the L2. Active participation by the learner is considered a crucial element of the learning process.

The salient characteristic of SLA that differentiates it from child language learning is that L2 learners already know a first language (L1), which must be overcome in the process of acquiring a second language. This process is difficult but can be facilitated by appropriate instruction. Ideal learning conditions include plentiful and accurate models and immediate and consistent feedback. Such a position has clear consequences for L2 instruction. Learners should be exposed to a large

number of target examples of language; they should imitate these models repeatedly and receive appropriate feedback: positive feedback for accurate imitations and correction of inaccurate ones. This process should be repeated until these behaviors have become automatic and error-free.

Behaviorism was not the only impetus behind this approach to language learning and teaching. It was closely linked to *structural linguistics,* which offered a compatible theory of language. Structural linguistics presented language as based on a finite set of predictable patterns. Language could be analyzed as a series of building blocks, beginning from the sound system all the way to sentence structure. The goal of structural linguistics was careful description. Explanation—why the language operates as it does—was not seen as within the purview of linguistics. Because structural linguistics portrayed language as based on a discrete and finite set of patterns, it blended easily with behaviorism, which viewed learning as the acquisition of a discrete set of behaviors. Thus, combining the insights of behaviorism and structural linguistics, applied linguistics at this time viewed a L2 learner's task as the imitation and internalization of these patterns.

Behaviorism offered several constructs, such as *conditioning, reinforcement,* and *punishment,* which remain important today. These are not directly observable; rather, they must be inferred from observation. For example, one can observe a stimulus, a response, and feedback. However, one can only infer that a response is conditioned or that a behavior has been reinforced. Some of these constructs have specific applications to SLA. As we have noted, the acquisition of an L2 was seen as the acquisition of a new set of behaviors, a process that was obstructed by the L1. The L1 had to be overcome in order for SLA to be successful. Obviously, SLA is not always immediately, or even ultimately, successful. This lack of success was blamed in part on **transfer**, an important construct in SLA at that time, one with direct behaviorist roots. Transfer was said to occur when learners relied on the L1 used in attempting to produce the L2.

Transfer can have either beneficial or negative consequences, depending on the distance between the L1 and L2. These differences were determined via *Contrastive Analysis.* This tool was used to compare languages, structure by structure, and sound by sound, to predict learner difficulty. Wherever languages were similar, it was predicted that there would be *positive transfer,* that is, learners would have little difficulty because they would simply be able to use their old habits in a new context. If the two languages were different—or two seemingly comparable structures were different—*negative transfer* was predicted, resulting in learner difficulty and error. This type of transfer is often referred to as interference, another important construct. The L1 was seen as interfering with the acquisition of L2 structures. Thus, errors were seen as evidence of lack of learning, primarily the result of L1 interference. An important goal of language teaching was help learners avoid these interference errors, lest they become ingrained. Repetition of correct models as well as immediate and consistent correction were seen as the best way to eradicate errors and facilitate language learning.

There are several important implications of this position. First, the L1, and specifically, the extent of the difference between it and the target language, was considered the primary source of learner difficulty and error. This leads to a second significant implication: Difference is related to difficulty. Where the L1 and L2 differ only slightly, relatively little difficulty would be expected; where the contrast between the two languages is greater, greater difficulty and, consequently, more error would be predicted. The consequences for language teaching were also clear: provision of correct models, massive repetition without learner reflection, avoidance of error, and provision of consistent feedback.

What Counts as Evidence for the Theory

There is, in fact, little empirical evidence for the structuralist-behaviorist explanation of SLA. Little actual research was done in SLA to confirm what was claimed by structural approaches or behaviorist theories; therefore, no exemplary study is presented here, as in the next section of this chapter and in later chapters. Nor was there much effort to explain evidence that fell outside of their predictions. Indeed, the goal of behaviorist research was to describe what was directly observable and not to explain the processes behind them. At the time, the primary proof that researchers adduced was indirect: the influence of the L1. The importance of the L1 in SLA seems apparent to the layman and experienced teacher alike. Many of the errors that learners make appear traceable to their L1s. For example, L2 learners of Spanish whose L1 is English may rely on English in attempting to speak Spanish:

I am eleven.
*Yo soy once.

Yet the fact that the L1 is an important factor in SLA does not in itself constitute an argument for this approach. In addition, because errors like these are so common, early researchers often assumed that the influence of the L1 on SLA was clear and direct. Subsequent research was to show that its influence is far more nuanced and complex.

How the Theory Addresses the Observable Phenomena of SLA

Of the observable phenomena listed in Chapter 1, behaviorist approaches could be used to explain the following:

Observation 1: Exposure to input is necessary for SLA. Within structuralist-behaviorist theory, the environment was seen as the controlling factor in any kind of learning. Given that language learning was seen a process of imitation and repetition of what was heard, it could not proceed without input. In particular, behaviorism stressed the use of target-language input as a stimulus for learning. In classrooms, language was provided by teachers who modeled the correct behavior, which students were

directed to imitate. However, it should be noted that the language provided by teachers normally wouldn't qualify as input by today's standards because it was not intended to communicate meaning but to simply model language.

Observation 2: A good deal of SLA happens incidentally. Language learning was thought to occur outside of consciousness. Behaviorists claimed that mental processes were not involved at all in learning; it was purely a response to external stimuli. Thus, all learning occurred as a by-product of the organism's interaction with its environment. Deliberate efforts to learn might facilitate the process.

Observation 5: Second language learning is variable in its outcome. This observation can also be explained by behaviorist accounts in that learning context affects the outcome of SLA in two ways: (a) Learners with different L1s may experience different outcomes because their L1-L2 differences vary and (b) learners who experience different environmental stimuli will experience different levels of eventual attainment. For example, if learners have different levels of exposure to target models, or if they receive different kinds of feedback, they may also differ in their level of attainment. If conditions are ideal, theoretically, all L2 learners with the same L1 should experience similar outcomes. However, this claim was never tested empirically.

Thus, behaviorism can explain some of these observed phenomena, and others, in only a limited way. Indeed, when the first major empirical studies of SLA were done in the 1970s, their findings did not support behaviorist claims. Error correction often did not improve learner performance. Teaching did not always result in learning. Many errors that were predicted by Contrastive Analysis did not occur, and many errors that did occur could not be explained by appealing to L1 influence. Thus, although most SLA researchers would concede the importance of L1 influence on SLA, the difference between this early view of language learning and views more widely held today cannot be overemphasized. The L1 is now considered one of many factors that interacts in the learning process, and its influence is neither simple nor direct. Finally, it is important to note the change in attitude toward errors since the behaviorist period. With the appearance of the seminal 1967 paper by S. Pitt Corder, "The Significance of Learners' Errors," errors came to be viewed as evidence of learning in progress—indeed, as a necessary step in the language learning process, rather than as one to be avoided.

The abandonment of behaviorist views of SLA does not mean that all of the factors privileged by the theory have also been discarded. We encounter some of them again, in particular, the role of practice and input frequency, in later chapters in this book (see Chapters 5 and 6).

The Explicit/Implicit Debate

The explicit/implicit debate did not exist under behaviorism. Because the theory eschewed speculation regarding mental processes, the only concern was whether behavior could be affected by outside stimuli. Internal mental processing was

ignored. Nonetheless, because all learning within behaviorism was seen as conditioned learning, one could argue that under behaviorism, all learning was implicit. That is, conditioned learning happened to an individual without that person (a) being aware of the conditioning, (b) explicitly trying to be conditioned, and (c) having any explicit knowledge about the conditioned behavior.

The Challenge of First and Second Language Acquisition Research

In the 1960s and 1970s, throughout the wider fields of psychology and linguistics, there was a widespread rejection of behavioral approaches to learning and structural approaches to language analysis. First language acquisition research in the early 1960s very quickly began to demonstrate that children could not possibly internalize a linguistic system according to the tenets of operant conditioning. The linguistic system was far too complex, and children's utterances showed evidence of processes beyond imitation and analogy. Instead, researchers began to argue that children bring an innate facility for language learning to the task of language acquisition. This facility was unaffected by the kinds of conditioning that were the basis of behaviorism. For example, children produce utterances that they could not have heard in the input, like *Don't giggle me* and *I love cut-upped eggs* (Pinker, 1994). They also acquire very complex rules that could not have been learned through mere imitation or analogy. Children can interpret the questions such as *When did Billy say he hurt himself?* as having two possible answers (*while he was skateboarding* or *He told us while we were eating dinner*), but *How did Billy say he hurt himself?* as having only one (*skateboarding*). Furthermore, they seem to acquire grammatical features in fixed orders that do not vary according to child, context, caregiver behavior, or any other external influence, as behaviorist accounts would predict. Finally, research documented learners' passage through these predictable stages in the acquisition, making only certain kinds of errors and not the full range of theoretically possible errors. For example, one might expect a child to make an error such as *He did his homework* → **He didn't his homework*. This utterance might be constructed on the analogy of other utterances in which *did* is negated with the form *didn't*. Yet, children do not make this error. Neither is simplicity an adequate explanation. In forming a question from the sentence: *That girl who is in your kindergarten class is coming over to play tomorrow,* several possibilities present themselves. If we assume that in sentences containing the verb *be,* question formation involves moving the verb to the front, which *is* should be fronted? The simplest solution would simply be to move the first one: **Is that girl who in your kindergarten class is coming over to play tomorrow?* However, children never make this error. From an early age, they unerringly choose the correct verb to front in forming a question. How do they know this? Linguists came to believe that much of this knowledge is innate and that language learning is guided by a specific mental faculty. In this way, language learning came to be viewed as unique, different from other kinds of learning.

These insights influenced researchers in SLA, and similar work with L2 learners soon followed. The results demonstrated that neither behaviorism nor Contrastive Analysis could fully predict or explain learner errors. They also suggested that L2 learners acquired many grammatical structures in relatively consistent sequences and furthermore, that many of the errors that they made were similar to those made by children learning their mother tongue. These findings led researchers to claim that all language acquisition is internally driven and that SLA is largely unaffected by the L1. In short, they claimed that SLA is very much like first language acquisition. This view has been referred to as the Creative Construction Hypothesis (Dulay & Burt, 1975). In direct contrast to behaviorist claims, the Creative Construction Hypothesis maintained that language learning is a creative process in which the learner makes unconscious hypotheses on the basis of input. The processing of input is, in turn, controlled by innate mechanisms, the same ones that operate in first language acquisition. This idea would form the cornerstone of Monitor Theory, to which we now turn.

Monitor Theory

One of the most ambitious and influential theories in the field of SLA, and one that is probably the most familiar to language instructors, is *Monitor Theory,* developed by Stephen Krashen in the 1970s and early 1980s. It was the first theory to be developed specifically for SLA. It has been particularly influential among practitioners, and it has also laid the foundation for important ideas in contemporary theorizing within SLA. Its broader success rests, in part, on its resonance with the experience of language learners and language teachers. An understanding of this theory is crucial to understanding the field of SLA theory and research as a whole.

The Theory and Its Constructs

Monitor Theory was the first in the field that was broad in scope and attempted to relate and explain a variety of phenomena in language learning, ranging from the effect of age on SLA to the apparently uneven effects of instruction. Unlike behaviorism, it proposes a language-specific model of language learning, though the actual processes involved in learning are not explained; thus labeling the Monitor Theory a theory of learning may be somewhat overstated. Though not articulated in Krashen's writing, Monitor Theory seems to be connected to Chomsky's theory of language (see Chapter 3), which states that humans are uniquely endowed with a specific faculty for language acquisition. Much of what we consider linguistic knowledge is, according to this view, part of our biological endowment. In other words, children come to the task of language already knowing a great deal; they simply need the triggering data in the input for language acquisition to take place. Krashen maintains that a similar process occurs in SLA, that is, that child and SLA processes are fundamentally similar.

Within Monitor Theory, the driving force behind any kind of acquisition is the comprehension of meaningful messages and the interaction of the linguistic information in those messages with the innate language acquisition faculty. According to Krashen, Monitor Theory can explain why what is taught is not always learned, why what is learned may not have been taught, and how individual differences among learners and learning contexts is related to the variable outcome of SLA.

Monitor Theory consists of five interrelated hypotheses. These, in turn, rest on several important constructs, key concepts that are inferred but are not directly observable.

The Acquisition-Learning Hypothesis

Perhaps the most important hypothesis in Monitor Theory is the acquisition-learning distinction. Krashen maintains that acquisition and learning, constructs within the theory, are two separate ways of gaining knowledge. Once gained, these types of knowledge are stored separately. *Acquisition* takes place naturally and outside of awareness; it emerges spontaneously when learners engage in normal interaction in the L2, where the focus is on meaning. Neither instruction nor the intention to learn is necessary. The theory claims that learners draw on acquired unconscious knowledge in spontaneous language use, and in this regard, Krashen would argue, SLA is much like first language acquisition. Typically, learners are not be able to articulate this knowledge and are said to operate "by feel" rather than "by rule."

Learning, conversely, involves gaining explicit knowledge about language such as its rules and patterns. It occurs when the L2 is the object, but not necessarily the medium, of instruction. Gaining and using this knowledge are conscious and effortful processes that are undertaken intentionally. The crucial and most controversial part of the distinction is that these two knowledge stores—the acquired system and the learned system—can never interact; that is, knowledge that is learned may not be converted into acquired knowledge via some kind of practice and become available for spontaneous use. For this reason, Monitor Theory is referred to as a noninterface theory. This is why learners may "know" rules; that is, they may be able to articulate them but may nevertheless be unable to use it in spontaneous production. Conversely, a learner may use a structure accurately and spontaneously yet be unable to verbalize the rule for its use. Both learners and teachers are all too familiar with this phenomenon, making the theory an intuitively appealing one. Thus, in Monitor Theory, even if learners formally study the grammar rules, they will not be able to draw on that knowledge in spontaneous communication because it has not been acquired. For this reason, Krashen argues, the effects of formal instruction on SLA, including feedback on errors, are peripheral, suggesting that such pedagogical approaches should be abandoned in favor of one based on the provision of copious input and the opportunity for meaningful interaction. The acquisition-learning distinction is the central hypothesis in Monitor Theory.

The Monitor Hypothesis

Within Monitor Theory, learned knowledge is not terribly useful. Its primary function is editing acquired knowledge during language production. What this means is that learners can draw on this knowledge—Krashen calls this construct *the Monitor*—when they have sufficient time to consult their rule knowledge, for instance, in an untimed writing assignment. Krashen maintains that this is only likely, however, when, in addition, the task requires the learner to pay attention to accuracy, as would be likely, for example, in a fill-in-the-blank exercise. Since these kinds of activities are relatively unimportant in overall language use and are arguably only language-like behavior, the utility of learned knowledge within Monitor Theory is negligible. It follows that it is not worth spending precious instructional time on developing it, as is typically the case in L2 classrooms.

The Natural Order Hypothesis

As we have noted, research in both first and second language acquisition had demonstrated that learners follow sequences in their acquisition of specific forms, such as the grammatical morphemes *-ing, -ed, -s,* and others. In addition, they appear to pass through predictable stages in their acquisition of grammatical structures, such as questions, negation, and relative clauses. Collectively, these have been taken as evidence for the *Natural Order Hypothesis.* One study of the Natural Order is presented at the end of this section. It was claimed that these orders were independent of instructional sequences or even of the complexity of the structures to be acquired. For example, although the third person singular *-s* ending in English is relatively straightforward, it appears to be challenging for L2 learners, even those of fairly advanced proficiency. According to Monitor Theory, these regularities occur because all language acquisition is guided by the innate language acquisition faculty.

The Input Hypothesis

According to Monitor Theory, humans acquire language in only one way—by understanding messages in the L2 or, as Krashen says, by receiving **comprehensible input**, another central construct in the theory. This aspect of Monitor Theory is referred to as the *Input Hypothesis.* Comprehensible input is input that contains language slightly beyond the current level of the learner's internalized language. In defining comprehensible input, Krashen introduces two more constructs: *i,* which he defines as a learner's current level of proficiency, and $i + 1$, which is a level just beyond the learner's. Krashen considers input that is $i + 1$ to be the most valuable data for SLA. It is not clear in Monitor Theory exactly what 1 is, or how either it or *i* is identified. In practical terms, however, their precise definitions are unimportant since these levels of input are never isolated from the general input.

Krashen specifies that *roughly tuned input* will automatically include several levels of input, including i, $i + 1$ and probably $i - 1$ and $i + 2$ as well. In other words, as long as a teacher or native speaker does not speak extremely quickly, using very complex language to a low-level learner, the presence of comprehensible input is probably assured. Learners will naturally access and use what they need, allowing acquisition to take place spontaneously as long as they are exposed to this rich and comprehensible input. This is most likely to occur when communication consistently focuses on meaning rather than form. This means that, not only is instruction about grammatical rules of little use, but according to this theory, output (production) activities are not of much value either. Production is considered the result, rather than the cause, of acquisition. Forcing learners to produce language before they are ready can even inhibit the acquisition process by taking learners' focus away from comprehension and processing of input. Rich input, combined with the power of the language acquisition faculty, is all that is needed to promote successful language acquisition. Indeed, Krashen has claimed that comprehensible input is not just a necessary condition for SLA, it is the sufficient condition. In the presence of comprehensible input, SLA is an inevitable result.

The Affective Filter Hypothesis

It is also important for learners to be comfortable and receptive to the input in their learning environment. To characterize this, Krashen posits another construct, *the affective filter.* Learners who are comfortable and have a positive attitude toward language learning have their filters set low, allowing unfettered access to comprehensible input. In contrast, a stressful environment, such as one in which learners are forced to produce before they feel ready, raises the affective filter, blocking the learner's processing of input. The affective filter, according to Krashen, can help explain the variable outcome of SLA across L2 learners, including differences in the learner's age and in classroom conditions.

Most evidence in support of the theory is indirect. Krashen has primarily marshaled general evidence in support of his theory. For example, he cited the overall positive outcome of language immersion programs and the widespread mediocre results of foreign language instruction in the United States at that time as proof of the central importance of comprehensible input and the relatively minor impact of direct instruction. He offered evidence from studies in which students who received massive amounts of comprehensible input through pleasure reading outperformed those who received traditional grammar-based instruction as well as individual learners in acquisition-poor environments who failed to acquire despite instruction.

An Exemplary Study: Larsen-Freeman (1974)

During the 1970s and early 1980s, many studies demonstrated consistent acquisition orders for grammatical morphemes for both children and adults. Krashen

maintained that the results of these studies provided evidence for Monitor Theory, specifically, the *Natural Order Hypothesis.* One such study, "The Acquisition of Grammatical Morphemes by Adult Learners," is described here in some detail.

Larsen-Freeman (1975) is a study designed to test whether the order that had been established for the acquisition of grammatical morphemes in previous studies would also be found using other elicitation tasks. Specifically, it tested whether the order would remain the same if skills other than speaking were tested. The answer to this question was sought in terms of the acquisition order of 10 grammatical morphemes: *-ing, be*-auxiliary, short plural (*-s*), long plural (*-es*), third person singular *-s,* past regular, past irregular, possessive *-s, be*-copula, and articles. The choice of these particular morphemes was based on work, done earlier with children and adults learning their second language, which had revealed a consistent order of acquisition. However, most of these studies had used the same instrument to elicit data from the participants: the Bilingual Syntax Measure (BSM), a series of cartoon pictures showing a variety of scenes. Larsen-Freeman's study was an effort to determine whether previous findings had been an artifact of this elicitation device or whether the orders were independent of task conditions. She also wished to confirm earlier results that suggested learners' L1 backgrounds made little difference regarding the order in which they acquired grammatical morphemes. She made no formal hypotheses regarding the outcome of the study.

The participants in this study were 24 beginning adult L2 learners of English. The participants came from four different language backgrounds: Arabic, Farsi, Japanese, and Spanish. Data containing the 10 grammatical morphemes were elicited from the participants as they performed several different tasks. The tasks were (a) the BSM, the instrument that had been used in previous research, (b) a forced-choice[1] listening task, (c) a forced-choice reading task, (d) a fill-in-the-blank writing task, and (e) and an elicited imitation task.

When Larsen-Freeman (1975) compared all four language groups, she found fairly consistent results across four of the tasks (the exception was the reading task). However, when she compared two languages at a time, she did not consistently find significant correlations in the orders. The BSM was the only the only task that yielded consistently significant correlations for all language groups. In further analysis of these data, she found that where a language group varied from the expected order, the deviation could generally be explained in terms of L1 features. Despite these smaller differences, taking her results as a whole, Larsen-Freeman concluded that "language background does not seem to radically influence the way in which learners order English morphemes" (p. 417).

In her analysis of the tasks themselves, Larsen-Freeman (1975) also found some consistency in the ranking of morphemes (particularly within the BSM and elicited imitation tasks) but by no means the rigid order that has been proposed in previous studies that had used the BSM as the sole elicitation device. Again, she concluded that overall, there was "some consistency in the ranking of certain morphemes across all five tasks" (p. 417), but she cautioned that the differences

she did find across tasks required further investigation. She suggested that factors such as modality differences, or specific task or skill differences, might explain her findings.

Krashen later explained these findings within Monitor Theory. What differences Larsen-Freeman (1975) did find were greatest in the writing and, particularly, the reading tasks. He reasoned that these "unnatural" orders occurred when learners were able to monitor their output, in other words, to draw on their learned knowledge. He specifically pointed to the fact that certain morphemes that ranked low in the natural order tended to rise in rank when learners were able to monitor their production. These morphemes, such as third person singular *-s* and regular past tense, were the morphemes that were easily learned but not so easily acquired. The task conditions for the reading and writing elicitations in Larsen-Freeman's study were, according to Krashen, precisely those conditions conducive to the use of the Monitor: they (a) required learners to focus on form and (b) provided ample time for them to reflect on their learned knowledge.

This and other morpheme studies were important milestones in the development of SLA as an independent field and one of the cornerstones of Krashen's Monitor Theory. The generally stable order found in the production of learners across different L1s suggested an internally guided process. The perturbations in the order that were found in tasks performed under specific conditions provided support for separate learning and acquisition processes and separate knowledge stores.

How the Theory Addresses the Observable Phenomena of SLA

Of the observed phenomena listed in Chapter 1, Monitor Theory can be used to explain the following:

Observation 1: Exposure to input is necessary for SLA. The role of input, specifically comprehensible input, in Monitor Theory is clear and explicit. Input is the driving force behind acquisition. Input is not only necessary for SLA; it is sufficient. In the presence of comprehensible input, SLA is inevitable. In its absence, SLA is impossible. The reason for this, according to Monitor Theory, is that L2 learners make use of the special language acquisition faculty in their brain similarly to child L1 learners.

Observation 2: A good deal of SLA happens incidentally. According to Monitor Theory, acquisition takes place naturally and spontaneously when the learner is focused on meaning. It is not necessary for learners to have the intention to learn for acquisition to take place. Again, this falls out of Monitor Theory relying on a special language faculty that responds to data in the input.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. As noted, this is one of the cornerstones on which Monitor Theory rests. Because all language learning is guided by internal and presumably universal processes, there are common routes of acquisition

for all learners, as evidenced by the staged development in children and adults of diverse L1 backgrounds. However, Monitor Theory cannot explain the actual orders (e.g., why *-ing* precedes past tense which precedes third-person *-s*).

Observation 5: Second language learning is variable in its outcome. Cross-learner variation can be explained by Monitor Theory, according to Krashen. He attributes variation in outcome to differential access to comprehensible input. In some cases, this may be a result of different settings of the Affective Filter, which can limit learners' access to comprehensible input. If the learning context is such that a learner's filter is set high, or such that little comprehensible input is available, learning outcomes may fall short of expectations.

Observation 8: There are limits on the effect of a learner's first language on SLA. Because all acquisition is guided by universal internal processes, according to Monitor Theory, the effects of the L1 are minimal. All learners use the same strategies in learning an L2, as demonstrated by the similarity of errors committed by learners with a variety of different language backgrounds.

Observation 9: There are limits on the effects of instruction on SLA. This is related to observation 2. Acquisition will take place naturally in the presence of comprehensible input, which is the only type of data that is useful to internal processors responsible for language acquisition. Pedagogy based on explicit instruction generally contains little comprehensible input. Such instruction can only contribute to learned knowledge, which is of limited use. In fact, it can get in the way of acquisition by limiting learner access to comprehensible input. Again, the limits of instruction are due to a specialized language faculty in the mind that is unaffected by explicit instruction.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. According to Monitor Theory, production is the result of acquisition and cannot contribute in any direct way to it. The internal processors that drive acquisition can only use one form of linguistic data: comprehensible input. When learners speak or write, they are generally using language they have already acquired.

The Explicit/Implicit Debate

Monitor Theory stakes out clear claims for the distinction between implicit and explicit learning and between implicit and explicit knowledge. The first distinction corresponds to learning and acquisition. Learning involves both awareness of the object of learning the intention to learn it, and the result is some kind of explicit knowledge. Conversely, acquisition occurs as a by-product of appropriate and meaningful input in a comfortable environment. The result of acquisition is implicit knowledge. According to Monitor Theory, learned or explicit knowledge is of limited use; acquired or implicit knowledge is the source of spontaneous communication. What is more, according to this theory, explicit knowledge cannot turn into implicit knowledge.

Conclusion: Criticisms and Appeal of Monitor Theory

Monitor Theory has come in for considerable criticism over the years. Each of its hypotheses has been seem as problematic in some way. Indeed, there have been few empirical studies actually testing any of the aspects of Monitor Theory. One reason is that there are problems with what researchers call *operationalization* of the constructs; specifically, they are vaguely defined, making empirical testing difficult. For example, there is no independent way of confirming which knowledge source—acquired or learned—a learner is using as the basis for use. When presented with evidence of spontaneous and error free production by L2 learners who have only been exposed to formal instruction in which comprehensive input is scarce, Krashen has claimed that learners have developed parallel language stores. Their acquired knowledge has simply "caught up" with the learned knowledge. Such a contention is difficult to prove, and Krashen's detractors maintain that he has failed to do so. Additionally, Krashen's use of the natural orders of acquisition as evidence for Monitor Theory has been criticized as circular. Predictable acquisition orders are both explained by and proof of an innate language faculty. In addition, beyond the general rationale that acquisition orders are the result of the interaction of input with an internal acquisition device, Monitor Theory does not provide an explanation for the specific findings. Why, for example, should *-ing* emerge before *-s* in the order? (Subsequent studies did tackle this question. See the discussion of Goldschneider and DeKeyser in Chapter 5.) Similarly, the affective filter has been criticized because, while an intuitively appealing notion, it is difficult to determine without circularity when the filter is high or low. If learners fail to progress, it can be attributed to a high affective filter, but then evidence of the filter's high setting is often the learner's failure to acquire. Though a valuable metaphor, the construct does not tell us a great deal about language learning processes. Finally, critics have commented that the construct $i + 1$ cannot be operationalized. If we wanted to do research, for example, to see if the provision of $i + 1$ in the input really does facilitate acquisition, how should we define i, and how do we subsequently operationalize $i + 1$? More detailed criticisms of the theory can be found in some of the suggested readings (see McLaughlin, 1987).

Yet for many practitioners (and learners), the most powerful evidence for Monitor Theory is their own experience: What is taught is not always learned, and what has apparently been mastered in drills and other controlled exercises seems to disappear in activities that call for spontaneous language use. This, coupled with the many instances of successful SLA in the absence of instruction, is enough to persuade many observers of the validity of the Input Hypothesis and particularly of the acquisition-learning distinction. There is no denying that teachers and learners alike experience the disjunction of knowledge that it captures.

Discussion Questions

1. Behaviorism emphasized the environment and the learner's observable experience with the environment to explain learning and human development. Can you cite a clear example of a human behavior that is learned through a stimulus-response type of experience? Can you cite a clear example that is not?
2. Select one of the observed phenomena that behaviorism cannot account for. In what way does it pose a challenge to the theory?
3. One criticism of Monitor Theory is that it is more descriptive of acquisition than explanatory in nature. That is, the natural order hypothesis merely describes a phenomenon in need of explanation. Do you think this is true of the acquisition-learning distinction? The input hypothesis?
4. Typically, a theory replaces another because of the latter's inadequacy. That is, the latter cannot account for observed phenomena and/or makes incorrect predictions about something. Why do you think Monitor Theory supplanted behaviorism?
5. In what ways are behaviorism and Monitor Theory in direct opposition to each other? (Hint: consider the issue of what mental apparatus learners take to the task of acquisition.)
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Note

1. Participants had to choose among sentences that contained the grammatical form appropriately supplied, inappropriately supplied, or not supplied.

Suggested Further Reading

Dulay, H., & Burt, M. (1975). Creative construction in second language learning and teaching. In M. Burt & H. Dulay (Eds.), *On TESOL, '75: New directions in second language learning, teaching and bilingual education* (pp. 21–32). Washington, DC: TESOL.
This article lays out the claims and research that formed the foundation of the Creative Construction Hypothesis.

Hatch, E. (Ed.). (1978). *Second language acquisition: A book of readings.* Rowley, MA: Newbury House.
This volume is a collection of the early empirical studies from the postbehaviorist era of SLA.

Krashen, S. (1981). *Second language acquisition and second language learning.* Oxford, England: Pergamon.

Krashen, S. D. (1982). *Principles and practice in second language acquisition*. Oxford, England: Pergamon Press.

Krashen, S. D. (1985). *The input hypothesis: Issues and implications.* London: Longman.
These three volumes expand on Krashen's views and the Monitor Theory introduced in this chapter.

Lado, R. (1957). *Linguistics across cultures.* Ann Arbor: University of Michigan Press.
This is the most important single volume the behaviorist–Contrastive Analysis tradition. It offers the insights of this perspective for second language learning and teaching.

McLaughlin, B. (1987). *Theories of second language learning.* London, England: Arnold.
This volume contains an introduction to many of the early theories in SLA, some of them still connected to an active research agenda. Of particular interest is McLaughlin's critique of the Monitor Model.

Robinett, B., & Schachter, J. (Eds.). (1983). *Second language learning: Contrastive analysis, error analysis, and related aspects.* Ann Arbor: University of Michigan Press.
This collection contains a variety of very early studies in the field, including several that demonstrate the use of Contrastive Analysis.

Schumann, J. H. (1978). *The pidginization hypothesis: A model for second language acquisition.* Rowley, MA: Newbury House.
This volume is a book-length treatment of Schumann's idea about the role of social and affective factors in SLA.

Selinker, L. (1972). Interlanguage. *International Review of Applied Linguistics, 10,* 209–231.
This article was a pioneering attempt to establish learner language, which Selinker termed "interlanguage," as an independent linguistic system.

Tarone, E. (1988). *Variation in interlanguage.* London, England: Edward Arnold.
This is a book-length look at explanations of variation within individual ILs. Tarone connects IL variation to theories of variation within sociolinguistics.

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3

LINGUISTIC THEORY, UNIVERSAL GRAMMAR, AND SECOND LANGUAGE ACQUISITION

Lydia White

The Theory and Its Constructs

The Linguistic Competence of Native Speakers and L1 Acquirers

Generative linguistic theory aims to provide a characterization of the **linguistic competence** of native speakers of a language and to explain how it is possible for child first language (L1) acquirers to achieve that competence. The generative perspective on second language (L2) acquisition has parallel goals, namely, to account for the nature and acquisition of interlanguage competence (see Gregg, 1996; White, 1989, 2003).

In this framework, language use (comprehension and production) is assumed to be based upon an abstract linguistic system, a mental representation of grammar (syntax, phonology, morphology, and semantics). The knowledge of language represented in this way is unconscious. Furthermore, much of this unconscious knowledge does not have to be learned in the course of L1 acquisition; rather, it is derived from **Universal Grammar** (UG). This claim is motivated by the so-called **logical problem of language acquisition** or the problem of *the poverty of the stimulus,* in other words the mismatch between the input that children are exposed to and their ultimate attainment (e.g., Chomsky, 1986b). Our knowledge of language goes beyond the input in numerous ways. For instance, children and adults can understand and produce sentences that they have never heard before, they know that certain structures are ungrammatical without being taught this, and they know that certain interpretations of sentences are not possible in certain contexts.

Consider the following example, from de Villiers, Roeper, and Vainikka (1990) and Roeper and de Villiers (1992). Imagine a scenario where a boy climbs a tree in the afternoon and falls out of it and hurts himself. In the evening, he tells his father about what happened. Now consider the questions in (1), uttered in this context.

(1)

a. When did the boy say (that) he got a bruise?
b. When did the boy say how he got a bruise?

In this context, a question like (1a) is ambiguous: It can be a question about the time that he got hurt (in the afternoon) or the time that he told his father about the incident (in the evening). Question (1b), conversely, is not ambiguous. Even though it differs by only one word (the embedded clause being introduced by *how*), this question can only have an answer that related to the time of telling, such as *in the evening* or *when he was in the bath*. In other words, it must be construed as a question about the main clause; the embedded clause interpretation is ungrammatical, even though it is perfectly acceptable and available in the case of (1a). De Villiers and colleagues conducted a series of experiments using such scenarios and found that young children acquiring English as their mother tongue are highly sensitive to the difference between these two sentence types, allowing both interpretations in the case of (1a) but only one interpretation (the matrix clause one) in the case of (1b).

How do children know this? It is most unlikely that children are explicitly told that certain sentences are ambiguous, while others (which are superficially very similar) are not. Nor does this kind of information seem to be inducible from the language that children hear, given that children will be exposed to a range of grammatical *wh*- questions, involving simple and embedded clauses. In other words, the input underdetermines the child's linguistic competence. Hence, it is argued, children must bring innate, built-in knowledge to bear on the task of first language acquisition. In this case, a principle of UG, one of a number of so-called **island constraints** (Ross, 1967), restricts ***wh*- movement** in particular ways. Effectively, these constraints state that certain constituents form islands, from which phrases cannot escape.[1] The embedded clause in (1b) is a *wh*- island, headed by a question phrase (*how*), whereas the embedded clause in (1a) is not. The *wh*- phrase *when* can 'escape' only in the case of (1a), passing through a position which is not available in the case of (1b), since it is already filled by *how.* The alternative interpretation is possible in both cases because *when* is construed with the main clause, no extraction from an embedded clause (island or otherwise) being involved.

A related effect of island constraints is that sentences involving *wh*- movement out of islands are ungrammatical in English, as shown in (2a). Here, *what* has been extracted out of an embedded *wh*- clause, an extraction that is impossible for the same reason that the embedded clause interpretation of (1b) is impossible. In contrast, (2b) is acceptable because the embedded clause is not an island: there is a position for the *wh*-phrase to 'escape' through, indicated by the intermediate *t* in (2b).

(2)

a. *What$_i$ does John wonder [who bought t$_i$]?
b. What$_i$ does John think [t$_i$ that Mary bought t$_i$]?

Once again, on learnability grounds, it is implausible to suppose that L1 acquirers of English arrive at knowledge of the ungrammaticality of sentences like (2a) on the basis of English input alone. Instead, constraints of this kind must derive from UG. In other words, acquisition of *wh*- movement (and many other properties of language) is constrained by innate principles; language is acquired presupposing such knowledge, with the consequence that L1 acquirers do not have to learn when certain kinds of sentences are ungrammatical or when there can or cannot be certain kinds of structural ambiguity.

Interlanguage Competence

Given that linguistic theory offers a model of the linguistic competence of native speakers, it may be able to provide a characterization of nonnative competence as well. This is the assumption of researchers working on second language acquisition (SLA) from the perspective of generative linguistics. It has long been observed that the language of L2 learners is systematic and rule-governed (e.g., Corder, 1967). The term *interlanguage,* coined by Selinker (1972), has been widely adopted to refer to the linguistic competence of L2 learners and L2 speakers (henceforth L2ers). L2 researchers working in the generative paradigm assume that interlanguage grammars, like native speaker grammars, involve unconscious mental representations, though they do not necessarily agree as to the precise nature of these representations, for example, the nature and degree of influence of the L1 and the status of UG constraints.

While the operation of UG in L2 acquisition cannot be taken for granted, considerations of learnability (the logical problem of L2 acquisition) apply in L2 acquisition as they do in L1 (e.g., White, 1989). That is, if it can be shown that L2ers acquire abstract and subtle properties that are underdetermined by the L2 input, this suggests that interlanguage competence must be subject to the same constraints as native competence.

Consider *wh*- movement once again. The fact that (1a) is ambiguous whereas (1b) is not, and the fact that (2a) is ungrammatical, in contrast to (2b), constitutes an L2 learnability problem, parallel to the problem faced by L1 acquirers. There is no reason to suppose that the L2 English input is any more informative about *wh*- questions than the L1 English input, unless L2ers receive specific instruction on this property, which seems highly unlikely. In other words, in the case of successful acquisition of this kind of abstract knowledge, island constraints must be implicated in L2 as well as L1.

However, if it turns out that L2ers indeed demonstrate the same kind of subtle knowledge as native speakers, a reasonable objection would be that the source of this knowledge is not UG directly; rather it is the mother tongue grammar (see, e.g., Bley-Vroman, 1989; Schachter, 1990). In other words, the L2er might show knowledge of island constraints because these have been activated in the L1 grammar and not because interlanguage grammars are UG-constrained as such. Hence, to eliminate this possibility, it is necessary to investigate cases where the L1 and L2 differ in such a way

that the mother tongue grammar could not provide the learner with the necessary knowledge. In the case of *wh-* questions, this would be achieved if the L1 is a language with so-called *wh- in situ* instead of *wh-* movement, such as Chinese, Japanese, or Korean. In these languages, in contrast to English, *wh-* phrases do not move but remain in their underlying positions. This is true of simple *wh-* questions, as in the Chinese example in (3a), and *wh-* questions from embedded clauses, as in (3b).[2]

(3)

a. ni xihuan shei?
   you like who
   'Who do you like?'
b. Zhangsan xiangxin shei mai-le shu?
   Zhangsan believe who buy-ASP books
   'Who does Zhangsan believe bought books?'

In (3a), there is no *wh-* fronting; rather, the *wh-* phrase (*shei* 'who') remains in object position within the clause. The same is true of (3b), where *shei* remains in subject position in the embedded clause.

Now consider Chinese equivalents of (1). In (4a), the *wh-* phrase (*shenmoshihou* 'when') does not move out of the embedded clause. In consequence, and in contrast to its English equivalent, this question is not ambiguous: it can only be a question about the time the boy got hurt (the embedded clause reading), not the time of telling (the main clause reading). To ask a question about the time of telling, *when* must be in the main clause, as in (4b). Again, this question is not ambiguous. In other words, in Chinese, each interpretation is reflected in a different word order (namely, (4a) vs. (4b)), in contrast to English, where one word order can have two meanings (as in (1a)).

(4)

a. nanhai shuo ta shenmoshihou nong qing
   boy say he when got bruise
   'When did the boy say that he got a bruise?'
b. nanhai shenmoshihou shuo ta nong qing
   boy when say he got bruise
   'When did the boy say that he got a bruise?'
c. nanhai shenmoshihou shuo ta zenyang nong qing
   boy when say he how got bruise
   'When did the boy say how he got a bruise?'

In the case of (4c), *when* again unambiguously requires the matrix interpretation. In other words, in Chinese, there is no contrast in ambiguity equivalent to the contrast found in English between (1a) and (1b). Thus, if L2 learners come to

know that English sentences like (1a) are ambiguous, whereas sentences like (1b) are not, this would suggest not only that they have acquired *wh*- movement but also that they have knowledge of constraints on *wh*- movement which could not have come from the L1.

We have also seen that sentences like (2a), involving *wh*-movement out of islands, are ungrammatical in English. In contrast, the Chinese sentence in (5) is grammatical because no *wh*- movement out of an island has taken place; rather, the *wh*- phrase remains *in situ*.

(5) ni xiang-zhidao shei mai-le shenme?
you wonder who buy-ASP what
'What is the thing such that you wonder who bought it?'
(cf. *What do you wonder who bought?)

To summarize so far, the linguistic competence of native speakers of a language includes knowledge of ambiguity and of ungrammaticality, as exemplified by the preceding restrictions on *wh*- movement. Given that the input alone is insufficient to account for how such knowledge could have been acquired, children acquiring their mother tongues must have an innate specification for language, UG, which guides and limits their hypotheses about the form of the grammar that they are acquiring. If L2 learners of English come to know similar restrictions on *wh*- movement, especially if these could not be derived from the L1 grammar, this provides evidence for the continuing functioning of UG constraints in interlanguage grammars as well.

Universal Grammar: Principles and Parameters

The precise nature and content of UG is the domain of linguistic theory; proposals change and are refined as the theory develops. Nevertheless, broadly speaking, the following assumptions hold true across different versions of generative grammar, such as Government and Binding (GB) theory (Chomsky, 1981) or Minimalism (Chomsky, 1995).

Principles of UG constrain the form of grammars, as well as the operation of linguistic rules. The island constraints discussed earlier are examples of such principles: They specify universal restrictions on *wh*- movement, the idea being that all cases of *wh*- movement will be subject to such constraints. As we have seen, the claim is that language acquirers do not have to learn these principles—they are built in to UG. *Parameters,* conversely, account for certain circumscribed differences across languages; the idea is that these differences are encoded in UG, so that language acquirers can easily determine what kind of language they are acquiring. Input data are said to *trigger* the appropriate parametric choice for the language being acquired (Lightfoot, 1989). In other words, the input determines the choice between parameter values made available by UG. As an example of a parameter, consider the case of *wh*- movement again. As we have seen, the position of *wh*- phrases differs across

TABLE 3.1 Parameters and Constraints Relating to *wh*- Expressions

	Parameters	*Constraints*
English	+*wh*-movement	Island constraints activated
Chinese	–*wh*- movement	Island constraints inactive

languages. This difference is attributed to a parameter, namely, ±*wh*- movement. Languages divide into two main types, those with *wh- in situ,* such as East Asian languages, and those with *wh*- movement, such as Germanic, Romance, and Slavic languages. In this case, input in the form of simple *wh*- questions will be enough to trigger the appropriate parameter value (see Crain & Lillo-Martin, 1999). The child acquiring English will be exposed to questions like (6a), with a fronted *wh*-phrase, indicating *wh*- movement, whereas the child acquiring Chinese will be exposed to sentences like (6b), indicating lack of movement.

(6)

a. What do you want?
b. ni xihuan shei?
   you like who

Universal principles do not necessarily operate in all languages, but only in that subset of languages that exhibit the relevant properties. In languages with overt *wh*-movement, movement is subject to UG principles in the form of island constraints. In other words, movement is not totally free; rather, there are certain kinds of constituents from which a *wh*- phrase cannot escape, as we have seen. These are *islands,* and it is UG that specifies which domains form islands.[3] In *wh- in situ* languages, conversely, island constraints are irrelevant, because of absence of movement.[4]

Table 3.1 summarizes the relevant differences between Chinese and English. If interlanguage competence is UG-constrained, then once L2ers reset the ±*wh*-movement parameter, *wh*- movement in the interlanguage grammar should be subject to island constraints.

What Counts as Evidence?

It must be understood that linguistic competence is an abstraction; it is impossible to "tap" linguistic competence directly. The generative perspective on L2 explores the nature of interlanguage competence by adopting a variety of performance measures to try to discover the essential characteristics of underlying mental representations. One frequently encountered problem is that it can be difficult to construct tasks that relate to unconscious knowledge, as opposed to conscious knowledge learned explicitly in the classroom. Ideally, performance data from a variety of sources should be brought to bear on the question of interlanguage competence.

Relevant data can be classified into three broad categories: *production data, intuitional data,* and *data relating to interpretations* (or comprehension). The appropriateness of a particular elicitation task will depend on what the researcher is trying to discover.

Spontaneous production data might seem to provide an obvious source of information as to the nature of interlanguage competence. However, usage does not necessarily provide an accurate reflection of knowledge or acquisition: Production data can result in an underestimation of an L2er's overall linguistic competence. For example, Lardiere (1998) shows that an L2er whose use of appropriate tense and agreement morphology is very infrequent in spoken English at the same time shows mastery of complex syntax. It is also possible that production data might lead one to overestimate a learner's competence. That is, L2ers may appear to be highly proficient, even native-like, and yet have nonnative grammars. In other words, sentences that superficially appear to be identical to those produced by native speakers might in fact have different underlying representations (e.g., Hawkins & Chan, 1997).

Furthermore, when researchers are interested in phenomena that might not show up readily in production, alternatives are required. In the case of the island constraints discussed earlier, the ambiguity of sentences like (1a) and lack of ambiguity of sentences like (1b) is unlikely to be observable in production. Similarly, it is unlikely that L2ers will produce sentences like (2a). However, failure to find violations of island constraints in production cannot be taken as evidence of knowledge of ungrammaticality, since their absence might be due to an accident of data sampling. Since a major research question in this framework is whether interlanguage grammars are constrained by UG, it is essential to discover whether forms ruled out by UG constraints are in fact ungrammatical in the interlanguage grammar. One potential means of establishing this is through elicited production (Crain & Thornton, 1998). If a task is set up so that a certain structure might be expected and this structure is avoided by L2ers, this suggests, indirectly, that the structure is ungrammatical for the learner. As we shall see, White and Juffs (1998) use this technique to investigate island constraints in L2.

The most commonly used task to determine knowledge of L2 (un)grammaticality is a task that taps linguistic intuitions, namely, the **grammaticality judgment** task. This kind of task allows the researcher to investigate whether sentences that are disallowed for native speakers because of principles of UG are also prohibited in the interlanguage grammar. Considering island constraints once again, another kind of island is formed by a complex NP (an NP containing a relative clause or a complement clause). Extraction of a *wh*- phrase from a complex NP is ungrammatical in English, as shown in (7a). In contrast, sentences like (7b) are grammatical, because no such extraction has taken place.

(7)

a. *Whose life did you read a biography that described?
   (cf. I read a biography that described someone's life.)
b. Whose life did you read about?

Suppose that you wish to determine whether an L2 learner of English knows that sentences like (7a) are ungrammatical, in other words, whether their grammar is subject to island constraints. To establish whether L2 learners "know" this constraint, a grammaticality judgment task is appropriate, in which learners are given a set of grammatical and ungrammatical sentences relevant to the structure in question and are asked to indicate whether the sentences are grammatical. If interlanguage grammars are constrained by UG, and provided that *wh*- movement has been acquired, then L2ers are expected to reject sentences like (7a), while accepting grammatical equivalents. Hence, by using grammaticality judgments, the experimenter can (indirectly) investigate aspects of interlanguage competence that may not otherwise be amenable to inspection. Again, White and Juffs (1998) use such a task to explore island effects in interlanguage grammars.

No single methodology is appropriate for investigating all aspects of linguistic competence. If questions of interpretation are being investigated, grammaticality judgments can be totally uninformative. Consider, once again, the ambiguity of sentences like (1a), contrasted with the lack of ambiguity of (1b). If L2ers were asked to judge such sentences and indicated that both sentences are grammatical, this would not help to determine how they were interpreting the sentences (i.e., whether *when* was being construed as a question about the embedded clause or the main clause). For this reason, in testing whether L1 acquirers of English know the relevant properties, de Villiers and colleagues adopted a comprehension task: Children were shown pictures and asked the test question; their responses indicated how they had interpreted that question.

Another way of investigating L2ers' interpretations of sentences involves the use of **truth-value judgments**. In this methodology, participants are presented with contexts, in the form of a short story or a picture, and have to judge whether a given sentence is true or false in that context. Dekydtspotter and colleagues (e.g., Dekydtspotter, Sprouse, & Swanson, 2001) have used this methodology to show that L2ers are sensitive to subtle interpretive properties related to word order in French, proposing that this sensitivity must come from UG rather than the L1. What makes this methodology particularly suitable as a means of providing evidence as to the nature of unconscious linguistic competence is that the judgments are not made on a metalinguistic basis, a potential problem with grammaticality judgments, where one cannot eliminate the possibility that conscious knowledge is being brought to bear on the judgment.

Common Misunderstandings

Here we consider four common areas of misunderstanding about generative SLA research. These relate to (a) the scope of the theory, (b) lack of native-like "success" in L2, (c) transfer, and (d) methodology.

To address the first of these misconceptions, the theory described in this chapter does not seek to account for all aspects of L2 acquisition. On the contrary, the theory is deliberately circumscribed, concentrating on description and explanation

of interlanguage competence, defined in a technical way. In other words, the focus is on how the learner represents the L2 in terms of a mental grammar. The theory does not aim to account for second language use, nor does it aim to account for all of the observable phenomena (see later).

It is important to understand that UG is a theory of constraints on representation, as shown by the examples discussed earlier; this is true both of L1 acquisition (e.g., Borer, 1996) and L2 (White, 2003). UG determines the nature of linguistic competence; principles of UG (constraints) guarantee that certain potential analyses are never in fact entertained. This says nothing about the time course of acquisition (L1 or L2) or about what drives changes to the grammar during language development. Similarly, the theory of parameter setting does not, in fact, provide a theory of language development, even though it is often seen as such. The concept of parameter resetting in L2 presupposes that some kind of change takes place in the interlanguage grammar, from the L1 parameter value to some other parameter value (e.g., the change from –*wh*- movement to +*wh*- movement). In other words, interlanguage grammars at different points in time may be characterized in terms of different parameter settings. However, the precise mechanisms that lead to such grammar change are not part of the theory of UG. Rather, the theory needs to be augmented in various ways (Carroll, 2001; Gregg 1996).

The second misconception is that if UG constrains interlanguage grammars, this necessarily predicts a "successful" outcome in SLA, such that the **endstate** grammars of L2ers should not differ in significant respects from those of native speakers. However, the claim that interlanguage grammars are UG-constrained is a claim that the linguistic representations of L2ers are subject to principles of UG, like other natural languages. It is not a claim that L2ers will necessarily achieve the same grammar as a native speaker would. Thus, UG does not dictate that *wh*-movement must be acquired (since it is not acquired by L1 acquirers of *wh- in situ* languages)—only that, if acquired, it must be constrained by the relevant principles, such as island constraints. Many factors come into play in L2 that simply do not arise in L1 acquisition—including prior knowledge of another language and possible deficiencies in the input—which might prevent native-like attainment.

The third misconception is that the L1 should play a relatively trivial role in L2 acquisition, if UG is involved, the idea being that strong L1 influence is somehow incompatible with the claim that UG is implicated in L2 acquisition. In fact, however, many proponents of generative SLA incorporate the L1 grammar as an integral part of the theory. In particular, the Full Transfer Full Access Hypothesis (FTFA) and its precursors claim that the initial state of L2 acquisition consists of the steady state grammar of L1 acquisition (Schwartz & Sprouse, 1996; White, 1989). In other words, L2ers initially adopt the L1 grammar as a means of characterizing the L2 data. This constitutes *full transfer.* Subsequently, in the light of L2 input, revisions to the grammar may be effected. Such revisions are assumed to be UG-constrained, hence *full access.* Transfer may be persistent or not, depending on particular linguistic properties and particular language combinations (see

observable phenomena, in what follows). In the event that L2ers fail to arrive at properties of the L2, interlanguage grammars are nevertheless expected to fall within the range permitted by UG; that is, they will be subject to constraints, like any natural language. It is also conceivable that L2ers arrive at analyses appropriate for other languages but not for the L1 or the L2 (e.g., Finer, 1991).

Continuing with our *wh-* movement examples, what this implies is that, prior to acquiring *wh-* movement, learners whose L1 is a *wh- in situ* language would be expected to treat the L2 as *wh- in situ* as well. In support of this, evidence for *wh- in situ* in the L2 English of speakers of Hindi (a *wh- in situ* language) is reported by Bhatt and Hancin-Bhatt (2002). Furthermore, even when L2ers appear, superficially at least, to have abandoned a *wh- in situ* analysis of the L2, they may not have acquired *wh-* movement, instead generating *wh-* phrases as clause initial topics, analogous to other topics in the L1 (Hawkins & Chan, 1997; Martohardjono & Gair, 1993; White, 1992). In consequence, island constraints would be nonoperative for the same reason that they are not operative with *wh- in situ,* namely, the fact that movement has not taken place.

Finally, there are misconceptions relating to methodology. It has been claimed (Carroll & Meisel, 1990; Ellis, 1991) that researchers working in the UG paradigm take grammaticality judgment tasks to have some kind of privileged status, such that they provide a direct reflection of linguistic competence. In fact, judgment data are recognized as being performance data, on par with other data (White, 1989, 2003). The only privilege that grammaticality judgment tasks offer is a relatively straightforward way of assessing knowledge of ungrammaticality. As described in the section on evidence, different kinds of data provide different kinds of evidence and the suitability of any particular task (and the performance data gathered by means of it) will depend on the precise issue that the researcher is trying to investigate.

An Exemplary Study: White and Juffs (1998)

White and Juffs (1998) address the question of whether the interlanguage grammars of adult L2 learners are constrained by principles of UG, in particular, island constraints. The study examines the case of native speakers of a *wh- in situ* language (Mandarin Chinese) acquiring *wh-* movement in L2 English. If L2 acquisition is UG-constrained, and if these learners have acquired *wh-* movement, they are expected to observe constraints on English *wh-* movement, even though these constraints are not activated in the L1.

Participants included 16 adult native speakers of Chinese who had never been outside the People's Republic of China (PRC). Their first significant exposure to English was as adults, at university (in the PRC); prior to that, they had received limited formal instruction in English in high school. Nineteen native speakers of English served as controls.[5]

Participants were tested on two tasks. The first was a timed grammaticality judgment task, consisting of grammatical and ungrammatical sentences, displayed

one at a time on a computer. Participants were asked to read each sentence and make a judgment by pressing a key (green for possible sentences, red for impossible). Test items included ungrammatical sentences violating island constraints (complex NPs, including noun complements and relative clauses, as well as subject islands and adjunct islands) and grammatical sentences of equivalent complexity (involving extractions from embedded clauses that are not islands). The rationale for this task is to investigate whether L2ers know that certain sentences are ungrammatical in English (i.e., island violations), while at the same time knowing that long distance *wh-* extraction is possible in principle. Accurate performance on both sentence types (acceptances of grammatical sentences and rejections of ungrammatical ones) would indicate the acquisition of *wh-* movement and constraints on such movement. Examples of test items are given in (8), where (8a) illustrates a case of grammatical *wh-* movement out of an embedded clause, while (8b) shows ungrammatical *wh-* movement out of an island (complex NP).

(8)

a. Which man did Jane say her friend likes?
b. *Which article did you criticize the man who wrote?

The second task involved elicited production. Participants were presented with a set of declarative sentences, each of which included an underlined word or phrase. They were asked to question the underlined word or phrase. Some of the sentences were constructed to result in grammatical *wh-* questions involving extraction from embedded clauses, whereas others would result in island violations. The rationale here is that participants whose grammars are UG-constrained will word their questions to avoid producing island violations, instead finding other ways to form the questions. Examples of test items are given in (9); potential responses are given in (10). Given a stimulus like (9a), the hypothesis is that L2ers will produce a grammatical response like (10a). Conversely, given a stimulus like (9b), they will not in fact produce the response (10b) (even though this is what a literal following of the instructions would dictate) because this violates an island constraint; instead, they should avoid the ungrammatical response and provide a grammatical alternative, such as (10a).

(9)

a. Tom claimed that Ann stole *his car.*
b. Sam believes the claim that Ann stole *his car.*

(10)

a. What did Tom claim that Ann stole?
b. *What does Sam believe the claim that Ann stole?

Results from both tasks suggest that the L2ers observe island constraints in their L2 English. In the case of the grammaticality judgment task, they reject ungrammatical sentences, while accepting grammatical ones. Mean accuracy on this task is given in Table 3.2. The L2 group shows a high level of rejection of ungrammatical sentences, which does not differ significantly from the native speaker controls. (Their somewhat lower accuracy on the grammatical sentences reflects independent properties of some of these sentences; see White & Juffs, 1998, for discussion.)

The results from the question formation task (for sentences targeting complex NP, subject and adjunct islands) are given in Table 3.3. While L2ers produce some ungrammatical questions (15% of all responses), these mostly involved failure to produce subject-auxiliary inversion. (For example, they would produce questions like *What Tom claimed that Ann stole?*) There are few violations of island constraints (6% of all responses). Instead, like native speakers, the L2 groups avoid producing violations by finding other ways of formulating a grammatical question.

Other studies have reported that L2 learners with Chinese, Japanese, or Korean as mother tongues accept violations of island constraints in grammaticality judgment tasks (e.g., Johnson & Newport, 1991; Schachter, 1990). I have suggested elsewhere that such results reflect a failure to represent *wh-* questions in terms of *wh-* movement (White, 1992; see also Hawkins & Chan, 1997; Martohardjono & Gair, 1993). In contrast, the results of the present study, using both grammaticality judgments and elicited production data, suggest that island constraints are active in the interlanguage grammars of L2ers, once *wh-* movement is acquired. This is the case even when the L1 is *wh- in situ* and when exposure to the L2 is as adults, in a country where the L2 is very much a foreign language. In other words, the results are consistent with the claim that parameters of UG can be reset (in this case from –*wh-* movement to +*wh-* movement) and that interlanguage grammars are subject to principles of UG (in this case, island constraints).

In a more recent approach to *wh-* movement and other L2 phenomena, Clahsen and Felser (2006) propose the *Shallow Structure Hypothesis* (SSH). Their claim is that

TABLE 3.2 Grammaticality Judgment Task: Mean Accuracy (in percentages)

	Acceptance of grammatical sentences	*Rejection of ungrammatical sentences*
Native speakers	92.5	94.0
L2ers	76.0	87.5

TABLE 3.3 Question Formation Task: Response Types (in percentages)

	Violations	*Other ungrammatical*	*Grammatical avoidance*
Native speakers	2.0	1.5	96.0
L2ers	6.0	15.0	78.0

L2ers, in contrast to native speakers, are unable to make full use of structural information in on-line processing, instead relying on lexical and semantic cues rather than syntax to parse L2 sentences. This affects L2ers' processing of long-distance dependencies, including cases of *wh*- movement, where the fronted *wh*- phrase (filler) must be associated with the structural position that it has moved from (gap). The claim of the SSH is that L2ers are not able to compute intermediate gaps (such as the intermediate *t* in (2b)). The implication, then, is that L2ers fail to observe island constraints because the structural differences between grammatical and ungrammatical *wh*- movement disappear: In the absence of an intermediate gap, sentences like (2a) and (2b) are effectively the same. However, the studies that Clahsen and Felser (2006) report on do not in fact include potential island violations in the test stimuli. Omaki and Schultz (2011) do include such stimuli and show that L2ers, like native speakers, are sensitive to the effects of islandhood in on-line tasks, suggesting that UG-constraints are operational both off-line and on-line.

Explanation of Observed Findings in SLA

In seeking to characterize the unconscious underlying linguistic competence of L2 learners, the generative perspective on L2 acquisition cannot and does not aim to account for all of the observable phenomena discussed in this volume. Nevertheless, this perspective does offer insights into several of them.

Observation 1: Exposure to input is necessary for SLA. According to UG theory, there are certain aspects of grammar that are not learned through exposure to input, namely, knowledge of universal constraints. Nevertheless, UG does not operate in a vacuum: Universal principles and language-specific parameter settings must be triggered by input from the language being acquired. In the case of our examples, learners acquiring an L2 with *wh*- movement will require input to motivate the +*wh*- movement value of the parameter. However, once they have established that the L2 involves *wh*- movement, they will *not* require input to determine that island constraints operate; these come for free, so to speak.

Observation 3: Learners come to know more than what they have been exposed to in the input. This is the central observation that the theory aims to account for. The main motivation for the proposal that L1 language acquisition is constrained by UG is precisely the fact that native speakers come to know more than they have been exposed to. Generative SLA researchers make the same claim in the case of L2 acquisition: L2ers come to know very subtle properties of the L2 (such as ambiguity and ungrammaticality) which are underdetermined by the L2 input, both naturalistic input and classroom instruction, and which cannot be explained in terms of the L1 grammar either.

Observation 6: Second language learning is variable across linguistic subsystems. It has frequently been observed by researchers working within the generative SLA framework that there is a dissociation between attainment in the syntactic and morphological domains. Syntax acquisition is largely successful, in contrast to

inflectional morphology, which is often not supplied or supplied inappropriately. This is not taken to reflect a failure of UG-constraints. Rather, Lardiere (1998, 2000) attributes this dissociation to a problem in mapping between these two domains, a problem that can be very persistent, showing up not just in the course of L2 acquisition but in the endstate. In a related vein, Prévost and White (2000) advance the *Missing Surface Inflection Hypothesis* (MSIH), proposing that learners have a low-level morphological deficit such that they cannot consistently realize L2 morphology, resorting to default forms when in doubt, while at the same time having no problems with associated syntax.

Another discrepancy that has been investigated in recent years involves syntax versus discourse. Sorace and colleagues (Belletti, Bennatti, & Sorace, 2007; Sorace, 2011; Sorace & Filiaci, 2006) report that near-native speakers of null subject languages achieve native-like proficiency in syntax but nevertheless show problems in at the interface between syntax and discourse, for example, overusing overt subjects in discourse contexts where null subjects would be more appropriate. These problems are attributed, in part, to lasting effects of discourse properties of the L1 or to processing problems that arise when syntax must be integrated with other domains.

Observation 7: There are limits on the effects of frequency on SLA. The claim of UG theory is that certain properties of language are not subject to frequency effects. Indeed, the idea is the opposite: UG allows learners to acquire properties quite unrelated to frequency; children achieve certain kinds of knowledge on the basis of little or no input. For example, consider the case of so-called parasitic gaps, illustrated in (11). In (11a), the sentence is ungrammatical because the verb *correcting* requires an overt direct object pronoun (i.e., *them*). The example in (11b), a yes–no question, is ungrammatical for the same reason. But (11c), a *wh*- question, is significantly better, even though *correcting* still lacks an overt object.

(11)

a. *By mistake, I filed the papers without correcting.
b. *Did you file the papers without correcting?
c. Which papers did you file without correcting?

The grammaticality of (11c) is a consequence of properties of *wh*- movement that are encoded in UG. Native speakers of English acquire the distinction between these sentence types, even though sentences like (11a) and (11b) will not be exemplified in the input (because they are ungrammatical), while sentences like (11c) are presumably relatively rare. In other words, frequency does not appear to play a role in such cases. The same claim would apply in L2: Certain properties of the L2 are expected to be acquired regardless of frequency.

Observation 8: There are limits on the effect of a learner's first language on SLA. We have already seen that certain versions of generative SLA (e.g., FTFA) assume

strong L1 influence, with the L1 grammar taken as the starting point (the initial state) in L2 acquisition. Although this claim implies that all parameters are initially set at the L1 setting in the interlanguage grammar, it does not imply that they will all be reset to the L2 value at the same time. Hence, L1 effects may be quite fleeting in some cases but lasting in others. Depending on the L1 and the L2 in question, triggering input may motivate resetting to the L2 value extremely early, as Haznedar (1997) shows for the headedness parameter (switching from head final L1 to head initial L2). Conversely, if the L2 input does not provide suitable positive evidence to motivate resetting, transfer effects will be much longer lasting, maybe even permanent. For example, as discussed earlier, some L2ers appear to take fronted *wh*- phrases in L2 English not as evidence for *wh*- movement as such but rather as evidence that *wh*- phrases can be topicalized (a possibility permitted in the L1). Once such an analysis is adopted, it is not clear what evidence would lead them to abandon this.

Observation 9: There are limits on the effects of instruction om SLA. Clearly one cannot instruct L2ers as to UG-constraints (nor does anyone attempt to do so). On the contrary, this kind of abstract, complex, and subtle knowledge is achieved without being taught. Furthermore, several researchers have shown that classroom instruction and information provided in textbooks can often be quite misleading, providing superficial and incorrect analyses of certain complex linguistic phenomena assumed to stem from UG (e.g., Belikova, 2008; Bruhn-Garavito, 1995). Conversely, it could be that instruction might be effective in providing L2 input necessary to trigger parameter resetting (e.g., in providing evidence—in the form of *wh*- questions—for or against *wh*- movement). Attempts have been made to provide learners with triggering input in the classroom, with mixed results (see White, 2003, for discussion).

The Explicit/Implicit Debate

As already discussed, a central assumption of the generative linguistic perspective on second language acquisition described in this chapter is that language learners (both L1 and L2) acquire linguistic competence, which takes the form of an abstract and unconscious grammar, achieved, at least in part, by means of UG. In other words, assuming Hulstijn's (2005) identification of explicit with conscious knowledge and implicit with unconscious knowledge, what this theory seeks to account for is the implicit linguistic knowledge that L2 learners attain. This does not mean that all linguistic behavior reflects implicit knowledge. There are aspects of language that involve what is sometimes called "encyclopedic" knowledge, including, for example, entries in the mental lexicon and morphological paradigms. Such knowledge may well be explicit and the way it is learned may be explicit, involving general cognitive processes such as attention and memorization.

It is the acquisition of implicit knowledge that is at the heart of the generative perspective on SLA. We now turn to the question of how this implicit knowledge

is achieved. Here the distinction between acquisition and learning originally formulated by Krashen (1981) becomes relevant (see Chapter 2). Schwartz (1986, 1993) has extended Krashen's proposal, arguing for a distinction between unconscious (i.e., implicit) linguistic competence (in the technical sense assumed in this chapter) and learned linguistic knowledge. (See also Felix, 1985, for a similar division of labor. Felix argues that competing systems are implicated in adult L2, namely, UG and problem-solving systems.)

Researchers working in the generative SLA framework agree that the acquisition process is implicit and that the outcome of acquisition (in terms of unconscious knowledge) is implicit. But there is ongoing debate about the exact relationship between the acquisition of an unconscious system and a more explicitly learned system and the extent to which linguistic input can be manipulated in the classroom to affect language acquisition.

Arguing for the claim that linguistic competence is acquirable only by means of implicit mechanisms, Schwartz (1986, 1993) follows Fodor (1983) in assuming that language involves cognitive processes that are domain specific, or modular, in contrast to more general, nonmodular processes that apply to other aspects of cognition. Language acquisition takes place by means of mechanisms within the language module (including UG). In other words, only implicit mechanisms, specific to language, are involved. Language acquisition cannot come about through conscious memorization of rules, for example, or by means of a conscious search for patterns in the input, or by paying explicit attention to certain aspects of the input. Schwartz furthermore makes the strong assumption (again, following Krashen, 1981) that the outcome of explicit learning can never become the input to the implicit acquisition system or to implicit competence. In other words, there is no interface between implicit and explicit knowledge, or between explicit learning and implicit linguistic competence.

Schwartz further extends these ideas to issues relating to the kinds of input typically available in language classrooms, arguing that explicit input (such as grammar teaching or correction) can never serve as input to the language acquisition system. In contrast, White (1991), making the same assumptions about the acquisition of implicit linguistic competence, has nevertheless argued that explicit input might contribute to the shaping of underlying competence, particularly in cases where the L2 positive input does not provide evidence of ungrammaticality. For more recent perspectives on such issues, see papers in Whong, Gil, and Marsden (2013).

Conclusion

In this chapter, the perspective offered by linguistic theory has been presented. The central tenet of the theory is that the linguistic competence of native speakers is underdetermined by the input that children are exposed to, hence that an innate UG is implicated in language acquisition. Researchers with a generative

perspective on SLA investigate whether the same holds true for L2 acquisition. If interlanguage competence goes beyond the L2 input and the L1 grammar in particular respects, then UG is implicated in nonnative language acquisition as well.

Discussion Questions

1. Like other researchers within a UG framework, White relies on the logical problem of learning and the poverty of the stimulus argument to posit an innate language faculty. What other explanation might there be, other than innateness, for the problems White discusses?
2. If both L1 acquisition and SLA are constrained by UG, how would you explain the observed differential outcomes between L1 acquisition and SLA (e.g., L1 acquisition is universally successful while SLA is not; L1 learners all attain some kind of native pronunciation, whereas most L2 learners do not)?
3. What evidence does White use to suggest language acquisition is different from other kinds of learning? Do you agree with this evidence? If not, how would you explain the findings of UG research?
4. Research within the UG framework tends to ignore the social context of language learning. Why is this appropriate for the framework?
5. As a theory of linguistic competence, the crux of research on UG is how learners come to know more than what they are exposed to. In addition to UG, what other mechanisms in the mind–brain would you suggest are necessary to explain language acquisition? For example, what *triggers* movement from one stage of acquisition to the next?
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Notes

1. Island constraints are also known as the Subjacency Principle. The situation is more complex than described here. There is a complex interaction depending on whether the *wh*-phrases are arguments or adjuncts, differences that are accounted for in terms of another constraint, the Empty Category Principle (ECP) (Chomsky, 1981).
2. Tones are omitted from the Chinese examples. Chinese examples in (3) and (5) come from Huang (1982). Thanks to Chen Qu for the examples (and judgments) in (4).
3. While the precise characterization/definition of the relevant principles has changed over time, the essential issues remain the same. In GB theory, islands were defined in terms of bounding nodes (e.g., Chomsky, 1981) or barriers (Chomsky, 1986a). In Minimalism, UG specifies universal computations (*merge*, *move*), which are subject to economy principles yielding the same effects (Chomsky, 1995).
4. Many people argue that *wh- in situ* languages have movement, but at the level of logical form (LF) (e.g., Huang, 1982). There is considerable debate as to the extent to which LF movement is subject to constraints (cf. Huang, 1982; Xu, 1990).
5. A second group of Chinese speakers tested in Canada will not be discussed here.

Suggested Further Reading

Hawkins, R. (2001). *Second language syntax: A generative introduction*. Oxford, England: Blackwell.

This book provides a clear and comprehensive introduction to L2 acquisition of syntax and morphology within a generative linguistic perspective.

White, L. (1989). *Universal grammar and second language acquisition.* Amsterdam, Netherlands: John Benjamins.

This book presents the logical problem of L2 acquisition and discusses research relevant to the debate over the availability of principles and parameters of UG in L2 acquisition.

White, L. (2003). *Second language acquisition and Universal Grammar.* Cambridge, England: Cambridge University Press.

In this book, theories as to the role of UG and the extent of mother tongue influence are presented and discussed. Particular consideration is given to the nature of the interlanguage grammar at different points in development, from the initial state to ultimate attainment.

White, L. (2012). Research timeline: Universal Grammar, crosslinguistic variation and second language acquisition. *Language Teaching, 45,* 309–328.

This paper traces some of the main strands of generative SLA research conducted between 1985 and 2011.

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4

ONE FUNCTIONAL APPROACH TO SLA

The Concept-Oriented Approach

Kathleen Bardovi-Harlig

The Theory and Its Constructs

Functionalist approaches to language hold that language is primarily used for communication and does not exist without language users. Functionalism views language in terms of *form-to-function* and *function-to-form* mappings. Functional approaches to second language acquisition investigate such mappings in interlanguage and are especially interested in how these change over time in the developing interlanguage system. Functionalist approaches to linguistics in general and to second language acquisition in particular are not common in North America, and readers might find the functionalist emphasis on meaning and function to be both exciting and unfamiliar.

This chapter provides an overview of the concept-oriented approach, one functionalist approach to second language acquisition. A functionalist approach can take either a form-oriented approach or a concept- (or meaning-) oriented approach. A form-to-function approach would begin with a form such as the English past tense (*-ed*) and follow the use of the form to discover how it functions. If we took this approach in second language acquisition to examine the acquisition of the simple past, we would likely discover that the first use of the simple past is as a marker of completion with a certain class of predicates. We would also discover a second function of indicating the main events in a story. Finally, we would observe that the morphological past takes the function of expressing past time regardless of predicate type or role in a story. These observations have been made under the auspices of the Aspect Hypothesis (Andersen, 1991; Bardovi-Harlig, 1998, 2000) and the Discourse Hypothesis (Bardovi-Harlig, 1995), examples of the form-to-function type of functional analysis (N. Ellis, 2013).

A function-to-form approach, typically called the concept-oriented approach, identifies one function, concept, or meaning and investigates how it is expressed.

In this way, the concept-oriented approach focuses on one direction of the form and function mapping, specifically the function-to-form mapping.[1] Within the concept-oriented approach, the main construct is the concept that is being investigated. Concepts can be overarching, like time or temporality, or they can be subsets of larger concepts, like futurity. Following Klein (2009), a concept such as time can be encoded linguistically by six devices: tense, grammatical aspect, lexical aspect, temporal adverbials, temporal particles, and discourse principles. Even semantically more restricted concepts like the future are expressed by a range of linguistic devices; for example, expression of future by learners of English includes temporal adverbials, modals, *will, going to,* and lexical futures (future-oriented verbs), such as *want to* or *need to* (Bardovi-Harlig, 2005). Concept-oriented studies have investigated a range of temporal and nontemporal concepts, which include past (Bardovi-Harlig, 1992, 2000; Dietrich, Klein, & Noyau, 1995), **reverse-order reports** (RORs) (Bardovi-Harlig, 1994), futurity (Bardovi-Harlig, 2004, 2005; Howard, 2012; Kanwit, 2014; Moses, 2002; Solon & Kanwit, 2014), and simultaneity (Aksu-Koç & von Stutterheim, 1994; LeClerq, 2009; Schmiedtová, 2004).

A basic tenet of the concept-oriented approach to second language acquisition is that adult learners of second or foreign languages have access to the full range of semantic concepts from their previous linguistic and cognitive experience. Von Stutterheim and Klein (1987) argue that "a second language learner—in contrast to a child learning his first language—does not have to acquire the underlying concepts. What he has to acquire is a specific way and a specific means of expressing them" (p. 194). The concept-oriented approach begins with a learner's need to express a certain concept, such as time, space, reference, or modality, or a meaning within a larger concept (such as past or future time, within the more general concept of time), and investigates the means that a learner uses to express that concept.

The basic claim of functional approaches is the centrality of meaning and function in influencing language structure and language acquisition. Cooreman and Kilborn (1991) outline two major tenets: Language serves communication and form serves function. Functional approaches always work on multiple levels of language. As Cooreman and Kilborn state, "there is no formal separation of the traditionally recognized subcomponents in language, i.e., morphosyntax, semantics, and pragmatics" (p. 196).

Consistent with other functional approaches, the concept-oriented approach embraces a multilevel analysis, including lexical devices, morphology, syntax, discourse, and pragmatics. In other words, the concept-oriented approach includes all means of expression used by learners. As Long and Sato (1984) note, "function to form analysis automatically commits one to *multi*-level analysis, since the entire repertoire of devices and strategies used by learners must be examined" (p. 217).

Thus, concept-oriented analyses document the range of linguistic devices that speakers use to express a particular concept (von Stutterheim & Klein, 1987), the interplay of ways to express a meaning, and the balance of what is explicitly

expressed and what is left to contextual information (Klein, 1995). As Klein observes, from the concept-oriented perspective, a substantial part of language acquisition is the permanent reorganization of the balance among means of expression. The analysis seeks to explain how meanings within a larger concept are expressed at a given time, and how the expression of the concept changes over time.

As an example of interplay among means of expression and the changing balance, consider a learner's expression of past time. The earliest resource that learners have is their interlocutors' turns which may provide a time frame on which a learner can build (this is called **scaffolding**), and on universal principles such as chronological order, by which listeners assume that events in narratives are told in the same order in which they happened. This is called the pragmatic stage (Meisel, 1987). In the next stage, the lexical stage, learners use temporal and locative adverbials as well as connectives (e.g., *and then*) to indicate time. Finally, learners may move to the morphological stage, in which tense indicates temporal relations. At the same time that past morphology develops, it also participates in structuring the narrative. The main story line (the foreground) is distinguished from the supporting information (the background) by high use of simple past in English (or preterit in Spanish and passé compose in French).

Note that both the inventory and the balances changes. The inventory changes as new forms are added: first lexical markers, then verbal morphology. The balance changes as the use of morphology becomes more reliable. In the early stages adverbs are used in the absence of tense, whereas in the morphological stage tense is used more than adverbials. However, as Schumann (1987) points out, adverbials persist in advanced interlanguage just as they do in the native speaker system.

The concepts of interplay and balance in a system also relate to the functionalist concept of **functional load**. Every linguistic device, whether a structure, morphology, or word, has a function. For example, if an adverb such as *yesterday* is the only indicator in a sentence that an event happened in the past, then the functional load of the adverb is high. If the sentence also employs past-tense verb morphology to indicate the time frame, the functional load of both the adverb and the verbal morphology is lower than either one occurring alone (Bardovi-Harlig, 1992).

One natural outcome of functionalism's interest in the interplay of linguistic resources and their change over time is an attempt to understand how interlanguage selects the first meaning-to-form mappings and how they expand. This interest in the development of function-to-form and form-to-function mapping has been captured by Andersen in two principles for SLA, the **one-to-one principle** and the **multifunctionality** principle (Andersen, 1984, 1990). The one-to-one principle states that an interlanguage system "should be constructed in such a way that an intended underlying meaning is expressed with one clear invariant surface form (or construction)" (Andersen, 1984, p. 79). As Andersen sums up, the one-to-one principle "is a principle of one *form* to one *meaning*" (p. 79; emphasis

original). The multifunctionality principle comes into play at later stages and was formulated as follows (Andersen, 1990):

> (a) Where there is clear evidence in the input that more than one form marks the meaning conveyed by only one form in the interlanguage, try to discover the distribution and additional meaning (if any) of the new form. (b) Where there is evidence in the input that an interlanguage form conveys only one of the meanings that the same form has in the input, try to discover the additional meanings of the form in the input. (p. 53)

The multifunctionality principle, then, allows multiple forms for a single meaning and multiple meanings for a single form.

As an illustration, consider the early expression of futurity by learners of English. Learners begin to express the futurity with *will,* and only later under certain circumstances expand their repertoire to include the *going to* future (Bardovi-Harlig, 2004, 2005). Audiences often ask me why the learners do not just use the present progressive (*I'm going to Chicago*). The data show that the present progressive is used less than 2% in learner expressions of the future. The explanation is rather straightforward functionally. The present progressive has the primary function of expressing ongoing action. In other words, it is involved in a one-to-one relationship with another meaning in the interlanguage. With time, learners do expand their systems beyond the initial stage described by the one-to-one principle and move into a stage characterized by multifunctionality, but at the outset they begin with a transparent, invariant, and simple association of futurity and *will.*

Adult learners use language in the service of communication, so making (and expressing) meaning is the main process underlying acquisition. Failure to convey the intended meaning in seen as an impetus to moving to the next acquisitional stage. Consider the three main stages in the expression of temporality: the pragmatic (such as use of chronological order or building on an interlocutor's discourse that provides temporal reference), the lexical (such as the use of temporal adverbials to establish a time orientation), and the morphological (the use of verb inflections to indicate time relations). Failure to convey the intended meaning using pragmatic means may drive learners to develop a more elaborated system, moving from the pragmatic to lexical stage, or from the lexical stage to greater lexical elaboration or to the acquisition of verbal morphology in the final stage (Dietrich et al., 1995).

The emphasis on the learner's use of various linguistic devices and the change in the balance of those devices in the course of acquisition aligns functional approaches with Selinker's (1972) influential concept of interlanguage (Bardovi-Harlig, 2014). The concepts of interlanguage (Selinker, 1972) and learner varieties (Dietrich et al., 1995; Klein, 1995; Klein & Dimroth, 2009) both emphasize the systematicity of the emerging linguistic system and de-emphasize comparison with achievement of target-language norms. Studies that quantify the use

of various means of expression do so, not in relation to target-language use, but rather in terms of other means used at the same time in the interlanguage (see, e.g., the example study in this chapter; also Bardovi-Harlig, 2004, 2005; Moses, 2002; Solon & Kanwit, 2014).

The concept-oriented approach is also compatible with research on variation in second language acquisition and the acquisition of variable targets. Gudmestad and Geeslin (2011, 2013) have investigated the expression of futurity in Spanish by advanced learners, and Kanwit and Solon (2013) explored the effect of regional exposure on the acquisition of Spanish future expression in two study abroad contexts.

In contrast to the theories and models outlined in other chapters in this volume, the concept-oriented approach is neither a theory, nor a model, but rather a framework for analysis.[2] Although it does not make predictions or model the acquisition process as theories and models do, it does provide an orientation to second language acquisition research that guides research and research questions. If one of the functions of a theory is to provide direction in identifying important research questions, this analytic framework satisfies that function. Klein (1995) compared the concept-oriented framework to a theory in the following way:

> A frame of analysis, such as the one used here, is not a theory which is meant to excel by the depth of its insights or by its explanatory power. Rather, it is an instrument designed for a specific purpose [to analyze language], and to serve this purpose, it should be simple, clear and handy. . . . A frame of analysis, if it is to be more than a temporary crutch, should also be flexible in the sense that it can easily be enlarged, refined and made more precise, whenever there is need to. (p. 17)

What Are the Origins of the Approach?

Functionalist approaches to SLA are related to functional linguistics more generally, a valuable resource for second language research. The interest in the function-to-form and form-to-function mapping is broader than the concept-oriented approach, and I will mention a few areas of investigation to give the reader a sense of the breadth of functionalist inquiry possible in L2 research.

Different approaches to functionalism explore different functions. Prague School functionalism pioneered work on functional sentence perspective (the role of information bearing elements, whether known or unknown, given or new) in determining word order (Firbas, 1979; Svoboda, 1974). This parallels a syntactic concern for word order but investigates it functionally. Similarly, research on topic (and topic-comment structure) in both L1 (Chafe, 1970; Kuno, 1980; Prince, 1981) and L2 (Hendriks, 2000; Huebner, 1983; Rutherford, 1983) offer a second perspective on word order. Discourse concerns related to text type, specifically narratives, have been investigated cross-linguistically for a range of languages by Hopper (1979) and for L2 (Bardovi-Harlig, 1995, 1998; Flashner, 1989; Kumpf,

1984; von Stutterheim, 1991; von Stutterheim & Lambert, 2005). Functionalist approaches can also be found in studies of processing and weighting of cues, most notably in the competition model (Bates & MacWhinney, 1981, 1987), which has influenced a number of L2 studies (Cooreman & Kilborn, 1991; Gass, 1987; Kilborn & Ito, 1989; MacWhinney, 1987).

The concept-oriented approach to second language acquisition owes its articulation to von Stutterheim and Klein (1987). The concept-oriented approach is particularly compatible with other meaning-oriented or function-oriented approaches to language and linguistic universals, such as semantic or notional typology which investigates the expression of semantic concepts across the world's languages (Croft, 1995; Palmer, 2001). The research on L2 temporality (the expression of time relations) has benefited greatly from cross-linguistic studies (e.g., Bybee, 1985; Bybee, Perkins, & Pagliuca, 1994; Dahl, 1985, 2000; Klein & Li, 2009). Such inquiries inform second language acquisition researchers about both the range of expressions and the range of systems in which they appear that are possible in human language.

What Counts as Evidence?

Studies in the concept-oriented framework typically take as evidence language used communicatively, a subset of what is generally called production data. Studies in this framework also prefer to observe production over time, in what is called a longitudinal design. The tasks used to elicit data allow learners to construct meaning. The studies tend to observe learners' production (or output) in fairly natural situations. When speakers communicate they encode particular meanings in various ways. Since the concept-oriented approach is interested in the way in which meanings or semantic concepts are expressed, communicative tasks or activities are used which have a clearly definable concept or purpose. Examples of some tasks that have been used include the telling of narratives (stories), retelling of short film excerpts, and giving directions for the reenactment of an event. Telling or retelling stories allows researchers to study how events in the past are expressed, for example. Asking learners to make predictions may reveal how they express the future, and also how they express certainty or uncertainty, which is related to future events. Giving directions on how to perform an action naturally allows learners to encode both the order of events (what to do first, second, and third) and spatial relations (where to put what).

Studies in this framework have typically employed a longitudinal design. Longitudinal designs allow individual learners to be observed for a relatively long time, which facilitates the observation of how the use of various linguistic devices changes over time. Longitudinal studies have included both instructed learners over 15–18 months (Bardovi-Harlig, 1994, 2000, 2004, 2005) and predominantly uninstructed learners over 30 months in a large multinational study (e.g., Becker & Carroll, 1997; Dietrich et al., 1995). Later studies tracked learners for an academic

year (Salsbury, 2000) or used a hybrid design following four levels of university students for an academic year (Moses, 2002). As interest in the concept-oriented approach grew, *cross-sectional studies* were conducted (Solon & Kanwit, 2014) as well as single-moment studies (Howard, 2012). Early studies investigated learners only in the host environment, but later studies have also included instructed foreign language learners (e.g., for French, Howard, 2012; Moses, 2002; for Spanish, Kanwit 2014; Solon & Kanwit, 2014).

Evidence of language processing is also valued in functional approaches (Cooreman & Kilborn, 1991). Evidence from processing studies suggest that second language learners' reliance in early stages on adverbs to convey temporal relations is mirrored by their comprehension; learners may use adverbs to understand temporal relations even when morphological indicators are present or when they conflict with the adverb (e.g., Lee, Cadierno, Glass, & VanPatten, 1997; Musumeci, 1989; Sanz & Fernández, 1992). Additional studies of the Spanish future have investigated the presence of adverbials as well as other factors (Lee, 2002; Rossomondo, 2007). In contrast to the concept-oriented studies which rely on production tasks that are as close to spontaneous communication as possible, processing studies rely on highly controlled experimental designs and the results are understood in terms of accuracy and rate of processing. What these different types of studies have in common, however, is their focus on investigating form-meaning associations. Any design which facilitates the investigation of such associations would be considered appropriate to a functional inquiry.

Because functionalist approaches do not seek to explain form for form's sake, or structure in the absence of function, functionalist inquiries, including concept-oriented studies, tend to avoid designs that focus on form rather than meaning or that focus on form in the absence of meaning. Thus, tasks such as grammaticality judgments, which are used by other approaches, are not found in functionalist studies. Similarly, one would not expect to find sentence correction tasks, if the sentences are isolated; however, if the sentences were part of a text and thus context and meaning are involved, it would be harder to rule out such a task a priori.

It is also important to consider what type of analysis would and would not be appropriate to the approach. Concept-oriented analyses report how learners use language and how they construct their language but typically do not report the findings in terms of whether the learners are correct or incorrect relative to the language being learned (what we call the *target language*). Consider that in a concept-oriented approach we would say that learners who use *goed* (*yesterday*) are using morphological inflection to express the past, but we would be unlikely to discount the form as ill-formed.

Common Misunderstandings

Ironically, although functionalist approaches are not very common, I do not think the concept-oriented approach is misunderstood, largely because few people

think about this approach to interlanguage research and analysis. I think many people instinctively like the concept-oriented approach (and other functionalist approaches) because it is meaning-oriented, but when novice researchers attempt studies in this framework, they find it very difficult not to refer to form as the primary focus or to describe learner production without evaluating accuracy based on what is expected in the target language. As an illustration, consider the concept of plurality, which is distinct from the plural morpheme (in English indicated by *-s*). Consider also the noun phrases *two boy, many friend,* and *three girls.* In a target-like analysis only one noun phrase, *three girls,* correctly uses plural morphology; formally speaking, it is the only noun phrase that is "plural." In contrast, in a concept-oriented analysis, all three noun phrases express plurality. The interlanguage is seen to have three means of indicating plurality, namely, quantifiers, numerals, and plural morphology. Over time, the balance will change and *-s* will become the dominant marker of plurality, co-occurring with the other markers.

Researchers who were trained in other traditions may regard the lack of formal separation of the traditionally recognized subcomponents in language (morphosyntax, semantics, and pragmatics) to be rather disconcerting and perhaps reflect "fuzzy thinking" as a syntactician suggested to me many years ago. However, to a functionalist, taking many levels into account at once leads to a more complete picture of language in the service of communication.

An Exemplary Study: Bardovi-Harlig (1994)

A concept-oriented approach typically begins with a concept to be investigated. It examines (a) how learners express the concept, (b) how the means of expression interact, and (c) how the expression changes over time. The study presented here, Bardovi-Harlig (1994), investigated the concept of RORs, or how learners conveyed events that are not in the order in which they happened.

Without evidence to the contrary, a series of events is understood to be in the order in which they happened, or *chronological order.* Narratives, for example, relate events in chronological order (Dahl, 1984). Any change from chronological order must be indicated, as Klein (1986) states, "unless marked otherwise, the sequence of events mentioned in an utterance corresponds to their real sequence" (p. 127).

Despite the strong tendency to report events in chronological order, narrators, including L2 learners, must also be able to deviate from chronological order. Compare example (1), which reports events in chronological order, with (2), which reports them in reverse order. The first event is labeled [1] and the second [2].

1. John graduated from high school in 1975. [1] He went to college five years later. [2]
2. John entered college in 1980. [2] He had graduated from high school five years earlier. [1]

3. The first one they met was a horse as thin as a stick, tied to an oak tree [2]. He had eaten the leaves as far as he could reach [1]. (Thompson, 1968, p. 2)
4. I ate my lunch [2] after my wife came back from her shopping [1]. (Leech, 1971, p. 43)

English signals RORs by tense (the pluperfect, as in 3), adverbials (4), and by a combination of both (2).

Method

This study is a longitudinal production study that followed 16 learners from 9 to 16 months. The learners were from four language backgrounds (Arabic, Japanese, Korean, and Spanish) and were low-level learners, as measured by their placement in level one out of six levels in an intensive English program. The intensive English classes met for 23 hours a week and provided instruction in listening and speaking, reading, writing, and grammar.

The data for the study came from two sources: primary language samples produced by the learners and teaching logs completed by participating grammar and writing instructors. The production data comprised the first three past-time texts from each half-month sampling period, resulting in 430 texts: 376 journal entries, 37 narratives from film retell tasks, and 17 essay exams and in-class compositions. Past-time texts were identified by the use of time adverbials that provided time frames (Bardovi-Harlig, 1992; Harkness, 1987; Thompson & Longacre, 1985) and program calendars.

Every verb supplied in past-time contexts was coded for its verbal morphology, and all adverbials were identified and coded (Harkness, 1987). Rates of appropriate use of past tense were calculated as the ratio of the number of different past tense forms (i.e., types) supplied to the number of obligatory environments. Next, the RORs were identified and coded for verbal morphology and presence of other markers, namely adverbials, relative clauses, complements, and causal constructions.

The findings show that RORs are indeed marked as Klein predicted. RORs are marked by a variety of devices; fewer lexical and syntactic devices are used when specialized verbal morphology is used; and RORs seem to emerge when expression of the past has stabilized. The individual research questions are examined in turn.

How Are RORs Expressed?

One hundred (94.2%) of the 103 RORs showed an explicit marker of reverse order, whereas only 3 (or 5.8%) did not. The explicitly marked RORs exhibited a variety of linguistic devices: morphological contrast (tense-aspect usage), adverbials (single and dual), and syntactic devices including causal constructions (especially the use of *because*), complementation (especially reported speech or thought), and relative clauses (Table 4.1). Sixty-three of the 103 RORs exhibited a contrast in verbal

TABLE 4.1 Past-Time Reverse-Order Reports

	Type of contrast					
	No morphological contrast[1]	*N*	%	*Morphological contrast*[2]	*N*	%
Devices						
No marking	She said to me "Yes." [2] She didn't eat breakfast, lunch [1] so also she was hungry.	3	5.8	N/A		
Morphology only	N/A			John and I went to her building [2]. She had invited her friends.[1]	14	20.6
Single adverb	My sister played piano very well. *Before* she played [2], we were very nervous [1]	13	25.0	*By the time* the baker caught her [2] she had run into our hero [1]. [Carlos T5.5]	23	33.8
Dual adverb	*In level two* I studied many new things for me [2], I didn't study *before in the another school* [1]	11	21.2	*Today* morning my father called us. [2] He told us [3] that grandmother has been sick *during two weeks* [1]	7	10.3
Relative clause	Then the bolice [police] but [put] the girl [2] *which* stole the bread [1] on the lory with Charlie	7	13.5	In order to avoid mistakes and misunderstandings I had to review severals time [2] what I had done [1].	11	16.2
Because	Yesterday was a pusy [busy] day because I had to go to Indiana bell [2] *because* I didn't biad [paid] my bell [1] so I did.	12	23.1	I spent that time with my family [2] *because* I had been here since Ogust [1].	7	10.3
Complement	He thought [2] *that* I said "Coming" [1]	6	11.5	I thought about [2] how she had bought them and packed them [1].	6	8.8
	Total	52	100.1	Total	68	100.0

[1] $N = 40$.

[2] $N = 63$.

morphology and 40 did not. Some of the RORs were indicated in multiple ways; thus, there are more markers of RORs than RORs themselves in Table 4.1.

The morphological contrasts employed are often target-like, and two-thirds of the sample showed a contrast between the simple past to indicate the second event and the pluperfect to indicate the first event. The remaining one-third comprises other contrasts including past [event 2] with present perfect or past progressive [event 1] and base forms [event 2] with past [event 1].

How Do the Means of Expression Interact?

When learners use verbal morphology to indicate reverse order reports, the use of other devices decreased (Table 4.1). The use of dual adverbials to show contrast declines by about half (21.2% to 10.3%). Learners also showed utterances that have neither lexical nor syntactic devices to indicate RORs *once verbal morphology marked reverse-order reports,* whereas this is very unusual when verbal morphology is not used: 20.6% of RORs with morphological contrast occur with no additional lexical or syntactic devices.

How Does Expression Change over Time?

Looking at language production over time shows that the learners exhibited variable rates of **emergence** for RORs. (*Emergence* refers to the earliest expression of a concept or a form.) Half of the learners began to use RORs within the first 3 months of observation, another four in the next 3 months, and another four between months 7 and 13. Although calendar time does not present a consistent picture, emergence with respect to other features of the temporal system does. RORs emerge when learners show stable use of simple past tense, at about 80% appropriate use in past-time contexts.

Pluperfect, the grammatical form that serves to uniquely mark in the past-in-the-past, emerges even later. Whereas half of the learners showed use of RORs in the first three months, only half of those showed early use of the pluperfect. One learner showed emergent use by the end of the sixth month, and another two by the end of the seventh month. Three additional learners started to use the pluperfect in the corpus between months 9.5 and 12.5.

As predicted by Klein's principle of natural order, deviations from chronological order were signaled in interlanguage. The expression of RORs is delayed until the learner can use a marker to distinguish them from the surrounding narrative.

The finding that the acquisition of the pluperfect serves the expression of RORs, but does not itself make RORs possible is an important result of employing a meaning-oriented approach to this inquiry. Both a form-focused approach (i.e., focusing on the acquisition of the pluperfect) and a meaning-oriented approach (focusing on the expression of RORs) could identify the acquisitional prerequisite of high appropriate use of past tense. However, focus on the form of the pluperfect

alone would fail to capture the fact that the pluperfect moves into an established semantic environment. Through a meaning-oriented approach both prerequisites for the acquisition of pluperfect, high appropriate use of past tense and expression of RORs, are revealed.

Explanation of Observed Findings in SLA

As noted at the beginning of this chapter, the concept-oriented approach is an analytic framework rather than a theory. It thus lacks the predictive power of a theory. It does, however, contribute to detailed descriptions of second language acquisition that take meaning as well as form in to account. Studies in the concept-oriented framework have contributed to a number of observations outlined in Chapter 1, especially, stages of acquisition, variable outcomes, influence of first language, and the effects of instruction. The longitudinal design which is favored by the concept-oriented studies permits the investigation of multiple learner variables. The functionalist approach offers accounts of two of the observations from Chapter 1: predictable stages and the limitations of instruction.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. The overriding concern of functionalism is communication. Therefore, it is in keeping with its orientation for functionalism to explain major stages in those terms. More successful communication—resulting in conveying the speaker's meaning—propels learners to the next acquisitional stage. In the sequence from pragmatic to lexical to morphological expression of temporality, each stage affords a learner a greater range of expression and less dependence on interlocutors, resulting in an increasingly independent language user who speaks an interlanguage with ever increasing communicative power.

Within the larger stages of development, there are multiple discrete stages. The morphological stage, for example, exhibits many substages, in which different morphological markings emerge and enter into meaning to form mappings. One explanation for the order of acquisition of morphemes within the same subsystem is functional load. Meanings for which there are reasonable (i.e., grammatical and communicatively comprehensible) means of expression are less likely than others to promote acquisition of a new form. Take as an example, the present perfect (e.g., *have gone*) and the pluperfect (e.g., *had gone*). Both are equally complex structurally, having both a tensed form of *have* plus a past participle. Longitudinal observation shows that the present perfect emerges noticeably earlier in adult second language acquisition, even when both are taught at the same time (Bardovi-Harlig, 2000). The difference between them is that the present perfect has no functional equivalent. In contrast, the meaning of the pluperfect (past in the past) can be expressed by the simple past plus an adverbial, as discussed earlier. This helps explain the order of emergence. It appears that an emergent interlanguage system puts greater store in range of expression (covering all the conceptual bases) than in redundancy.

Observation 9: There are limits on the effects of instruction on SLA. Naturally, the explanation for instructional effects depends on the instructional effects that one sees. When I look at the results from instructional investigations of varying types, I see second language acquisition itself. If instructed and uninstructed learners are compared in the early period before instructed learners overtake uninstructed learners (Bardovi-Harlig, 2000), the stages are the same. As Gass (1989) argued, the fundamental psycholinguistic process of second language acquisition is the same whether learners enter classrooms or acquire language outside of them.

On the level of expression of individual concepts, instruction is also seen as having a limited role. The stage of acquisition of individual learners also interacts with instruction as Pienemann (1989, 1998) has argued. To better understand what leads to development in temporal expression, the study reported on earlier (Bardovi-Harlig, 1994) also collected instructional logs. Comparing the documented form-focused instruction with the emergence and use patterns of the pluperfect revealed that learners began to use the pluperfect at or following the time of instruction if they had already passed through the prerequisite stages for the pluperfect: stable use of past (above 80%) and expression of RORs. Learners who had not established a stable use of past, or had not expressed RORs, did not show spontaneous use of pluperfect in their written texts.

This suggests that meeting these acquisitional prerequisites is a necessary step even when the pluperfect is available in instructional input, but it also shows that merely meeting the prerequisites at the time of instruction is not sufficient. This is consistent with Pienemann's teachability hypothesis, according to which the effects of instruction on the developing interlanguage are constrained by the learner's current stage of acquisition. However, even learners who apparently satisfy the acquisitional prerequisites for an instructionally targeted form may not immediately integrate that form into productive use.

The learners in the ROR study show a similar lack of incorporation of a targeted form after instruction in the expression of futurity. Learners show a delay in using *going to.* The presence of targeted forms in instructional input and completion of acquisitional prerequisites, within continued nonuse of the target form suggests that even in the presence of focused instruction, the one-to-one principle is at work. When learners have an established means of expression a given concept in interlanguage (and especially when that form is communicatively clear and grammatical), they may be slow to expand their grammars even in the face of instruction.

In addition to linguistic and cognitive constraints on the effect of instruction, Klein and Dimroth (2009) outline three potentially disadvantageous ways in which instructed learning differs from untutored acquisition which are particularly relevant to the concerns of a functionalist approach. Compared to contact language learning, classrooms offer preprocessed language in contrast to communication outside the classroom, reduce communicative urgency, and provide an external arbiter of correctness (the teacher) rather than allowing learners to

develop their own assessment of their success by asking themselves "Do I understand, am I understood? and "Do I have the impression that my way of speaking is exactly like that of the others?" (p. 508). All of these emphasize the centrality of communication to a functional approach to language development.

Explicit/Implicit Learning

The seminal works of the concept-oriented approach (Dietrich et al., 1995; Klein, 1995, 2009; von Stutterheim & Klein, 1987) do not directly address the constructs of explicit and implicit learning. It is clear from the early writing that researchers regarded the linguistic phenomena under observation to be the product of acquisition or implicit knowledge (R. Ellis, 2009). This is even clearer in light of Klein and Dimroth's (2009) characterization of instruction as somewhat disadvantageous to acquisition processes found in the communicatively oriented experiences of untutored learners.

Because the concept-oriented approach is a framework for analysis rather than a theory (following Klein, 1995), this section evaluates the likelihood that the phenomena investigated by the seminal research studies were indeed reflexes of implicit knowledge using R. Ellis's (2009) work on explicit and implicit knowledge as a framework.

The early concept-oriented studies shared at least three design characteristics: learners were essentially untutored and often had low literacy skills in L1 (and L2) and produced both personal narratives and narratives based on film retells. All data were oral. Using the categories of degree of awareness, focus of attention, and utility of **metalanguage** (R. Ellis, 2009, p. 47), the elicited narratives would score high in the implicit knowledge categories of production by feel for degree of awareness, meaning for focus of attention, and "no" for utility of metalanguage. In fact, the extended narratives that form the data for the concept-oriented studies far exceeds the focus on meaning and communication of the read-and-repeat task called "oral narrative" in Ellis's (2009) test battery (Bardovi-Harlig, 2013).

In addition, the learners in the early concept-oriented studies (Dietrich et al., 1995; Klein, 1995, 2009; von Stutterheim & Klein, 1987) and the early form-oriented studies (Andersen, 1991) were untutored learners, thereby further increasing the likelihood that implicit knowledge accounted for observed patterns of development. Relatively low educational levels and low literacy levels in L1 and L2 may have further contributed to limiting the potential for explicit knowledge.

As functional analyses were adopted in other sites, researchers added instructed learners in the host environment and later foreign language learners to the learner populations, careful to retain oral, meaning-oriented communication tasks that have included personal narrative, narrative retells, and personalized narratives (Bardovi-Harlig, 2000) and sociolinguistic interviews and danger of death stories (Bayley, 1994; see Bardovi-Harlig, 2013, for an analysis of texts and tasks in tense-aspect research). Given the literacy levels of the instructed learners and the

potential for pronunciation to affect the oral production of verbal morphology (English past creates consonant clusters in verbs such as *walked* which may not be articulated by some learners), written narratives were added for comparison. As the concepts broadened from past to futurity, narratives necessarily gave way to elicitation tasks suited to future expression (Moses, 2002; Solon & Kanwit, 2014).

The value that functional approaches in general, and the concept-oriented approach in particular, place on communication heavily favors tasks that tap implicit knowledge, but as can be seen from the number of variable involved, does not guarantee it, All approaches to SLA must consider features of the task and learner characteristics when designing elicitation tasks.

Conclusion

The study of interlanguage development from a concept-oriented approach highlights the relationship of the various linguistic devices that learners may employ to express a given concept. In this chapter, we saw how various linguistic means convey temporal reference, how they relate to each other, and how the balance changes over time. Because the concept-oriented approach investigates concepts rather than specific forms, the approach encourages the investigation of the interlanguage system from the very earliest stages, although it also allows investigation in advanced stages as well. It thus allows the SLA researcher to document premorphological stages that importantly form part of the sequences of second language acquisition. The concept-oriented approach also emphasizes the investigation of the interlanguage system in its own right. This is important because target-language orientations, which are more common in the literature, often focus on the distance between a learner's interlanguage and the target language rather than exploring the emergence, interplay, and balance of features of the interlanguage as a linguistic system.

Discussion Questions

1. Compare and contrast White's approach with Bardovi-Harlig's. As a starting point, you might consider what counts as evidence within each approach. Are the kinds of evidence similar or different, and what do they suggest about each framework?
2. How does a functionalist approach explain staged development in SLA?
3. Identify a concept or question that you would like to investigate using a concept-oriented framework. How would you set up the study? Keep in mind that you need to determine how learners express the concept, how the various means of expression interact, and how the expression changes over time.
4. Functionalist approaches are useful for explaining the acquisition of many if not all meaning-based aspects of language. Can you think of areas of language that are not meaning-based? If so, how would a functionalist approach account for their acquisition?

5. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Notes

1. Such meaning-oriented studies in second language acquisition are known by a variety of names, including the concept-oriented approach (von Stutterheim & Klein, 1987), the conceptual approach (Klein, 1995), the semantically oriented approach (Giacalone Ramat, 1992), the functional-grammatical perspective (Skiba & Dittmar, 1992), the meaning-oriented approach (Bardovi-Harlig, 2000), and function-to-form studies (Long & Sato, 1984; Trévise & Porquier, 1986).
2. That is not to claim that there are no functional theories, however, just that the particular approach discussed in this chapter is not one. For examples of classic functional theories, see, for example, Functional Grammar (Dijk, 1978), Role and Reference Grammar (Foley & Van Valin, 1984), and Cognitive Grammar (Langacker, 1987).

Suggested Further Reading

Bardovi-Harlig, K. (2000). *Tense and aspect in second language acquisition: Form, meaning, and use.* Oxford, England: Blackwell.

This book synthesizes research on the acquisition of tense and aspect from a variety of research perspectives, including concept-/meaning-oriented perspectives, across a variety of target languages. See especially Chapters 2 and 6.

Becker, A., & Carroll, M. (Eds.). (1997). *The acquisition of spatial relations in a second language.* Amsterdam, Netherlands: John Benjamins.

For readers who would like to see how the concept-oriented framework is applied to areas beyond the expression of time, this European Science Foundation–sponsored study (see also Dietrich et al., 1995) reports on the expression of spatial concepts in five languages.

Cooreman, A., & Kilborn, K. (1991). Functionalist linguistics: Discourse structure and language processing in second language acquisition. In T. Huebner & C. A. Ferguson (Eds.), *Cross currents in second language acquisition and linguistic theory* (pp. 195–224). Amsterdam, Netherlands: John Benjamins.

This article presents another view of functionalism in second language acquisition research, including a comparison of functionalism and the competition model (Bates & MacWhinney, 1987).

Dietrich, R., Klein, W., & Noyau, C. (1995). *The acquisition of temporality in a second language.* Amsterdam, Netherlands: John Benjamins.

Sponsored by the European Science Foundation, the study reported here is a masterful undertaking. The acquisition of temporal expression in five languages (English, French, German, Swedish, and Dutch) by adult learners is reported on from a concept-oriented approach. Summary introduction and conclusion chapters provide an overview of the procedures and results.

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This seminal article introduces the concept-oriented approach to the second language acquisition literature in English.

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5

USAGE-BASED APPROACHES TO SLA[1]

Nick C. Ellis and Stefanie Wulff

The Theory and Its Constructs

Various approaches to second language acquisition (SLA) can be labeled as "usage-based." What unites these approaches is their commitment to two working hypotheses:

(1) Language learning is primarily based on learners' exposure to their second language (L2) in use, that is, the linguistic input they receive.
(2) Learners induce the rules of their L2 from the input by employing cognitive mechanisms that are not exclusive to language learning, but that are general cognitive mechanisms at work in any kind of learning, including language learning.

In the following, we will look at the following major constructs of usage-based approaches to SLA in more detail:

- Constructions: language learning is the learning of constructions, pairings of form and meaning or function. Constructions range from simple morphemes like *-ing* to complex and abstract syntactic frames such as Subject-Verb-Object-Object (as in *Nick made Steffi a sandwich*).
- Associative language learning: learning constructions means learning the association between form and meaning or function. The more reliable the association between a form and its meaning or function, the easier it is to learn. For example, the sound sequence /ˈsæn(d)wɪtʃ/ is reliably associated with a particular meaning ("slices of meet and/or cheese between two slices of bread"). The form *-ing,* in contrast, has different meaning/functions in different contexts, making it comparatively harder to learn.

- Rational cognitive processing: language learning is rational such that a learner's knowledge of a given form–meaning pair at any point in their language development is a reflection of how often and in what specific contexts the learner has encountered that form–meaning pair.
- Exemplar-based learning: language learning is in large parts implicit in the sense of taking place without the learner being consciously aware of it. The learner's brain engages simple learning mechanisms in distributional analyses of the exemplars of a given form–meaning pair that take various characteristics of the exemplar into consideration, including how frequent it is, what kind of words and phrases and larger contexts it occurs with, and so on.
- Emergent relations and patterns: language learning is a gradual process in which language emerges as a complex and adaptive (in the sense of continuously fine-tuning) system from the interaction of simple cognitive learning mechanisms with the input (and in interaction with other speakers in various social settings).

Constructions

The basic units of language representation are **constructions**. Constructions are pairings of form and meaning or function. By that definition, we know that simple words like, say, *squirrel,* must be constructions: a form—that is, a particular sequence of letters or sounds—is conventionally associated with a meaning (in the case of *squirrel,* something like 'agile, bushy-tailed, tree-dwelling rodent that feeds on nuts and seeds'). In Construction Grammar, constructions are not restricted to the level of words (Goldberg, 2006). Instead, these form–function pairings are assumed to pervade all layers of language. Simple morphemes such as *-licious* (roughly meaning 'delightful or extremely attractive') are constructions. Idiomatic expressions such as *I can't wrap my head around this* (meaning 'I do not fully comprehend this') are constructions. Even abstract syntactic frames are constructions: sentences like *Nick gave the squirrel a nut, Steffi gave Nick a hug,* or *Bill baked Jessica a cake* all have a particular form (Subject-Verb-Object-Object) that, regardless of the specific words that realize its form, share at least one stable aspect of meaning: something is being transferred (nuts, hugs, and cakes). Some constructions do not have a meaning in the traditional sense, but serve more functional purposes; passive constructions, for example, serve to shift what is in attentional focus by defocusing the agent of the action (compare an active sentence such as *Bill baked Jessica a cake* with its passive counterpart *A cake was baked for Jessica*).

Constructions can be simultaneously represented and stored in multiple forms and at various levels of abstraction: *table + s = tables;* [Noun] + (morpheme *-s*) = 'plural things'). Ultimately, constructions blur the traditional distinction between lexicon and grammar. A sentence is not viewed as the application of grammatical rules to put a number of words obtained from the lexicon in the right order; a sentence is instead seen as a combination of constructions, some of which are simple

and concrete while others are quite complex and abstract. For example, *What did Nick give the squirrel?* comprises the following constructions:

- *Nick, squirrel, give, what, do* constructions
- VP, NP constructions
- Subject-Verb-Object-Object construction
- Subject-Auxiliary inversion construction

We can therefore see the language knowledge of an adult as a huge warehouse of constructions. Constructions vary in their degree of complexity and abstraction. Some of them can be combined with one another while others cannot; their combinability largely depends on whether their meanings/functions are compatible, or can at least be coerced into compatibility, given the specific context and situation in which a speaker may want to use them together. The more often a speaker encounters a particular construction, or combination of constructions, in the input, the more entrenched that (arrangement of) constructions becomes.

Associative Learning Theory

Constructions that are frequent in the input are processed more readily than rare constructions are. This empirical fact is compatible with the idea that we learn language from usage in an associative manner. Let's stick to words for now, though the same is true for letters, morphemes, syntactic patterns, and all other types of constructions. Through experience, a learner's perceptual system becomes tuned to expect constructions according to their probability of occurrence in the input, with words like *one* or *won* occurring more frequently than words like *seventeen* or *synecdoche*.

When a learner notices a word in the input for the first time, a memory is formed that binds its features into a unitary representation, such as the phonological sequence /wʌn/ or the orthographic sequence *one*. Alongside this representation, a so-called detector unit is added to the learner's perceptual system. The job of the detector unit is to signal the word's presence whenever its features are present in the input. Every detector unit has a set resting level of activation and some threshold level which, when exceeded, will cause the detector to fire. When the component features are present in the environment, they send activation to the detector that adds to its resting level, increasing it; if this increase is sufficient to bring the level above threshold, the detector fires. With each firing of the detector, the new resting level is slightly higher than the previous one—the detector is primed. This means it will need less activation from the environment in order to reach threshold and fire the next time. Priming events sum to lifespan-practice effects: features that occur frequently acquire chronically high resting levels. Their resting level of activation is heightened by the memory of repeated prior activations. Thus our pattern-recognition units for higher-frequency words require

less evidence from the sensory data before they reach the threshold necessary for firing.

The same is true for the strength of the mappings from form to interpretation. Each time /wʌn/ is properly interpreted as *one,* the strength of this connection is incremented. Each time /wʌn/ signals *won,* this is tallied too, as are the less frequent occasions when it forewarns of *wonderland*. Thus the strengths of form–meaning associations are summed over experience. The resultant network of associations, a semantic network comprising the structured inventory of a speaker's knowledge of language, is tuned such that the spread of activation upon hearing the formal cue /wʌn/ reflects prior probabilities of its different interpretations.

Many additional factors qualify this simple picture. First, the relationship between frequency of usage and activation threshold is not linear but follows a curvilinear "power law of practice" whereby the effects of practice are greatest at early stages of learning, but eventually reach asymptote (see Chapter 6). Second, the amount of learning induced from an experience of a construction depends upon the salience of the form (i.e., how much it stands out relative to its context) and the importance of understanding it correctly. Third, the learning of a construction is interfered with if the learner already knows another form that cues that interpretation, or conversely, if the learner knows another interpretation for that form. Fourth, a construction may provide a partial specification of the structure of an utterance, and hence an utterance's structure is specified by a number of distinct constructions which must be collectively interpreted. Some cues are much more reliable signals of an interpretation than others, and it is not just first-order probabilities that are important—sequential probabilities matter a great deal as well, because context qualifies interpretation. For example, the interpretation of /wʌn/ in the context *Alice in wun . . .* is already clear after the learner has heard *Alice in . . .*; in other words, *Alice in* and /wʌn/ are highly reliably associated with each other. If a sentence starts out with *I /wʌn/ . . .,* in contrast, several competing interpretations are co-activated (*I wonder . . ., I won . . ., I once . . .,* etc.) because the first person pronoun *I* is a much less reliable cue for the interpretation of /wʌn/ than *Alice.*

Rational Language Processing

These associative underpinnings allow language users to be rational in the sense of having a mental model of their language that is custom-fit to their linguistic experience at any given time (Ellis, 2006a). The words that they are likely to hear next, the most likely senses of these words, the linguistic constructions they are most likely to utter next, the syllables they are likely to hear next, the graphemes they are likely to read next, the interpretations that are most relevant, and the rest of what's coming . . .? (next) across all levels of language representation, are made readily available to them by their language processing systems. Their unconscious language representation systems are adaptively tuned to predict the linguistic constructions

that are most likely to be relevant in the ongoing discourse context, optimally preparing them for comprehension and production. As a field of research, the **rational analysis of cognition** is guided by the principle that human psychology can be understood in terms of the operation of a mechanism that is optimally adapted to its environment in the sense that the behavior of the mechanism is as efficient as it conceivably could be, given the structure of the problem space and the cue-interpretation mappings it must solve (Anderson, 1989).

Exemplar-Based Learning

Much of our language use is formulaic, that is, we recycle phrasal constructions that we have memorized from prior use (Wulff, 2008). However, we are obviously not limited to these constructions in our language processing. Some constructions are a little more open in scope, like the slot-and-frame greeting pattern [*Good* + (time-of-day)] which generates examples like *Good morning* and *Good afternoon*. Others still are abstract, broad-ranging, and generative, such as the schemata that represent more complex morphological (e.g., [NounStem-PL]), syntactic (e.g., [Adj Noun]), and rhetorical (e.g., the iterative listing structure, [*the* (), *the* (), *the* (), . . ., *together they* . . .]) patterns. Usage-based theories investigate how the acquisition of these productive patterns, generative schema, and other rule-like regularities of language is based on **exemplars**. Every time the language learner encounters an exemplar of a construction, the language system compares this exemplar with memories of previous encounters of either the same or a sufficiently similar exemplar to retrieve the correct interpretation. According to exemplar theory, constructions such as *Good* + (time of day), [Adj Noun], or [NounStem-PL] all gradually emerge over time as the learner's language system, processing exemplar after exemplar, identifies the regularities that exemplars share and makes the corresponding abstractions.

The Associative Bases of Abstraction

Prototypes, the exemplars that are most typical of their categories, are those that are similar to many members of their category but not similar to members of other categories. People more quickly classify sparrows as birds (or other average sized, average colored, average beaked, average featured specimens) than they do birds with less common features or feature combinations, like geese or albatrosses. They do so on the basis of an unconscious frequency analysis of the birds they have known (their usage history) with the prototype that reflects the central tendencies of the distributions of the relevant features of these memorized exemplars. We don't walk around consciously counting these features, but yet we have very accurate knowledge of the underlying distributions and their most usual settings.

We are really good at this. Research in cognitive psychology demonstrates that such implicit tallying is the raw basis of human pattern recognition, categorization,

and rational cognition. As the world is classified, so language is classified. As for the birds, so for their plural forms. In fact, world and language categorization go hand in hand: Psycholinguistic research demonstrates that people are faster at generating plurals for the prototype or default case that is exemplified by many types, and are slower and less accurate at generating "irregular" plurals, the ones that go against the central tendency and that are exemplified by fewer types, such as [plural + 'NounStem*s*' = 'NounStem*s-es*'] or, worse still, [plural + *moose* = ?], [plural + *noose* = ?], [plural + *goose* = ?].

These examples make it clear that there are no 1:1 mappings between cues and their outcome interpretations. Associative learning theory demonstrates that the more reliable the mapping between a cue and its outcome, the more readily it is learned. Consider an ESL learner trying to learn from naturalistic input what *-s* at the ends of words might signify. This particular form has several potential interpretations: It could be the plural (*squirrels*), it could indicate possession (*Nick's hat*), it could mark third person singular present (*Steffi sleeps*), and so on. Therefore, if we evaluate *-s* as a cue for any one of these outcomes, it is clear that the cue will be abundantly frequent in learners' input, yet neither of the cues are reliably associated with their interpretation or outcome. A similar picture emerges when we reverse the directionality of our thinking: plural *-s,* third person singular present *-s,* and possessive *-s* all have variant expression as the allomorphs [*s*], [*z*], and [ɨz].Thus if we evaluate just one of these, say, [ɨz], as a cue for one particular outcome, say, plurality, then it is clear that there are many instances of that outcome in the absence of the cue. Such **contingency** analysis of the reliabilities of the cue-interpretation associations suggests that they will not be readily learnable. High-frequency grammatical functors are often highly ambiguous in their interpretations (Goldschneider & DeKeyser, 2001).

Connectionism is one strand of research in SLA that seeks to investigate how simple associative learning mechanisms such as the kind of contingency analysis mentioned earlier meets the complex language evidence available to a learner in their input and output. The term "connectionist" reflects the idea that mental and behavioral models are in essence interconnected networks of simple units. Connectionist models are typically run as computer simulations. The simulations are data-rich and process-light: Massively parallel systems of artificial neurons use simple learning processes to statistically generalize over masses of input data. It is important that the input data is representative of learners' usage history, which is why connectionist and other input-influenced research rests heavily on large-scale, maximally representative digital collections of authentic language (these are often called databanks or **corpora**). Connectionist simulations show how prototypes emerge as the prominent underlying structural regularity in the whole problem space, and how minority subpatterns of inflection regularity, such as the English plural subpatterns discussed earlier (or the much richer varieties of the German plural system, for example), also emerge as smaller, less powerful attractors. Connectionism provides the computational framework for testing usage-based

theories as simulations, for investigating how patterns appear from the interactions of many language parts.

Emergent Relations and Patterns

Complex systems are those that involve the interactions of many different parts, such as ecosystems, economies, and societies. All complex systems share the key aspect that many of their systematicities are **emergent**: They develop over time in complex, sometimes surprising, dynamic, and adaptive ways. Complexity arises from the interactions of learners and problems too. Consider the path of an ant making its homeward journey on a pebbled beach. The path seems complicated as the ant probes, doubles back, circumnavigates, and zigzags. But these actions are not deep and mysterious manifestations of intellectual power. Instead the control decisions are simple and few in number. An environment-driven problem solver often produces behavior that is complex because it relates to a complex environment.

Language is a complex adaptive system (Beckner et al., 2009; Ellis & Larsen-Freeman, 2009; see also Chapter 12). It comprises the interactions of many players: People who want to communicate and a world to be talked about. It operates across many different levels (neurons, brains, and bodies; phonemes, constructions, interactions, and discourses), different human conglomerations (individuals, social groups, networks, and cultures), and different timescales (evolutionary, epigenetic, ontogenetic, interactional, neurosynchronic, diachronic). "Emergentists believe that simple learning mechanisms, operating in and across the human systems for perception, motor-action and cognition as they are exposed to language data as part of a communicatively-rich human social environment by an organism eager to exploit the functionality of language, suffice to drive the emergence of complex language representations" (Ellis, 1998, p. 657).

Two Languages and Language Transfer

Our neural apparatus is highly plastic in its initial state. It is not entirely an empty slate, since there are broad genetic constraints on the usual networks of system-level connections and on the broad timetable of maturation. Nevertheless, the cortex of the brain is broadly equipotent in terms of the types of information it can represent (Elman et al., 1996). From this starting point, the brain quickly responds to the input patterns it receives, and through associative learning, it optimizes its representations to model the particular world of an individual's experience. The term "neural plasticity" summarizes the fact that the brain is tuned by experience. Our neural endowment provides a general purpose cognitive apparatus that, constrained by the makeup of our human bodies, filters and determines our experiences. In the first few years of life, the human learning mechanism optimizes its representations of the first language (L1) being learned. Thousands of hours of L1

processing tunes the system to the cues of the L1 and automatizes its recognition and production. It is impressive how rapidly we start tuning into our ambient language and disregarding cues that are not relevant to them (Kuhl, 2004). One result of this process is that the initial state for SLA is no longer a plastic system; it is one that is already tuned and committed to the L1. Our later experience is shaded by prior associations; it is perceived through the memories of what has gone before. Since the optimal representations for the L2 do not match those of the L1, SLA is impacted by various types of L1 interference. Transfer phenomena pervade SLA (Flege, 2002; Jarvis & Pavlenko, 2008; Lado, 1957; MacWhinney, 1997; Odlin, 1989; Weinreich, 1953).

Associative Aspects of Transfer: Learned Attention and Interference

Associative learning provides the rational mechanisms for L1 acquisition from input—analysis and usage—allowing just about every human being to acquire fluency in their native tongue. Yet although L2 learners too are surrounded by language, not all of it "goes in," and SLA is typically limited in success. This is Corder's distinction between input, the available target language, and intake, that subset of input that actually gets in and that the learner utilizes in some way (Corder, 1967). Does this mean that SLA cannot be understood according to the general principles of associative learning? If L1 acquisition is rational, is SLA fundamentally irrational? No. Paradoxically perhaps, it is the very achievements of L1 acquisition that limit the input analysis of the L2. Associative learning theory explains these limitations too, because associative learning in animals and humans alike is affected by what is called **learned attention**.

We can consider just one example of learned attention here. Many grammatical form–meaning relationships are both low in salience and redundant in the understanding of the meaning of an utterance. It is often unnecessary, for instance, to interpret inflections that mark grammatical meanings such as tense because they are usually accompanied by adverbs that indicate the temporal reference: "if the learner knows the French word for 'yesterday,' then in the utterance *Hier nous sommes allés au cinéma* (Yesterday we went to the movies) both the auxiliary and past participle are redundant past markers" (Terrell, 1991, p. 59). This redundancy is much more influential in SLA than L1 acquisition. Children learning their native language only acquire the meanings of temporal adverbs quite late in development. But L2 learners already know about adverbs from their L1 experience, and adverbs are both salient and reliable in their communicative functions, while tense markers are neither (see Chapter 7). Thus, the L2 expression of temporal reference begins with a phase where reference is established by adverbials alone, and the grammatical expression of tense and aspect thereafter emerges only slowly if at all (Bardovi-Harlig, 2000; see also Chapter 4).

This is an example of the associative learning phenomenon of "blocking," where redundant cues are overshadowed because the learners' L1 experience leads them to look elsewhere for the cues to interpretation (Ellis, 2006b). Under normal L1 circumstances, usage optimally tunes the language system to the input; under these circumstances of low salience of L2 form and blocking, however, all the extra input in the world can sum to nothing, with interlanguage sometimes being described as having "fossilized" (Han & Odlin, 2006). Untutored adult associative L2 learning from naturalistic usage can thus stabilize at a "Basic Variety" of interlanguage which, although sufficient for everyday communicative purposes, predominantly comprises just nouns, verbs, and adverbs, with little or no functional inflection and with closed-class items, in particular determiners, subordinating elements, and prepositions, being rare or not present at all (Klein, 1998).

The usual social-interactional or pedagogical reactions to such nonnative-like utterances involve an interaction partner (Long, 1983; Mackey, Abbuhl, & Gass, 2011; see also Chapter 10) or instructor (Doughty & Williams, 1998) who intentionally brings additional evidence to the learner's attention by some means of attentional focus that helps the learner to "notice" the cue (Schmidt, 2001). This way, SLA can be freed from the bounds of L1-induced selective attention: a focus on form is provided in social interaction (Tarone, 1997; see also Chapter 11) that recruits the learner's explicit conscious **processing**. We might say that the input to the associative network is "socially gated" (Kuhl, 2007).

What Counts as Evidence?

Like other enterprises in cognitive science and cognitive neuroscience, usage-based approaches are not restricted to one specific research methodology or evidential source. Indeed, different approaches require different methods, and often a combination of different qualitative and quantitative methods. As mentioned earlier, many usage-based analyses employ data from large digitized collections of language, so-called corpora; computational modeling is at the heart of rational cognition analysis, exemplar theory, and emergentist analyses alike. Other relevant research methods include classroom field research, psycholinguistic studies of processing, and dense longitudinal recording.

Corpus-based analysis constitutes a particularly growing trend across usage-based paradigms (McEnery & Hardie, 2012; Sinclair, 1991). If language learning is in the social-cognitive linguistic moment of usage, we need to capture all these moments so that we can objectively study them. We need large, dense, longitudinal corpora of language use, with audio, video, transcriptions, and multiple layers of annotation, for data sharing in open archives. We need these in sufficient dense mass so that we can chart learners' usage history and their development (Tomasello & Stahl, 2004). We need them in sufficient detail that we can engage in detailed analyses of the processes of interaction (Kasper & Wagner, 2011). MacWhinney has long been working toward these ends, first with CHILDES (MacWhinney, 1991), a corpus

of L1 acquisition data, and later with Talkbank (MacWhinney, 2007), a corpus that also covers language data from L2 learners. Alongside these and other corpora, a growing number of computer tools are becoming available that assist the researcher in analyzing corpus data. These corpus tools can help researchers interested in the most diverse areas of SLA by covering the full range from qualitative data analysis, such as a fine-grained conversation analysis of individual corpus files (say, a transcribed conversation between a student and an ESL teacher), to semi-quantitative analysis of a representative sample of attestations of a particular phenomenon (such as the use of the *-ing* morpheme by English language learners), to large-scale quantitative analysis of distributional patterns (e.g., the association strength between verbs and the larger constructions they occur in; see the exemplary study in this chapter or Gries & Wulff, 2005, 2009, for examples).

What Are Some Common Misunderstandings about the Theory?

Broad frameworks, particularly those that revive elements of no-longer-fashionable theories such as behaviorism or structuralist approaches to linguistics, open the potential for misunderstanding. Common misconceptions include that connectionism is the new behaviorism; that connectionist models cannot explain creativity and have no regard for internal representation; and that cognitive approaches deny influence of social factors, motivational aspects, and other individual differences between learners. At the heart of most of these misunderstandings is the idea that usage-based analyses only do number-crunching, with too much of a focus on the effects that the frequency of constructions and other cues play in the learning process. While it is true that most usage-based approaches will discuss frequency as one of several factors, no usage-based theorist would claim that frequency is the only factor impacting SLA. In fact, there is a lively debate among usage-based theorists about the exact role frequency effects play in what is conceived of as a complex network of factors that can mute and amplify each other in complex ways (Ellis & Larsen-Freeman, 2006). At an even more fundamental level, what constitutes a frequency effect in the first place is a question we are far from having answered. Without going into too much detail here, there is ample empirical evidence, for instance, that we cannot always define a frequency effect by the rule "the more frequent, the more salient/important/relevant"—by that rationale, English articles and prepositions, which are the most frequent words in the English language, should not pose such an obstinate challenge to the average language learner! Instead, it seems that frequency effects come in different kinds (as absolute frequencies, ratios, association strengths, and other distributional patterns), and they will have differently weighted impacts depending on the target structure under examination, and, crucially, depending on the state of the learner's language development. An emergentist/complex systems approach views SLA as a dynamic process in which regularities and systems emerge from many of the processes covered

in this volume—from the interaction of people, brains, selves, societies, and cultures using languages in the world (Beckner et al., 2009; Ellis, 2008)—while at the same time investigating component processes in a rigorous fashion.

An Exemplary Study: Ellis, O'Donnell, and Römer (2014a)

Research Questions

While previous studies were able to demonstrate that frequency, prototypicality, and contingency are factors that impact L2 learners' constructional knowledge, most of these studies have considered only one of these factors at a time. This study wanted to determine whether and how these factors jointly affect L2 learners' constructional knowledge. The specific kind of constructions this study focused on are so-called verb-argument constructions (VACs). VACs are semi-abstract patterns that comprise verbs and the arguments they occur with, such as 'V *across* N' or 'V *of* N'; in this study, the authors examined VACs that another team of researchers previously identified using corpus analysis (Francis, Hunston, & Manning, 1996).

Methods

One hundred thirty-one German, 131 Spanish, and 131 Czech advanced L2 learners of English as well as 131 native speakers of English were engaged in a free association task: They were shown 40 VAC frames such as 'V *across* N or '*it* V *of the* N' and asked to fill in the verb slot with the first word that came to mind. The learners' responses were compared with results obtained from two native speaker databases. To get an impression of the frequencies with which different verbs occur in the VACs examined, and to calculate how strongly each verb is associated with the individual VACs, the authors consulted the British National Corpus (BNC). The BNC is a 100 million word corpus of British English that strives to be representative of language use across different registers and genres. To obtain the verb type frequencies, one can simply run a search for the VACs in the BNC and count how often each verb type occurs. To calculate the association strength between each verb type and each VAC, the authors used a specific association measure called DeltaP (for more information on how DeltaP works, see Ellis, 2006a). To see how prototypical the verbs selected by the participants would be for each VAC, the authors consulted a second database called WordNet (Miller, 2009). WordNet is a lexical database, so unlike the BNC, it is not a collection of cohesive and complete texts and dialogues, but rather a thesaurus-like database that groups words together based on their meanings. Using sophisticated computational techniques, the authors used this information to generate semantic networks for each of the VACs examined. For the 'V *across* N' VAC, for instance, the verbs in the center of the network are *go, move, run,* and *travel,* while verbs like *shout, splash,* and *echo* constitute less prototypical verbs in that VAC.

Main Findings

A multifactorial analysis (i.e., a statistic that can gauge the impact of more than one factor on a specific outcome at a time; in our example, it measured the potential impact of frequency, prototypicality, and contingency on speakers' associations) revealed that for all of the VACs examined, each factor made an independent contribution to learners' and native speakers' associations:

1. The more frequently a particular verb occurred in a specific VAC in the native speaker corpus data, the more likely it was elicited as a response for that VAC in the word association experiment.
2. The more strongly a verb and a VAC were associated with each other as expressed in their DeltaP association scores, the more likely that verb was elicited as a response for that VAC in the word association experiment.
3. The more prototypical a verb was for the VAC as indicated by its position in the semantic networks the authors generated for each VAC, the more likely it was elicited as a response for that VAC in the word association experiment.

Theoretical Implications

Based on the statistical analyses, the authors concluded that advanced L2 learners' knowledge of VACs involves rich associations that are very similar in kind and strength to those of native speakers (Ellis, O'Donnell, & Römer, 2014). The word associations generated in the experiment testified to learners having rich associations for VACs that are tuned by verb frequency, verb prototypicality, and verb-VAC contingency alike—factors that, in combination, interface across syntax and semantics.

Why/How This Theory Provides an Adequate Explanation of Observable Phenomena in SLA

Observation 1: Exposure to input is necessary for SLA. Usage based approaches are input-driven, emphasizing the associative learning of constructions from input. As with other statistical estimations, a large and representative sample of language is required for the learner to abstract a rational model that is a good fit to the language data. Usage is necessary, and it is sufficient for successful L1 acquisition though not for SLA. This is because the initial state for SLA is knowledge of an L1, and the learner's representations, processing routines, and attention to language are tuned and committed to the L1.

Observation 2: A good deal of SLA happens incidentally. The majority of language learning is implicit. Implicit tallying is the raw basis of human pattern recognition, categorization, and rational cognition. All of the counting that underpins the setting of thresholds and the tuning of the system to the probabilities of the

input evidence is unconscious. So also is the emergence of structural regularities, prototypes, attractors, and other system regularities. At any one point we are conscious of one particular communicative meaning, yet meanwhile the cognitive operations involved in each of these usages are tuning the system without us being aware of it (Ellis, 2002). We know (or can be shown to be sensitive to in our processing) far too many linguistic regularities for us to have explicitly learned them. Usage-based approaches maintain that incidental associative learning provides the rational mechanisms and is sufficient for L1 acquisition from input-analysis and usage, allowing just about every human being to acquire fluency in their native tongue. They do not suffice for SLA because of learned attention.

Observation 3: Learners come to know more than what they have been exposed to in the input. The study of implicit human cognition shows us to know far more about the world than we have been exposed to or have been explicitly taught. Prototype effects are one clear and ubiquitous example of this: learners who have never been exposed to the prototype of a category nevertheless classify it faster and more accurately than examples further from the central tendency, and name it with the category label with great facility. The same is true for language, where learners go beyond the input in producing **U-shaped learning**, with novel errors (like *goed* instead of *went*) and other systematicities of stages of interlanguage development in L2 acquisition, for example of negation or question formation. These creations demonstrate that the learners' language system is constantly engaged in making generalizations and finding abstractions of systematicities.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. As in L1 acquisition, SLA is characterized not by complete idiosyncrasy or variability but rather by predictable errors and stages during the course of development: interlanguage is systematic. Usage-based approaches hold that these systematicities arise from regularities in the input: For example, constructions that are much more frequent, that are consistent in their mappings and exhibit high contingency, that have many friends (constructions that behave in a similar way) of like-type, and that are salient, are likely to be acquired earlier than those that do not have these features (Ellis, 2007).

Observation 6: Second language learning is variable across linguistic subsystems. The learners' mental lexicon is diverse in its contents, spanning lexical, morphological, syntactic, phonological, pragmatic, and sociolinguistic knowledge. Within any of these areas of language, learners may master some structures before they acquire others. Such variability is a natural consequence of input factors such as exemplar type and token frequency, recency, context, salience, contingency, regularity, and reliability, along with the various other associative learning factors that affect the emergence of attractors in the problem space. Some aspects of these problem spaces are simpler than others. Second language learning is a piecemeal development from a database of exemplars with patterns of regularity emerging dynamically.

Observation 7: There are limits on the effects of frequency on SLA. This is explicitly addressed above under Associative aspects of transfer: learned attention and interference.

Observation 8: There are limits on the effect of a learner's first language on SLA. The effect of a learner's L1 is no longer considered the exclusive determinant of SLA as proposed in the Contrastive Analysis Hypothesis. Usage-based accounts see the major driving force of language acquisition to be the constructions of the target language and the learner's experience of these constructions. However, the significance of transfer from L1 in the L2 learning process is uncontroversial. As we explain earlier under "Two Languages and Language Transfer," at every level of language, there is L1 influence, both negative and positive. The various cross-linguistic phenomena of learned selective attention, overshadowing and blocking, latent inhibition, perceptual learning, interference, and other effects of salience, transfer, and inhibition all filter and color the perception of the L2. So usage-based accounts of L2 acquisition look at the effects of both L1 and L2 usage upon L2A (Robinson & Ellis, 2008).

Observation 9: There are limits on the effects of instruction on SLA. L1-tuned learned attention limits the amount of intake from L2 input, thus restricting the endstate of SLA. Attention to language form is sometimes necessary to allow learners to notice some blocked, overshadowed, or otherwise nonsalient aspect of the language form. Reviews of the empirical studies of instruction demonstrate that social recruitment of learners' conscious, explicit learning processes can be effective.

However, instruction is not always effective. Any classroom teacher can provide anecdotal evidence that what is taught is not always learned. But this observation can be made for all aspects of the curriculum, not just language. Explicit knowledge about language is of a different stuff from that of the implicit representational systems, and it need not impact upon acquisition for a large variety of reasons. Explicit instruction can be ill-timed and out of synchrony with development (Pienemann, 1998; see also Chapter 9); it can be confusing; it can be easily forgotten; it can be dissociated from usage, lacking in transfer-appropriateness and thus never brought to bear so as to tune attention to the relevant input features during usage; it can be unmotivating; it can fail in so many ways.

The Explicit/Implicit Debate

Learning a new symbol, for example, the French word for the symbol ★, *étoile,* initially involves explicit learning: you are consciously aware of the fact that you did not know the French word for 'star' before, and that now you do (Ellis, 1994). Some facts about how to use *étoile* properly you may not know yet, such as its proper pronunciation, its grammatical gender, synonymous forms, words, phrases, and idioms that *étoile* is associated with. Some of these facts you will learn by making a conscious effort, that is, via explicit learning; other facts you will not consciously figure out but rather learn implicitly. Without you being aware of it,

your language system is hard at work, upon each subsequent encounter of *étoile,* to fill in these knowledge gaps and fine-tune the mental representation you have for this construction.

Despite that many of us go to great lengths to engage in explicit language learning, the bulk of language acquisition is implicit learning from usage. Most knowledge is tacit knowledge; most learning is implicit; the vast majority of our cognitive processing is unconscious. Implicit learning supplies a distributional analysis of the problem space: our language system implicitly figures out how likely a given construction is in particular contexts, how often they instantiate one sense or another, how these senses are in turn associated with different features of the context, and so on. To the extent that these distributional analyses are confirmed time and again through continuous exposure to more input, generalizations and abstractions are formed that are also largely implicit.

Implicit learning would not do the job alone. Some aspects of an L2 are unlearnable—or at best are acquired very slowly—from implicit processes alone. In cases where linguistic form lacks perceptual salience and so goes unnoticed by learners, or where the L2 semantic/pragmatic concepts to be mapped onto the L2 forms are unfamiliar, additional attention is necessary in order for the relevant associations to be learned. To counteract the L1 attentional biases to allow implicit estimation procedures to optimize induction, all of the L2 input needs to be made to count (as it does in L1 acquisition), not just the restricted sample typical of the biased intake of L2 acquisition.

Ellis (2005) reviews the instructional, psychological, social, and neurological dynamics of the interface by which explicit knowledge of form–meaning associations impacts upon implicit language learning:

> The interface is dynamic: It happens transiently during conscious processing, but the influence upon implicit cognition endures thereafter. Explicit memories can also guide the conscious building of novel linguistic utterances through processes of analogy. Patterned practice and declarative pedagogical grammar rules both contribute to the conscious creation of utterances whose subsequent usage promotes implicit learning and proceduralization. Flawed output can prompt focused feedback by way of recasts that present learners with psycholinguistic data ready for explicit analysis. (p. 305)

Once a construction has been represented in this way, its use in subsequent implicit processing can update the statistical tallying of its frequency of usage and probabilities of form–function mapping.

So we believe that learners' language systematicity emerges from their history of interactions of implicit and explicit language learning, from the statistical abstraction of patterns latent within and across form and function in language usage. The complex adaptive system of interactions within and across form and function is far richer than that emergent from implicit or explicit learning alone (Ellis, 2014).

Conclusion

In the terms of Chapter 1, the usage-based approaches touched upon here are too broad and far—ranging to qualify as a theory. Instead, they are a framework for understanding many of the complex agents that underlie language learning. No single factor alone is a sufficient cause of SLA. Language is a complex adaptive system. It comprises the interactions of many players: people who want to communicate and a world to be talked about. It operates across many different levels, different human configurations, and different timescales. Take out any one of these levels and a different pattern emerges, a different conclusion is reached. But nevertheless, like other complex dynamic systems, there are many systematicities that, like Observations 1–10, emerge to form the things a theory should explain.

Discussion Questions

1. One critique of the type of approach Ellis and Wullf take has been that it is an updated version of behaviorism. Do you agree with this criticism? How do the authors of the chapter handle this criticism?
2. Explain the difference between rule-based and rule-like behavior.
3. How do usage-based approaches address explicit and implicit learning and the nature of their interface?
4. Consider the case of the acquisition order of the present perfect and the pluperfect from Bardovi-Harlig (Chapter 4). The functionalist approach offers one explanation for the order of emergence. How would usage-based approaches account for the order? What evidence might distinguish the two interpretations?
5. As we saw in Chapter 3, the principal foundation of the approach White takes is the *proverty of the stimulus* (POS) situation or the *logical problem of language acquisition*. How do usage-based approaches view the POS? (You might want to review the examples in Chapter 3 before answering.)
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Note

1. We thank Ryan K. Boettger for his editorial advice.

Suggested Further Reading

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6

SKILL ACQUISITION THEORY

Robert DeKeyser

Skill Acquisition Theory accounts for how people progress in learning a variety of skills, from initial learning to advanced proficiency. Skills studied include both cognitive and psychomotor skills, in domains that range from classroom learning to applications in sports and industry. Research in this area ranges from quite theoretical (computational modeling of skill acquisition, the place of skills in an architecture of the mind) to quite applied (how to sequence activities for maximal learning efficiency in areas as diverse as teaching high school algebra, tutoring college physics, coaching professional basketball, or training airplane pilots).

The scientific roots of Skill Acquisition Theory are to be found in various branches of psychology, but this research area has proven to be remarkably resilient through various developments in psychology, from behaviorism to cognitivism to connectionism. After all, the practical needs as well as the fundamental theoretical questions and the basic empirical facts remain, regardless of the continuous developments in psychological theory, methodology, and terminology.

The Theory and Its Constructs

The basic claim of Skill Acquisition Theory is that the learning of a wide variety of skills shows a remarkable similarity in development from initial representation of knowledge through initial changes in behavior to eventual fluent, spontaneous, largely effortless, and highly skilled behavior, and that this set of phenomena can be accounted for by a set of basic principles common to the acquisition of all skills. The terminology in the previous sentence was deliberately chosen to be nontechnical and theory-neutral; it will come as no surprise that a theory that has been applied to so many domains over such a long period of time has seen its share of technical terms, which have varied with the area of psychology researchers have

worked in and the types of skills they have studied. Generally speaking, however, researchers have posited three stages of development, whether they called them cognitive, associative, and autonomous, as Fitts and Posner (1967); or declarative, procedural, and automatic, as Anderson (e.g., Anderson, 1982, 1993, 2007; Anderson et al., 2004; Taatgen, Huss, Dickison, & Anderson, 2008); or presentation, practice, and production, as Byrne (1986).

These three stages are characterized by large differences in the nature of knowledge and its use, as reflected in various ways through introspection, verbalization, and most importantly various aspects of behavior especially under demanding conditions. Initially, a student, learner, apprentice, or trainee may acquire quite a bit of knowledge ABOUT a skill without ever even trying to use it. That knowledge may be acquired through perceptive observation and analysis of others engaged in skilled behavior (e.g., learning a new dance move), but most often is transmitted in verbal form from one who knows to one who does not (as in a parent or driving instructor teaching a teenager how to drive a car), and often through a combination of the two, when the "expert" demonstrates the behavior slowly while commenting on the relevant aspects (e.g., teaching a child how to swim or how to play tennis).

Next comes the stage of "acting on" this knowledge, turning it into a behavior, turning "knowledge that" into "knowledge how," or in more technical terms, turning **declarative knowledge** into **procedural knowledge**. This **proceduralization** of knowledge is not particularly arduous or time consuming. Provided that the relevant declarative knowledge is available and drawn on in the execution of the target behavior, proceduralization can be complete after just a few trials/instances. Anderson et al. (2004, p. 1046), for instance, point out that, in a typical psychology experiment, the participant is converting from a declarative representation and a slow interpretation of the task (as set forth in the experimenter's instructions) to a smooth, rapid, procedural execution of the task (for an example in second language learning, see DeKeyser, 1997, who argues that proceduralization was essentially complete after the first 16-item block of practice items). Yet, proceduralized knowledge has a big advantage over declarative knowledge: It no longer requires the individual to retrieve bits and pieces of information from memory to assemble them into a "program" for a specific behavior; instead, that "program" is now available as a ready-made chunk (as a result of production compilation; see Anderson, 2007; Taatgen & Lee, 2003) to be called up in its entirety each time the conditions for that behavior are met.

Once procedural knowledge has been acquired, there is still a long way to go before the relevant behavior can be consistently displayed with complete fluency or spontaneity, rarely showing any errors. In other words, the knowledge is not yet robust and fine-tuned. A large amount of **practice** is needed to decrease the time required to execute the task ("reaction time"), the percentage of errors ("error rate"), and the amount of attention required (and hence interference with/from other tasks, or more generally "robustness"; cf. Taatgen et al., 2008). This practice leads to

gradual **automatization** of knowledge. **Automaticity** is not an all-or-nothing affair; even highly automatized behaviors are not 100% automatic, as becomes clear when we stumble walking down the stairs, when we realize we are driving too fast when engaged in an exciting conversation with a passenger, or when we stumble over our words while uttering a simple sentence in our native language.

It should be stressed that this intensive practice (sometimes called overlearning) *after* mastery over the task has been achieved is only useful if it takes learners from the proceduralization stage (where declarative and procedural knowledge are used) to the automatization stage (where knowledge is completely procedural already). In such cases, however, its impact is great, not only because of the obvious immediate advantages of reaching high levels of automaticity, but also because procedural knowledge is known to decay less with time. On the other hand, while some tasks can be carried out completely on the basis of procedural knowledge (esp. motor skills), others keep requiring access to at least some declarative information, and hence benefit less from overlearning (Kim, Ritter, & Koubek, 2013).

A central concept in the study of skill acquisition is the **power law** of learning (named this way because its mathematical formalization is a power function: an equation with an exponent, which in this case represents the amount of practice). This equation formalizes mathematically what has been observed many times, for skills as different as making cigars out of tobacco leaves or writing computer programs: that both reaction time and error rate decrease systematically as a consequence of practice. If the learning curves for reaction time and error rate for such a variety of skills share the very specific shape of a power function (and not even a quite similar one like that of an exponential function), then this shape must contain the key to some fundamental learning mechanisms. Since Newell and Rosenbloom's (1981) seminal article on the power law, a variety of hypotheses have been formulated to explain this robust empirical phenomenon. This chapter is not the place to discuss the relative merit of these hypotheses (for more discussion, see DeKeyser, 2001; Segalowitz, 2010), but what they all have in common is that they posit a qualitative change over time, as a result of practice, in the basic cognitive mechanisms used to execute the same task. What superficially seems like a set of smooth quantitative changes (reaction time and error rate declining following a power function) in fact reflects a qualitative change in mechanisms of knowledge retrieval, quite radical for a while, and then gradually stabilizing without ever reaching an absolute endpoint (hence the learning curve in the specific shape of a power function illustrated in Figure 6.1).

Probably the most widely accepted interpretation of this change is that it represents first a shift from declarative to procedural knowledge (achieved rather quickly, hence the rather steep initial section of the curve) followed by a much slower process of automatization of procedural knowledge. The term automatization itself can be interpreted in various ways, ranging from a mere speed-up of the same basic mechanisms to a speed-up of a broader task through a qualitative change in its components. Again, we are not taking a position here on this point

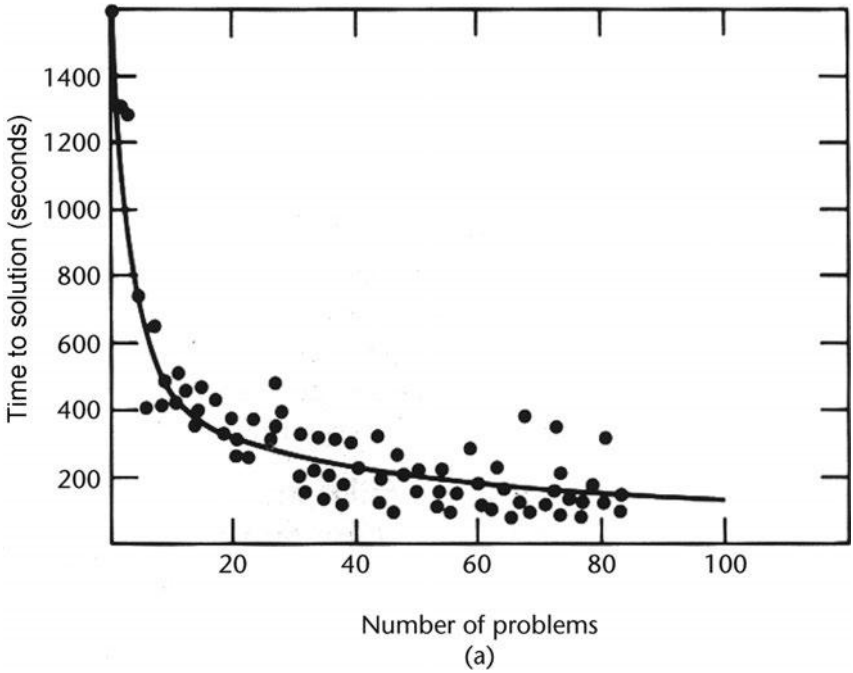

FIGURE 6.1 A sample graph of the power of learning curve.

either (for more discussion, see DeKeyser, 2007a; Segalowitz, 2010), but we *are* using automatization in a more specific sense than just "improvement through practice," because we are reserving the term for the latter, flatter part of the learning curve, after the steep decline due to rapid proceduralization has taken place (see Figure 6.1).

Another point on which there is widespread agreement is that, regardless of the exact nature of the knowledge drawn on in the later stages of development, this knowledge is much more specific than at the beginning, and in fact, so highly specific that it does not transfer well, even to what may seem quite similar tasks. A well-known example from the skill acquisition literature is reading versus writing computer programs (see Singley & Anderson, 1989), and an obvious parallel in the domain of language learning is comprehension versus production (De Jong, 2005; DeKeyser, 1997; DeKeyser & Sokalski, 2001; Shintani, Li, & Ellis, 2013; Tanaka, 2001). Other examples, of course, would be transfer from speaking to writing, or from one situation to another (such as from orderly dialogue to argument with multiple interlocutors or from the kitchen table to the boardroom). The implication for training is that two kinds of knowledge need to be fostered, both highly specific procedural knowledge, highly automatized for efficient use in the situations that the learner is most likely to confront in the immediate future, and solid abstract declarative knowledge that can be called upon to be integrated into much

broader, more abstract procedural rules, which are indispensable when confronting new contexts of use.

What is often overlooked is that this whole sequence of proceduralization and automatization cannot get started if the right conditions for proceduralization are not present (the declarative knowledge required by the task at hand and a task setup that allows for use of that declarative knowledge). Anderson, Fincham, and Douglass (1997), in particular, show convincingly that the combination of abstract rules and concrete examples is necessary to get learners past the declarative threshold into proceduralization. DeKeyser (2007b) argues that precisely this is often lacking in language teaching in general and in preparing students for maximum benefit from a stay abroad in particular.

What Counts as Evidence?

The oldest form of evidence in this area is behavioral in nature: reaction times, error rates, and differences in performance from one condition to another such as interference from a secondary task. Any overview of the behavioral data should start with Newell and Rosenbloom (1981), not because it was the first study in this area but because it was seminal in that it brought together empirical data from so many different studies about so many different forms of skill acquisition and proposed both a quantitative model (the power law) and a qualitative interpretation for this mountain of data. Some of the domains of learning included motor behavior, reading, decision making, and problem solving. For information on the individual studies included, see Newell and Rosenbloom's article. Major empirical studies since then include Anderson et al. (1997) on the role of rules and examples in the proceduralization of a simple reasoning task, and Logan (1988, 1992, 2002) on the learning of a new form of arithmetic (with letters), and Taatgen et al. (2008) on robustness and flexibility of procedural knowledge as a function of the form of the production rules (with or without explicit statement of pre- and postconditions in the environment).

In the last 25 years, less direct evidence in the form of computational modeling has become very important in the study of skill acquisition, even more so than in other subfields of psychology. This line of evidence includes large amounts of work with a variety of computer models such as the various consecutive incarnations of ACT (see especially Anderson, 1993, 2007; Anderson & Lebiere, 1998; Anderson et al., 2004; Taatgen & Anderson, 2008), EPIC (Meyer & Kieras, 1997), SOAR (Newell, 1990) and 3CAPS (Just & Carpenter, 1992). In all such models, the aim is to show how a cognitive mechanism can work and with which implications for reaction time and error rate, but of course the model never proves that the processes taking place in the human mind are the same.

During this same period, skill acquisition researchers have begun to draw on what some would see as data that are even more direct than the behavioral data themselves, that is, neuroimaging and other forms of neurological evidence such

as evoked potentials (measures of electrophysiological activity in specific areas of the brain, experimentally linked to specific cognitive tasks).

Increasing use of techniques from cognitive neuroscience has yielded studies such as Raichle et al. (1994) using PET (positron emission tomography) to trace the effect of practice on the relative involvement of different brain areas in the same task (word generation), and Qin, Anderson, Silk, Stenger, and Carter (2004) using fMRI (functional magnetic resonance imaging) to investigate the effect of children's practice in algebra. (For discussion of the role of neuroimaging, and fMRI in particular, in the development of skill acquisition models, see esp. Anderson, 2007, Chapter 2 and pp. 169–181; see also Chein & Schneider, 2005; Hill & Schneider, 2006, for a broader discussion of neuroimaging of skill development.)

In sum, the behavioral data show the similarity in skill development across different cognitive domains (how reaction time and error rate develop as a result of practice); the neurological data show how different areas of the brain are involved to a different extent after different amounts of practice; and the computational models show the hypothetical inner workings of the mechanisms that cannot be observed directly through behavioral or neurological data.

As should be clear from the literature cited earlier, evidence for central constructs such as the power law, procedural knowledge, or automatization abounds in the psychological literature. What is harder to come by is empirical data that unambiguously point to a specific interpretation of these phenomena in terms of learning mechanisms. More importantly for our purposes here, very little research in the field of second language learning has explicitly set out to gather data from second language learners to test (a specific variant of) Skill Acquisition Theory.

The same can be said about other directions in which skill acquisition research has expanded in recent years: the study of the forgetting of skills and the role of **distributed versus massed practice** in learning and forgetting. The long-standing topic of what constitutes ideal distribution of practice has been revived in the cognitive and educational psychology literature in the last decade, and the results of individual studies often appear contradictory, but a provisional conclusion from this literature as a whole (see esp. the meta-analysis in Cepeda et al., 2006; the literature review in Carpenter et al., 2012; and the studies by Cepeda et al., 2009; Rohrer & Pashler, 2007) is that the ideal spacing of practice is determined by the ratio of inter-session interval (the amount of time between different encounters with the same item) and retention interval (the amount of time between the end of practice and the beginning of testing).

On this point, too, the SLA literature is still rather limited. On one hand, studies on complete foreign language programs (Collins et al., 1999; Lightbown & Spada, 1994; Serrano, 2011; Serrano & Muñoz, 2007; White & Turner, 2005) have shown massed practice to be more effective. Much more narrowly focused studies, on the other hand, have come to divergent conclusions. Bird (2010) found distributed practice to be superior for past tense practice in ESL, and Nakata (2012) obtained similar results for vocabulary learning in ESL. Suzuki and DeKeyser (in press),

however, in a study which was narrowly focused on the "gerund" in Japanese SL but still required integration of grammatical skills and vocabulary knowledge, found that massed practice was best for the acquisition of procedural skill; they also found that memory was more important in massed practice and analytical ability more in distributed practice. Finally, long-term studies on forgetting of L2 skills among foreign language learners (as opposed to heritage learners or fluent second language speakers) are rare (see, however, Bahrick, Hall, Goggin, Bahrick, & Berger, 1994; Bahrick, Hall, & Baker, 2013); none have taken a skill acquisition perspective.

One of the reasons why research from a skill acquisition perspective is so rare in the field of second language acquisition is the methodology required. Experiments on skill acquisition typically involve rather large numbers of participants over rather long periods of time, yielding very large amounts of data for statistical analysis. Moreover, the collection of these data, and the control required over the treatments and practice conditions requires a certain amount of investment in hardware and software.

This methodological challenge, combined with the fact that focus on form was out of fashion for a number of years in applied linguistics research, explains the small volume of directly relevant empirical research so far. The studies that have tested the predictions of skill acquisition most directly are DeKeyser (1997), Robinson (1997), de Jong (2005), De Jong and Perfetti (2011), and Rodgers (2011). The first two each test one of two competing theories of skill acquisition with L2 data: DeKeyser (1997) found that the concepts of proceduralization, automatization, and specificity of procedural rules accounted well for the learning curves for reaction time and error rate during a semester of practice of a small number of grammar rules. Robinson (1997), on the other hand, found that his data on the learning of an ESL grammar rule did not fit the predictions of Logan's competing theory of automatization through retrieval of specific instances from memory instead of rules.

De Jong (2005), with learners of Spanish as a second language, provides further evidence for the skill specificity documented by DeKeyser (1997). She showed that extensive aural comprehension training, while increasing processing speed in comprehension, did not preempt a substantial number of errors in production and that, conversely, early production did not hinder acquisition. Rodgers (2011) worked with learners of Italian L2 to show that automatization of verbal morphology developed as a function of practice but that it was less advanced in production than in comprehension, providing further evidence still for the specificity of procedural knowledge. Zooming in on proceduralization, De Jong and Perfetti (2011) showed in detail how indices of proceduralization such as length of runs and phonation/time ratio develop as a result of repeated but gradually sped-up practice with a task, either identical or similar. (This study is described in more detail in the boxed inset.)

Given the increasing sophistication of the technology as well as the research methodology at the disposal of second language researchers, along with a return

to focus on form and explicit learning in recent years (see, e.g., DeKeyser, 2003; Doughty, 2001; Doughty & Williams, 1998; R. Ellis, 2012; Norris & Ortega, 2000; Spada & Tomita, 2010), one can expect this area of research to pick up, especially as many researchers have begun to at least interpret existing findings from the second language literature within the framework of Skill Acquisition Theory (de Bot, 1996; Healy et al., 1998; Lyster, 2004; Lyster & Sato, 2013; Macaro, 2003; O'Malley & Chamot, 1990; Ranta & Lyster, 2007; Sato & Lyster, 2012; Towell & Hawkins, 1994; Towell, Hawkins, & Bazergui, 1996). Researchers do not need to be trained in computational modeling or neuroscience at all to contribute to research on skill acquisition; with a sophisticated approach to design, data collection, and data analysis, using technology that is fairly easily available at research institutions, behavioral data still have much to contribute to this area.

Common Misunderstandings

Two kinds of misunderstanding about the contribution of Skill Acquisition Theory to second language acquisition research are very common: the idea that skill acquisition either explains everything about second language acquisition or nothing, in other words, that it competes with other theories to be the one and only valid explanation of the set of phenomena we call "second language acquisition," and the idea that it is incompatible with a variety of empirical findings in the field. These two misunderstandings are, of course, related, as we see later.

Because of its emphasis on the importance of explicit/declarative knowledge in initial stages of learning, Skill Acquisition Theory is most easily applicable to what happens in (a) high-aptitude adult learners engaged in (b) the learning of simple structures at (c) fairly early stages of learning in (d) instructional contexts. That does *not* mean these four conditions all have to be fulfilled for Skill Acquisition Theory to be applicable, but it does mean that the more the learning situation deviates from this prototypical situation in one of these four respects, the less likely it is that concepts from Skill Acquisition Theory will account well for the data. If adults have below-average verbal aptitude, they may find it hard to form declarative representations of grammar rules (whether with the help of a teacher and textbooks or not). By the same token, children will not be able to conceptualize most grammar rules, which are of course inherently abstract. This problem is even worse when the rules are very complex: In that case even adults of above-average aptitude will find it hard to understand, and especially to proceduralize and automatize, the rule. Finally, as learners enter more advanced stages of learning (where they interact constantly and fluently with native speakers, and are exposed to a large amount of oral and written input), the likelihood of implicit learning of frequent and relatively concrete patterns in the input increases substantially. That in turn does *not* mean that skill acquisition theory is of marginal relevance: a substantial amount of second/foreign language learning is done by adolescents and adults of above-average aptitude going through the initial stages of learning

in a school context. Moreover, if the potential for learning in these initial stages is not maximized (because everything we know about cognitive skill acquisition is ignored), this will have repercussions, of course, for all learning thereafter.

Related to overgeneralization of Skill Acquisition Theory to the situations where it does not apply well is the tendency to see the theory as incompatible with a number of empirical findings as well as theoretical positions in the field. Some will overinterpret the theory as predicting that any kind of construction can be learned, practiced, and automatized by anybody in any order and that therefore it is incompatible with the literature on the natural order of acquisition (summarized, e.g., in Dulay, Burt, & Krashen, 1982; Goldschneider & DeKeyser, 2001; Luk & Shirai, 2009; see also Chapter 2). This reasoning actually combines a misreading of both Skill Acquisition Theory and research on the natural order of acquisition, because the latter never found an ordering for all or even most structures in the language, only for a few morphemes in some studies or for a few closely related syntactic patterns in others, and because most studies of order of acquisition were carried out with learners who had massive exposure to the language and/or were young learners, which means that they were largely implicit learners and that the skill acquisition model (going from declarative/explicit to procedural/implicit knowledge) did not apply to them.

Similarly, Skill Acquisition Theory should not be seen as being in competition with the theory underlying processing instruction (see esp. VanPatten, 2004), as long as the latter is not seen as implying that practice in production is not important for full-fledged skill acquisition or the fine-tuning of declarative knowledge; in fact, processing instruction does for comprehension skills exactly what Skill Acquisition Theory suggests should be done: taking students from explicitly taught (or induced) declarative knowledge, through careful proceduralization by engaging in the relevant task while the declarative knowledge is maximally activated, to (very initial stages of) automatization. Skill Acquisition Theory is not incompatible either with other contemporary tendencies in the way focus on form is implemented, such as task-based learning (see esp. R. Ellis, 2003; Long & Norris 2000; Long & Robinson, 1998; Robinson, 2011; Van den Branden, 2006), because engaging in carefully sequenced tasks (from a psycholinguistic perspective) will again lead to proceduralization and potentially some degree of automatization provided that the requisite declarative knowledge is at the disposal of the learner during the task. Nor does Skill Acquisition Theory contradict the notion that implicit learning is important (leading directly to implicit knowledge, that is, knowledge that one is not aware of, which is stressed both in the universal grammar approach [see Chapter 3] and the usage-based approach to learning [see Chapter 5]). While stressing the importance of implicit learning in general and frequency in particular, N. Ellis (see esp. N. Ellis, 2002, 2005; see also Chapter 5) makes it very clear that "many aspects of a second language are unlearnable—or at best acquired very slowly—from implicit processes alone" (N. Ellis, 2005, p. 307), and that "slot-and-frame patterns, drills, mnemonics, and declarative statements

of pedagogical grammar . . . all contribute to the conscious creation of utterances that then partake in subsequent implicit learning and proceduralization" (p. 308).

Finally, perhaps the most common misunderstanding concerns the concept of declarative knowledge "turning into" procedural knowledge. This is not meant to suggest that any mysterious transformation or move happens in the brain (for more about the declarative/procedural distinction and the brain, see Ullman, 2004; see also Chapter 8), not even that the more procedural knowledge there is, the less declarative knowledge. The phrase "turning into" is a bit misleading on that point; all that is claimed is that existing declarative knowledge, via practice, plays a causal role in the development of procedural knowledge (see, e.g., DeKeyser, 2009).

An Exemplary Study: De Jong and Perfetti (2011)

I have chosen this article as exemplary study because it addresses the crucial problem in skill acquisition head-on: how best to proceduralize declarative knowledge of grammar and vocabulary. An additional advantage is that this is a study carried out with regular students in a regular classroom, while at the same time the computerized delivery provided much more control over the treatment than is typically the case in classroom research.

Participants in this study were 20 ESL students in the United States who were given practice in oral production with the 4-3-2 procedure (Arevart & Nation, 1991): They had to tell a story first in 4 minutes, then in 3, then in 2, to improve fluency; they did this three times in as many training sessions. There were two conditions: One group told the same story three times within a training session; the other told three different stories. The researchers wanted to know whether the 4-3-2 sequences would lead to proceduralization, whether this learning effect would last until a delayed test several weeks later, whether it would transfer to new stories, and whether the two conditions would yield different results. Proceduralization was operationalized as increase in (a) mean length of runs (without corresponding change in length of pauses or in phonation/time ratio, that is, actual sound production as a percentage of speaking time) or in (b) stable length of runs (with improving length of pauses and in phonation/time ratio).

The researchers found that for the repetition condition either mean length or stable length of runs increased, while for the no repetition condition, there was no change over time. The gains for the repetition group occurred mostly from pretest to posttest but were maintained on the delayed posttest (after 4 weeks), and for stories on different topics. Therefore, the gains in fluency cannot be attributed to increased lexical access, or more generally to effects of priming and planning. These findings are far from trivial: One may expect that the group that practiced different stories all the time would do better on the new stories in the posttests and delayed posttests, but the opposite was found. Repeating the same story a couple of times, each time at a faster rate, was more effective for the proceduralization of the knowledge that students had to drawn on for the posttests. The design of

the study does not allow us, however, to pinpoint exactly what knowledge was proceduralized.

Explanation of Observed Findings in SLA

Observation 7: There are limits on the effects of frequency on SLA; Observation 9: There are limits on the effects of instruction on SLA; Observation 10: There are limits on the effects of output (learner production) on language acquisition. The findings that there are limits on the effects of frequency, on the effects of instruction, and on the effects of output are very easily explained in this framework: factors such as whether students receive instruction, produce output, and are exposed to certain structures frequently play little role if (explicit) instruction and practice with input and output are not integrated in a way that makes sense according to this theory. Automatization requires procedural knowledge. Proceduralization requires declarative knowledge and slow deliberate practice. The acquisition of declarative knowledge of a kind that can be proceduralized requires the judicious use of rules and examples. These stages cannot be skipped, reversed, or rushed. Unfortunately, however, just about any kind of existing teaching methodology tends to do at least one of the latter three.

Observation 5: Second language learning is variable in its outcome; Observation 6: Second language learning is variable across linguistic subsystems. The findings that second language learning is variable in its outcome and variable across linguistic subsystems are equally easy to explain in this framework. Different learners achieve very different levels of proficiency in a given area because of their different levels of ability to grasp the declarative knowledge, the widely differing amounts of practice of specific kinds that individual learners receive for specific structures, and most importantly, the different sequencing of various kinds of explicit information, implicit input, and practice with input and output that different learners receive or create for themselves (which are influenced in turn by motivation, personality, and social context). Learners also show a large amount of intraindividual variation between the different linguistic domains because of differential aptitude, instruction, and practice. Even more importantly, Skill Acquisition Theory easily explains the differences in performance from task to task that are so often observed for the same subcomponent of language in the same individual learner. Performance draws on procedural knowledge, which we saw is very specific, and unevenly developed depending on the amount of practice of various elements of the language under various task conditions. In the same vein, Skill Acquisition Theory explains a factor that is not often addressed in the more linguistically oriented literature, but that is of tremendous importance in the more applied literature: the importance of learning activities *and* their sequencing and spacing. No amount of any activity means much if it does not fit into the right point of development of skill for a given individual.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. The fact that learners follow a predictable

path in their development for a given structure also fits well with Skill Acquisition Theory, especially if it is understood somewhat more broadly than in merely linguistic terms. Learners who are exposed to little or no instruction may learn different variants of a structure in a certain order through implicit mechanisms, and show little task variation at a given point in time, but learners who are carefully guided through the stages of skill acquisition for a given structure may show less developmental variation in that kind of structure, but more developmental variation in speed and systematicity of use of this structure, including variation due to (even small variations in) task conditions. When such learners are forced to perform beyond the level of skill they have reached, they may or may not fall back on the same variants of structures used by implicit learners, depending on factors such as how much exposure they have received along with their systematic instruction and what age they are (these two factors influence their opportunity for and their relative susceptibility to implicit and explicit learning).

Skill Acquisition Theory and the Explicit/Implicit Debate

As stated in the previous sections, Skill Acquisition Theory stresses the importance of the distinction between declarative and procedural knowledge and sees the transition from mostly declarative to mostly procedural as the norm in skill development (cf. Anderson, 2007). The declarative/procedural and explicit/implicit distinctions do not quite coincide, but for our purposes here, they are equivalent (for more in-depth discussion, see DeKeyser, 2009). It is important to realize, however, that Skill Acquisition Theory by no means denies a role for implicit learning. There can even be "synergy" between the two types of learning for a particular rule or a distribution of roles between the two when a variety of different rules, patterns, or regularities need to be learned. Research on skill acquisition outside of the language domain, as well as research with artificial languages and research with regular second/foreign language learning is increasingly concerned with such synergies or role distributions of implicit and explicit learning processes.

Early work with serial reaction time tasks (Cohen, Ivry, & Keele, 1990) or artificial grammars (Mathews et al., 1989) already hinted at such synergies. More recently and again with artificial grammars, Sallas, Mathews, Lane, and Sun (2007) showed that while chunk learning may lead to better approximation, structure learning through animated model presentation leads to a much higher number of *perfect* letter strings. Ferman, Olshtain, Schechtman, and Karni (2009) showed that there may be a role distribution in the sense that the simpler rules tend to be learned explicitly and the complex or probabilistic ones—being hard to induce, comprehend, or proceduralize—tend to fare very poorly in explicit learning, to the extent that implicit learning, slow and probabilistic as it may be, yields better results. The latter study with an artificial grammar (letter strings without meaning) is reminiscent of earlier research with

a miniature linguistic system constituting a made-up natural language, that is, with a meaning component (DeKeyser, 1995), which also showed that explicit learning worked significantly better for the abstract, but simple and categorical rules of morphology, while implicit learning yielded at least descriptively better results for the concrete, but complex and probabilistic patterns of allomorphs. (For thorough reviews of the implicit–explicit learning issue in SLA, see, e.g., DeKeyser, 2003, 2009; Williams 2009; for a discussion of the potential interaction in SLA, see esp. N. Ellis, 2005.)

Skill Acquisition Theory, then, does not reject the possibility or usefulness of implicit learning, but focuses on how explicit learning (which is often the only realistic possibility for specific learning problems because of time constraints or logistic issues) can, via proceduralization and automatization of explicitly learned knowledge, lead to knowledge that is functionally equivalent to implicit knowledge. From a purely psycholinguistic point of view, it is important to stress, as does Paradis (2009), that explicit knowledge never becomes implicit through practice; from an applied point of view, however, it is equally important to stress that what matters is fast, accurate, and robust use, the hallmark of automatized procedural knowledge. Given how difficult it is to determine whether knowledge is implicit or explicit (and even more whether learning was implicit or explicit), even under controlled laboratory conditions, it stands to reason that the implicit/explicit distinction in this narrow sense should be of little concern to second language learners and teachers. Proceduralization, however, as well as a certain degree of automatization of explicitly acquired knowledge, are necessary conditions for practically useful levels of proficiency. How exactly to get to that point is what Skill Acquisition Theory is all about.

Conclusion

In this chapter, I have presented both major findings and methodological aspects of skill acquisition research, illustrated them with a study from the second language domain, and explained how Skill Acquisition Theory is quite compatible with many of the major findings from second language acquisition research and even explains some phenomena better than other theories. In closing, however, it is only fitting to take a somewhat broader view of how well explanations of second language acquisition phenomena based on Skill Acquisition Theory fit into the larger enterprise of cognitive science; in our case, that means trying to understand how the same mind that learns how to recognize the neighbors, play chess, appreciate music, ride a bicycle, program a computer, or use a native language also learns to understand and produce a second language.

An advantage of the approach illustrated in this chapter is definitely that it fits in very well with other aspects of cognitive science. The same mechanisms, whether couched in psychological or neurological terms, are invoked to explain second language learning and a wide variety of other skills. Second, this approach

to skill learning has itself proven to be quite robust over the decades, despite the obvious changes in emphases, methodology, and terminology.

Furthermore, research on skill acquisition, whether carried out with behavioral data or through neuroimaging or computer modeling, is tremendously explicit in its procedures and claims. Power curves, computer programs, and brain scanners give precise answers to precise questions (even though interpreting the answers can still leave a lot of room for discussion). Most important of all, perhaps, research in this area is truly developmental. It does not take snapshots of learners at two or three points between initial learning and near-native proficiency and speculate on how learners got from point a to point b. It can document learning day after day and show how rapid acquisition of declarative knowledge about some structures, rapid proceduralization of knowledge about others, and automatization of some elements of knowledge for specific uses all happen in parallel, while other elements never get automatized, or maybe not even proceduralized, or perhaps not even learned. It may have less to say about which elements of language are going to be learned in what order than other, more (psycho-)linguistically oriented approaches, but it is painstakingly precise and explicit about the big and small steps a learner takes in acquiring (a specific use of) a specific structure.

Discussion Questions

1. Central to Skill Acquisition Theory are the constructs of declarative knowledge, proceduralization, and automatization. Discuss each, paying particular attention to the difference in proceduralization and automatization as well as the context(s) in which automatization may occur.
2. Both De Keyser and Ellis and Wulff offer approaches that are cognitive in nature, that is, built on models/theories from psychology rather than, say, linguistics. How are the two approaches similar or different?
3. It is clear that Skill Acquisition Theory is concerned with language behavior. Do you think that such an approach is incompatible with an approach that focuses on competence (e.g., Chapter 3)?
4. One interpretation of Skill Acquisition Theory is that it is better suited to explain tutored language acquisition as compared to nontutored language acquisition. Another is that it is better suited to explain adult SLA but not child L1A or child SLA. Do you agree?
5. As you read in Chapter 1, a perennial issue in SLA concerns the roles of explicit and implicit learning and knowledge. Now that you have read about four different theories and models (Chapters 3–6), compare and contrast what each has to say about this issue.
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Suggested Further Reading

Anderson, J. R. (2007). *How can the human mind occur in the physical universe?* New York, NY: Oxford University Press.

This book provides a more thorough and at the same time more readable account of what was covered in the 2004 article, with ample discussion of how modeling skill acquisition fits into the broader psychological currents of the last three decades.

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C., & Qin, Y. (2004). An integrated theory of the mind. *Psychological Review, 111,* 1036–1060.

An overview of ACT-R theory, with new emphases on neuro-imaging data and the issue of modularity of the mind. Parts are very technical; others are very readable.

DeKeyser, R. (Ed.). (2007). *Practice in a second language: Perspectives from applied linguistics and cognitive psychology.* New York, NY: Cambridge University Press.

A book that takes a broad view of practice, with many chapters drawing on Skill Acquisition Theory, applying it to issues from error correction in the classroom to interaction with native speakers during study abroad.

DeKeyser, R. M., & Criado-Sánchez, R. (2012). Automatization, skill acquisition, and practice in second language acquisition. In C. A. Chapelle (Ed.), *The encyclopedia of applied linguistics* (pp. 323–331). Oxford, England: Wiley-Blackwell.

A discussion of what Skill Acquisition Theory means for practice activities in a second language.

Hulstijn, J. H., van Gelderen, A., & Schoonen, R. (2009). Automatization in second language acquisition: What does the coefficient of variation tell us? *Applied Psycholinguistics, 30*(4), 555–582.

An interesting discussion of the coefficient-of-variation criterion for automaticity introduced by Segalowitz and Segalowitz (1993) and used (by, e.g., Rodgers, 2011).

Lyster, R., & Sato, M. (2013). Skill acquisition theory and the role of practice in L2 development. In M. García Mayo, J. Gutierrez-Mangado, & M. Martínez Adrián (Eds.), *Contemporary approaches to second language acquisition* (pp. 71–91). Amsterdam, Netherlands: John Benjamins.

A thorough discussion of Skill Acquisition Theory and practice in L2, with some emphasis on the role of feedback. Very useful to read in conjunction with this chapter.

Segalowitz, N. (2010). *Cognitive bases of second language fluency.* London, England: Routledge.

The most thorough discussion to date of automaticity and the process of automatization as they apply to second language learning and bilingualism.

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7

INPUT PROCESSING IN ADULT SLA

Bill VanPatten

Imagine the speaker of Spanish learning English. In a conversation or discussion, she hears someone say, "The police officer was killed by the robber." Although for the native speaker it is clear that it was the police officer who died, the learner of English may interpret this sentence as "The police officer killed the robber." Why does the learner make this misinterpretation? It cannot be due to L1 influence because Spanish has the exact same construction: *El policía fue matado por el ladrón*.

Imagine another English speaker learning Spanish in a formal setting. That learner studies the preterit (simple past) in Spanish. A month later she hears someone say *Juan estudió en Cuernavaca* 'John studied in Cuernavaca'. However, she interprets this sentence to mean that John is studying in Cuernavaca, even though she has studied and practiced past tense formation in Spanish and even though English also clearly marks past from present (e.g., 'studies' vs. 'studied'). Why does she make this misinterpretation?

Input processing (IP) is concerned with these situations, the reason being that acquisition is, to a certain degree, a by-product of comprehension (see, e.g., Truscott & Sharwood Smith, 2004). Although comprehension cannot guarantee acquisition, acquisition cannot happen if comprehension does not occur. Why? Because a good deal of acquisition is dependent upon learners making appropriate **form–meaning connections** during the act of comprehension. A good deal of acquisition is dependent upon learners correctly interpreting what a sentence means (Carroll, 2001; VanPatten & Rothman, 2014; White, 1987).

In this chapter, I deal with the fundamentals of IP and the research associated with it. What will become clear is that IP is not a comprehensive theory or model of language acquisition. Instead, it aims to be a theory or model of what happens during comprehension that may subsequently affect or interact with other processes. I will begin with a sketch of the theory and its constructs.

The Theory and Its Constructs

IP is concerned with three fundamental questions that involve the assumption that an integral part of language acquisition is making form–meaning connections during comprehension:

- Under what conditions do learners make *initial* form–meaning connections?
- Why, at a given moment in time, do they make some and not other form–meaning connections?
- What internal psycholinguistic strategies do learners use in comprehending sentences and how might this affect acquisition?

Let's take a concrete example based on the introduction of this chapter. In English as an L2, learners must, at some point, map the meaning of PASTNESS onto the verb inflection /-t/ (or "-ed" in written form). How does this happen and why don't learners do this from the first time they encounter this form in a context in which the speaker is clearly making reference to the past? In this regard, IP is a model of moment-by-moment sentence processing during comprehension and how learners connect or don't connect particular forms with particular meanings at a given moment in time. It is a model of how learners derive the initial data from input for creating a linguistic system, that is, the data that are delivered to other processors and mechanisms that actually store and organize the data (e.g., UG; see Chapter 3[1]). This can be sketched as in Figure 7.1.

IP makes a number of claims about what guides learners' processing of linguistic data in the input as they are engaged in comprehension. These claims can be summarized as follows.

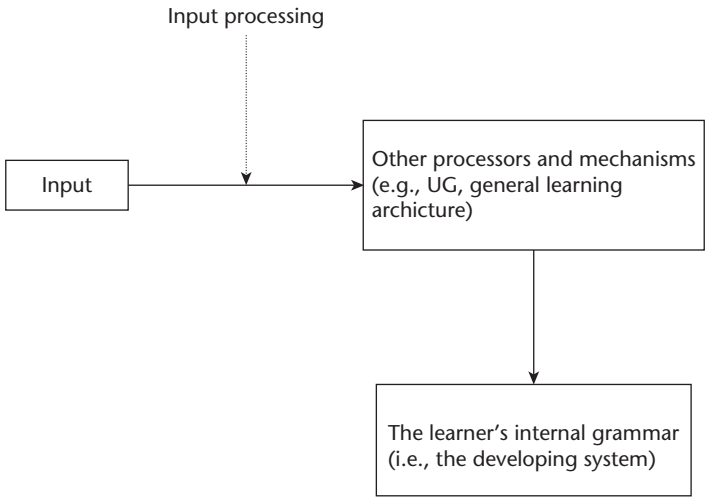

FIGURE 7.1 Where IP fits into an acquisition scheme.

- Learners are driven to get meaning while comprehending.
- Comprehension for learners is initially quite effortful in terms of cognitive processing and working memory. Unlike L1 native speakers, L2 learners must develop the ability to comprehend, and comprehension for some time may tax the computational resources as learners engage in the millisecond-by-millisecond analysis of a sentence. This has consequences for what the input processing mechanisms will pay attention to.
- At the same time, learners are limited capacity processors and cannot process and store the same amount of information as native speakers can during moment-by-moment processing.
- Learners may make use of certain universals of IP but may also make use of the L1 input processor (or parser, which we will define shortly).

The first claim has led to the principle in IP that learners will seek to grasp meaning by searching for lexical items, although the precise manner in which this is done is still not clear.[2] In other words, learners enter the task of SLA knowing that languages have words. They are thus first driven to make form–meaning connections that are lexical in nature. For example, if they hear "The cat is sleeping" and this sentence is uttered in a context in which a cat is indeed sleeping, the learner will seek to isolate the lexical forms that encode the meanings of CAT and SLEEP, for instance, because the learner (a) has these concepts stored somewhere in the mind/brain based on past human experience and (b) knows that there are probably words for these concepts that must be somewhere in the speech stream. What is more, learners know that there are differences between content lexical items (e.g., 'cat', 'sleep') and noncontent lexical items (e.g., 'the', 'is') and will seek out content lexical items first as the building blocks of interpreting sentences. Thus, in "The cat is sleeping" the learner may initially only make the connections between cat-CAT and sleep-SLEEP (again, the reader is reminded that such a sentence is uttered in a context in which there is a cat sleeping). These claims are codified in the following IP principle:

> *The Primacy of Content Words Principle.* Learners process content words in the input before anything else.

At this point, the learner most likely does not process the non-content words or the inflections on nouns and verbs, **process** referring specifically to actually making connections between meaning and form (as opposed to mere "noticing"). If the learner does process noncontent words and/or inflections, it is likely that the (other) processors responsible for data storage and grammar building may not yet be able to make use of them and will dump them, preventing further processing. One example is the auxiliary *do* in English. This auxiliary may be initially perceived by learners (it is almost always in sentence-initial position in *yes/no* questions such as *Do you like Mexican food?*; see the later definition of the "Sentence

Location Principle"), but because learners can't attach any meaning to it in the early stages of processing, *do* does not get processed after it is initially perceived.

However, the model of IP also makes another claim regarding such things as inflections and grammatical markers, namely, that if the marker is redundant, it may not get processed because the learner is focused on getting content words first. Processing the content word (i.e., the Primacy of Content Words) obviates the need to process the grammatical marker *if it encodes the same meaning.* In this scenario, presented with a sentence such as 'I called my mother yesterday', learners will not process tense markers. Instead, they will derive tense from their processing of adverbs of time (e.g., 'yesterday', 'tomorrow'). The Primacy of Content Words principle thus has consequences for what learners extract from the input when grammatical devices are present. This is codified in the following principle:

> *The Lexical Preference Principle.* Learners will process lexical items for meaning before grammatical forms when both encode the same semantic ("real world") information.

Learners will first tend to link semantic notions with content lexical items in the input and only later link grammatical forms that encode the same semantic notions. There are two possible consequences of this particular principle. The first is that learners will begin to process redundant grammatical markers only when they have processed and incorporated corresponding lexical forms into their developing linguistic systems. Thus, past tense markers won't be processed and incorporated until learners have processed and incorporated lexical forms such as 'yesterday', 'last night', and so on.[3] If so, the Lexical Preference Principle might be revised to state the following:

> *(Revised) Lexical Preference Principle.* If grammatical forms express a meaning that can also be encoded lexically (i.e., that grammatical marker is redundant), then learners will not initially process those grammatical forms until they have lexical forms to which they can match them.

The other possible consequence is that learners may begin to rely exclusively on lexical forms for all information and never process grammatical markers in the input at all. In this scenario, the processing of lexical items "overrides" any need to process grammatical markers when redundancy is involved (i.e., the lexical form and the grammatical form express the same meaning as in PASTNESS/-ed, FUTURE/will, THIRD-PERSON SINGULAR/-s,[4] and so on). In either scenario, one of the predictions of the model of IP is that learners will continue to focus on the processing of lexical items to the detriment of grammatical markers given that lexical items maximize the extraction of meaning, at least from the learner's point of view. Grammatical markers will be processed later. In VanPatten and Keating (2007), we demonstrated this in one study in which learners of Spanish L2 with English L1

processed Spanish sentences in which the adverb matched or didn't match the verb for tense (e.g., 'Yesterday I am talking to John' vs. 'Now I'm talking to John'). Using eye-tracking (for a discussion of eye-tracking, see the section "What Kind of Evidence"), we found that native speakers lingered or "regressed" to verb forms to verify temporal reference, whereas beginners and intermediate staged learners tended to linger or regress to adverbs to verify temporal reference. However, advanced learners patterned like native speakers, suggesting that eventually learners begin to focus on grammatical inflections in the input to obtain temporal information (see also Ellis & Sagarra, 2010; Lee, Cadierno, Glass, & VanPatten, 1995). At the same time, VanPatten and Keating found that Spanish L1 speakers of English L2 did not begin the processing of English sentences by relying on the Spanish preference for verbs. Instead, their early-stage learners of English patterned after the English L1 learners of Spanish, using adverbials to process temporal reference in sentences, suggesting this strategy is universal and not dependent on L1 experience.

Not all grammatical markers are redundant. In English, *-ing* is the sole marker of the semantic notion of an event in progress as in 'The cat is sleeping [IN PROGRESS]'. There is no lexical indication of IN PROGRESS in the sentence with *-ing.* This contrasts with something like 'The cat sleeps ten hours everyday', where the meaning of *-s* of 'sleeps' [THIRD PERSON, SINGULAR, ITERATIVE] is encoded lexically in 'the cat [THIRD-PERSON, SINGULAR]' and 'everyday [ITERATIVE]'. Because learners always search for ways in which meaning is encoded, if it is not encoded lexically, only then will they turn to grammatical markers to see if a semantic notion is expressed there. Thus, if learners are confronted with something like *-ing* on verb forms, they will be forced to make this form–meaning connection sooner than say third-person *-s* because the latter is redundant and the former is not. This leads to another principle of IP:

> *The Preference for Nonredundancy Principle.* Learners are more likely to process non-redundant meaningful grammatical markers before they process redundant meaningful markers.[5]

Until now, we have considered only grammatical markers that carry meaning such as *-s* on the end of a noun means 'more than one' and *-ing* means 'in progress'. But there are some grammatical markers, albeit not many, that do not carry meaning. Consider 'that' in the sentence 'John thinks that Mary is smart'. What real word semantic information does 'that' encode? It's not a tense marker. It's not an indication of whether or not the event is in progress or iterative. It's not a plurality marker or any other such semantically linked grammatical device. As a word, there is nothing you can point to in the world or describe and say "that's a 'that'" as you might with "that's a cow" and "that's love." It has a grammatical function, to be sure—to link two sentences (i.e., introduce an embedded clause) but it doesn't encode any semantic information. In Spanish, adjective agreement is similar. In the case of *el libro blanco* ('the white book') and *la casa blanca* ('the white

house'), there is no semantic reason why in one case *blanco* must be used and in another *blanca* must be used.[6] Spanish just makes adjectives agree with nouns. The model of IP says that such formal features of language will be processed in the input later than those for which true form–meaning connections can be made. The principle says:

> *The Meaning before Nonmeaning Principle.* Learners are more likely to process meaningful grammatical markers before nonmeaningful grammatical markers.

IP is more, however, than making form–meaning connections. When a person hears a sentence, whether in the L1 or the L2, that person also does a micro-second-by-micro-second computation of the syntactic structure of that sentence. This is called **parsing**. For example, in English when a person hears 'The cat . . .' the parsing mechanism (called a *parser*) does the following: the cat = NP (noun phrase) = subject. This is a called a *projection* because the parser projects a syntactic structure (i.e., the parser is making the best guess at what the grammatical relationships will be among words). If a verb follows, the parser may continue in this path. For example: 'The cat chased . . .', the cat = NP = subject, chased = verb [so far, so good for the syntactic projection]. If a phrase like 'the mouse' comes next, the parser may continue: the cat = NP = subject, chased = verb, the mouse = NP = object; parsing completed, syntactic projection successful, sentence computed and understood. But if instead of 'the mouse' what follows is 'by the boy', the parser must reanalyze on the spot and project something different onto the syntactic structure: the cat = NP = subject, chased = verb, by the boy = oops, not an object therefore 'the cat chased by the boy' = NP = subject. If a verb follows such as 'howled' the parser continues: the cat chased by the boy = NP = subject, howled = verb, parsing completed and successful.

The previous description of parsing is greatly simplified to be sure,[7] but for the present discussion it allows us to ask the following question: how do learners parse sentences in the L2 when they do not have a fully developed parser as they do for L1 sentence processing? (Again, I am ignoring here how learners come to perceive word boundaries and isolate words during parsing.) The first avenue is that learners possess universal parsing strategies (or procedures) and apply these as they begin interacting with the L2 input. The other avenue is that learners transfer or attempt to transfer their L1 parsing strategies (or procedures) when interacting with the L2 input. These two positions are clear when we examine sentences such as the following in English and Spanish:

(1) a. Mary hates John.
    b. María detesta a Juan.
    c. A Juan María lo detesta.

(2) a. Mary hates him.
b. María lo detesta.
c. Lo detesta María.

(3) a. She hates him.
b. Lo detesta.

In English, only subject-verb-object (SVO) order is possible, regardless of whether an object is a full noun (*John*) or a pronoun (*him*) as in (1a), (2a), and (3a). This is true whether the sentence is a simple declarative or whether it is a *yes/no* question. In Spanish, however, although SVO is certainly prototypical, SOV (with pronouns as in 2b), OVS (with full nouns and pronouns as in 1c and 2c), and OV (when the subject is null, that is, not expressed as in 3b).[8] In Spanish, OV and OVS are fairly standard for *yes/no* questions, are not infrequent in simple declaratives, and are the prototypical orders for sentences containing certain verbs. So what happens when a language learner, say of English L1 background, first encounters (and continues to encounter) OVS and OV type sentences? Research has shown that such learners misinterpret such sentences and reverse "who does what to whom." In the case of *A Juan lo detesta María,* learners misinterpret this as 'John hates Mary' rather than 'Mary hates John'. In the case of *Lo detesta María,* they misinterpret this sentence as 'He hates Mary' rather than 'Mary hates him'. The result is that incorrect form–meaning connections are made (e.g., *lo* = he[subject] rather than *lo* = him[object]) and wrong data about sentence structure is provided to the internal processors responsible for storage and organization of language; in this case, these processors receive incorrect information that Spanish is rigid SVO and the pronoun system becomes a mess.

The question is this: is this parsing problem due to some universal strategy[9] or to the English parser interacting with Spanish input data? In previous research, I have taken the position that this is a universal strategy and posed the following principle:

The First-Noun Principle. Learners tend to process the first noun or pronoun they encounter in a sentence as the subject.

Under this universal position, any learner, whether from an SVO language or a language with flexible word order or rigid OVS order, would initially process the first noun as the subject.

Under the alternative position, that the L1 parser is transferred into L2 IP, the principle would look different and would have different consequences. The principle might look like this:

The L1 Transfer Principle. Learners begin acquisition with L1 parsing procedures.

In this case, problems would be language specific in terms of transfer. So, the Italian speaker learning Spanish would not have difficulty with OV and OVS structures in Spanish because these exist in Italian (e.g., *Lo vede Maria* 'Maria sees him') and the L1 parser has computing mechanisms for dealing with them. The English speaker, on the other hand, would have difficulty due to the rigid word order of English with no parsing mechanism to handle non-SVO structures (except cleft sentences such as "Him I hate") (see Isabelli, 2008, for a sample study on this issue).

A question arises with this example: Is the transfer due to syntactic parsing or lexical transfer? Spanish and Italian share object pronouns such as *lo* and *la* so that the Italian speaker learning Spanish can transfer these lexical items along with their functional features into the new lexicon. The English speaker cannot do this. The underlying features of *lo* prohibit it from being taken as a subject in Italian, and presumably this would happen in Spanish as L2 for these learners. On the other hand, there is research on the acquisition of passives that suggests that word for word passive structure equivalents in languages like English and French do not transfer, so that early-stage learners of French tend to misinterpret passives in terms of who does what to whom (Ervin-Tripp, 1974). Thus, the question is open as to whether and to what degree there is L1 influence in basic IP, and whether that influence is an actual processing procedure or lexical influence.

Other factors may influence how learners parse and thus interpret sentences. Consider the following verb: *scold*. Which is more likely, for a parent to scold a child or a child to scold a parent? In the real world, the first situation is more likely. So what happens if a learner hears 'The child scolded the mother'? In such cases, it is possible (though not necessary) that the probability of real life scenarios might override the First Noun Principle (or the alternative L1 Transfer Principle). The learner might incorrectly reparse the sentence to mean 'the parent scolded the child' and send information to the internal processors that the language has OVS structures (when it may not). This is what would happen during parsing under this scenario: the child = NP = subject, scolded = verb, the parent = NP = object, but wait, children don't scold parents, parents scold children so the sentence must mean that the parent scolded the child, reanalyze the parse: the child = NP = object, scolded = verb, the parent = NP = subject. The influence of what are called event probabilities is captured in the following principle:

> *The Event Probability Principle.* Learners may rely on event probabilities, where possible, instead of the First-Noun Principle to interpret sentences.

Similarly, learners also come to the task of parsing knowing that certain verbs require certain situations. For example, the verb 'kick' requires an animate being with legs for the action to occur. Thus, people, horses, frogs, and even dogs can kick, but snakes, rocks, and germs cannot kick. When confronted with the

sentence 'The cow was kicked by the horse,' the First-Noun Principle (or L1 Transfer Principle) may cause a misinterpretation: The cow did the kicking. However, when confronted with the sentence 'The fence was kicked by the horse', a faulty interpretation is unlikely (how can a fence kick anything?) and the sentence may actually cause the parser to reanalyze what it just computed (assuming there is time to do so). This situation involves what is called *lexical semantics.* Lexical semantics refers to how the meanings of verbs place requirements on nouns for an action or event to occur. Does the event expressed by the verb require an animate being to bring the event about? Does the event require particular properties of a being or entity for the event to come about? Note that lexical semantics is different from event probabilities in a fundamentally different way: with event probabilities, either noun may be capable of the action but one is more likely. With lexical semantics, it is the case that only one noun is capable of the action. Thus, both a child and a parent can scold, but one is more likely to scold the other (event probabilities). However, between the two entities 'horse' and 'fence' a horse can kick something else; a fence cannot kick something else (lexical semantics). The use of lexical semantics during parsing can be expressed by the following principle:

> *The Lexical Semantics Principle.* Learners may rely on lexical semantics, where possible, instead of the First-Noun Principle (or an L1 parsing procedure) to interpret sentences.

Research on L2 IP has also demonstrated that context may affect how learners parse sentences. Consider the following two sentences:

(4a) John is in the hospital because Mary attacked him.
(4b) John told his friends that Mary attacked him.

In Spanish, the embedded clause can either be SOV (*María lo atacó*) or OVS (*lo atacó María*). If the First-Noun Principle or its L1 alternative were active (for English speakers, say), the OVS structure could be misinterpreted as 'he attacked Mary'. But note that if the preceding context is "John is in the hospital" a misinterpretation is less likely. Why would John be in the hospital if he attacked Mary? He'd be in jail, if anything. No, it's most reasonable that he's in the hospital as the result of an injury so Mary must have attacked him. If the preceding context is neutral as in "John told his friends . . .," there is nothing to constrain interpretation of the following clause: John could equally tell his friends that he attacked Mary or that Mary attacked him. The effects of context, then, result in another principle:

> *The Contextual Constraint Principle.* Learners may rely less on the First Noun Principle (or L1 transfer) if preceding context constrains the possible interpretation of a clause or sentence.

So far, we have dealt with factors that affect the connection of form and meaning during processing, as well as parsing (e.g., computation of syntactic structure). There is another area of processing that enters the picture: where elements are more likely to appear in a sentence. Imagine you hear the following set of numbers:

11 32 51 4 8 42 71 39 7 22 60 15 96 12 85 44

If you are typical, you will remember the numbers at the beginning (say 11, 32) before you would remember numbers at the end (say 44, 85) and in turn would remember both before you would remember any numbers in the middle (say 39, 7, or 60). This ability to process and remember best things at the beginning, followed by things at the end, followed by things in the middle is true of a good deal of human information processing, and language is no different. We can couch this phenomenon in the following principle:

The Sentence Location Principle. Learners tend to process items in sentence initial position before those in final position and those in medial position.

Barcroft and VanPatten (1997) found this to be the case for the initial detection of the grammatical morpheme *se* in Spanish, in which the morpheme was much more frequently detected by naïve learners of Spanish in sentences such as *Se levanta Juan temprano todos los días* compared with *Todos los días Juan se levanta temprano.*

To be sure, the principles just outlined (and any others that might affect IP[10]) do not act in isolation. One can envision, for example, that even though object pronouns in Spanish can and do appear in initial position (e.g., in OVS structures) this does not mean that learners will process them correctly. The First-Noun Principle would most likely interact with object pronouns so that learners may indeed process the object pronoun because it is in initial position in an OVS structure (as opposed to when it might normally appear in medial position in the sentence) but they would process it incorrectly. What is important to keep in mind here is that the term 'process' means that learners link meaning and form, either locally (words, morphology) or at the sentence level. As I will discuss later, processing is not an equivalent term for 'noticing'.

What Counts as Evidence?

It is probably clear that only data gathered during comprehension-oriented research is appropriate for making inferences about IP. Typical research designs include sentence interpretation tasks and eye tracking experimentation.

Sentence Interpretation Tasks

In this kind of experimentation, participants hear sentences and indicate what they understand. For example, in the case of word order, participants might hear

"The cow was kicked by the horse." They are then asked to choose between two pictures that could represent what they heard. In one picture, the cow is kicking the horse. In the other, the horse is kicking the cow. If the participant chooses the first picture, then we can infer that the First-Noun Principle is guiding sentence processing. If the participant selects the second picture, then the First-Noun Principle is not guiding sentence processing (see, e.g., VanPatten, 1984).

With form–meaning connections, a variation on this type of task may occur. Participants might hear sentences such as *Mi mamá me llamó por teléfono* 'My mother called me on the phone' and *Mi amigo me ayuda con la casa* 'My friend is helping me with the house'. Note that there are no adverbials of time in the sentences. At the same time, the subject may hear similar sentences but an adverbial of time is present, as in *Mi mamá me llamó anoche por teléfono* 'My mother called me on the phone last night'. Learners are then asked to indicate whether the action occurred in the past, is happening now or happens everyday, or is going to/will happen in the future. If learners fail to correctly make such indications when the adverbs are not present in sentences but correctly do so when they are, this tells us they are relying on lexical items to get semantic information and not verbal inflections.

Eye-tracking

Eye-tracking research involves having participants read sentences or text on a computer screen while tiny cameras track eye-pupil movements via a very small infrared light directed at their pupils. As people read, they unconsciously skip words and parts of words, regress to some words, and so on, on a millisecond-by-millisecond basis (see Keating, 2013, for an overview of eye-tracking research in L2). Eye-tracking can reveal, for instance, whether learners attend to verbal inflections during IP and whether they regress like native-speakers do when encountering something that does not seem right. For example, given the sentence 'Last night my mother calls me on the phone', native speakers eye-tracking reveals fixations on the verb 'calls' often with regression to the phrase 'last night'. We do not see the same eye-movement behavior from beginning and intermediate learners. However, when asked to press a button to indicate past, present, or future for the action, both native speakers and nonnatives always press 'past'. These combined results suggest that learners do indeed rely on lexical cues for meaning and skip over grammatical markers that encode the same meaning as they process sentences.

There are other on-line methods in addition to eye-tracking that can be used to research IP. The reader is referred to Jegerski and VanPatten (2013) for a volume dedicated to psycholinguistic methods used in L2 research.

Common Misunderstandings

There are several common misunderstandings about both IP and the specific model of IP described here.

Misunderstanding 1: IP is a model of acquisition. People who claim this believe that IP attempts to account for acquisition more generally. It does not. As stated, IP is only concerned with how learners come to make form–meaning connections or parse sentences. Acquisition involves other processes as well, including accommodation of data (how the data are incorporated into the developing linguistic system and why they might not be), how Universal Grammar acts upon the data, restructuring (how incorporated data affect the system, such as in when regular forms cause irregular forms to become regularized), how learners make output, how interaction affects acquisition, and others. In short, *IP is only concerned with initial data gathering.* Consider the following analogy: honey making. Bees have to make honey. To do so, they have to gather nectar. They go to some flowers and not others. They have to find their way to flowers and then back to the hive. They then process the nectar to produce honey. They build combs to store the honey, and so on. All of these endeavors are part of honey making. But we can isolate our research to ask the following questions: How do bees gather nectar? Why do they select some flowers and not others? This is similar to the concerns of IP: how do learners make form–meaning connections? Why, at a given period in time, to they make some connections and not others? IP isolates one part of acquisition; it is concerned with the "nectar gathering aspect" of acquisition and leaves other models and theories to account for what happens to the nectar when it gets to the hive. (See Rothman & VanPatten, 2013, as well as VanPatten, 2014a, for a discussion of how various theories are necessary to account for the complex picture that is acquisition.)

Misunderstanding 2: Input processing discounts a role for output, social factors, and other matters. Under this scenario, the person believes that because there is a focus on one aspect of acquisition, that the researcher or scholar does not believe anything else plays a role in acquisition. We thus hear of such things as "the input versus output debate" or "comprehension versus production" in SLA. Again, if we go back to the honey analogy, clearly someone who examines how bees collect nectar and why they do it they way they do it understands quite well that gathering nectar is not the same as making honey. And hopefully someone who researches what happens in the hive once the nectar arrives clearly understands that without nectar there is no honey-making. That a researcher focuses on one particular part of the acquisition puzzle, does not mean he or she discounts the rest. It means that the researcher is merely staking out a piece of the puzzle to examine in detail.

Misunderstanding 3: Input processing is equivalent to "noticing." Some readers of research on IP mistakenly equate processing with noticing. As a reminder to the reader, processing means that learners are connecting meaning and form. Examples are /kaet/ means 'cat', however this concept is represented in the mind of the learner, /tahkt/ means that the talking happened in a past time frame, and 'John was told a lie by Mary' means that Mary did the lying to John. Noticing, as defined by Schmidt (e.g., Schmidt, 1990, 2001) does not entail a connection between form and meaning. Noticing simply means that learners have become

aware of a formal feature of language (including new words). In addition, noticing has not been applied to the sentence level; its use is almost always restricted to morpholexical form. The distinction between the two is important because in some publications, researchers have argued against the principles outlined in this chapter. However, their research methods use techniques for noticing and not processing, including measures of knowledge (e.g., grammaticality judgment tasks), introspective think-alouds (e.g., "Tell me what you notice in what you are reading"), and mark-up tasks (e.g., "As you read, circle anything in the text that catches your attention"). One cannot use research paradigms for noticing to argue against principles related to processing (see, e.g., VanPatten, 2014b).

Misunderstanding 4: Input processing is a meaning-based approach to studying acquisition and ignores what we know about syntactic processes. People who make this claim are focused on aspects of the model in which lexical primacy and the quest to get meaning from the input drives sentence interpretation, for example. Their conclusion is understandable, but it is not correct. As we have seen with the issue of the First-Noun Principle and with parsing, the model is also concerned with syntactic aspects of parsing and how these affect sentence interpretation and processing (which in turn affects acquisition). What is more, sometimes those who believe IP to ignore syntactic processes may be thinking of what we know about adult native-speaking models of sentence interpretation, which are largely (but no exclusively) syntactic in nature. The idea is that if this is what native-speaking processing models entail, shouldn't L2 models do the same? The answer is maybe. The position taken by those of us in IP research is that other than the kinds of principles described here, processing develops over time. What learners begin with may not be processing mechanisms that can make full use of syntactic processes in sentence interpretation the way native speakers can. For example, in one experiment, researchers have shown that native speakers and nonnatives process "gap" sentences differently. Gap sentences are those in which a *wh-* element (e.g., *who*) has been moved out of one part of the sentence into another: "The nurse who the doctor argued that the rude patient had angered is refusing to work late." In this kind of sentence, *who* (the relative clause marker) is actually linked to the verb *angered* (i.e., is the object of the verb *angered*). What the researchers noticed is that even though both natives and non-natives can equally determine who was rude to whom, their millisecond-by-millisecond processing reveals substantial differences in how they make use of syntactic processing with the nonnatives relying much more on lexical-semantic and other non-syntactic cues. This is referred to as the Shallow Structure Hypothesis (Clahsen & Felser, 2006). This does not mean that the model of IP and the SSH are equivalent; the point here is that it is possible to process sentences and not make full use of syntactic resources in doing so.

Misunderstanding 5: Input processing is a pedagogical approach. Some people believe that the model of IP as described here is a pedagogical model. This is because there is a pedagogical intervention called *processing instruction* (what some people mistakenly call "input processing instruction") that is derived from insights about

IP. Processing instruction is directed at the following question: If we know what learners are doing wrong at the level of input processing, can we create pedagogical intervention that is comprehension-based to push them away from non-optimal processing? IP, however, is not about pedagogy nor is it concerned with what learners in classrooms do. As a model of processing, it is meant to apply to all learners of all languages in all contexts (in and out of classrooms). Thus, the First-Noun Principle could be researched with learners of English as immigrants in the United States, learners of English in a classroom in Canada, learners of English in a classroom in Saudi Arabia, and so on. The model attempts to describe what learners do on their own, the same way research on say Universal Grammar describes what learners do on their own regardless of instruction. With this said, there have been many more studies on processing instruction than on IP. Perhaps for this reason there is some confusion in the literature.

An Exemplary Study: Tight (2012)

In this study, Tight (2012) set out to investigate how learners interpret sentences with only one noun. His focus was verbs of the type 'listen' which can optionally take an object as in 'John listens to Mary' (SVO) and 'John listens well' (SV). In Spanish, these sentences would be, respectively, *Juan escucha a María* and *Juan escucha bien*. Tight was particularly interested in the objectless sentences. As we have seen, Spanish allows flexible word order under various discourse conditions such that both *Juan escucha bien* (SV) and *Escucha bien Juan* (VS) are possible. Tight wanted to see if the First-Noun Principle held when there was only one noun and it appeared in post-verbal position.

Tight tested L2 learners of Spanish with L1 English across three levels of university study: first semester (n = 37), third semester (n = 39), and fifth semester (n = 23). His participants heard a total of 16 target sentences, each one containing a subject noun in either pre-or postverbal position, a verb such as 'listen', 'call', 'understand' (among others), and no object noun; for example, *La profesora comprende* The professor understands' and *Comprende la mujer* 'The woman understands'. Thus, there were eight target SV sentences and eight target VS sentences using the same verb but not necessarily the same subject noun. Distractors consisted of simple declarative sentences such as *El chico es alto* 'The boy is tall' and *El maestro duerme ocho horas* 'The teacher sleeps for eight hours'. His method was relatively simple. Participants heard pre-recorded sentences and then indicated on a response sheet the best translation (e.g., Ecucha bien Juan A. Juan listens well. B. They listen to Juan well).

Tight's results yielded two sets of results. First, that as proficiency increased, so did accuracy on sentence interpretation. This is not surprising and is not of central concern here. The second set of results center on how the participants actually interpreted SV and VS sentences. To be expected, they were quite accurate on the SV sentences, with all three semester levels scoring at 95% or above. The picture

was quite different for the VS sentences. Here, the three groups' scores were significantly lower, with the percentage of correct scores ranging from 25% to 48%. What this means is that the participants were misinterpreting subjects as objects.

At first blush, these results seem to run counter to any prediction from the First-Noun Principle, which predicts that learners will tend to interpret the first noun they encounter as the subject. But in Tight's VS examples, the participants tended to interpret the first noun they encountered as the object, while probably projecting a null subject (e.g., for *Comprende la mujer,* they may have assumed that someone 'out there' understood the woman). What makes this study exemplary is not only its simplicity but that it suggests other possible corollaries for the First-Noun Principle or even a refinement of the First-Noun Principle. For example, based on Tight's results, we might amend the First-Noun Principle to say that learners tend to interpret the first noun they encounter as the subject when two or more nouns are present. If only one noun is present, then learners may interpret a preverbal noun as the subject and a postverbal noun as the object. (For ease of discussion, I am using noun here to mean both full nouns and pronouns.) What also makes this study exemplary is the additional research warranted by the findings. What is missing in Tight's study and in previous research are VNN sequences of the type *Comprende Juan a María* and *Comprende a María Juan,* both meaning 'John understands Mary'. Both Tight's results and previous research suggest two possibilities: either the first noun is interpreted as the subject or it is not. In addition, given that Tight used a translation task as opposed to the standard picture-matching task used in IP research on the First-Noun Principle, it remains to be seen to what extent a translation task reduces the effects of the First-Noun Principle. Thus, Tight's research (which is as recent as 2012 compared to VanPatten's original study in 1984) suggests that continued research on the parsing of simple sentences and how learners interpret nouns (as well as the research designs used to do so) is justified.

Explanation of Observed Findings in SLA

Observation 1: Exposure to input is necessary for SLA; *Observation 2: A good deal of SLA happens incidentally.* It goes without saying that IP incorporates the important role of input. What is more, however, is that the model of IP would suggest that most of acquisition is incidental. As we noted earlier, IP is dependent on comprehension (learners actively engaged in getting meaning from what they hear or read). In a certain sense, acquisition is a byproduct of learners' actively attempting to comprehend input. Their primary focus is on meaning and the connection of form–meaning and the parsing of sentences is a result of the learners' communicative endeavors.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. Although it is not the goal of IP to explain all of SLA, there are certain observed phenomena for which it can help to account.

Due to its concern with the question of "Why do learners make some form–meaning connections and not others?" it can speak to orders of acquisition. When taken together, the various principles of IP account for why the verbal inflection system in English, for example, emerges the way it does. Learners will first process (and subsequently acquire) *-ing* due to the Meaning before Non-meaning Principle and due to the Lexical Preference Principle (no lexical items carry the meaning of *-ing*). Third-person *-s* will be acquired last because of the Preference for Nonredundancy Principle (third-person *-s* is always redundant whereas the other verbal inflections in English are not). Likewise, the initial stages of the acquisition of negation in English, for example, are marked by the isolation of specific words to indicate negation: notably 'no' and unanalyzed 'don't' (that is, the learner does not know that 'don't' consists of two words, 'do' and 'not', and merely uses it as a substitute for 'no'). What this suggests is that initial input processing is attempting to isolate content words to indicate negation.

Observation 7: There are limits on the effects of frequency on SLA; *Observation 8: There are limits on the effect of a learner's first language on SLA.* Within IP, frequency is not a major factor. Because IP is concerned with initial processing and the factors that affect it, frequency does not play a major role. For example, adjective agreement is frequent in Spanish, but the principle regarding redundancy mitigates against initial processing of agreement. Other less frequent things, if they are not redundant, will get processed sooner. The problem with frequency is that sometimes it goes hand-in-hand with redundancy/nonredundancy. For example, *-ing* may be more frequent in English than simple past tense, *-ed*. But *-ing* is also never redundant whereas *-ed* often is (see earlier). The question then becomes is it frequency that gets *-ing* processed before *-ed* or is it the nonredundancy and meaning based nature of *-ing* as suggested by the Lexical Preference Principle? Such questions can only be answered by continued research on a variety of languages.

IP accounts for limits of the effects of both frequency and the L1. The various principles that deal with Lexical Preference, Nonredundancy, Meaning before Nonmeaning, and so on, would mitigate against the sheer effects of frequency as well as against the L1. Just because a form is highly frequent does not mean it will be processed if (a) it is redundant and/or (b) if it carries no meaning, for example. At the same time, if parsing strategies turn out to be at least partially universal rather than L1 based (see the discussion on the First-Noun Principle), then the model of IP would account even more for the limited effects of the L1.

Observation 9: There are limits on the effects of instruction on SLA. The present model of IP also helps to account for the limited effects of instruction. A good deal of instruction is centered on product rather than process. That is, instruction is most often concerned with rules and with learner output. Our model of IP suggests that part of the learning problem is in processing. Thus, if instruction fails to account for how things get processed in the input, it may not be as useful as we think. Work on IP has lead to an instructional intervention called *processing instruction,* which speaks to this very issue. In processing instruction, instruction actually

seeks to intervene during IP, thus altering learners' processing behaviors and leading to more grammatically rich (one might even say more "appropriate") intake.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. Although IP does not speak directly to issues of output, the model would suggest that the effects of learner output would be constrained if output does not help to alter learners' processing behaviors. For example, an English-speaking learner of Spanish can produce all the sentences he or she wants in a variety of contexts. But if the interaction does not lead to the learner to realize that he or she has misinterpreted an OVS sentence, then little will change in terms of acquisition. That learner will continue to process Spanish first (pro)nouns as subjects. Under this scenario, output is useful if it leads learners to register and then correct their misinterpretations of others' meanings (see VanPatten, 2004c, for some discussion on this).

The Explicit/Implicit Debate

The model of IP presented in this chapter is neutral/agnostic on the issue of whether adults engage implicit or explicit processes when learning a second language. In most models of parsing and processing, syntactic computations and mappings occur outside of awareness, except perhaps in the case of learning lexical items (see, e.g., Truscott & Sharwood Smith, 2004, 2011). Indeed, processing would be a very laborious process if the learner stopped at each word or piece of morphological datum to explicitly register it (e.g., "this is a verb, it means X, it refers to a 3rd person, it's in the past tense" and so on). Such explicit processing would grind comprehension to a halt. People can and do experience moments of "what?" while listening or reading, very brief milliseconds of recognizing that what they heard or read is not what was meant. But even in such cases, it is not clear that the resolution of what was meant happens explicitly; that is, awareness of a problem does not necessarily entail awareness of how to resolve the problem (e.g., "oh, that was a reduced relative clause and not a main verb . . .", "oh, that was a past tense verb form and not a present tense verb form . . ."). And, there is some evidence that, as far as explicit processing is concerned—that is, the explicit teaching of information about the language and whether that information can be used during on-line comprehension—explicit information usually is not and probably cannot be used to process language (e.g., VanPatten, Borst, Collopy, Qualin, & Price, 2013).

Conclusion

IP as a phenomenon should be viewed as one part of a complex set of processes that we call acquisition. As such, any model or theory of IP should not be expected to be a model or theory of acquisition more generally. Ideally, one would like to see various models that account for different processes in acquisition and when viewed this way, a better picture of acquisition ought to emerge.

Models and theories undergo change and evolution and this is no less true for a model of L2 IP. As is the case with almost every theory and model in SLA, challenges have been leveled against IP resulting in lively debate in the professional literature (see, e.g., DeKeyser, Salaberry, Robinson, & Harrington, 2002; VanPatten, 2002, for one exchange; and Harrington, 2004; Carroll, 2004; VanPatten, 2004b, for another exchange). However, these challenges are leveled at the specifics of the model and not at the underlying questions that drive the model, namely, "Why some form–meaning connections and not others? Under what conditions?" Some kind of model of input processing will need to coexist alongside models that deal with how linguistic data are incorporated into the developing system as well as how learners access the system to make output, and so on. The current model of IP is our first pass at considering how learners process input during real time comprehension.

Discussion Questions

1. IP theory claims that lexical items are privileged in input processing (i.e., the Primacy of Content Words Principle). Do you think lexical items are privileged in acquisition more generally? What about learner attempts to produce language? What about learner strategies in terms of overt attempts to learn a language (e.g., conscious strategies to try and comprehend what someone else is saying)?
2. VanPatten argues that L2 parsing may involve universal procedures or it may be L1-based initially (i.e., the L1 parser is "transferred"). Or some combination of both may be at play. Which do you think is more likely? Can you think of additional experimentation and data that would help to determine which position is more likely?
3. The theory of IP in this chapter claims that learners' initial orientation toward input is to process it for meaning; that is, they do what they can to extract basic meanings from sentences. Can you think of any circumstances under which learners would approach processing sentences for form/structure first? Do you think this leads to acquisition? Keep in mind the definition of processing as the connection of form and meaning.
4. Take the language you teach or are most familiar with and try to apply either the Lexical Preference Principle or the First-Noun Principle to input processing for that language. Can you make any predications about processing problems? For example, under the Lexical Preference Principle, what formal features of the language tend to co-occur with lexical items or phrases that express the same concept? What is your prediction about processing?
5. One of the most well-known outcomes of the model of IP is VanPatten's *processing instruction*. Select one of the following studies and present it to your class: Cadierno (1995), VanPatten et al. (2013), Uludag and VanPatten (2012).

6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Notes

1. Although I take a generative perspective on the nature of representation and "what is learned" (see, e.g., Rothman & VanPatten, 2013; VanPatten & Rothman, 2013), IP is compatible with a variety of frameworks as the principles that underlie IP presented in this chapter are not generative in nature.
2. What is meant is that it is not clear how learners of different languages actually come to know where word boundaries are in the language, but clearly they do. Issues of how learners process sounds and segment units of speech are part of another set of processes (see, e.g., Carroll, 2001).
3. Clearly a learner need not process and incorporate all possible lexical items for a given grammatical marker. It is enough that the learner process one or two, for example.
4. Although the term "third-person singular" sounds like a grammatical concept and not a semantic concept, it actually is semantic and means "someone other than you or me." In English, the third-person singular form of a verb also carries the feature "iterative" (habitual) as opposed to "in progress" (at one particular point in time).
5. Learners do not enter the task of processing input already knowing what things are redundant and what things are not. They do, however, enter the task unconsciously knowing that redundancy exists in language more generally. The point here is that if a learner knows that the context is referring to an action in progress, he or she will look to see how that is encoded lexically first. If it is not, as in the case of English, then he or she will subsequently begin looking for grammatical markers that mark this nonredundant meaning.
6. It is unfortunate that ancient grammarians adopted the semantic term "gender" to apply to nouns when nonanimate nouns such as house, shoe, moon, pie, and lamp do not have gender. So when we talk about "gender agreement" in a language like Spanish, we are not talking about adjective agreement due to the biological sex of anything. We are talking about a purely grammatical phenomenon. To be sure, some languages, such as Basque, base gender on animacy, and languages may have three, four, five, and even more categories of "gender" that require agreement or noun marking.
7. For some work on parsing, see Pritchett (1992), Carreiras, García-Albea, and Sebastián-Gallés (1999), and Clifton, Frazier, and Rayner (1994).
8. Spanish is what is called a "null subject" language in that subject pronouns are not required in simple declarative sentences, and in some cases, pronouns are prohibited. For example, in most discourse situations, subject pronouns are not used as in *¿Qué haces?* 'What are you doing?' In this sentence, there is no overt 'you' expressed in Spanish. What is more, in English, "It's raining" can never be "*Is raining." In Spanish, 'it' cannot be expressed under any circumstances as a subject of weather expressions or time expressions, and the sentence is simply *llueve* (or *está lloviendo*—progressive) with no overt subject noun or pronoun equal to 'it'.
9. Universal strategy should not be construed as being part of Universal Grammar (see Chapter 3).
10. Other possible factors remain to be investigated that we have reason to believe may be important, such as acoustic stress: syllables with stress may be processed before syllables with weak stress. Frequency of occurrence of a form in the input is another. However, these particular strategies don't directly affect how learners connect meaning to form, either at the local level or the sentence level. And in some cases, they underlie principles presented here (e.g., content words tend to carry strong stress).

Suggested Further Reading

VanPatten, B. (2009). Processing matters in input enhancement. In T. Piske & M. Young-Scholten (Eds.), *Input matters* (pp. 47–61). Clevedon, England: Multilingual Matters.
This book chapter compares and contrasts three frameworks related to input processing, discussing such things as structure distance and the role of the L1.

VanPatten, B. (Ed.). (2004). *Processing instruction: Theory, research, and commentary.* Mahwah, NJ: Lawrence Erlbaum.
This book is, essentially, an update on VanPatten's (1996) book *Input Processing and Grammar Instruction: Theory and Research*. The 2004 volume contains two important expository essays (one on input processing and one on processing instruction). Also included are 10 previously unpublished research papers. What makes the book interesting is the inclusion of commentary and criticism by six other scholars, offering a balance for the reader.

VanPatten, B., & Rothman, J. (2014). Against "rules." In A. Benati, C. Laval, & M. J. Arche (Eds.), *The grammar dimension in instructed second language acquisition: Theory, research, and practice* (pp. 15–35). London, England: Continuum Press.
This chapter takes a generative perspective on language and language acquisition, while demonstrating the role that processing plays in acquisition. It thus situates one theory alongside another to demonstrate how two perspectives are not in competition but may work together to help understand acquisition.

VanPatten, B., Williams, J., & Rott, S. (2004). Form–meaning connections in second language acquisition. In B. VanPatten, J. Williams, S. Rott, & M. Overstreet (Eds.), *Form–meaning connections in second language acquisition* (pp. 1–26). Mahwah, NJ: Lawrence Erlbaum.
This first chapter in the VanPatten, Williams, Rott, and Overstreet book offers an overview of the many factors that contribute to how form–meaning connections are made and strengthened. As such, it extends beyond the scope of IP theory, demonstrating how IP fits into a larger picture of acquisition.

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8

THE DECLARATIVE/ PROCEDURAL MODEL

A Neurobiologically Motivated Theory of First and Second Language[1]

Michael T. Ullman

In evolution and biology, previously existing structures and mechanisms are constantly being reused for new purposes. For example, fins evolved into limbs, which in turn became wings, while scales were modified into feathers. Reusing structures to solve new problems occurs not only evolutionarily, but also developmentally, as we grow up. For example, reading seems to depend on previously existing brain circuitry that is coopted for this function as we learn to read.

It thus seems likely that language should depend at least partly, if not largely, on neurobiological systems that existed prior to language—whether or not those systems have subsequently become further specialized for this domain, either through evolution or development. In this chapter, I focus on long-term memory systems, since most of language must be learned, whether or not aspects of this capacity are innately specified. Specifically, we are interested in whether and how two memory systems, **declarative memory** and **procedural memory**, play roles in language. These are arguably the two most important long-term memory systems in the brain in terms of the range of functions and domains that they subserve. The declarative/procedural (DP) model simply posits that these two memory systems play key roles in language in ways that are analogous to the functioning of these systems in other domains.

Importantly, these memory systems have been well studied in both animals and humans, and thus are relatively well understood at many levels, including their behavioral, brain, and molecular correlates. This understanding leads to a wide range of predictions about language that one might have no reason to make based on the more limited study of language alone. For example, if a particular brain structure or gene is known to play a particular role in these memory systems, we might expect it to play an analogous role in language, even if one might have had no reason to make such a prediction based on our understanding of language alone. The DP model is thus a very powerful theoretical framework.

The Theory and Its Constructs

In this section, I first present an overview of the two memory systems and how they interact with each other. I then examine predictions for language that follow from this knowledge of the memory systems. Although I focus on predictions for second language (L2), I explicitly compare L2 and first language (L1), since the predictions for L2 are intimately bound up with those for L1. For more on the DP model, including background, predictions, and evidence, see Ullman (2001b, 2004, 2007, 2008, in press). For a focus of the model on second language, see Ullman (2001a, 2005, 2012) and Morgan-Short and Ullman (2011).

Before we delve into the two memory systems, however, I will first provide a quick tour of the brain, as an overview of the necessary neurobiological basics. The largest part of the brain, and the most important for cognition, including language, is the cerebrum (Figure 8.1). The cerebrum is composed of two hemispheres, each of which contains four lobes: the frontal, temporal, parietal, and occipital lobes. Each lobe contains many smaller structures known as gyri and sulci (singular: gyrus and sulcus). The gyri are the ridges on the surface of the brain, and the sulci the valleys that lie between them. These gyri and sulci form the outer part of the cerebrum, called cortex.

Although most studies of language focus on cortical regions such as **Broca's area** (which corresponds to the opercular and triangular part of the inferior

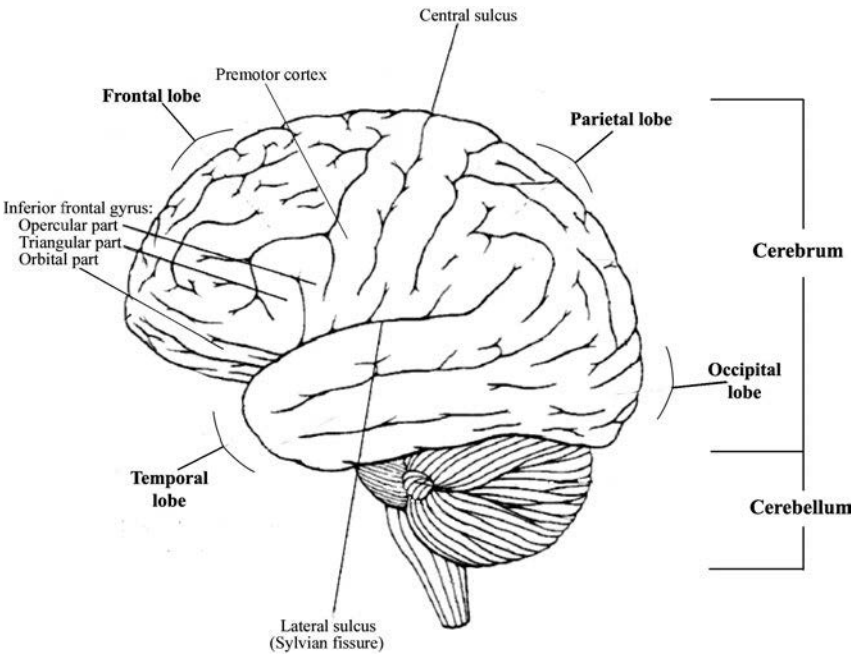

FIGURE 8.1 The left side of the brain, indicating structures referred to in the chapter.

frontal gyrus; see Figure 8.1), other brain structures are also important for language. The cerebellum, which lies below the cerebrum at the back of the brain, used to be thought of as being involved only in movement. However, we now know that it plays roles in cognition, including memory and language. There are also a number of structures deep inside the cerebrum itself (see Figure 8.2 in the color plate section). Of particular interest here are two sets of structures: first, the **basal ganglia** (including the caudate nucleus, and other portions not discussed here), which were previously thought to be mainly involved in movement, and second, the **hippocampus** and other medial (i.e., inner) temporal lobe regions, which were thought to underlie only memory. As we shall see, however, both of these sets of structures also play important roles in language.

Declarative Memory

The declarative memory brain system has been intensively studied in both humans and animals. The hippocampus and other medial temporal lobe structures (i.e., structures located toward the inner part of the temporal lobe) are critical for learning and consolidating new knowledge in this system (consolidation refers to the strengthening of memories after learning, for example, during sleep). These medial temporal lobe (MTL) structures may be not just involved, but actually *required* for learning idiosyncratic (unpredictable) bits of information and linking them together; evidence for this comes from studies of patients with extensive MTL damage. These individuals, such as the famous patient H.M., cannot learn new, idiosyncratic information. Although MTL structures are critical for acquiring new knowledge in this system, eventually this knowledge seems to depend less on MTL structures and more on neocortex, especially in the temporal lobes (neocortex refers to all cerebral cortex outside the MTL; for example, all of the cortex you see in Figure 8.1 is neocortex). Additionally, a region corresponding largely to the triangular and orbital parts of the inferior frontal cortex—often simplified to Brodmann's Areas (BAs) 45 and 47, respectively—may underlie the encoding of new memories as well as their later recall. The molecular bases of declarative memory are also beginning to be understood. For example, various genes (e.g., for the proteins BDNF or APOE) play important roles in declarative memory and hippocampal function, as does the hormone estrogen (higher levels are associated with better declarative memory). (For more information about the declarative memory brain system and its functions, see Eichenbaum, 2012; Henke, 2010; Squire & Wixted, 2011; Ullman, 2004, in press.)

The functions of this network of brain structures are reasonably well characterized. Their role in learning idiosyncratic knowledge across a wide range of modalities and domains may explain why they are important for learning information about facts (semantic knowledge) and events (episodic knowledge), such as the fact that French, Swiss-German, Italian, and Romansch are all spoken in Switzerland, or that yesterday evening I roasted chestnuts in the fireplace with my

daughter Clemi while it was snowing outside. Knowledge can be learned very rapidly in declarative memory, with as little as a single exposure of the stimulus (the reader now knows what I did yesterday evening), although additional exposures of course strengthen these memories. This knowledge is at least partly, although *not* completely, explicit (available to conscious awareness): The system also underlies implicit (nonconscious) knowledge (Henke, 2010); also see "The Explicit/Implicit Debate" later in this chapter. Nevertheless, declarative memory appears to be the only long-term memory system that underlies explicit knowledge; thus, any explicit knowledge must have been learned in declarative memory.

Finally, a number of subject-level factors appear to modulate learning and retention in this system. Of particular interest for second language acquisition, learning in declarative memory seems to improve during childhood and plateaus in adolescence and early adulthood, after which it declines. Thus an older child or young adult tends to be better at learning in this system than a young child. Sex is also a factor, with evidence suggesting that females have an advantage at declarative memory over males, possibly due to their higher estrogen levels. Other factors that seem to affect declarative memory include handedness (left-handedness may be associated with an advantage at declarative memory), sleep (memory consolidation seems to improve during sleep), and exercise (which may enhance declarative memory).

Procedural Memory

Although procedural memory is not as well understood as declarative memory, the workings of this memory system are becoming clearer. The system is composed of a network of interconnected brain structures rooted in frontal/basal ganglia circuits. The basal ganglia, and especially the caudate nucleus, play a critical role in the learning and consolidation of new motor and cognitive skills. In contrast, frontal regions may be more important for processing skills that have been automatized—in particular premotor cortex and the opercular part of the inferior frontal cortex (Figure 8.1), often simply referred to as BA 6 and BA 44, respectively. The cerebellum also seems to play a role, though exactly how and in what ways remain unclear. Some aspects of the molecular bases of procedural memory are also beginning to emerge. For example, certain genes playing roles in procedural memory have been identified, including for the proteins FOXP2, DARPP-32, and DRD2. (For more on this memory system, see Ashby, Turner, & Horvitz, 2010; Doyon et al., 2009; Eichenbaum, 2012; Packard, 2008; Ullman, 2004, in press.)

This brain circuitry underlies the implicit (nonconscious) learning and processing of a wide range of activities and functions, including sequences, rules, categories and routes (for navigation). The system may be specialized for learning to predict, perhaps especially probabilistic outcomes—for example, the next item in a sequence or the output of a rule. Learning in the system requires extended practice, which seems to eventually result in more rapid and automatic processing of skills and knowledge than does learning in declarative memory. Various factors

seem to affect procedural memory, including, of particular interest to L2 learning, one's age: Unlike declarative memory, learning and consolidation in procedural memory seem to be already robust early in childhood, though they appear to decline during childhood/adolescence, resulting in poorer learning/consolidation abilities in adulthood.

Interactions between the Memory Systems

Declarative and procedural memory also interact with each other. (For more information, see Packard, 2008; Poldrack & Packard, 2003; Ullman, 2004, in press.) First, with important consequences for L2 learning, the two systems can complement each other in acquiring the same or analogous knowledge, including knowledge of sequences and rules. Thus, they play at least partly *redundant* roles, in that they can at least partly learn and process the same knowledge, though generally in different ways from each other. Various factors appear to modulate which of the two systems is relied on more. Declarative memory may acquire knowledge initially, thanks to its rapid acquisition abilities, while the procedural system gradually learns analogous knowledge, which is eventually processed rapidly and automatically. The learning context can also affect which system is relied on more. Explicit instruction (e.g., of sequences), or conscious attention to input stimuli and an attempt to understand underlying rules or patterns, can increase learning in declarative memory. Conversely, a lack of explicit instruction, as well as manipulations that reduce attention to the stimuli, or a high level of complexity of rules or patterns (thus decreasing the learner's ability to explicitly detect patterns), can all shift learning toward procedural memory.

Second, animal and human studies suggest that the two systems also interact competitively, resulting in a "seesaw effect." For example, the dysfunction or attenuation of one system may lead not only to an increased dependence on the other system for those tasks and functions that can depend on either one, but *also* to the enhanced functioning of this other system.

Finally, some evidence suggests that the learning and/or retrieval of knowledge in declarative memory may block (inhibit) the learning and/or retrieval of analogous knowledge in procedural memory. The converse may hold as well. For example, neuroimaging evidence in humans suggests that learning in declarative memory may inhibit, or at least override, learning of analogous knowledge in procedural memory. And in rats, even when a task is learned initially in declarative memory, it can be overridden by procedural memory when the task is subsequently learned in that system.

Predictions for Language

The DP model posits that the declarative and procedural memory systems should play roles in language that are largely analogous to the roles they play in other

domains. Thus, our independent knowledge of the two memory systems, as laid out above, leads to quite specific predictions for language. Here I lay out a number of these predictions, specifying where they are common to L1 and L2, and where they hold particularly for L2.

Predictions: Declarative Memory

Since declarative memory is important, and perhaps necessary, for learning arbitrary pieces of information and associating them, this memory system should be crucial for all learned idiosyncratic knowledge in language. This should hold for both L1 and L2. Thus, simple content words (e.g., *cat, devour*), including their phonological forms, meanings, subcategorization frames (e.g., *devour* requires a complement), and mappings between them (e.g., the sound-meaning mappings), should be learned in this system. Some sort of knowledge about irregular morphological forms, both inflectional and derivational (e.g., *dig-dug, solemn-solemnity*) should also be stored in declarative memory, as should idiosyncratic knowledge about idioms, proverbs, and so on (e.g., *jump the gun, a bird in the hand is worth two in the bush*).

Since declarative memory is so flexible in what it can learn, it should also be available for learning nonidiosyncratic, rule-governed aspects of language. Thus, just like simple and irregular words, one should be able to store, in some manner (e.g., as "chunks"), at least some rule-governed complex forms (e.g., "*walked*," "*the cat*"), together with their meanings. Grammatical rules and constraints should also be learnable by this system (implicitly or explicitly), even though these are generally acquired by procedural memory. As we shall see, complex forms and grammatical knowledge should generally depend more on declarative memory (and less on procedural memory) in L2 than L1, due to factors such as age of acquisition and learning context.

In both L1 and L2, linguistic knowledge in declarative memory should be learned relatively rapidly, perhaps in some cases even from a single presentation of the information (e.g., if the information is simple enough), though repeated exposures should improve learning and retention. Linguistic knowledge learned in this system can be explicit or implicit, since both types can be learned by declarative memory. However, any explicit long-term knowledge of language must have been learned by declarative memory, since this is the only long-term memory system that seems to underlie explicit knowledge. Most importantly for L2, language learning that depends on declarative memory should ameliorate during childhood, plateau in adolescence/early adulthood, and then decline.

We can also make neurobiological predictions about language knowledge learned in declarative memory. The functional neuroanatomy of this knowledge, whether in L1 or L2, should reflect the functional neuroanatomy of declarative memory. Thus it should crucially depend on the hippocampus and other MTL structures, at least during learning. Eventually MTL structures should become less

important, with a corresponding increasing role for neocortical regions, especially in the temporal lobes. The area encompassing BA 45 and 47 should underlie the encoding of new linguistic information being learned in declarative memory, as well as the recall of that knowledge once it has been learned. Finally, the genes and molecules involved in declarative memory should play analogous roles in aspects of language learned by this system.

Predictions: Procedural Memory

Given what we know about procedural memory, this memory system may be expected to underlie the learning and processing of sequences and rules in both first and second language. Those that are probabilistic may depend especially on this system. The system may be particularly important in learning to predict in language, such as predicting the next item in a sequence or the output of a linguistic rule. Only rules or sequences that are implicit should be learned by procedural memory. Given that the mental grammar heavily involves implicit rules, in particular ones that involving sequencing (especially hierarchical sequencing), we would expect procedural memory to play a major role in grammar. This should hold across linguistic subdomains, including syntax, morphology, and phonology. Other aspects of L1 and L2 may also be learned in procedural memory. Given the role of this system in category learning, it might also underlie the acquisition of linguistic categories (e.g., syntactic categories). Other nongrammatical implicit learning in language may also depend on procedural memory, especially if it involves probabilistic patterns, sequences, and learning to predict. For example, the implicit learning of word boundaries in a speech stream may be expected to depend on procedural memory.

Since procedural memory learns with repeated exposure, linguistic knowledge learned in this system should be acquired gradually. Although only implicit (not explicit) knowledge in L1 and L2 should rely on procedural memory, not all implicit knowledge should involve this system, since there are other implicit memory systems, and, as we have seen, declarative memory also subserves implicit knowledge (also see "The Explicit/Implicit Debate"). Of particular importance for L2, language learning in procedural memory should be better in childhood than adulthood. Thus grammar should be easier to acquire in procedural memory in childhood (whether in L1 or L2) than in adulthood (generally as an L2).

As with declarative memory, neurobiological predictions for L1 and L2 follow largely from what we know about procedural memory from animal and human studies. Linguistic skills and knowledge learned in this system should involve frontal and basal ganglia structures, and perhaps the cerebellum. Learning and consolidation should engage the basal ganglia, especially the caudate nucleus. Once automatized, knowledge and skills should rely especially on neocortical regions, in particular premotor cortex and BA 44. And genes such as FOXP2 may modulate learning and processing in this system.

Predictions: Interactions between the Memory Systems

Our understanding of interactions between the two memory systems also leads to predictions for language and is of particular interest to L2. First, to some extent, we expect the two memory systems to acquire the same or analogous knowledge or skills, that is, to play at least partly redundant roles. In both L1 and L2, as in nonlinguistic domains, such redundancy should be found for any tasks or functions that can be subserved by both systems. Given the learning flexibility of declarative memory, and the fact that this system can underlie implicit as well as explicit knowledge, we might expect it to be able to at least partly support most, if not all, linguistic functions that are learned by procedural memory, including grammar. Declarative memory could support such knowledge in a variety of ways, including storing rule-governed complex forms as chunks (which could be structured or unstructured) or learning rules (explicitly or implicitly) (Ullman, 2005, 2006a).

Various factors should modulate which of the two memory systems is relied on more for linguistic knowledge that can be learned by either system. Such knowledge, in particular for grammar, should be learned first by declarative memory, but more slowly and in parallel by procedural memory, which should eventually lead to highly automatized knowledge. Since learning in declarative memory improves during childhood up to adolescence and young adulthood, while learning in procedural memory seems to become less effective during this period (perhaps due to the seesaw effect), young adult L2 learners should on average rely more on declarative and less on procedural memory for grammar than (L1 or L2) child learners, holding constant their exposure to the language. And even though the grammar should eventually become at least somewhat proceduralized in both child and adult learners, this process should occur faster and more completely in children. Thus, even after years of exposure, adult L2 learners might not attain the degree of proceduralization of their grammar as L1 or early L2 learners. It is worthwhile pointing out that adult L2 learners and adult L1 learners are often compared in empirical studies examining L1 and L2 processing, even though this comparison probes the two groups at different points in the learning trajectory; that is, L2 learners at earlier stages than L1 learners.

Explicit language instruction, or attention to language stimuli or patterns in the input, may increase language acquisition in declarative memory, while a lack of such instruction or attention, and greater complexity of rules or patterns (e.g., more complex grammatical rules or constraints), may lead to a greater relative dependence on procedural memory. Thus, explicit instruction of grammar, as is often given in classrooms to L2 learners, should encourage learning in declarative memory (which may then inhibit learning or processing in procedural memory). Conversely, exposure to the L2 without explicit instruction, as often occurs in immersion contexts, might enhance grammar acquisition in procedural memory, and thus lead to more L1-like processing of grammar.

Summary of Predictions

Here I summarize some of the main nonneurobiological predictions, focusing on similarities and differences between L2 and L1. First of all, in some ways, the predictions are similar in first and second language. In both L1 and L2, declarative memory should underlie the learning, storage, and use of all idiosyncratic knowledge in language. Thus idiosyncratic lexical knowledge should always be stored in this system, across linguistic subdomains (e.g., simple words and their meanings, irregular morphology, syntactic complements, idioms). In both L1 and L2, aspects of grammar should initially be learned in declarative memory. In parallel, procedural memory should also gradually learn grammatical knowledge. After sufficient experience with the language, procedural memory-based grammatical processing should tend to take precedence over analogous declarative knowledge, resulting in increasing automatization of the grammar.

However, L2 acquisition is also expected to differ in important ways from L1 acquisition. Perhaps most importantly, grammar should tend to depend more on declarative memory and less on procedural memory in L2 than L1, for several reasons. First, L2 learners will always have had less language exposure than L1 learners at the same age, simply because they began learning the L2 later. The later the L2 age of acquisition, the more pronounced this difference. Since declarative memory learns quite rapidly, while procedural memory learns only gradually, at any given age a learner's L2 grammar should be less proceduralized and should thus depend more on declarative memory than their L1 grammar. Thus, just for this reason alone, L2 grammar should tend to rely more on declarative memory than L1 grammar.

Second, because learning in procedural memory seems to be established early and then declines, while declarative memory shows the opposite pattern, L1 learners (and early L2 learners) should tend to rely particularly on procedural memory for learning grammar (especially after a reasonable amount of language exposure), while later (L2) learners should rely more on declarative memory, and indeed may never proceduralize their grammar to the same extent as L1 learners. Importantly, this pattern should hold even after the same amount of language exposure in L1 and L2. However, most neurocognitive studies do not compare L1 children with L2 adults (e.g., both after 10 years of language exposure). Rather, as pointed out earlier, most studies comparing the neurocognition of L2 with L1 examine both groups at the same age (e.g., a given subject's L1 and L2), and thus at different points in the learning trajectory. This is not problematic per se, but it must be kept in mind when interpreting the data.

Third, even the type of language experience may influence learning and the learner's relative dependence on the two memory systems. As we have seen, explicit, classroom-like instruction of the grammar may encourage learning in declarative memory, perhaps at the expense of learning in procedural memory. Conversely, the lack of explicit instruction, as often occurs in immersion contexts, may encourage learning in procedural memory. These predictions should hold

for both L1 and L2 learners. However, L1 learning generally occurs primarily in an immersion (naturalistic) context, further encouraging proceduralization of the grammar in L1 speakers and eventual automatization. In contrast, since L2 learners vary considerably with respect to the type of exposure, this factor should in general have a larger impact on the neurocognition of L2 and should tend to increase the reliance of grammar on declarative memory in L2.

Note that much of the literature on the neurocognition of L2 grammar, and whether L1-like neurocognitive grammatical processing can be attained, has focused on two factors: age of acquisition and proficiency. However, proficiency is somewhat of a problematic variable. First, it is operationalized and measured quite differently across studies. Perhaps more importantly, in the vast majority of studies proficiency is highly confounded with other variables, in particular the amount of exposure and even the type of exposure, since higher proficiency is associated with higher exposure and even in many studies with more immersion experience. As we have seen, the DP model makes separate predictions for both the amount and the type of exposure. In contrast, the model does not take a strong position on proficiency itself to the extent that it may vary independently from these other variables. For example, it might (or might not) be that higher proficiency is associated with greater grammatical proceduralization, even holding constant the amount and type of experience. Future research will hopefully elucidate this issue.

What Counts as Evidence?

Multiple types of evidence can help test the predictions laid out earlier. This includes evidence from different methodologies, different language paradigms (e.g., natural languages, artificial languages, artificial grammars), different tasks, and different experimental designs. Importantly, every methodology, paradigm, task, and design has both strengths and weaknesses. Thus, it is crucial to obtain evidence from multiple approaches to test for *converging evidence.* Only with converging evidence should we begin to have confidence in a theory. Here I discuss several lines of relevant evidence.

Behavioral Evidence: Correlational Studies

Various types of behavioral evidence can be used test the predictions of the DP model. One of the most straightforward and intuitive behavioral approaches is examining correlations across subjects, between how well they learn in the memory systems and how well they learn or process language. For example, if people who are better at learning in declarative memory are also better at word learning, this may be taken to suggest that word learning depends on declarative memory. However, we have to be careful, because correlation does not imply causation. A correlation between word learning and declarative memory could be explained

not just by words being learned in declarative memory, but instead by some general cognitive process that underlies both word learning and declarative memory.

One way to address this problem is to hold such other factors constant (e.g., in statistical analyses), if one can identify them. Another way is to show the specificity of the correlation. If word learning or processing correlates with declarative memory but *not* with procedural memory, this suggests that lexical memory has a particular link to declarative memory that is not found with all learning systems. Moreover, if the converse holds, that is, performance at grammar learning or processing correlates with learning in procedural but not declarative memory, this would further strengthen the specificity both of the relation of lexicon to declarative memory and of grammar to procedural memory. Indeed, such **double dissociations** have been found (Kidd, 2012; Lum, Conti-Ramsden, Page, & Ullman, 2012).

Similarly, one can use correlations to test the DP model's prediction that grammar depends particularly on declarative memory at low L2 exposure, but on procedural memory at high exposure: across subjects, at low L2 exposure grammar measures (e.g., syntactic judgment) should correlate with one's ability to learn in declarative (but not procedural) memory, whereas at high exposure grammar should correlate with learning in procedural (but not declarative) memory. This pattern of correlations was in fact found in a recent study, supporting the predictions of the DP model (Morgan-Short, Faretta-Stutenberg, Brill-Schuetz, Carpenter, & Wong, 2014).

Finally, other types of behavioral evidence can also be used to test the DP model in L1 and L2, for example, the examination of priming and frequency effects; for more information on these, see Babcock, Stowe, Maloof, Brovetto, and Ullman (2012).

Neurological Evidence: The Lesion Method

If a person suffers from damage (lesions) to particular brain structures, and then loses the ability carry out certain cognitive functions, one might infer that the lost functions previously depended on the damaged structures. Using this approach to understand which brain structures normally underlie which functions is referred to as the lesion method. For example, the fact that lesions to the occipital lobes consistently lead to visual deficits supports the conclusion that the occipital lobes are important for vision. By analogy, if you damage your lungs, you will have trouble breathing, whereas if you damage your stomach, you will probably have trouble with your digestion. This shows that one cannot perform these functions without these particular organs, and so these organs are necessary for these functions.

The lesion method can be used to test the DP model. Patients with lesions limited to the medial temporal lobes, including the hippocampus, should have trouble learning not only facts and events in declarative memory, but also words. This is indeed the case, for example for the famous amnesic patient H.M. (Postle & Corkin, 1998). Additionally, patients with lesions that extend to temporal neocortex (e.g.,

from Alzheimer's disease) should have more trouble with an L2 grammar than with an L1 grammar. Conversely, patients with lesions to frontal/basal ganglia circuits (e.g., from strokes or from Parkinson's disease) should have greater grammatical impairments in their L1 than their L2. And in any such patients who have more than one L2, we should see evidence of greater grammatical impairment in the L2 to which they had more exposure. Note that these predictions are striking given that the L1 (and the higher exposure L2) had presumably been better learned than the L2 (and the lower exposure L2), and yet are predicted to be more impaired. Indeed such double dissociations have been found, supporting the DP model (Hyltenstam & Stroud, 1989; Johari et al., 2013; Zanini, Tavano, & Fabbro, 2010).

Like all other methods, however, the lesion method has its weaknesses. Clearly, we cannot go around causing brain injury in people willy-nilly. Rather, we must test patients who have already had a brain injury. But such 'accidental experiments' are not ideal. One cannot choose the location of the lesion, which is moreover often large and involves multiple brain structures, complicating structure-function inferences: How do you know which brain structure does what when many structures are damaged? Timing is also an issue. If one waits too long after the onset of an acute brain lesion, other structures may take over some of the functions that the damaged structure used to perform. Such compensation confuses one's inferences, since a lesioned structure may indeed have been critical for a function, but compensation by a different part of the brain leads to normal functioning, and thus could lead to the false conclusion that the lesioned structure is not important for the function. On the other hand, if one tests a patient too quickly after a stroke or head injury, the loss of function can be much greater than is attributable to the damaged regions, because nearby regions are often temporarily affected by a number of factors, such as tissue swelling. In practice, researchers tend to err on the side of longer periods of time, usually waiting months or even a year or more after acute brain damage before testing a patient.

Electrophysiological Evidence: Event-Related Potentials

Event-Related Potentials (ERPs) are measures of brain activity, specifically the electrical activity that constitutes the basis of brain function. In an ERP study, just as in a sleep study measuring EEGs (electroencephalograms), electrical potentials from brain activity are recorded from electrodes placed on the scalp. ERPs are simply the EEG activity that occurs right after a person hears or sees a word, sees a picture, and so on. The presentation of such a stimulus is called an "event," hence the name Event-Related Potentials.

ERPs offer several advantages over some other methodologies. First, unlike functional neuroimaging methods like fMRI or PET (see later), ERPs provide excellent **temporal resolution**, with millisecond measurements that allow one to examine the actual time course of language processing. On the down side however, localizing the neuroanatomical source of ERPs in the brain is quite difficult.

Second, ERP research has revealed a set of widely-studied language-related ERP patterns ("ERP components") in L1, whose characteristics and underlying functions are reasonably well understood: primarily the N400, LAN and P600 (see later). Moreover, lexical and grammatical processing in the L1 are each associated with largely distinct ERP components. These components thus provide a relatively clear way of comparing the neurocognition of language processing between L2 and L1, in particular for these language domains. Finally, since ERPs can be sensitive to effects that are not actually observed with behavioral measures, including in language learning studies, they can potentially reveal L2-L1 differences and similarities that might not be found with behavioral approaches. (For reviews of ERP research in L2, see Bowden, Steinhauer, Sanz, & Ullman, 2013; Kotz, 2009; Morgan-Short & Ullman, 2011; Steinhauer, White, & Drury, 2009.)

Here I briefly outline the main ERP language components—the N400, LAN, and P600—and explain how they can be used to test the DP model. In L1, lexical manipulations, such as seeing or hearing an unexpected word (e.g., "Adrian likes to eat planets") reliably leads to N400 ERP components: that is, negative (hence the N) potentials that are generally found about 400 milliseconds after the presentation of the word, mainly at electrodes on the top of the head (see Figure 8.3 in the color plate section). It has been argued that the N400 reflects, at least in part, the processing of knowledge learned in declarative memory (Ullman, 2001a). Since the DP model predicts that lexical memory depends on declarative memory not only in L1, but also in L2, lexical manipulations should consistently elicit N400s in L2 as well as in L1. Indeed, this is the case.

Disruptions of rule-governed grammatical processing (of syntactic word order, or of morphosyntax such as agreement or tense, as in the sentence "Yesterday my father Fred walk all around Prague") often produce two ERP components in L1. First, they can elicit early Anterior Negativities ("ANs"; Figure 8.3), which are often larger in the left hemisphere. These can begin as early as 100 milliseconds after the critical word (e.g., "walk") and often continue for hundreds of milliseconds. It has been suggested that ANs may partially reflect the processing of knowledge learned in procedural memory. Second, grammatical disruptions often also produce P600s, positive potentials that often begin around 600 milliseconds (Figure 8.3). The P600 seems to reflect conscious processing of syntax and is not posited to depend on procedural memory; thus ANs are more relevant for testing the DP model. The DP model predicts that grammar depends more on declarative memory in L2 than L1, in particular in low exposure L2, but can be proceduralized at high exposure L2. Thus, grammatical disruptions should elicit N400s in L2, especially at lower levels of L2 experience, but ANs at higher levels. The evidence thus far is indeed consistent with this pattern.

Functional Neuroimaging Evidence

Functional neuroimaging methods such as PET (positron emission tomography) and the more common fMRI (functional magnetic resonance imaging) have also

been widely used to examine the neural bases of both L1 and L2. These techniques detect changes in blood flow (PET) or blood oxygen levels (fMRI) that are known to correlate with changes in neuronal activity. For example, if during grammar processing neurons fire particularly in the area of BA 44, this region should show particular changes in blood flow and oxygen levels (since firing neurons need more oxygen), suggesting that this region is especially important for grammar. The primary benefit of functional neuroimaging techniques is their excellent **spatial resolution**, allowing one to pinpoint activity to within a few millimeters in the brain. In contrast, such changes in the blood are too slow to allow the detection of real-time processing changes, so (unlike with ERPs) one cannot use functional neuroimaging to measure real-time language processing in the brain. For a summary of fMRI and other neuroimaging methods, including their pros and cons, see Ullman (2006b).

Functional neuroimaging can be used to test the DP model. The model predicts that word learning should show activation initially in the MTL, including the hippocampus, whereas once words are learned neocortical regions, especially in the temporal lobe, should be more active. Grammar should also initially yield MTL activation. However, as learning proceeds during L2 acquisition, activation should decrease in the MTL, and should increase both in neocortical regions subserving declarative memory and in procedural memory structures. In particular, activation should be found in the basal ganglia, especially the caudate nucleus (since it is involved in procedural learning), but increasingly in BA 44 (for the processing of already-learned procedures). At high L2 exposure, it is possible that declarative memory structures will drop out for grammar, and the basal ganglia will no longer be reliably engaged, leaving only BA 44 activation. The specificity of these predictions allows the DP Model to be clearly tested, and potentially falsified (i.e., shown to be incorrect).

Thus far, the neuroimaging evidence from fMRI and PET has been somewhat inconsistent. Nevertheless, some patterns seem to be emerging. Word learning does engage MTL structures, including the hippocampus (Breitenstein et al., 2005; Davis & Gaskell, 2009). In contrast, MTL regions are not reliably engaged in lexical/semantics in adults (Binder, Desai, Graves, & Conant, 2009; Ullman, 2004). Grammar learning may also engage MTL structures as well as the caudate nucleus at very early stages, with continuing activation of the caudate nucleus and later engagement of BA 44 (Lieberman, Chang, Chiao, Bookheimer, & Knowlton, 2004; Ruschemeyer, Fiebach, Kempe, & Friederici, 2005; Ullman, in press). However, further studies are needed, ideally with better controls for factors such as age of acquisition and the amount and type of L2 experience.

Common Misunderstandings

Here I address two common misunderstandings about the DP model and also discuss how this model differs from other neurocognitive perspectives of L2. I will

discuss the various misunderstandings regarding the relation between the declarative and procedural memory systems on the one hand, and explicit and implicit knowledge on the other, in the section "The Explicit/Implicit Debate."

First, there is a common misunderstanding regarding the domain generality of the two memory systems. On one hand, both systems are "domain general" in that they underlie multiple cognitive domains. However, this does not preclude subspecialization for language within either system, which could come about either evolutionarily or during development. Indeed, evidence from other domains suggests that subspecialization can occur in both systems. For example, different portions of the MTL and different regions of temporal neocortex underlie different types of information (Ullman, in press). Likewise, different frontal/basal ganglia circuits subserve different sorts of information (Middleton & Strick, 2000). Nevertheless, at this time there is no convincing evidence for *domain-specific* circuitry for language (i.e., dedicated to this domain), either within structures involved in the two memory systems or elsewhere in the brain (Ullman, Lum, & Conti-Ramsden, in press). Future research may further clarify this issue.

Second, another common misconception is that the changes in the reliance of grammar from declarative to procedural memory are due to some sort of "transformation" of knowledge from one to the other system. This is not the case. Rather, the two systems seem to independently acquire knowledge. Thus, proceduralization of grammar does not constitute the "transformation" of declarative into procedural representations but rather the gradual acquisition of grammatical knowledge in procedural memory, which is increasingly relied on, with an accompanying decrease in reliance on declarative memory.

Finally, to clarify any potential misconceptions regarding differences between the DP model and other neurocognitive models of L2, here I will compare the models. The DP model lies within one of three broad classes of neurocognitive models of L2. One class of models posits that the neurocognitive mechanisms underlying L2 are essentially the same as those subserving L1 (Abutalebi, 2008; Ellis, 2005; Green, 2003; Hernandez, Li, & MacWhinney, 2005; Indefrey, 2006; MacWhinney, 2011; Perani & Abutalebi, 2005). Second, it has been suggested that the mechanisms underlying L2 are fundamentally different from those of L1 (Bley-Vroman, 1989). A third group of models hypothesize that L2 learners initially depend heavily on different substrates than L1, but, with increasing experience or proficiency, gradually rely more on L1-like neurocognitive mechanisms. This group of theories includes the views espoused by Paradis and by Clahsen as well as the DP model. Although these views are similar in certain respects, they also differ. Paradis (2004, 2009) suggests that a shift between neurocognitive systems can take place both for rule-governed grammatical processes, and at least some lexical properties, specifically, grammatical properties of lexical items that are generally implicit in L1. More generally, Paradis takes a traditional view equating the explicit/implicit distinction with the declarative/procedural memory distinction, a view that is not tenable given what we know about the

memory systems (see details on the memory systems above, and the later section "The Explicit/Implicit Debate"). Clahsen proposes a model that is quite similar to the DP model in many respects, though with less of an expectation that the processing of grammar can become L1-like (Clahsen & Felser, 2006a, 2006b; Clahsen, Felser, Neubauer, Sato, & Silva, 2010). Additionally, Clahsen's model focuses on psycholinguistic processing claims, rather than the neurocognitive bases of language.

Exemplary Study: Morgan-Short et al. (2012)

A major limitation of L2 research that examines the L2 learning trajectory is the time it takes learners to reach high proficiency. This makes it impractical to examine subjects over the full course of language learning (i.e., in a longitudinal study). As a result, the trajectory of learning has almost always been examined between groups of learners at different proficiency or exposure levels. However, like any between-subjects design, this approach is not ideal. The difficulty in selecting and matching different subject groups on critical factors of L2 exposure and use, let alone on other factors that may influence language learning (e.g., genotype), can introduce noise and inconsistency, reducing confidence in the findings.

To address these weaknesses, some studies have turned to artificial grammars or artificial languages. An artificial grammar typically involves presenting subjects with letter or tone sequences that are generated by some grammar. Artificial grammars can be learned to high proficiency quickly, in minutes to hours. However, even though the rules of artificial grammars can be consistent with the rules of natural languages, they are not fully language-like, since they lack vocabulary and the sequences have no meanings. Additionally, unlike a natural language, one does not speak or comprehend artificial grammars. Artificial languages address some of these concerns. An artificial language contains a small, meaningful lexicon and a limited number of grammatical rules, generally consistent with those found in natural languages. The sentences have meanings, and the language can be spoken and understood. Crucially, their small size makes them learnable to high proficiency within hours, allowing one to longitudinally examine the L2 learning trajectory to high proficiency.

A recent study using an artificial language paradigm examined L2 learning longitudinally to high proficiency (Morgan-Short, Steinhauer et al., 2012). Monolingual native English-speaking adults were trained to speak and comprehend an artificial language, Brocanto2. The words in this language refer to the pieces and moves of a computer based game, and the rules follow those of natural languages. Half the subjects in this study were given "explicit", instructed, classroom-like training, and half were given an equivalent amount of "implicit," uninstructed, immersion-like training. ERPs on violations of syntactic word order (discussed here) and morpho-syntactic agreement (see Morgan-Short, Sanz, Steinhauer, & Ullman, 2010) were measured three times: at low proficiency, high proficiency, and

again about 5 months later, to test for the neurocognition of L2 retention (retention testing is reported in Morgan-Short, Finger, Grey, & Ullman, 2012).

Behavioral analyses showed that both the explicitly and implicitly trained groups learned the language to high proficiency and then retained it 5 months later, and did not differ from each other at any of these time points. In contrast, ERPs showed clear group differences (here I discuss word order violations; for agreement violations, see Morgan-Short et al., 2010). At low proficiency and exposure the implicitly trained group showed an N400, whereas the explicitly trained group showed no detectable ERP effects (Figure 8.3). At high proficiency and exposure, the implicitly trained group showed an AN/P600 biphasic pattern (although the AN was not significantly left-lateralized), with the AN continuing as a late anterior negativity. In contrast, the explicitly trained group showed only an anterior positivity (not typical of native language) followed by a P600. At retention testing 5 months later, the implicitly trained group showed a more robust and left-lateralized AN than at high proficiency, the explicitly trained group no longer showed the (non-L1-like) anterior positivity and developed a more robust P600, and both groups showed a stronger late anterior negativity.

In sum, L1-like processing of syntactic word order, including ANs, was more likely for implicit, uninstructed (immersion-like) training than for explicit, instructed (classroom-like) training, and more likely at retention testing than at high proficiency/exposure than at low proficiency/exposure. Specifically, N400s were only found at low proficiency, suggesting a reliance of syntax early in the learning trajectory on declarative memory. The fact that no N400 or any other ERP component was reliably found in the explicitly trained subjects at low proficiency may be due to greater temporal variability (i.e., in when the component occurs) for explicit, conscious, strategies, resulting in the lack of any consistent ERP components in any given time window (Morgan-Short, Steinhauer et al., 2012). At high proficiency more native-like grammatical ERP components were found, including an AN. This is consistent with proceduralization, and more generally with greater L1-like grammatical processing emerging with greater exposure and proficiency. The findings that both training groups showed more native-like syntactic processing at retention testing may have been due in part to continuing consolidation of the grammar in procedural memory (Morgan-Short et al., 2012). Finally, the greater native-like processing resulting from implicit than explicit training is consistent with immersion leading to more native-like processing and proceduralization than explicit instructed classroom training (Bowden et al., 2013).

This study is exemplary in several respects. First, the use of an artificial language allows one to control for the amount, type, and timing of L2 exposure. Second, the fact that an artificial language rather than an artificial grammar was examined, and moreover one that subjects learned to speak and comprehend, and that followed the rules of natural languages, suggests that the results are reasonably likely to generalize to natural languages, which is of course what we actually care about

understanding. Third, the measurement of ERPs as well as behavioral assessments provides a variety of advantages (see earlier), including revealing ERP differences that were not found in behavior. Fourth, examining and contrasting instructed, explicit, classroom-like training and uninstructed, implicit, immersion-like training, moreover in a tightly controlled design, elucidates neurocognitive effects of the type as well as the amount of input. Fifth, examining retention, moreover after quite an extended period, provides insights into longer-term outcomes of language learning. Since people usually learn an L2 to retain it (at least for a reasonable period), this is particularly important.

Explanation of Observed Findings in SLA

Observation 1: Exposure to input is necessary for SLA; *Observation 2: A good deal of SLA happens incidentally.* As discussed earlier, the evidence suggests that not only is exposure to input necessary for learning an L2, but the amount and even the type of input is important. Specifically, more exposure (correlating with higher proficiency), and immersion experience (which presumably is associated with incidental learning) may be critical for proceduralization of the grammar and the attainment of L1-like neurocognitive grammatical processing.

Observation 5: Second language learning is variable in its outcome; *Observation 6: Second language learning is variable across linguistic subsystems.* According to the DP model, both behavioral and neural correlates of L2 learning should vary on the basis of multiple factors, including biological variables (e.g., sex and genetic variability), input variables (e.g., amount and type of L2 exposure), and linguistic subsystems (e.g., lexicon vs. grammar). Moreover, a number of these variables likely interact. Some of these factors have already been reasonably well examined (in particular, lexicon vs. grammar, and input variables), and indeed the evidence suggests that they influence SLA. A host of other variables should be examined in future studies.

Observation 9: There are limits on the effects of instruction on SLA. As we have seen, implicit, uninstructed immersion-like L2 training appears to be more effective than instructed classroom-like training in the attainment of L1-neurocognition of grammar.

The Explicit/Implicit Debate

At first blush the distinction between the declarative and procedural memory brain systems seems to parallel that between explicit and implicit knowledge. Indeed, explicit knowledge is subserved only by declarative memory, while procedural memory underlies implicit knowledge. However, the parallel largely falls apart at this point.

First, the DP model is based on claims about brain systems, whereas the explicit/implicit distinction is premised on claims about awareness. This latter distinction is somewhat problematic in that awareness is difficult not only to define, but also

to test (DeKeyser, 2003; Schmidt, 1994). In contrast, the distinction between the declarative and procedural brain systems is relatively clear, and the dichotomy can be tested, as we have seen, with a variety of methodological approaches.

Second, the mapping between declarative/procedural memory, on one hand, and explicit/implicit knowledge on the other, is by no means isomorphic (one-to-one). On the one hand, information stored in declarative memory can be explicit (accessible to conscious awareness in some sense). Indeed, as we have seen, this brain system appears to be the only long-term memory system to underlie explicit knowledge—a finding that is useful since it allows us to identify declarative memory as the locus of any long-term explicit knowledge. However, this system also underlies implicit knowledge. Although declarative memory was historically associated only with explicit knowledge, this was always a highly problematic assumption (even though this problem was rarely discussed). It was never shown (how would one do so?) that this *brain system* does *not* underlie implicit knowledge. Indeed, work in nonhuman animals such as rats and monkeys on this brain system did not assume that learning involved explicit knowledge, since testing animals' conscious awareness of what they have learned would clearly be very difficult. And of course it is also highly unwarranted to simply define a biological entity such as a brain system as having particular behavioral characteristics, in this case that it only underlies explicit knowledge. Rather this is an empirical question. Thus, not only was it always the case that the assumption that declarative memory underlies only explicit knowledge was unwarranted, but evidence now indicates that this assumption was not correct, and that this declarative memory also underlies implicit knowledge (Henke, 2010; Ullman, in press). In sum, although declarative memory appears to be the only long-term memory system in the brain that underlies explicit knowledge, it also underlies implicit knowledge.

There are also often confusions with respect to procedural memory. Brain researchers generally define procedural memory as it is defined here, that is, as a brain system rooted in particular brain structures. Importantly, procedural memory is only one of *several* brain systems that underlie implicit knowledge, including not just declarative memory, but also other systems (e.g., those underlying priming and habituation) (Eichenbaum, 2012; Squire & Wixted, 2011). Nevertheless, the terms procedural memory and implicit memory are still often used interchangeably in some fields, which can result in substantial confusion. To clarify: although procedural memory appears to only underlie implicit knowledge, several other brain systems, *including* the declarative memory system, also underlie implicit knowledge.

I have been discussing problems pertaining to explicit/implicit knowledge. However, the explicit/implicit distinction in other respects is at least as problematic. First, one may hear of a distinction between explicit and implicit learning. This distinction usually refers to whether knowledge is explicit or implicit, but during the learning period rather than subsequent to learning (i.e., the product). The terms explicit and implicit are also used with respect to the input (e.g., see the

exemplary study in this chapter). However, this terminology is perhaps even more problematic, since it also causes confusion as to where the explicit knowledge is supposed to lie, with the instructor (experimenter) or the learner (subject). If the knowledge lies with the teacher/experimenter, then it is uninteresting with respect to learning; if the knowledge lies with the learner/subject, then again the same issues described above apply. Clearer terms, such as instructed and uninstructed learning, may be more useful. In the exemplary study, we used the terms explicit and implicit training to be consistent with the use of these terms in the existing literature, though we attempted to further clarify them by specifying that the distinction can also be described as instructed/uninstructed and classroom-like/immersion-like.

Conclusion

The DP model appears to be a useful and informative theoretical approach. First, it is motivated by basic principles of evolution and biology. Second, it generates a wide range of behavioral and neurobiological predictions, for both L1 and L2, many of which would be unwarranted by the more limited study of language alone. Thus it is a very powerful theory. Third, it is highly testable by multiple methods. Fourth, converging evidence from different methods and experimental paradigms supports the basic predictions of the DP model.

Finally, the DP model likely has important applied implications. For example, the model seems likely to make useful predictions and offer explanatory accounts for factors that may lead to improvements in L2 acquisition, the attainment of native-like processing, and the retention of what has been learned. One line of research seems particularly promising. Studies of memory have shown that a number of variables and interventions can lead to better learning and memory in brain memory systems: not only intrinsic biological factors such as sex or genotype, but also external manipulations, that is, interventions, such as spaced versus massed presentation, the testing effect, and exercise (Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006; Roediger & Karpicke, 2006; Stern & Alberini, 2012). The DP model specifically predicts that if these techniques enhance learning and retention in declarative or procedural memory, they should also enhance language learning, including in second language acquisition.

Discussion Questions

1. One of the major underlying tenets of the Declarative/Procedural model is that the memory systems used in nonlanguage learning are coopted for learning language. Does this perspective suggest that language learning is like learning anything else? Is it possible for language to make use of human memory systems and yet be "special" in the way that, say, Lydia White suggests language is special in Chapter 3?

2. Both Skill Theory and the DP Model make distinctions between declarative and procedural memory. What differences do you see between these constructs in the two approaches?
3. One of the predictions of the DP Model is that learning grammar in procedural memory becomes more difficult as age increases, over the course of childhood and adolescence. Compare and contrast this perspective with what is known as the Critical Period Hypothesis, which basically states that adults cannot make use of the same devices for language acquisition as children learning a first language.
4. An interesting finding is that immersion-like L2 experience seems to result in more L1-like (i.e., native-like) neurocognition that instructional experience. What do you make of this finding in the context of the DP Model?
5. Explain, in your own words, why one cannot equate declarative memory with explicit knowledge/learning and procedural memory with implicit knowledge/learning.
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Note

1. I would like to thank Jarrett Lovelett, Harriet Bowden, Kara Morgan-Short, Kaitlyn Tagarelli, and Sarah Grey for help on this chapter.

Suggested Further Reading

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This paper gives an in-depth overview of the DP model and relevant evidence.

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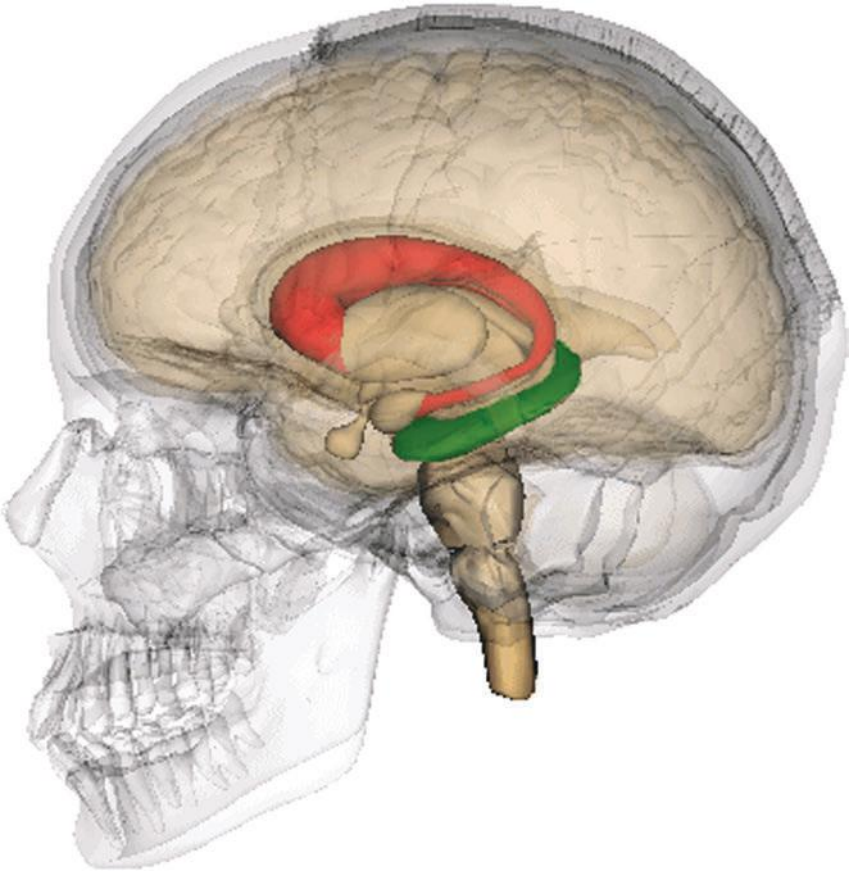

FIGURE 8.2 The caudate nucleus (red), part of the basal ganglia, and the hippocampus (green), in the medial temporal lobe.

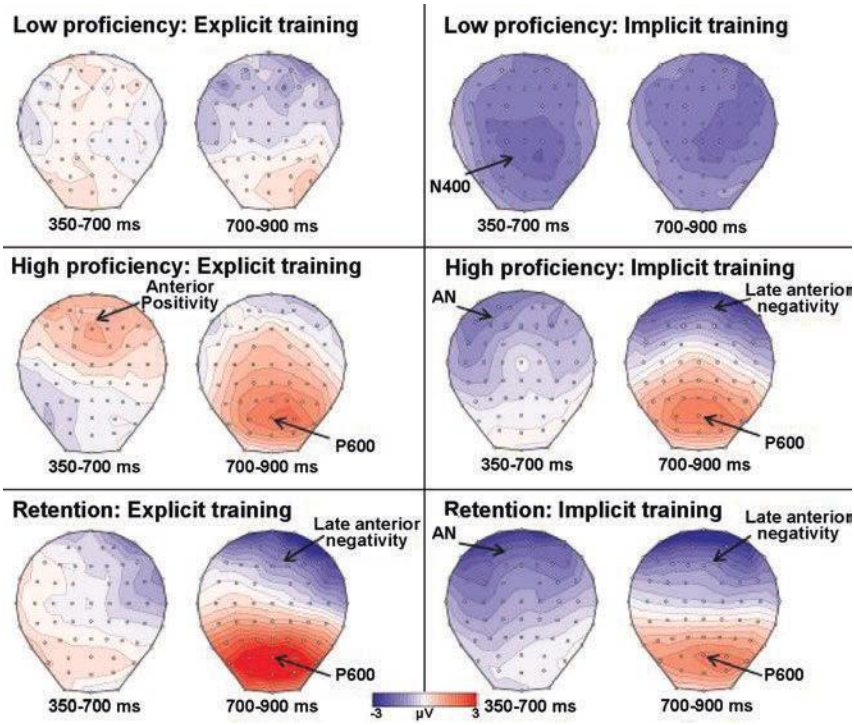

FIGURE 8.3 ERPs for word-order violations as compared to correct sentences, for subjects undergoing explicit (instructed) or implicit (uninstructed) training: at low proficiency, high proficiency, and 5 months later. Adapted from Morgan-Short, Finger, Grey, and Ullman (2012) and Morgan-Short, Steinhauer, Sanz, and Ullman (2012).

9

PROCESSABILITY THEORY

Manfred Pienemann and Anke Lenzing

The Theory and Its Constructs

Processability Theory (PT) (e.g., Pienemann, 1998) is a theory of second language development. The logic underlying PT is the following: At any stage of development the learner can produce and comprehend only those second language (L2) linguistic forms which the current state of the language processor can handle. It is therefore crucial to understand the architecture of the language processor and the way in which it handles an L2. This enables one to predict the course of development of L2 linguistic forms in language production and comprehension across languages.

The architecture of the language processor accounts for language processing in real time and within human psychological constraints such as word access and working memory. The incorporation of the language processor in the study of L2 acquisition therefore brings to bear a set of human psychological constraints that are crucial for the processing of languages. The view on language production followed in PT is largely that described by Levelt (1989), which overlaps to some extent with the computational model of Kempen and Hoenkamp (1987) and Merrill Garrett's work (e.g., Garrett, 1976, 1980, 1982). The basic premises of that view are the following:

- Processing components operate largely automatically and are generally not consciously controlled (i.e., the speaker does not need to be aware of the grammatical structures he/she produces).
- Processing is incremental (i.e., the speaker can start producing an utterance without having planned all of it).
- The output of the processor is linear, although it may not be mapped onto the underlying meaning in a linear way (for instance, the idea produced first does

not need to occur first in natural events, e.g., 'Before I drove off, I started the engine').

- Grammatical processing has access to a temporary memory store that can hold grammatical information (e.g., in the sentence 'The little kid loves ice cream', the grammatical information "singular, third person" present in 'the little kid' is retained in grammatical memory and it is used when the verb 'loves' is produced, which is marked for third person) (see Pienemann, 1998, for details).

The core of PT is formed by a universal processability hierarchy that is based on Levelt's (1989) approach to language production. PT is formally modelled using Lexical Functional Grammar (Bresnan, 2001). PT is a universal framework that has the capacity to predict developmental trajectories for any L2. The notion **developmental trajectory** implies a developmental dimension known as staged development as well as a variational dimension accounting for individual differences between developmental trajectories.

In this paradigm, each stage represents a set of grammatical rules that shares certain processing routines, and each interlanguage variety represents a specific variant of the grammatical rules. For instance, in ESL question formation the following developmental sequence has been found (Pienemann, 1998):

Stage	*Structure*	*Example*
Stage 1	SVO question	He live here?
Stage 2	WH+SVO	Where he is?
Stage 3	Copula inversion	Where is he?
Stage 4	Aux-second	Where has he been?

Learners attempting to produce 'Aux-second' at stage 3 (i.e., before they are ready for this structure) have been found to produce the following interlanguage variants:

A Where he been?
B Where has been?
C Where he has been?
D He has been where?

What variants A to D have in common is that they get around placing the auxiliary in second position after an initial *wh*- word. In other words, they constitute different solutions to the same learning problem. In the course of L2 development, learners accumulate grammatical rules and their variants, allowing them to develop individual developmental trajectories while adhering to the overall developmental schedule. In this way, PT accounts for both universal stages of development and individual variation within stages.

There are two separate problems that are crucial to address in understanding L2 acquisition. The original version of PT focused solely on what is known as the **developmental problem** (i.e., why learners follow universal stages of acquisition). The extended version of PT (Pienemann, DiBiase, & Kawaguchi, 2005) and recent developments of the theory (Lenzing, 2013) also begin to address the so-called **logical problem** (i.e., how do learners come to know what they know if their knowledge is not represented in the input?) (see Chapter 4). The developmental and the logical problem are the key issues of any theory of language acquisition, and PT addresses these issues in a modular fashion. One module deals with the developmental problem; a separate, but a connected module deals with the logical problem. Both modules are based on Lexical-Functional Grammar (LFG) because LFG is designed to account for linguistic knowledge in a way that is compatible with the architecture of the language processor, and both these components are needed for PT to address the developmental and the logical problem. The developmental problem is addressed by describing the constraints the language processor places on development, and the logical problem is addressed using specific components of LFG that are summarized later in this chapter.

The basic claim of the original version of PT is that language development is constrained by processability, the definition of which will emerge as the discussion progresses. This affects first language (L1) and L2 development (albeit in different ways). It also affects interlanguage variation and L1 transfer. In other words, both interlanguage variation and L1 transfer are constrained by processability. The extended version of PT adds to this the claim that the initial form of grammar in L2 acquisition is determined by the default relationship between argument structure (i.e., who does what to whom) and the way they are expressed by the grammatical forms of the target language. We turn our attention now to the major constructs of the theory.

Processability Hierarchy

In Pienemann (1998) the **processability hierarchy** is based on the notion of transfer of grammatical information within and between the phrases of a sentence. For instance, in the sentence 'Little Peter goes home' the grammatical information "third person singular" is present in the phrase 'Little Peter' and in 'goes'. This is commonly referred to as 'subject-verb agreement'. In LFG and in Levelt's model of language generation, it is assumed that the language processor checks if the two parts of the sentence, 'Little Peter' and 'goes', contain the same grammatical information. To be able to carry out this matching operation, the procedures that build phrases in language generation need to have developed in the L2 processing system. In our example, learners need to have developed a procedure for building noun phrases such as 'Little Peter' and verb phrases such as 'goes home'. They also need to have developed a procedure for putting these two phrases together to form a sentence. In Levelt's model of language generation, it is assumed that the

grammatical information "third person singular" needs to be stored in the procedures that build the phrases in which this information is used and that the two sets of information are compared within the procedure that puts the two phrases together to form a sentence. The learner of a language needs to develop procedures that can handle the job of storing and comparing grammatical information. This way, speakers learn to decide which sentences are grammatically acceptable and which ones are not. For instance, in the sentence *'Little Peter go home' the phrase 'Little Peter' is marked for "third person singular," but the verb is not. This will be detected by a competent speaker when the noun phrase and the verb phrase are assembled to form a sentence. However, if the learner has not yet developed a fully functioning sentence procedure, the mismatch will not be detected.

The same principle applies to grammatical information contained within phrases. For instance, in the noun phrase 'two kids' the grammatical information "plural" is contained in the numeral 'two' and in the noun 'kids'. In language generation, these two bits of information are compared when the noun phrase is assembled by the noun phrase-procedure. In the case of 'two' and 'kids' the two bits of grammatical information match. The different types of information exchange are illustrated in Figure 9.1.

We can now see that in both examples grammatical information has to be matched between parts of the sentence. In LFG, this process is called **feature unification**. In nontechnical language we might describe this process as information matching. LFG uses formal means to account for such processes. The fact that LFG has this capacity is one of the key reasons why PT uses LFG to model these psycholinguistic processes.

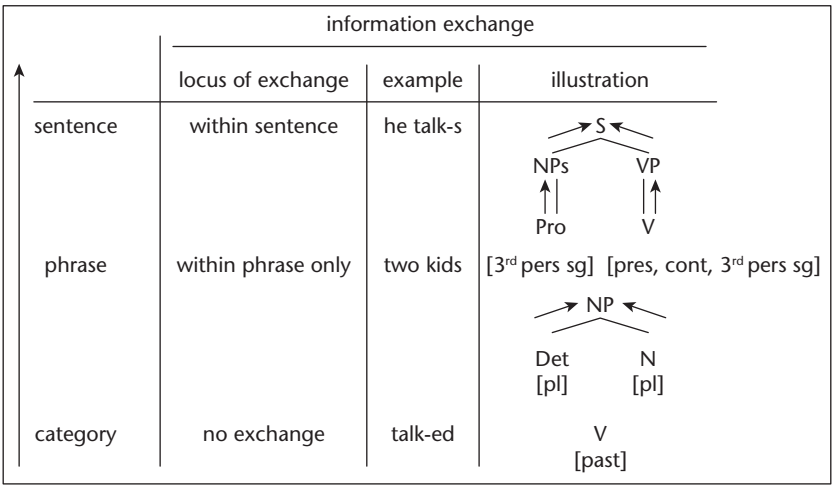

FIGURE 9.1 A simplified account of the processability hierarchy.

The two examples we have used also illustrate the processability hierarchy. It is easy to see that in the 'Little Peter' example grammatical information has to be matched between a noun phrase and the verb phrase and that this occurs when the two pieces are assembled to form the sentence. In contrast, in the second example (i.e., 'two kids') the information matching occurs in the noun phrase procedure—*before* the sentence is assembled. In other words, there is a time sequence involved in the matching of grammatical information, which forms the basis of the original processability hierarchy. Noun phrases are assembled before verb phrases, which are assembled before sentences. In addition, individual words belong to categories such as "noun" and "verb," and category procedures are the memory stores that hold grammatical information such as "singular" or "past." Therefore category procedures appear before noun phrase procedures.

The following is an overview of the original processability hierarchy, following Pienemann (1998):

1. no procedure (e.g., producing a simple word such as 'yes')
2. category procedure (e.g., adding a past tense morpheme to a verb as in 'talk**ed**')
3. noun phrase procedure (e.g., matching plurality as in '**two** kids')
4. verb phrase procedure (e.g., moving an adverb out of the verb phrase to the front of a sentence 'I went yesterday/yesterday I went')
5. sentence procedure (e.g., subject-verb agreement as in 'Peter sees a dog')
6. subordinate clause procedure (e.g., use of subjunctive in subordinate clauses triggered by information in a main clause as in 'The doctor insisted that the patient be quiet')

The basic hypothesis underlying PT is that learners develop their grammatical inventory following this hierarchy for two reasons: (a) the hierarchy is implicationally ordered, that is, every procedure is a necessary prerequisite for the next procedure, and (b) the hierarchy mirrors the time-course in language generation. Therefore the learner has no choice but to develop along this hierarchy. Phrases cannot be assembled without words being assigned to categories such as 'noun' and 'verb', and sentences cannot be assembled without the phrases they contain and so forth. The fact that learners have no choice in the path they take in the development of processing procedures follows from the time-course of language generation and the design of processing procedures. This is how the architecture of language generation constrains language development. So, observed stages of development are a direct result of the stage of processing in which learners find themselves. For example, if learners are in stage 3 of processing (they can only exchange information in a phrase), they will produce *wh*- questions that do not exhibit processing abilities beyond stage 3 (e.g., they will not be able to use auxiliaries correctly as in 'Where has he gone?') because

such questions involve processing that relies on the exchange of information outside phrases.

As mentioned earlier, the original version of the processability hierarchy focuses on information transfer within phrase structure. In the extended version of PT (Pienemann et al., 2005) the processability hierarchy is extended to include further aspects of language generation, in particular, the relationship between what is known as argument structure and grammatical structure. Argument structure refers to the basic ideas conveyed in a sentence: Who does what to whom? The extended version of PT also includes the relationship between what is intended to be said and the way this is expressed using L2 grammatical forms. This extension is also modeled using LFG. Details will be summarized later on.

Hypothesis Space

The processability hierarchy has been described as the sequence in which the fundamental design of the language processor develops in L2 acquisition, and it has been added that the learner is constrained to follow this sequence. At the same time, the processing procedures developed at every stage of the hierarchy do allow for some degree of leeway for the shape of the L2 grammar. **Hypothesis space** is created by the interplay between the processability hierarchy and the leeway it generates at every level.

An example may illustrate the constraining effect of the processability hierarchy. At stage 3 (noun phrase procedure) grammatical information can be exchanged only within noun phrases, not beyond the phrasal boundary. Therefore grammatical structures requiring information exchange beyond the phrase boundary, such as subject verb-agreement, cannot be processed at this stage. At the same time, these constraints leave sufficient leeway for learners to find different solutions to structural learning problems. We illustrated this previously with the example of the position of auxiliaries in English *wh*- questions. This position requires processing procedures from a much later stage in the hierarchy. L2 learners nevertheless must produce *wh*- questions. When they attempt to do this, they have four structural options that avoid the placement of the auxiliary in second position. The reader will recall the examples given previously. Note how the learner can remain in stage 3 of processing (i.e., can only process information in noun phrases) even when confronted with target structures that require "higher" processing procedures. In each example that follows, the reader can see how learners delete something or use a nonstandard or unexpected word order to avoid moving elements across phrases.

A Where he been?
B Where has been?
C Where he has been?
D He has been where?

Transfer of Grammatical Information and Feature Unification

As previously mentioned, the original version of PT focused on phrase structure (which is called "constituent structure" in LFG) and the transfer of grammatical information within it. This information transfer process is modelled using feature unification. Every entry in the learner's mental lexicon needs to be annotated for the specific features of the target language. For instance, the entry *Peter* needs to be assigned to the lexical class "noun." It needs to be annotated as a proper noun, and the feature NUMBER needs to have the value "singular." The lexical entry 'sees' needs to be assigned to the lexical class "verb," and the features NUMBER, PERSON, TENSE, and ASPECT need to have the following values:

NUMBER = singular
PERSON = 3
TENSE = present
ASPECT = non-continuous

To achieve subject verb-agreement in the sentence 'Peter sees a dog', the value of the features NUMBER and PERSON have to be matched (or unified). The features NUMBER and PERSON have the values "third" and "singular," and these values reside in the lexical entries of the noun 'Peter' and the verb 'sees'. This grammatical information is passed on to the noun phrase procedure (NP) and verb phrase procedure (VP), respectively. From there the two sets of information are passed on to the sentence procedure (S), where they are matched.

In the design of PT, the point of unification is related to the hierarchy of processability that reflects the time course of real time processing. The hierarchy that results from a comparison of the points of feature unification can be ordered as follows:

1. No exchange of grammatical information (= no unification of features),
2. Exchange of grammatical information within the phrase,
3. Exchange of grammatical information within the sentence.

Once one applies this hierarchy to ESL, the following developmental trajectory can be predicted:

1. past *-ed* will appear before
2. plural *-s* which in turn will appear before
3. third person *-s*.

To appreciate the universal nature of PT, it is crucial to consider that the processability hierarchy is not language-specific and that, in principle, it applies to the transfer of grammatical information in any language. In contrast, the examples

that were given for ESL morphology utilize this hierarchy and apply it to one specific target language.

What the preceding discussion suggests is that learners develop a lexically driven grammar; that is, the lexicon stores grammatical information. For instance, the lexical entry for 'walked' is marked for past tense and it lists the core argument of the verb as "agent." This lexical information is required in the assembly of the sentence and thus grammatical information and features must be matched or unified.

Lexical-Functional Grammar

LFG has three independent and parallel levels of representation, as shown in Figure 9.2: (a) argument structure (a-structure), (b) constituent structure (c-structure), and (c) functional structure (f-structure). The three levels of linguistic representation are related to each other by specific linking or mapping principles to unify the information that is encoded in each of the three levels. These three levels are illustrated in Figure 9.2.

Argument structure is related to who does what to whom in a sentence. It contains the verb and its corresponding arguments. Arguments take specific thematic roles (such as "agent," "experiencer," "locative," or "patient/theme") that are ordered according to a universal hierarchy of thematic roles. The arguments for each verb are listed in the lexical entry of the verb. As illustrated in the following, different verbs require both different numbers and types of arguments.

For instance, the argument roles of the English verbs 'throw' are "agent" and "patient/theme" and of 'see' are "experiencer" and "patient/theme."

1. John (agent) threw the ball (patient/theme).
2. Peter (experiencer) sees ghosts (patient/theme).

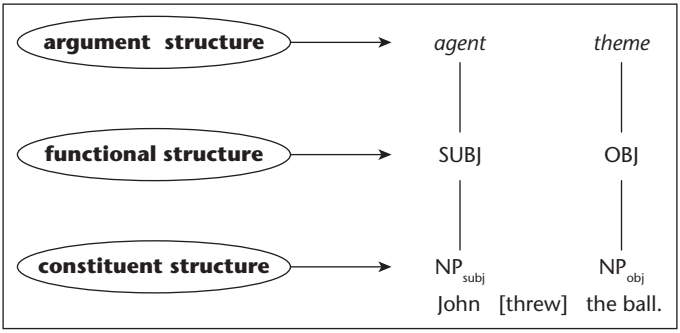

FIGURE 9.2 Sample of three levels of structure in LFG.

As previously mentioned, "constituent structure" is basically another name for "phrase structure" and describes the structure of the parts of sentences. This component consists of units that are constructed according on the basis of a universal core of constituent categories ("verb," "noun phrase," etc.), but these are arranged in a way that is specific for every language. For instance, in some languages, adjectives precede the noun, whereas in other languages, they follow the noun.

Functional structure consists of universal grammatical functions (such as SUBJECT or OBJECT) that are related to constituent structure in a language-specific way. Functional structure serves to connect argument structure and constituent structure. For instance, in example (1), the constituent $[[\text{John}]_{N}]_{NP}$ is the grammatical subject of the sentence.

(1) *play* *<agent, patient/theme>*

| |

SUBJ *OBJ*

| |

John played the piano.

Lexical Mapping

Lexical Mapping Theory is a component of LFG (e.g., Bresnan, 2001). It specifies the mapping processes from a-structure to f-structure, that is, from arguments to grammatical functions.

This design of LFG as a theory of language ensures that universal argument roles can be expressed using a whole range of different grammatical forms. For instance, in English the argument role "agent" can be expressed as a grammatical subject, as can "experiencer" in the examples we saw earlier with the verbs 'throw' and 'see'. But note that in English, other arguments can be expressed as subjects in sentences such as passives, 'The ball was thrown by John'. In this example, the theme is now the subject. In other words, the relationship between argument structure and the other two levels of structure is variable in a specific language and it also varies between languages. This variable relationship between what is intended to be said (argument structure) and the way it is expressed using grammatical forms (such as grammatical morphemes or word order) creates expressiveness in language, but it also creates what Levelt (1981) calls the **linearization problem**. As mentioned previously, the output of the processor is linear, but it may not be mapped onto the underlying meaning in a linear way.

In the case of the active-passive alternation introduced earlier, the linearization problem applies to the relation between argument structure and functional structure. The passive in the preceding example deviates from a simple match between underlying meaning and grammatical form, as the mapping of the theme to the

subject function introduces a degree of nonlinearity. In this context it is crucial to bear in mind that in LFG no linguistic material is moved from one position to another throughout the sentence generation process. Instead, c-structure is generated in one go without any intervening movement operations. The mapping operations contained in LFG connect arguments, grammatical functions, and c-structure.

Unmarked Alignment

Lexical Mapping Theory accounts for the mapping of argument structure onto functional structure. In PT the default mapping principle is **unmarked alignment**, which is based on the one-to-one mapping of argument roles onto grammatical functions. In English, for instance, "agent" = SUBJECT is the prototypical or default association between argument structure and functional structure. But as we saw with passives, languages allow for a much wider range of relationships between argument structure and functional structure and the ability to map these relationships develop step-wise in L2 acquisition. Principles of lexical mapping can account for these developmental processes. For L2 acquisition, unmarked alignment is the initial state of development and results in canonical word order (i.e., the most typical word order for that language). For ESL this is SVO. Unmarked alignment simplifies language processing for the learner who, at this stage, will analyze the first noun phrase as the agent. This way, canonical word order avoids any kind of transfer of grammatical information during language processing.

PT implies that L2 acquisition starts with an unmarked assignment of functional structure. Subsequent changes of the relationship between arguments and functional structure will require additional processing procedures that will be acquired later. Hence the unmarked alignment hypothesis implies a developmental prediction for L2 structures affecting the relationship between argument structure and functional structure. Let's return to the passive we saw earlier. In the passive the relationship between argument roles and syntactic functions may be altered as illustrated in examples (2) and (3).

(2) *throw* *<agent, patient/theme>*

| |

SUBJ *OBJ*

| |

John threw the ball.

(3) *thrown* *<agent, patient/theme>*

| | |

Ø *SUBJ* *(ADJ)*

The ball was thrown by John.

Sentences (2) and (3) describe the same event involving two participants. The difference between the two is that in (3) the constituent 'the ball' that is OBJECT in (2) is realized as SUBJECT, and the constituent 'John' that is SUBJECT in (2) is realized as ADJUNCT.

These alterations of the relationship between argument roles and syntactic functions constitute a deviation from unmarked alignment. In order for this type of marked alignment to be possible, the function of a noun phrase (SUBJECT, OBJECT, or ADJUNCT, among others) can be established only by assembling information about the constituents in the sentence procedure, and this construction requires a procedure in the processability hierarchy higher than the category procedure. Therefore PT predicts that in English the passive is acquired later than active SVO sentences.

The TOPIC Hypothesis

As mentioned earlier, Lexical Mapping Theory specifies the relationship between argument structure and functional structure, and PT derives developmental predictions from the language-specific relationship between argument structure and functional structure using Lexical Mapping Theory. Similar predictions can also be derived from the relationship between functional structure and constituent structure. One set of such predictions is entailed in the TOPIC Hypothesis. To account for developmental dynamics in the relationship between functional structure and constituent structure Pienemann et al. (2005) propose the TOPIC hypothesis, which predicts that learners will initially not differentiate between SUBJECT and other grammatical functions in sentence-initial position (e.g., TOPIC). In this context it is important to note that in LFG TOPIC is a grammatical function. For instance, in the sentence 'Ann, he likes', 'Ann' has two functions, OBJECT and TOPIC. In this case, the TOPIC function is assigned to a constituent in sentence-initial position other than the SUBJECT. This process is referred to as topicalization. When the learner is able to add a constituent before the subject position, this will trigger the differentiation of the grammatical functions TOPIC and SUBJECT.

The TOPIC hypothesis predicts that initially, the first noun phrase is mapped onto the SUBJ function (as in 1), as the learner does not differentiate between the grammatical function TOPIC and SUBJ (see also Chapter 7). At a later stage, the unmarked alignment between constituents and grammatical functions is altered: The assignment of the TOPIC function to nonargument functions results in the occurrence of adjuncts in sentence-initial position (as in 2). Finally, the TOPIC function is assigned to a core argument that is not the subject. This applies for instance to the topicalization of objects (as in 3).

1. TOPIC and SUBJECT are not differentiated.

```
(Peter saw Mary.)        He liked the girl.
                          |        |
                         SUBJ     OBJ
```

2. The initial constituent is an ADJUNCT or a question-word. TOPIC is differentiated from SUBJECT.

   Yesterday everyone smiled

   | |

   ADJ SUBJ

3. The TOP function is assigned to a core argument other than SUBJ.

   Ann, I think, he likes.

   | |

   OBJ SUBJ

The Initial L2 Grammatical System

As pointed out earlier, PT is based on the assumption that the IL grammar is constrained by the limited processing resources available to the learner. This assumption materializes in form of hypothesis space, which delineates structural hypotheses available to the learner at any given stage. Processing constraints also delineate possible L1 transfer. PT predicts the initial state of syntax to follow canonical word order (SVO, SOV etc.).

Lenzing (2013) analyzed large quantities of early L2 learner data and found that the first impression of these data appears to contradict this prediction. At first glance, the oral performance data of early L2 learners appear to be much more *diverse* than the highly constrained initial state assumed in PT would predict. Early learners produce "strange" utterances that differ from the target language in several ways. For instance, the structures differ in terms of their syntax, as in 'Ski the mouse' (learner C18). Other utterances are semantically ill-formed: The learners produce question forms such as 'What's the spaghetti?' (learner C02) and 'What's you {ne} sister?' (learner C03). In these cases, the intended meaning of the question can only be inferred from the context; that is, learner C02 intends to ask "Do you like spaghetti?" and the question produced by learner C03 means "Do you have a sister?" A further deviation from the target language relates to the number of arguments the learners express in their utterances. These range from utterances with missing arguments, as in 'Is sleep on the {wolk}' (= The elephant is sleeping on the cloud) (learner C09), in which the agent is missing, to structures which contain more arguments than the learner wishes to express, as is the case in 'She likes you spinach' (= Do you like spinach?) (learner C08). Finally, in a number of utterances in the learner data the lexical class does not match. In the question form 'It's a pink?' (learner C06), the lexical item 'pink' does not seem to be annotated for its syntactic category "adjective." The same applies to the structure 'What's your eating?' (C24). Table 9.1 summarizes these observations.

However, a detailed distributional analysis of a large corpus of very early learner data revealed that semantic and syntactic deviations as shown in Table 9.1 are

TABLE 9.1 Deviations in Early L2 Learner Utterances

1. Syntactic deviation	*Ski the mouse* (= The mouse is skiing)
2. Semantic deviation	*What's the spaghetti?* (= Do you like spaghetti?) *What's you {ne} sister?* (= Do you have a sister?)
3. Number of arguments (participants in event)	*sleeping on the {wolk}.* (= The elephant is sleeping on the cloud) *She likes you spinach?* (= Do you like spinach?)
4. Lexical class does not match	*It's a **pink**?* (= Is it pink?) *What's your **eating**?* (= What do you like to eat?)

limited to a very small class of verbs in the context of a highly limited lexicon. The same is true for non-target-like argument structures. Lenzing's analysis revealed that the linguistic system of very early learners is highly constrained in its constituent structure, its argument structure and lexicon. She concluded that the unpredicted 'chaotic' structures shown in Table 9.1 are not generated by the learners' grammatical system. Instead, these structures are based on lexical processes where the arguments are mapped directly onto surface form. This implies that initially, no c-structure is present. In some cases, the learners rely on formulaic units (such as 'What's' or 'She likes') and simply attach to this unit the lexical item(s) that best match the argument(s) they intend to express. This process results in idiosyncratic question forms composed of a formulaic question marker and one or more lexical items attached to it, as in 'What's the spaghetti?'

Initially, learners also fail to assign a lexical class to L2 words. For instance, in the question *'It's a pink?', the adjective 'pink' occurs in the wrong position in the sentence. Lenzing concludes that the L2 constituent structure and argument structure need to be discovered step-wise by the learner, and lexical classes need to be assigned gradually to new lexical entries. As essential features and functions are underdeveloped or missing, feature unification and mapping cannot be carried out at the initial state. Lenzing refers to these assumptions as the **Multiple Constraints Hypothesis** (MCH).

In PT the universal grammatical functions (SUBJ, OBJ, etc.) are assumed to be present in the initial L2 mental grammatical system. The MCH makes the additional assumption that grammatical functions are inaccessible at the initial state, as the mapping process from a- to f-structure is blocked. The L2-specific c-structure is assumed to develop gradually in the acquisition process following the predictions spelled out in PT. Its gradual development is characterized by basic, flat-c-structures to more complex, hierarchical ones.

The MCH is illustrated in Figure 9.3, which shows the direct mapping of a-structure onto c-structure bypassing f-structure. Development of this initial learner system into the L2 is driven by the gradual annotation of the lexicon, which permits the processor to map a- and c- structure onto f-structure thus facilitating nonlinear mapping processes.

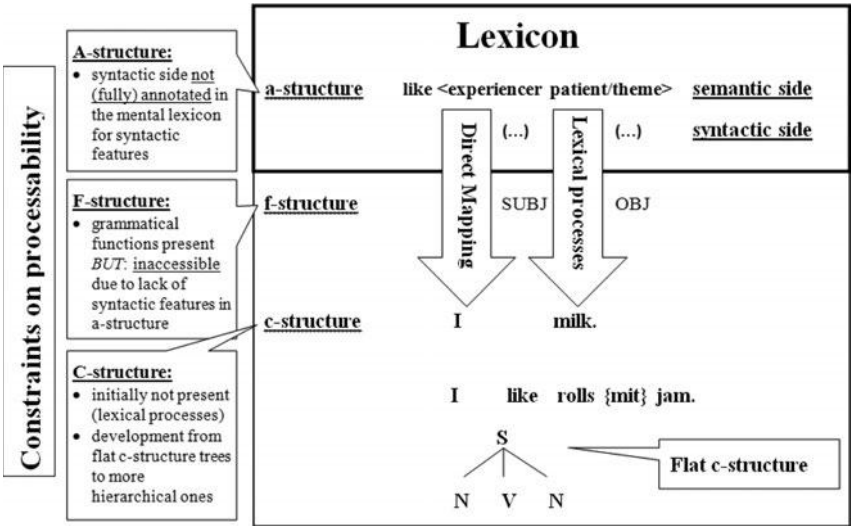

FIGURE 9.3 The Multiple Constraints Hypothesis.

What Counts as Evidence?

Given the focus of PT on developmental dynamics, the most suitable research design is a longitudinal or cross-sectional study with a large set of data relevant for the phenomena under scrutiny. In such studies the researcher collects naturalistic or elicited speech data that form the corpus on which the study is based. Relevant data do not necessarily imply a large data set. The data need to be relevant to the point to be studied. For instance, the study of subject-verb agreement marking requires a large set of contexts for subject-verb agreement marking. This will allow the researcher to decide if the verbal marker is supplied or not. If no context appears, no conclusion can be drawn. However, even the presence of a number of morphological markers is no guarantee that these are based on productive interlanguage rules. To exclude the use of formulae and chunks the researcher needs to check lexical and morphological variation (i.e., same morpheme on different words and same word with different morphemes).

For instance, to determine whether the structure 'he goes' is used productively or merely stored as a chunk in the learner's mental lexicon, one needs to ensure that the morpheme occurs on the one hand with different lexical verbs in the speech sample (e.g., 'eat-s', 'walk-s', 'sleep-s', 'like-s'). On the other hand, the verb has to appear with different suffixes (e.g., 'go-ing', 'go-Ø').

Apart from corpus data, reaction time experiments also constitute a valid basis of a test of PT. As an example, a learner might be tested on subject-verb agreement. The learners reads two sentences on a computer screen and must judge if the two sentences are identical or not by pressing particular computer keys for "yes" and "no." Some pairs of sentences are grammatical, and some are not. The

trick is that the sentences only appear briefly, say, for 300 milliseconds. What is measured is the time it takes the learner to make the judgment. The prediction is that ungrammatical sentences take longer to process because the learner is "checking for feature agreement."

Common Misunderstandings

A major misunderstanding regarding PT is that it can be applied to any language without first considering how particular features of a target language are processed. For example, some scholars who have tried to apply PT to a new target language have based their application on the developmental trajectories found for English and German, the two key target languages in early research on PT. These researchers looked for such things as agreement or word order phenomena that appeared similar to the developmental stages found in English and German. But the grammars of individual languages may vary considerably—as may the processes involved in producing specific structures.

For instance, languages differ in how grammatical functions, such as SUBJ and OBJ, are realized at the phrase structure level. The language-specific nature of the relationship between grammatical functions and constituent structure becomes evident when comparing English and Italian. Let us consider the sentence 'I see them'. In English, the grammatical functions SUBJ and OBJ appear as noun phrases (NPs) in constituent structure ($[I]_{SUBJ}$ see $[them]_{OBJ}$) (cf. Figure 9.4).

In Italian, grammatical functions are marked differently in constituent structure: The SUBJ function is marked on the verb by means of a morphological subject marker, and the OBJ function appears as a clitic ($[li]_{OBJ}$ ved-$[o]_{SUBJ}$) (cf. Figure 9.5).

This example shows that the processes involved in the production of sentences different in English and Italian and thus the rules for English cannot be applied wholesale to Italian. Instead, one has to take into account how the mapping of grammatical functions onto phrase structure is modeled for different languages in LFG.

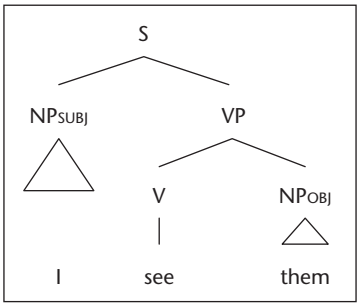

FIGURE 9.4 Matching grammatical functions onto c-structure in English. Adapted from DiBiase and Kawaguchi (2002).

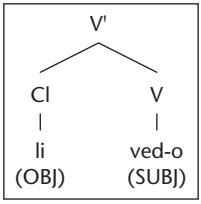

FIGURE 9.5 Matching grammatical functions onto c-structure in Italian. Adapted from DiBiase and Kawaguchi (2002).

Note how the exemplary study presented in this chapter does not fall into this misunderstanding. As we shall see in the exemplary study on Japanese SLA, the processability hierarchy needs to be applied to a new target language on the basis of the fundamental principles of PT, not on the basis of developmental trajectories found in specific target languages. Utilizing fundamental principles of PT includes a detailed analysis of the information transfer required for the production of specific structures. This is best done on the basis of an LFG analysis of the structures in question.

An Exemplary Study: Kawaguchi (2005)

Given that PT has been designed as a universal theory of L2 development, it is important to demonstrate that it can be applied to typologically distant languages and that the predictions for developmental trajectories derived from this application are borne out by empirical studies. Kawaguchi's (2005) study exemplifies the applicability of PT to the acquisition of Japanese by deriving a developmental trajectory for the acquisition of Japanese as a second language (JSL), which is supported by longitudinal data.

To appreciate Kawaguchi's application of PT to JSL, it is crucial to consider some of the key features of Japanese grammar that the predicted developmental trajectory is based on: Japanese is a "head-last" language, and the verb is always in final position. However, syntactic relations (such as SUBJECT, OBJECT) are not marked by word order (unlike in English). Instead, syntactic relations are marked by nominal particles that follow the noun to be marked. Kawaguchi (2005, p. 259) gives the following example:

(4) Piano-o Tamiko-ga hii.ta
Piano-ACC Tamiko-NOM play-PAST
'Tamiko played the piano'

In this example the marker *-o* marks the word 'piano' for accusative, and the particle *-ga* marks 'Tamiko' for nominative. These markers allow the correct interpretation of the sentence with 'Tamiko' as the agent and 'piano' as the theme.

As Kawaguchi points out, Japanese word order is relatively free. Therefore the two noun phrases in (4) may be scrambled without affecting the meaning of the sentence.

Kawaguchi derives a specific and testable developmental trajectory from Extended PT for JSL. For the purpose of this chapter, we summarize only the three example structures that follow from the hypotheses discussed previously:

Level	*Information transfer*	*structure*
1. Lexical procedure	category	**- TOP_{SUBJ} (O)V**
2. Phrasal procedure	phrase	**- Topic + S(O)V**
3. Sentence procedure	sentence	**- OBJECT Topicalization**

The TOPIC hypothesis predicts that initially SLA learners will not differentiate between TOPIC and SUBJECT. This is reflected in the structure TOP_{SUBJ} (O) V, where TOP_{SUBJ} is si the canonical word order that applies to Japanese (SOV). At the phrasal level TOPIC and SUBJECT can be two different phrases (Topic + S(O)V), and at the sentence level objects can be in initial, that is, in topic position. The latter two steps are also predicted by the TOPIC hypothesis, which states that the TOPIC function will first be applied to non-arguments (e.g., adjuncts) and only then to arguments (i.e., to OBJECTS in Kawaguchi's study). Kawaguchi demonstrates that these structures are related to the general levels of the processability hierarchy as shown above. It is this systematic linkage of the specific JSL structures with the processability hierarchy that yields the crucial prediction of a JSL developmental trajectory.

Kawaguchi conducted two longitudinal studies spanning two and three years, respectively. The informants were Australian native speakers of English who started learning Japanese in a formal setting. The informants also had regular contact with Japanese exchange students using Japanese. The informants received six hours of linguistic input per week for 24 weeks per year. Data were collected in natural conversation and using communicative tasks. Data collection started four weeks after commencement of the course. Each session lasted between 20 and 30 minutes. Samples were collected every month. The data were transcribed and further transliterated using a romanization system that permits a computer-based analysis of the data. To test the hypotheses derived from PT, Kawaguchi carried out a distributional analysis of the data. For this analysis, she searched the learner data for the structures that are included in the hypothesized developmental trajectory. She then counted every absence or presence of these structures.

The data analysis revealed that in Kawaguchi's corpus, all structures included in her hypotheses follow the predicted sequence: The verb appeared in the last position in every sentence and every session right from the start. The structure TOP_{SUBJ} (O)V appeared in a clearly distinguishable next step, and this was followed by structures in which Topic and SUBJECT are differentiated. Thus, the

results support the predications made by PT involving how processing constrains language development.

Explanation of Observed Findings in SLA

Processability Theory can account for several of the observed phenomena in SLA outlined in Chapter 1.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. Explaining this observation is one of the key points of Processability Theory. PT has the capacity to predict stages of acquisition in typologically diverse languages by locating grammatical structures of the L2 within the processability hierarchy. These predictions can be universally applied because they are specified within LFG.

Observation 5: Second language learning is variable in its outcome. Interlanguage variability is generated by the leeway defined by hypothesis space at every stage of development. We demonstrated above that every learning problem (i.e., every developmental structure) can be solved in a limited number of different ways and that the range of solutions is defined by hypothesis space. In the course of development, the learner thus accumulates different variants of developmental structures. The accumulated choices made by the learner determine the shape of the interlanguage variety of the learner. One class of choices made by learners implies that the specific interlanguage rule cannot develop further. When learners accumulate many of these choices the interlanguage stabilizes. Different degrees of "bad choices" made by the learner determine the point in development at which the interlanguage system stabilizes.

Observation 7: There are limits on the effects of frequency on SLA. Given the hierarchical nature of the processability hierarchy none of the processing procedure constraints in the hierarchy can be skipped because every lower procedure constitutes a prerequisite for the next higher one. Therefore frequency cannot override the constraints of the hierarchy.

Observation 8: There are limits on the effect of a learner's first language on SLA. The key assumption of PT is that L2 learners can produce only those linguistic forms for which they have acquired the necessary processing procedures. Under this scenario, L1 features and structures can only be transferred when the learner begins to process L2 features and structures that are relevant to the L1. For example, learners cannot transfer knowledge or abilities regarding L1 subject-verb agreement until they get to the stage where they can process this kind of grammatical information in the L2. This claim is referred to as the Developmentally Moderated Transfer Hypothesis (Pienemann, Di Biase, Kawaguchi, & Håkansson, 2005).

Observation 9: There are limits on the effects of instruction on SLA. Given that every processing procedure in that hierarchy forms a key prerequisite for the next higher stage, none of the stages/prerequisites can be skipped. Therefore stages of acquisition cannot be skipped through formal instruction. In other words, the effect

of teaching is constrained by processability. This was formerly referred to as the Teachability Hypothesis (Pienemann, 1984) and has been subsumed under PT.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. Because output is constrained by processability, learners cannot produce structures that are beyond their level of processing. Thus, practice does not make perfect in language learning, and interaction in which learners may become aware of structures may not lead to their being produced. Production of new features and structures reflects a change in processing and is not the cause of it.

The Explicit/Implicit Debate

PT does not address the explicit/implicit debate directly. Given that PT is based on Levelt's approach to language generation, it shares Levelt's assumptions regarding the automaticity and implicit nature of several of the processing components. The key component of Levelt's approach utilized by PT is the Grammatical Encoder, which is seen as a component that runs largely automatically and is based on implicit knowledge. In the context of Levelt's model, explicit knowledge comes into play through monitoring, which is seen as highly constrained by the overall architecture of the language generator. These assumptions allow for a very constrained interface between explicit and implicit knowledge. What is more, PT is less concerned with how a grammar comes to be in a learner's mind/brain and instead focuses on the processes that make use of that grammar in real time. To this end, PT would not take a stand on explicit/implicit learning as it is normally discussed in the literature.

Discussion Questions

1. How does Processability Theory explain staged development in SLA?
2. In what ways is Processability Theory different from (or similar to) generative or cognitive theories used in SLA research?
3. Select two different structures from a language you know or have studied. What would you predict about their relative-order emergence based on PT? What processing procedures seem to be involved?
4. What instructional implications, if any, do you see in Pienemann's work?
5. Why does PT primarily rely on "naturalistic" or "spontaneous" production data as evidence?
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Suggested Further Reading

Lenzing, A. (2013). *The development of the grammatical system in early second language acquisition: The Multiple Constraints Hypothesis.* Amsterdam, Netherlands: John Benjamins.

This book introduces the Multiple Constraints Hypothesis. Based on PT and LFG, it focuses on the nature of the L2 initial grammatical system and its underlying constraints.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation.* Cambridge, MA: MIT Press.
This book is foundational for all work on speech production and is critical for a deeper understanding of how PT operates. It is also foundational for understanding L1 speech production.

Pienemann, M. (1998). *Language processing and second language development: Processability Theory.* Amsterdam, Netherlands: John Benjamins.
This is the first book published on PT and is essential reading. The first and second chapters are particularly useful for grasping the basic tenets of the theory.

Pienemann, M. (Ed.). (2005). *Cross-linguistic aspects of Processability Theory.* Amsterdam, Netherlands: John Benjamins.
This volume contains a good overview of PT in the first chapter. Other chapters include empirical research on the predictions made by PT to languages such as Arabic, Chinese, and Japanese.

Pienemann, M., & Keßler. J.-U. (Eds.). *Studying Processability Theory: An introductory textbook.* Amsterdam, Netherlands: John Benjamins.
This textbook provides a reader-friendly introduction to PT. Designed for students with basic knowledge of (applied) linguistics, it offers a comprehensive overview of the key issues of the theory.

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Kempen, G., & Hoenkamp, E. (1987). An incremental procedural grammar for sentence formulation. *Cognitive Science, 11*, 201–258.

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Pienemann, M. (1998). *Language processing and second language development: Processability Theory.* Amsterdam, Netherlands: John Benjamins.

Pienemann, M., Di Biase, B., & Kawaguchi, S. (2005). Extending Processability Theory. In M. Pienemann (Ed.), *Cross-linguistic aspects of Processability Theory* (pp. 199–252). Amsterdam, Netherlands: John Benjamins.

Pienemann, M., Di Biase, B., Kawaguchi, S., & Håkansson, G. (2005). Processing constraints on L1 transfer. In J. F. Kroll & A. M. B. DeGroot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 128–153). New York, NY: Oxford University Press.

10

INPUT, INTERACTION, AND OUTPUT IN SECOND LANGUAGE ACQUISITION

Susan M. Gass and Alison Mackey

The Theory and Its Constructs

As VanPatten and Williams note in Chapter 1, a distinction needs to be made between models and theories. Notably, they distinguish between the *how* and the *why*. They also describe hypotheses, which differ from theories in that a hypothesis "does not unify various phenomena; it is usually an idea about a single phenomenon." This chapter deals with input, interaction, feedback, and output in second language acquisition. These constructs have been integrated and were originally referred to as the Interaction Hypothesis. However, following a significant amount of empirical work leading to greater specificity and theoretical advancement, it is now generally referred to in the literature as *the interaction approach*.

In its current form, the interaction approach subsumes some aspects of the **Input Hypothesis** (e.g., Krashen, 1982, 1985) together with the **Output Hypothesis** (Swain, 1985, 1995, 2005). It has also been referred to as the input, interaction, output *model* (Block, 2003) and interaction *theory* (Carroll, 1999). As Mackey (2012) notes, "it is important to point out that the Interaction Hypothesis was not intended or claimed to be a complete theory of SLA, despite the fact that it is occasionally characterized this way in the literature . . . (p. 4). As Pica points out, 'as a perspective on language learning, [the Interaction Hypothesis] holds none of the predictive weight of an individual theory. Instead, it lends its weight to any number of theories'" (1998 p. 10).

If we follow the distinction provided by VanPatten and Williams, it becomes clear that the Interaction Hypothesis of SLA includes elements of a hypothesis (an idea that needs to be tested about a single phenomenon), elements of a model (a description of processes or a set of processes of a phenomenon), as well as elements of a theory (a set of statements about natural phenomena that explains why these phenomena occur the way the do). Recent work reflects the nature and

development of the interaction approach from its inception over the past two and a half decades. In fact, Jordan (2005) suggested that the Interaction Hypothesis shows signs of progression toward a theory, using it as an example of how "an originally well-formulated hypothesis is upgraded in the light of criticism and developments in the field" (p. 220). At the point when this book was published in its first edition, various aspects of the Interaction Hypothesis had been tested and links between interaction and learning clearly demonstrated, thereby suggesting that it was time for a change in the term *hypothesis*. Its inclusion in a volume on theories of SLA, references to it as the "model that dominates current SLA research" (Ramírez, 2005, p. 293) and "the dominant interactionist paradigm" (Byrnes, 2005, p. 296) supported this view, together with the appearance of book-length critiques of it (Block, 2003), which collectively showed that researchers were moving toward thinking about the Interaction Hypothesis in terms of a model of SLA. Using the framework of this book, for example, it is a model in the sense that it describes the processes involved when learners encounter input, are involved in interaction, receive feedback and produce output. However, it is moving toward the status of theory in the sense that it also attempts to explain why interaction and learning can be linked, using cognitive concepts derived from psychology, such as **noticing**, **working memory**, and **attention**. In this chapter, then, as in much of the current literature, including recent handbook and encyclopedia articles (García-Mayo & Alclón-Soler, 2013; Gor & Long, 2009; Mackey, 2012; Mackey, Abbuhl, & Gass, 2012; Mackey & Goo, 2012), we refer to it as the interaction *approach*.

Since the early 1980s and since Long's update in 1996, the interaction approach has witnessed a growth in empirical research and is now at a point where meta-analyses and research syntheses can be carried out (Keck, Iberri-Shea, Tracy-Ventura, & Wa-Mbaleka, 2006; Li, 2010; Lyster & Saito, 2010; Mackey & Goo, 2007; Norris & Ortega, 2000; Plonsky & Gass, 2011; Russell & Spada, 2006). It is now commonly accepted within the SLA literature that there is a robust connection between interaction and learning. In the current chapter we provide an update in which we present a description of the constructs of the interaction approach as well as a discussion of the theoretical underpinnings that account for the link between interaction and learning.

The interaction approach attempts to account for learning through the learner's exposure to language, production of language and feedback on that production. As Gass (2003) notes, interaction research "takes as its starting point the assumption that language learning is stimulated by communicative pressure and examines the relationship between communication and acquisition and the mechanisms (e.g., noticing, attention) that mediate between them" (p. 224). In the following sections, we turn to an examination of the major components of this approach.

Input

Input is the *sine qua non* of acquisition. Quite simply it refers to the language that a learner is exposed to in a communicative context (i.e., from reading or listening,

or, in the case of sign language from visual language). In all approaches to second language acquisition, input is an essential component for learning in that it provides the crucial evidence from which learners can form linguistic hypotheses.

Because input serves as the basis for hypotheses about the language being learned, researchers within the interaction approach have sought over the years to characterize the input that is addressed to learners, and like UG researchers (see Chapter 3), interaction researchers also see input as providing positive evidence, that is, information about what is possible within a language. Early interaction researchers have shown that the language addressed to learners differs in interesting ways from the language addressed to native speakers and fluent second language speakers (for overviews, see Gass & Selinker, 2001; Hatch, 1983; Wagner-Gough & Hatch, 1975). This language that is addressed to learners has been referred to as modified input or, in the earlier literature, as foreigner talk.

One proposal concerning the function of modified input is that modifying input makes the language more comprehensible. If learners cannot understand the language that is being addressed to them, then that language is not useful to them as they construct their second language grammars. An example of how individuals modify their speech and the resultant comprehensibility is given below (from Kleifgen, 1985). In this example, a teacher of kindergarteners, including native and nonnative speakers of English at varying levels of proficiency, is providing instructions to the class and to individuals.

(1) Instructions to a kindergarten class

a. Instructions to English NSs in a kindergarten class

These are babysitters taking care of babies. Draw a line from Q to q.

From S to s and then trace.

b. To a single NS of English

Now, Johnny, you have to make a great big pointed hat.

c. To an intermediate-level native speaker of Urdu.

No her hat is big. Pointed.

d. To a low intermediate level native speaker of Arabic.

See hat? Hat is big. Big and tall.

e. To a beginning level native speaker of Japanese.

Big, big, big hat.

As shown in the example, when addressing a learner of a language, speakers often make adjustments that are likely to render the language comprehensible,

which, in turn, ease the burden for the learner. It is important to note that simplifications are not the only form of adjustments, which can also include elaborations, thereby providing the learner with a greater amount of semantic detail. An example of elaboration is seen in (2) (from Gass & Varonis, 1985). In this example, when the NNS indicates a possible lack of understanding (*Pardon me?*), the NS replies by elaborating on her original comment about nitrites, adding an example and restating that she doesn't eat them.

(2) Elaboration

NNS: There has been a lot of talk lately about additives and preservatives in food. In what ways has this changed your eating habits?
NS: I try to stay away from nitrites.
NNS: Pardon me?
NS: Uh, from nitrites in uh like lunch meats and that sort of thing. I don't eat those.

Input, along with negative evidence obtained through interaction (to which we turn next), is believed to be crucial for acquisition to occur, not only in the interaction approach but in other approaches as well (e.g., input processing) (see Chapter 7).

Interaction

Interaction, simply put, refers to the conversations that learners participate in. Interactions are important because it is in this context that learners receive information about the correctness and, more important, about the incorrectness of their utterances. Within the interaction approach, negative evidence, as in the UG literature (see Chapter 3), refers to the information that learners receive concerning the incorrectness of their own utterances. For our purposes, learners receive negative evidence through interactional feedback that occurs following problematic utterances, and provides learners with information about the linguistic and communicative success or failure of their production. Gass (1997) presents the model in Figure 10.1 to characterize the role negative evidence plays in the interaction-learning process.

Interpreting this, negative evidence, which can come *inter alia* through overt correction or negotiation, is one way of alerting a learner to the possibility of an error in his or her speech. Assuming that the error is noticed, the learner then has to determine what the problem was and how to modify existing linguistic knowledge. The learner then comes up with a hypothesis as to what the correct form should be (e.g., *he wented home* versus *he went* home). Obtaining further input (e.g., listening, reading) is a way of determining that in English one says *he went home*, but never says *he wented home*. Thus, listening for further input is a way to confirm or disconfirm a hypothesis that he or she may have come up with regarding

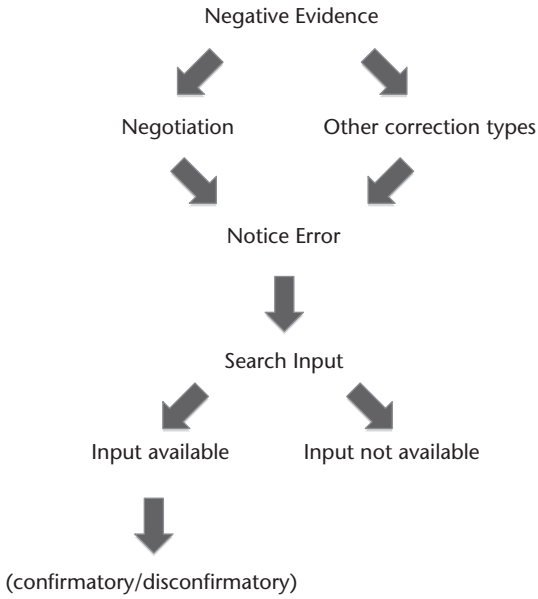

FIGURE 10.1 The function of negative evidence.

the nature of the target language. The learner may also use output to test these hypotheses, which we address next.

Output

Known in the literature as the Output Hypothesis (Swain, 1985, 1993, 1995, 1998, 2005), Swain's observations about the importance of output emerged from her research that took place in the context of immersion programs in Canada. Swain observed that children who had spent years in immersion programs still had a level of competence in the L2 that fell significantly short of native-like abilities. She hypothesized that what was lacking was sufficient opportunities for language use. She claims that language production forces learners to move from comprehension (semantic use of language) to syntactic use of language. As Swain (1995) states,

> output may stimulate learners to move from the semantic, open-ended nondeterministic, strategic processing prevalent in comprehension to the complete grammatical processing needed for accurate production. Output, thus, would seem to have a potentially significant role in the development of syntax and morphology. (p. 128)

For example, after producing an initially problematic utterance ('what happen for the boat?') and receiving feedback about its lack of comprehensibility in the

form of a clarification request ('what?'), the NNS in (3) appears to realize that his utterance was not understood. Pushed to reformulate his initial utterance in order to facilitate NS understanding, he modifies his linguistic output by reformulating the utterance in a more target-like way.

(3) Modified output (from McDonough, 2005)

LEARNER: what happen for the boat?
NS: what?
LEARNER: what's wrong with the boat?

In addition to pushing learners to produce more target-like output, another function of production, as mentioned earlier, is that it can be used to test hypotheses about the target language. An example of hypothesis testing is provided in example (4). This example comes from a study in which learners were involved in interactions (videotaped) and then interviewed immediately following, using the video as a prompt. The retrospective comments, given in the learners' L1 which was English (in particular, 'I'll say it and see') demonstrate that the learner was using the conversation as a forum through which she could test the accuracy of her knowledge.

(4) From Mackey, Gass, McDonough (2000) (INT=interviewer)

NNS: *poi un bicchiere*
then a glass
INT: *un che, come*?
a what, what?
NNS: *bicchiere*
glass
NNS RECALL COMMENTS: "I was drawing a blank. Then I thought of a vase but then I thought that since there was no flowers, maybe it was just a big glass. So, then I thought I'll say it and see."

Another function of output is to promote **automaticity**, which refers to the routinization of language use. Little effort is expended when dealing with automatic processes (e.g., driving from home to work is automatic and does not require much thought as to the route to take). Automatic processes come about as a result of "consistent mapping of the same input to the same pattern of activation over many trials" (McLaughlin, 1987, p. 134; cf. Chapter 6). We can consider the role of production as playing an integral role in automaticity. To return to the example of driving, the automaticity of the route from home to work occurs following multiple trips along that route. The first time may require more effort and more concentration. With regard to language learning, continued use of language moves learners to more fluent automatic production.

How Interaction Brings about Learning

The relationship among these three components can be summed up by Long's (1996) frequently cited explanation that

> *negotiation for meaning,* and especially negotiation work that triggers *interactional* adjustments by the NS or more competent interlocutor, facilitates acquisition because it connects input, internal learner capacities, particularly selective attention, and output in productive ways. (pp. 451–452)

Furthermore,

> it is proposed that environmental contributions to acquisition are mediated by selective attention and the learner's developing L2 processing capacity, and that these resources are brought together most usefully, although not exclusively, during *negotiation for meaning.* Negative feedback obtained during negotiation work or elsewhere may be facilitative of L2 development, at least for vocabulary, morphology, and language-specific syntax, and essential for learning certain specifiable L1-L2 contrasts. (p. 414)

In this view, through interaction, a learner's attentional resources (selective attention) are directed to problematic aspects of knowledge or production. First, the learner may notice that what she says differs from what a native speaker says. This is often referred to as *noticing the gap* (Schmidt & Frota, 1986). In addition, learners may notice that since they can't express what they want to express, they have a hole in their interlanguage (Swain, 1998). The interaction itself may also direct learner's attention to something new, such as a new lexical item or grammatical construction, thus promoting the development of the L2.

Feedback

There are two broad types of feedback: explicit and implicit. Explicit feedback includes corrections and metalinguistic explanations. Of concern to us here are implicit forms of feedback, which include negotiation strategies such as

- confirmation checks (expressions that are designed to elicit confirmation that an utterance has been correctly heard or understood, for example, *Is this what you mean*)
- clarification requests (expression designed to elicit clarification of the interlocutor's preceding utterances, for example, *What did you say?*)
- comprehension checks (expressions that are used to verify that an interlocutor has understood, for example, *Did you understand?*)
- recasts (a rephrasing of a non-target-like utterance using a more target-like form while maintaining the original meaning)

Feedback may help to make problematic aspects of learners' interlanguage salient and may give them additional opportunities to focus on their production or comprehension, thus promoting L2 development. For instance, in example (5), the NS's provision of implicit feedback in the form of confirmation checks (lines 2 and 4) gives the learner the opportunity to infer (from her interlocutor's lack of comprehension) that there was a problem with her pronunciation.

(5) Implicit feedback (from Mackey et al., 2000)

1 NNS: There's a basen of flowers on the bookshelf
2 NS: a basin?
3 NNS: base
4 NS: a base?
5 NNS: a base
6 NS: oh, a vase
7 NNS: vase

Feedback occurs during **negotiation for meaning**. Long (1996) defines negotiation as

> the process in which, in an effort to communicate, learners and competent speakers provide and interpret signals of their own and their interlocutor's perceived comprehension, thus provoking adjustments to linguistic form, conversational structure, message content, or all three, until an acceptable level of understanding is achieved. (p. 418)

Negotiation for meaning has traditionally been viewed and coded in terms of the "three Cs": confirmation checks, clarification requests, and comprehension checks, each of which we defined earlier. A confirmation check was seen in example (5). Examples (6) and (7) exemplify clarification requests. In example (6) the clarification request and rephrasings result in input that the learner finally seems to understand.

(6) Clarification Request and Rephrasing (from Mackey, 2000)

NS: A curve slightly to the left here and then straight ahead the road goes
NNS: A Er er straight?
NS: No, it goes on a curve left first, then it goes straight ahead
NNS: No, because dry cleaner is the way is here? Curve? It means how?
NS: Exactly so go a little bit to the left, curve slightly left, then go straight ahead with it
NNS: Oh a little bit left around then straight ahead goes first curve
NS: right, like that, exactly, right, curve, go straight ahead, no, no, no I mean left right curve left [laughs]
NNS: [laughs] curve

Example (7) illustrates a clarification request, in which Learner 2 needs more information to understand Learner 1's question about what is important to the character in the task.

(7) Clarification Request (from Gass, Mackey, & Ross-Feldman, 2005, 2011)

LEARNER 1: ¿Qué es importante a ella?
What is important to her?
→LEARNER 2: **¿Cómo?**
What?
LEARNER 1: ¿Qué es importante a la amiga? ¿Es solamente el costo?
What is important to the friend? Is it just the cost?

A comprehension check is an attempt to anticipate and prevent a breakdown in communication. In example (8) Learner 1 asks if Learner 2 needs him to repeat what he has just said, basically checking to see if Learner 2 has understood the previous utterance.

(8) Comprehension Check (from Gass et al., 2005)

LEARNER 1: La avenida siete va en una dirección hacia el norte desde la calle siete hasta la calle ocho. ¿Quieres que repita?
Avenue Seven goes in one direction toward the north from Street Seven to Street Eight. ***Do you want me to repeat?***
LEARNER 2: Por favor.
Please.
LEARNER 1: La avenida seven, uh siete, va en una dirección hacia el norte desde la calle siete hasta la calle ocho.
Avenue Seven, uh Seven, goes in one direction toward the north from Street Seven to Street Eight.

Through negotiation, input can be uniquely tailored to individual learners' particular strengths, weaknesses, and communicative needs, providing language that is in line with learners' developmental levels. Pica (1994, 1996) and Mackey (2012) describe how negotiation contributes to the language learning process, suggesting that negotiation facilitates comprehension of L2 input and serves to draw learners' attention to form–meaning relationships through processes of repetition, segmentation, and rewording. Gass (1997) similarly claims that negotiation can draw learners' attention to linguistic problems and proposes that initial steps in interlanguage development occur when learners notice mismatches between the input and their own organization of the target language.

Interaction research, with its focus on the cognitive processes that drive learning, has augmented and in some cases replaced the three Cs with other constructs, including *recasts.* Recasts are a form of implicit feedback, have received a great deal

of attention in recent research. Nicholas, Lightbown, and Spada (2001) define recasts as "utterances that repeat a learner's incorrect utterance, making only the changes necessary to produce a correct utterance, without changing the meaning" (p. 733). In other words, recasts are interactional moves through which learners are provided with more linguistically target-like reformulations of what they have just said. A recast does not necessarily involve the repetition of a learner's entire utterance, and may include additional elaborations not present in the original propositional content, but it is semantically contingent upon the learner's utterance and often temporally juxtaposed to it. For instance, in example (9), a NS recasts a NNS's utterance.

(9) Recast (from Oliver & Mackey, 2003)

NNS: A dog in here, or two of them
NS: A duck in the pond or two ducks
NNS: Yes

Recasts have been associated with L2 learning in a number of primary research studies (e.g., Ammar, 2008; Ammar & Spada, 2006; Ayoun, 2001; Bigelow, Delmas, Hansen, & Tarone, 2006; Braidi, 2002; Carpenter, Jeon, MacGregor, & Mackey, 2006; Egi, 2007; Ellis & Sheen, 2006; Goo, 2012; Han, 2002; Ishida, 2004; Iwashita, 2003; Kim & Han, 2007; Leeman, 2003; Loewen & Philp, 2006; Lyster, 2004; Lyster & Izquierdo, 2009; Mackey & Philp, 1998; McDonough & Mackey, 2006; Morris, 2002; Nassaji, 2009; Nicholas et al., 2001; Philp, 2003; Révész, 2012; Révész & Han, 2006; Sachs & Suh, 2007; Sagarra, 2007; Sheen, 2008; Storch, 2002; Trofimovich, Ammar, & Gatbonton, 2007) as well as meta-analyses (e.g., Mackey & Goo, 2007; Li, 2010). Current research has also indicated that recasts and negotiation may work to impact learning in different ways. For example, recasts are complex discourse structures that have been said to contain positive evidence (a model of the correct form), negative feedback (since the correct form is juxtaposed with the non-target-like form) in an environment where the positive evidence is enhanced (because of the juxtaposition). If learners do not selectively attend to and recognize the negative feedback contained in recasts, then the documented contribution of recasts to learning might be attributed to the positive evidence they contain, or to the enhanced salience of the positive evidence, which is one of Leeman's (2003) suggestions.

While negotiation for meaning always requires learner involvement, as shown in example (5), recasts do not consistently make such participatory demands, as shown by the learner's simple "yes" in response to the recast in example (9). As a number of researchers (e.g., Lyster, 1998a, 1998b) have pointed out, reformulations sometimes occur after grammatical utterances as well, and a recast may be perceived as responding to the *content* rather than the *form* of an utterance, or as an optional and alternative way of saying the same thing. Thus, learners may not repeat or rephrase their original utterances following recasts, and they may not even perceive recasts as feedback at all (Mackey et al., 2000; McDonough &

Mackey, 2006). It also must be kept in mind that even when learners *do* understand the corrective nature of recasts, they may have trouble understanding and addressing the source of the problem (as discussed by several researchers, including Carroll, 2001). However, it is possible that neither a response nor a recognition of the corrective intent of the recast is crucial for learning (Mackey & Philp, 1998) and a substantial body of research, using increasingly innovative methods, has linked recasts with L2 learning of different forms, in different languages, for a range of learners in both classroom and laboratory contexts (for a review, see Mackey & Gass, 2006).

Language-Related Episodes

Another construct, language-related episodes (LREs), is also studied within the context of interaction. Briefly defined, LREs refer to instances where learners consciously reflect on their own language use, or, more specifically "instances in which learners may (a) question the meaning of a linguistic item; (b) question the correctness of the spelling/pronunciation of a word; (c) question the correctness of a grammatical form; or (d) implicitly or explicitly correct their own or another's usage of a word, form or structure" (Leeser, 2004, p. 56; see also Swain & Lapkin, 1998; Williams, 1999). LREs, as Williams (1999) notes, encompass a wide range of discourse moves, such as requests for assistance, negotiation sequences, and explicit and implicit feedback, and are generally taken as signs that learners have noticed a gap between their interlanguages (or their partners' interlanguages) and the system of the target language. Example (10) illustrates a language-related episode where students discuss the gender of the word for 'map'.

(10) Language-Related Episode (from Gass et al., 2005)

LEARNER 1: Los nombres en el mapa. ¿Es el mapa o la mapa?
The names on the map. Is it the (m.) map or the (f.) map?
LEARNER 2: El mapa
The (m.) map

Based on this example, it might be possible to conclude that Learner 1 recognized a gap in her knowledge of Spanish gender, and thus produces an LRE (an explicit request for assistance). A number of studies investigating L2 learners' use of LREs have found that LREs not only represent language learning in process (Donato, 1994; Swain & Lapkin, 1998) but are also positively correlated with L2 development (e.g., Basturkmen, Loewen, & Ellis, 2002; Leeser, 2004; Williams, 2001).

Attention

While input such as that provided in recasts may be regarded as a catalyst for learning, and LREs as evidence that learning processes are being engaged, attention

is believed to be one of the mechanisms that mediates between input and learning (or intake, as the input-learning process is sometimes called). It is widely agreed that second language learners are exposed to more input than they can process, and that some mechanism is needed to help learners "sort through" the massive amounts of input they receive. As Gass, Svetics, and Lemelin (2003) explain, "language processing is like other kinds of processing: Humans are constantly exposed to and often overwhelmed by various sorts of external stimuli and are able to, through attentional devices, 'tune in' some stimuli and 'tune out' others" (p. 498). Attention, broadly conceptualized, may be regarded as the mechanism that allows learners to "tune in" to a portion of the input they receive.

Although generally held to be crucial for SLA, attention has nevertheless been the focus of much recent debate in the field. Schmidt (1990, 2001), for example, argues that learning cannot take place without awareness because the learner must be consciously aware of linguistic input in order for it to become internalized; thus, awareness and learning cannot be dissociated. Similarly, Robinson (1995, 2001, 2002) claims that attention to input is a consequence of encoding in working memory, and only input encoded in working memory may be subsequently transferred to long-term memory. Thus, in Robinson's model, as in Schmidt's, attention is crucial for learning, and in both models, no learning can take place without attention and some level of awareness. An alternative and distinct perspective, emerging from work in cognitive psychology (Posner, 1988, 1992; Posner & Peterson, 1990), is presented by Tomlin and Villa (1994), who advocate for a disassociation between learning and awareness. As can be seen from this brief overview, not all researchers use the same terminology when discussing attention, and in fact, there have been proposals that have divided attention into different components. What is important for the current chapter is that interaction researchers assume that the cognitive constructs of attention, awareness, and the related construct of noticing are part of the interaction-L2 learning process.

Working memory (WM) has also been implicated as a potential explanation for how interaction-driven L2 learning takes place, as well as language learning in general. For example, in a study of Japanese L1 English language learners, Mackey, Philp, Egi, Fujii, and Tasumi's (2002) research showed that WM was associated with the noticing of recasts, Trofimovich, Ammar, and Gatbonton (2007) suggested that WM (along with attention control and analytical ability) was associated with their Francophone learners' production of English morphosyntax. Such research suggests that WM may play an important role in the processing and use of recasts by L2 learners. Another factor that may relate to a learner's ability to benefit from interaction is their ability to suppress information, referred to as inhibitory control. Gass, Behney, and Uzum (2013) found evidence that those individuals who were better able to suppress interfering information were also better able to learn from interaction.

There have been in total nearly a hundred empirical studies of the various different aspects of interaction since the mid-1990s. As outlined in Mackey et al.

(2012), researchers have concentrated on interaction and its impact on specific morphosyntactic features, finding benefits for a range of features, "including articles (Muranoi, 2000; Sheen, 2007), questions (Mackey, 1999; Mackey & Philp, 1998; Philp, 2003), past tense formation (Doughty & Varela, 1998; Ellis, 2007; Ellis, Loewen, & Erlam, 2006; McDonough, 2007), and plurals (Mackey, 2006)" (p. 10). As they also point out, these results have been found with children as well as adults (Mackey & Oliver, 2002; Mackey & Silver, 2005; van den Branden, 1997) and older adults (Mackey & Sachs, 2012), and in classroom as well as laboratory settings (Gass, Mackey, & Ross-Feldman, 2005; Russell & Spada, 2006), and with several different languages, including French (Ayoun, 2001; Swain & Lapkin, 1998, 2002), Japanese (Ishida, 2004; Iwashita, 2003), Korean (Jeon, 2007), and Spanish (de la Fuente, 2002; Gass & Alvarez-Torres, 2005; Leeman, 2003) as well as in CALL contexts (Smith, 2012).

The interaction research agenda now seems focused on a range of different questions, including (a) grammatical aspects of the L2 and their likelihood of being impacted by interaction, (b) individual difference variables, such as working memory, inhibition, and cognitive creativity, and how these might be related to the link between interaction and L2 development, and (c) what forms of interaction (and in particular, what types of feedback) are the most beneficial for L2 learner in particular contexts and settings. There has also been a move to recognize the influence of the social context in interaction, with factors such as the relationship between the learners affecting *inter alia* their willingness to communicate (Dornyei, 2009) and therefore their opportunities to learn through interaction (Philp & Mackey, 2010). The field has reached some level of maturity with the before mentioned meta-analyses, and analyses of quality (Plonsky & Gass, 2011).

What Counts as Evidence?

As Mackey and Gass (2005) point out, the goal of much interaction-based research involves manipulating the kinds of interactions that learners are involved in, the kind of feedback they receive during interaction, and the kind of output they produce, to determine the relationship between the various components of interaction and second language learning. Thus, longitudinal designs, cross-sectional designs (sampling learners at different proficiency levels) and case studies are all appropriate methods. However, the most common way of gathering data is to involve learners in a range of carefully planned tasks.

Tasks

Various ways of categorizing task types have been discussed (for discussions of task categorization, see Ellis, 2003; Mackey & Gass, 2007; Pica, Kanagy, & Falodun, 1993). For example, a common distinction is to classify tasks as one-way and two-way. In a one-way task, the information flows from one person to the other, as

when a learner describes a picture to her partner. In other words, the information that is being conveyed is held by one person. In a two-way task, there is an information exchange whereby both parties (or however many participants there are in a task) hold information that is vital to the resolution of the task. For example, in a story completion task, each learner may hold a portion of the information and must convey it to the other learner(s) before the task can be successfully completed. Each type of task may produce different kinds of interaction, with different opportunities for feedback and output.

Interaction researchers are usually interested in eliciting specific grammatical structures to test whether particular kinds of interactive feedback on non-target-like forms are associated with learning. Learning is sometimes examined through immediate changes in the learners' output on the particular structures about which they have received interactional feedback, although short- and longer-term change on posttests is generally considered to be the gold standard.

Obviously, tasks need to be carefully pilot-tested to ensure they produce the language intended. It is also possible, and becoming more common in interaction research, to try to examine learners' thought processes as they carry out a task or to interview learners on previous thought processes. For example, if a researcher employed a dictogloss task (a type of consensus task where learners work together to reconstruct a text that has been read to them; Swain & Lapkin, 2002), that researcher could examine the text that learners produce (the output). Or, instead of examining the output in isolation, the researcher could also ask the learners to think aloud as they carry out the task (this is known as an introspective protocol or "think aloud"). Alternatively, the researcher could ask the learners to make retrospective comments as soon as they are finished with a task. This is often done by providing the learners with a video replay to jog their memories (a procedure known as **stimulated recall**) (Gass & Mackey, 2000).

Difficulties in Determining Learning

It is often difficult to determine if learning has actually taken place. One difficulty, common in any approach to SLA, is in the operationalization of learning. If a learner utters a new form once and then does not do so again for two months, does that constitute knowledge? If a learner utters a new form two times, does that constitute knowledge? All of these (and many more) are ones that are often faced when conducting research on interaction and second language learning more generally.

A second difficulty in determining learning occurs when considering actual interactions in the absence of posttests or in the absence of some commentary, as in a stimulated recall or a language related episode. If we consider the example presented in (5), for instance, it might appear on the surface that the NS and NNS have negotiated the difficulty to the point where the NS did understand that the NNS is referring to a *vase* rather than a *basin*. But when we focus on the NNS,

we need to ask what learning has occurred. Is she simply repeating what the NS had said without true understanding, or did some type of learning take place? Or was some process engaged that might eventually lead to, or facilitate, later learning. Example (11), taken from Hawkins (1985), illustrates a similar concern:

(11) From Hawkins (1985)

NS:	Number two, . . . is . . . the man . . . look for help
NNS:	Uh-huh, (yes) for help.
NS:	Help, you know . . ."Aah! Help" (shouts softly)
NNS:	Uh-huh. (yes)
NS:	No *Up* . . . *HELP.*
→NNS:	Help
NS:	Yeah . . . He asked, . . . he asked . . . a man . . . for . . . help.
→NNS:	. . . for help
NS:	Yeah . . . he asked . . . the man . . . for telephone.

The question that must be addressed is what does *help* and *for help* mean. Is it a recognition that implies comprehension? Or, can we assume that this learner has indicated comprehension and that this is indeed an initial part of the learning process? In fact, an interview with the participants showed that no comprehension had taken place and hence no learning. The response was only a means for keeping the social discourse from falling apart.

These examples help foreground the concern that whatever the data source, the important point is not to rely solely on the transcript of the interaction but to investigate the link between interaction and learning by whatever means possible. For this reason, research designs which employ pretests and posttests (and ideally, delayed posttests and possibly tailor-made posttests as well) and/or designs that include introspective or retrospective protocols are of value. As research designs progress, clearer answers to the questions about interaction and learning can be obtained.

Common Misunderstandings

Here we will consider two common areas of misunderstanding about input, interaction, and SLA. These relate to the nature of the interaction approach and the relationship of the interaction approach to teaching methods.

The first misunderstanding concerns the scope of the interaction approach. Although occasionally criticized for not addressing all aspects of the learning process (such as how input is processed, or the sociocultural context of the learning), the interaction approach, like all SLA approaches and theories, takes as its primary focus *particular aspects* of the second language learning process. Some theories focus on innateness, others on the sociolinguistic context, and still others purely on the

cognitive mechanisms involved in learning a language. The interaction approach, for the time being, is focused primarily on the role of input, interaction, and output in learning. Future research will undoubtedly be enriched by exploring the connections between various approaches to SLA in greater depth, so as to arrive at a more comprehensive explanation of the second language acquisition process.

A second misunderstanding is that the interaction approach can be directly applied to classroom methodology. For example, work on task-based language teaching (see Bygate, Skehan, & Swain, 2001; Ellis, 2003) and focus on form (Long & Robinson, 1998) both draw heavily on the Interaction Hypothesis as part of their theoretical basis. Task-based language teaching and the research that supports its use, in the words of Ellis (2003), "has been informed primarily by the interaction hypothesis" (p. 100). Like most SLA researchers, however, Ellis is cautious about making direct connections between theory, research, and teaching practice, saying both that "the case for including an introduction to the principles and techniques of task-based teaching in an initial teacher-training program is a strong one" and also that "if task-based teaching is to make the shift from theory to practice it will be necessary to go beyond the psycholinguistic rationale . . . to address the contextual factors that ultimately determine what materials and procedures teachers choose" (p. 337). The interaction approach, like most other accounts of second language acquisition, is primarily focused on how languages are *learned*. Thus, direct application to the classroom may be premature.

An Exemplary Study: Mackey, Gass, and McDonough (2000)

The study carried out by Mackey et al. (2000) illustrates many of the issues and constructs discussed in this chapter. Their research investigated how second and foreign language learners perceived the feedback they received in the course of interaction. The main research questions were as follows: (a) Could learners accurately perceive feedback that was offered to them during task-based interaction? (b) Did learners perceive the feedback as feedback? (3) Did they recognize the linguistic target(s) of the feedback?

The participants were nonnative speakers in an ESL context and in an Italian as a foreign language (IFL) context. They were adult learners enrolled in language courses at a U.S. university. The ESL learners (n = 10) were from a variety of L1 backgrounds including Cantonese, French, Japanese, Korean, and Thai. The IFL learners (n = 7) had studied or were studying Italian at the same university. All participants were classified at the beginner or lower-intermediate level.

Each learner carried out a communicative task with a native (English) or near-native (Italian) interviewer. The tasks were two-way information exchange activities. All participants had a picture that was similar to their partners' picture. The tasks involved the learners and interviewers working together to identify the differences between their pictures. Each session lasted for approximately 15–20 minutes and was videotaped. During the interaction, the English and Italian interviewers

provided interactional feedback when the participants produced a non-target-like utterance. The interviewers were instructed to provide interactional feedback wherever it seemed appropriate and in whatever form seemed appropriate during the interaction. Thus, the feedback provided during the task-based interaction occurred in response to errors in morphosyntax, phonology, lexis, or semantics and occurred in the form of negotiation and recasts.

Introspective data were collected from the learners using stimulated recall methodology (Gass & Mackey, 2000). Immediately following completion of the task-based activities, the videotape was rewound and played for each learner by a second researcher who also gave the directions for this part of the research to the learner. While watching the videotape, the learners could pause the tape if they wished to describe their thoughts at any particular point in the interaction. The researcher also paused the tape after episodes in which interactional feedback was provided, and asked learners to recall their thoughts at the time the original interaction was occurring. These recall sessions, which were audiotaped, were conducted in English (the L2 for the ESL participants and the L1 for the IFL participants). This recall procedure was aimed at eliciting learners' original perceptions about the feedback episodes—that is, their perceptions at the time they were taking part in the interaction.

The interactional feedback episodes and the stimulated-recall comments that were provided about the episodes were coded and analyzed. The number of feedback episodes in the ESL data in which the learners perceived the target of the feedback differed according to the feedback type. Whereas learners' reports indicated they often recognized the feedback for lexis and phonology (83% and 60%, respectively), they generally did not indicate that they recognized the target of morphosyntactic feedback (13%). In relation to morphosyntactic feedback, ESL learners were more likely to report that they were thinking about the semantic content of the morphosyntactic episodes (38%) or not about the content at all (21%). With such a small percentage of morphosyntactic feedback being recognized as being about morphosyntax, the window of opportunity for these learners to notice grammar in interaction may have been relatively small. Having said this, it is important to note that although the study did touch upon the learners' reports and therefore their internal processes, more focused research is necessary to examine the relationship between noticing and L2 development.

For the Italian learners, when the feedback provided to the learner during interaction was morphosyntactic in nature, learners recognized the nature of 24% of the feedback. Almost half of the time, they perceived morphosyntactic feedback as being about lexis. The amount of phonological feedback provided to the learners was quite low (18%), with less than a quarter being perceived as related to phonology. In contrast, lexical feedback episodes were perceived to be about lexis almost two-thirds of the time (66%).

In summary, what this study of L2 learners' perceptions about feedback in conversational interaction showed was that learners were most accurate in their

perceptions about lexical and phonological feedback, and were generally inaccurate in their perceptions about morphosyntactic feedback. Morphosyntactic feedback was often perceived as being about semantics for the ESL learners and about lexis for the IFL learners. Proponents of the interaction approach have suggested that interaction can result in feedback that focuses learners' attention on aspects of their language that deviate from the target language. If learners' reports about their perceptions can be equated with attention, then the findings in this study are consistent with the claims of the Interaction Hypothesis, at least with regard to the lexicon and phonology.

Explanation of Observable Phenomena

As we noted in the first section of this chapter, the interactionist approach does not address all aspects of SLA and therefore does not account for all of the observable phenomena outlined in Chapter 1. In this section, therefore, we discuss the observable phenomena that are most relevant to the interactionist approach.

Observation 1: Exposure to input is necessary for SLA. The interactionist approach relies heavily on input to account for SLA and so is in agreement with Observation 1. However, there is no assumption in the interactionist approach that input alone is sufficient. In fact, it is the way that a learner interacts with the input (through interaction) that is at the heart of this approach. If input were sufficient, we would not have so many learners, who despite years in a second language environment, are not highly proficient. For example, the French immersion students Swain makes reference to in her studies should have been able to acquire native-like proficiency in the L2 as they were consistently exposed to the L2.

Observation 2: A good deal of SLA happens incidentally. The interactionist approach does not deal specifically with incidental learning, but insofar as attention is seen a driving explanatory force behind the interactionist approach, incidental learning is not seen as major part of second language learning. Within the interactionist approach, learning takes place through an interactive context. For example, negotiation for meaning involves the learner in directing specific attention toward a linguistic problem.

Observation 5: Second language learning is variable in its outcome. To the extent that this observation is compatible with the idea that individuals vary in whether and how they negotiate meaning as well as the extent to which they focus attention on specific parts of language, it is in keeping with interactionist proposals. Keeping in mind the importance to interaction proposals of the individual learner and their cognitive capacity (as opposed to innate dispositions), this would suggest, then, that individuals will have different results in terms of their outcomes.

Observation 7: There are limits on the effects of frequency on SLA. A frequency-based explanation of SLA is compatible with some of the interactionist claims in that one way in which interactional modifications are claimed to impact development

is through facilitating pattern identification and recognition of matches and mismatches. However, input frequency is not sufficient to account for learning in the absence of some other considerations. For example, in an interactionist approach, the native language might play some role when trying to understand which forms a learner might attend to following feedback, particularly implicit feedback. The impact of frequency is dependent on a learner's noticing the input. Other factors such as the native language may play a role in determining what is noticed and what is not.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. At this point in SLA research, no approach or theory can account for all learning. The interactionist approach is no exception. The interactionist approach takes a particular perspective on output and highly values pushed or modified output, or that output which involves a learner attempting to go beyond his/her current level of knowledge. In other words, the most important output is that output which stretches the limited linguistic resources of a learner. Thus, while output that is pure practice may be important for automatization, it is less valuable for language development.

The Explicit/Implicit Debate

Regarding the role of explicit and implicit learning in relation to the interaction approach, the approach does not make claim about learning processes or knowledge types, but it does make claims about feedback types, in particular, the roles of implicit and explicit feedback. As has been noted in earlier discussions, one of the central components of the interaction approach is the role of attention. If attention is central, one must then consider how attention is drawn to language forms and/or functions. For example, is it explicit (e.g., through metalinguistic correction) or is it implicit (e.g., through recasts)? Both are beneficial for language learning (see Goo & Mackey, 2013, for a review of the recast literature), but the interaction approach, with few exceptions, does not go further to investigate the type of knowledge that results.

One notable exception comes from Ellis, Loewen, and Erlam (2006) who measured two types of feedback on the acquisition of English past tense and their relationship to implicit and explicit knowledge (learning processes are not dealt with in their study). Their learning data came from three tests, an untimed grammaticality judgment test, a metalinguistic knowledge test, and an oral imitation test. The first two of these were intended to provide information about explicit knowledge and the latter about implicit knowledge. What they claim is that both implicit and explicit knowledge benefit from feedback (more so from metalinguistic feedback than implicit feedback).

Thus, even though interaction-based research is centrally concerned with development that emanates from an interactive event that includes both implicit and explicit information, it has been silent on the result of the predicted result of that information.

Conclusion

In this chapter, the perspective offered by input and interaction has been presented. The central tenet of the approach is that interaction facilitates the process of acquiring a second language, as it provides learners with opportunities to receive modified input, to receive feedback, both explicitly and implicitly, which in turn may draw learners' attention to problematic aspects of their interlanguage and push them to produce modified output.

Discussion Questions

1. The authors describe this approach as a model and not a theory. Do you agree? Why?
2. Is the Input-Interaction-Output approach compatible with, for example, the UG approach (Chapter 3) and frequency-based approach (Chapter 5)?
3. Describe the role of negative evidence within Gass and Mackey's approach. Does this differ from other approaches you have read about in this volume?
4. The concept of "negotiation of meaning" has gained wide acceptance in language teaching circles in North America. Why do you think this is so? In what contexts or situations do you think negotiation of meaning might not be as enthusiastically embraced?
5. One possible critique of the Input-Interaction-Output approach is that it ignores the broader social context of language learning variables that may come to play in peoples' interactions, for example, power relationships, social status, or gender. Do you think this is a valid criticism? To what extent would a theory of SLA need to consider such social factors?
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Suggested Further Reading

Gass, S. M. (1997). *Input, interaction, and the second language learner.* Mahwah, NJ: Lawrence Erlbaum.

This book provides a thorough and accessible introduction to the main components of the interaction approach, including classroom applications and implications.

Gass, S. M. (2003). Input and interaction. In C. Doughty & M. H. Long (Eds.), *Handbook of second language acquisition* (pp. 224–255). Oxford, England: Blackwell.

In this article, Gass provides an overview of the interaction approach from a cognitive perspective. The article considers the role of input and output from the perspective of the *sine qua non* of learning. She considers both input and interaction in early and more recent SLA studies and discusses the research that links interaction and learning. Gass additionally focuses on the role of attention and relates it to the theory of contrast proposed by Saxton (1997).

Long, M. H. (1996). The role of the linguistic environment in second language acquisition. In W. Ritchie & T. K. Bhatia (Eds.), *Handbook of language acquisition: Vol. 2. Second language acquisition* (pp. 413–468). San Diego, CA: Academic Press.
One of the most often cited articles in the field, Long's article discusses the theoretical underpinnings of the interaction approach, including positive evidence, comprehensible input, input and cognitive processing, and negotiating for meaning.

Mackey, A. (2007). Interaction and second language development: Perspectives from SLA research. In R. DeKeyser (Ed.), *Practice in second language learning: Perspectives from linguistics and psychology.* (pp. 85–110). Cambridge, England: Cambridge University Press.
In this chapter, research on interaction in second language acquisition pointing to the importance of a range of interactional processes in the second language learning process is discussed. These processes include negotiation for meaning, the provision of feedback, and the production of modified output. Highlighted in this chapter is the importance of cognitive (learner-internal) factors such as attention, noticing, and memory for language.

Mackey, A. (Ed.). (2007). *Conversational interaction in second language acquisition*. Oxford, England: Oxford University Press.
This book provides an edited collection of empirical studies on a variety of issues concerning the relationship between conversational interaction and second language learning. In particular, it highlights the benefits of interactional feedback, explores the relationship between learners' perceptions and learning, and investigates individual differences and social and cognitive factors.

Mackey, A. (2012). *Input, interaction, and corrective feedback in L2 learning.* Oxford, England: Oxford University Press.
This book provides a comprehensive and up-to-date survey of 20 years of research on interaction-driven second language learning, with a particular interest in the recent growth in research into the role of cognitive and social factors in evaluating how interaction works.

Mackey, A., & Abbuhl, R. (2005). Input and interaction. In C. Sanz (Ed.), *Internal and external factors in adult second language acquisition* (pp. 207–233). Washington, DC: Georgetown University Press.
This chapter provides a detailed overview of the interaction approach, discussing both empirical work that has investigated the relationship between interaction and L2 development and implications for L2 pedagogy.

Mackey, A., Abbuhl, R., & Gass, S. (2012). Interactionist approach. In S. Gass & A. Mackey (Eds.), *The Routledge handbook of second language acquisition* (pp. 7–23). New York, NY: Routledge.
This chapter provides an overview of the historical background of the interactionist approach and discusses core issues surrounding it. It examines some ways of collecting data, explores practical applications of the approach, and gives directions for future research.

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11

SOCIOCULTURAL THEORY AND SECOND LANGUAGE DEVELOPMENT

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The intent of this chapter is to familiarize readers with the principles and constructs of an approach to learning and mental development known as *Sociocultural Theory* (SCT).[1] SCT has its origins in the writings of the Russian psychologist L. S. Vygotsky and his colleagues. SCT argues that human mental functioning is fundamentally a **mediated** process that is organized by **cultural artifacts,** activities, and concepts (Ratner, 2002).[2] Within this framework, humans are understood to utilize existing, and to create new, cultural artifacts that allow them to **regulate,** or more fully monitor and control, their behavior. Practically speaking, developmental processes take place through participation in cultural, linguistic, and historically formed settings such as family life, peer group interaction, and institutional contexts like schooling, organized social activities, and workplaces (to name only a few). SCT argues that while human neurobiology is a necessary condition for **higher mental processes,** the most important forms of human cognitive activity develop through interaction within social and material environments, including conditions found in instructional settings (Engeström, 1987). Importantly, and as an outgrowth of SCT's roots in Marxism and continental social theory (see discussion immediately following), SCT and its sibling approaches, such as cultural-historical activity theory, emphasize not only research and understanding of human developmental processes, but also praxis-based research, which entails intervening and creating conditions for development (see Lantolf & Poehner, 2014). Indeed, contemporary SCT-informed projects increasingly weight intervention studies and active engagement, as will be discussed in the exemplary study and other sections of this chapter.

The intellectual roots of sociocultural theories of human development extend back to 18th and 19th century German philosophy (particularly Hegel and

Spinoza), the sociological and economic writings of Marx and Engels (specifically *Theses on Feuerbach* and *The German Ideology*), and most directly to the research of Vygotsky and his colleagues Luria and Leont'ev (see Valsiner & van der Veer, 2000). Despite the fact that Vygotsky suffered an untimely death in 1934 at only 38 years of age, he had a tremendously productive career that was profoundly influenced by the fact that he came of age during the Russian Revolution. In his work, Vygotsky attempted to formulate "a psychology grounded in Marxism" (Wertsch, 1995, p. 7) that emphasized locating individual development within material, social, and historical conditions. Wertsch (1985, p. 199) has suggested that Vygotsky's developmental research was inspired by three essential principles of Marxist theory: the idea (a) that human consciousness is fundamentally social, rather than merely biological, in origin, (b) that human activity is mediated by material artifacts (e.g., computers, the layout of built environments) and psychological and symbolic tools/signs (e.g., language, literacy, numeracy, concepts), and (c) that units of analysis for understanding human activity and development should be holistic in nature.

This chapter describes the major theoretical principles and constructs associated with SCT and focuses specifically on second language acquisition (SLA) as a psychological process that should be accounted for through the same principles and concepts that account for all other higher mental processes. Particular attention is given to development in instructed settings, where activities and environments may be intentionally organized according to theoretical principles in order to optimally guide developmental processes. In the first section, we elaborate on mediation—the central construct of the theory. We then discuss and relate to SLA other aspects of SCT, namely, **private speech, internalization,** regulation (closely connected to mediation and **internalization**), and the **Zone of Proximal Development.** We also consider SCT-informed L2 pedagogy, in particular the growing bodies of work in **dynamic assessment** and **Systemic-Theoretical Instruction.**

The Theory and Its Constructs

Mediation

Vygotsky developed a unified theory of human mental functioning that initiated a new way of thinking about development. He acknowledged that the human mind comprised **lower mental processes,** but the distinctive dimension of human consciousness was its capacity for voluntary control over biology through the use of higher level symbolic artifacts (i.e., language, literacy, numeracy, categorization, rationality, logic, etc.). These artifacts, all of which derive from the historical accumulation of human cultural activity and development (Tomasello, 1999), serve as a buffer between the person and the environment and act to mediate the relationship between the individual and the social-material world.

To better understand psychological mediation via conceptual and semiotic tools, we can consider the more obvious relationship between humans and the physical world that is mediated by concrete tools. If we want to dig a hole in the ground to plant a tree, it is possible, following the behavior of other species, simply to use our hands. However, modern humans rarely engage in such nonmediated activity; instead we mediate the digging process through the use of a shovel, which allows us to make more efficient use of our physical energy and to dig a more precise hole. We can be even more efficient and expend less physical energy if we use a mechanical digging device such as a backhoe. Notice that the object of our activity remains the same whether we dig with our hands or with a tool, but the action of digging itself changes its appearance when we shift from hands to a shovel or a backhoe. Physical tools imbue humans with a great deal more ability than natural endowments alone. We are generally not completely free to use a tool in any way we like. The design of the tool as well as the habitual patterns of its use influence the purposes to which it is put and methods by which it is used (Thorne, 2003, 2009).

Within SCT, an important form of mediation is termed regulation. When children learn language, words not only function to isolate specific objects and actions, they also serve to reshape biological perception into cultural perception and concepts (see also Gibson, 1979; for an interface of SCT and language socialization, see Duff, 2007). SCT researchers describe a developmentally sequenced shift in the locus of control of human activity as object-, other-, and self-regulation. Object-regulation describes instances when artifacts in the environment afford cognition/activity, such as the use of an online translation tool to look up unknown words while reading or writing, the use of PowerPoint or an outline when making an oral presentation, or pen and paper for making a to-do list or working out mathematical problems. Other-regulation describes mediation by people and can include explicit or implicit feedback on grammatical form, corrective comments on writing assignments, or guidance from an expert or teacher. In our later discussion of the Zone of Proximal Development we will illustrate how other-regulation functions in the case of second language (L2) learning. Self-regulation refers to individuals who have internalized external forms of mediation for the execution or completion of a task. In this way, development can be described as the process of gaining greater voluntary control over one's capacity to think and act either by becoming more proficient in the use of meditational resources, or through a lessening or severed reliance on external meditational means (Thorne & Tasker, 2011).

To be a proficient user of a language, first language (L1) or otherwise, is to be self-regulated; however, self-regulation is not a stable condition. Even the most proficient communicators, including native speakers, may need to **reaccess** earlier stages of development (i.e., other- or object-regulation) when confronted with challenging communicative situations. Under stress, for example, adult native users of a language produce ungrammatical and incoherent utterances (see Frawley,

1997). In this instance, an individual may become regulated by the language as an object and instead of controlling the language; they become disfluent and may require assistance from another person or from objects such as a thesaurus, dictionary, or exemplar of a genre specific text. Each of the three stages—object regulation, other regulation, and self-regulation—are "symmetrical and recoverable, an individual can traverse this sequence at will [or by necessity], given the demands of the task" (Frawley, 1997, p. 98).

Mediation by Symbolic Tools

Vygotsky reasoned that in a parallel fashion to the development and use of material tools, humans also have the capacity to create and use symbols as tools to mediate their own psychological activity. He proposed that while physical tools are outwardly directed, symbolic tools are inwardly or cognitively directed. Just as physical tools serve as auxiliary means to enhance the ability to control and change the physical world, symbolic tools serve as an auxiliary means to control and reorganize our biologically endowed mental processes. This control allows humans, unlike other species, to inhibit and delay the functioning of automatic biological processes. Rather than reacting instinctively and nonthoughtfully to stimuli, we are able to consider possible actions (i.e., plan) on an ideal plane before realizing them on the objective plane. Planning itself entails memory of previous actions, attention to relevant (and overlooking of irrelevant) aspects of the situation, rational thinking, and projected outcomes. All of this, according to Vygotsky, constitutes human consciousness. From an evolutionary perspective, this capacity imbues humans with a considerable advantage over other species, because, through the creation of auxiliary means of mediation, we are able to assay a situation and consider alternative courses of action and possible outcomes on the ideal or mental plane before acting on the concrete objective plane (see Arievitch & van der Veer, 2004).

Language in all its forms is the most pervasive and powerful cultural artifact that humans possess to mediate their connection to the world, to each other, and to themselves. The key that links thinking to social and communicative activity resides in the double function of the linguistic sign, which simultaneously points in two directions—outwardly, "as a unit of social interaction (i.e., a unit of *behavior*)," and inwardly, "as a unit of thinking (i.e., as a unit of *mind*)" (Prawat, 1999, p. 268; italics original). The inward or self-directed use of language as a symbolic tool for cognitive regulation is called private speech (see Lantolf & Thorne, 2006). When we learn to communicate socially, we appropriate the patterns and meanings of this social speech and also utilize it inwardly to mediate our mental activity.

Considerable research has been carried out on the development of private speech among children learning their first language (see Diaz & Berk, 1992; Wertsch, 1985). L2 researchers, beginning with the work of Frawley and Lantolf (1985), have also begun to investigate the cognitive function of private speech. Private speech is defined as an individual's externalization of language for

purposes of maintaining or regaining self-regulation, for example to aid in focusing attention, problem solving, orienting oneself to a task, to support memory related tasks, to facilitate internalization of novel or difficult information (e.g., language forms, sequences of numbers and mathematical computation), and to objectify and make salient phenomena and information to the self (e.g., DiCamilla & Anton, 2004; Frawley, 1997; McCafferty, 1992; Ohta, 2001). Such use of language shares empirical features that include averted gaze, lowered speech volume, altered prosody, abbreviated syntax, and multiple repetitions. Recent research on private speech has explored its social functions in contexts such as collaborative play and in-class group activities in L2 classrooms. In these cases, and in addition to its facilitation of the producer's cognitive functioning, private speech uttered by one individual serves as a public display that enables collective attention to group-relevant problems and issues (e.g., Smith, 2007; Steinbach-Koehler & Thorne, 2011). This research suggests that private speech serves both as a cognitive affordance for an individual's self-regulation while also helping to make visible any ruptures or problems that may be present in the communicative encounter at hand.

Internalization

Vygotsky (1981) stated that the challenge to psychology was to "show how the individual response emerges from the forms of collective life [and] in contrast to Piaget, we hypothesize that development does not proceed toward socialization, but toward the conversion of social relations into mental functions" (p. 165). The process through which cultural artifacts, including language, take on a psychological function is known as **internalization** (Kozulin, 1990). Drawing from earlier theorists such as Janet (see Valsiner & van der Veer, 2000), Vygotsky (1981) described the process of internalization as follows:

> Any function in the child's cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people as an **interpsychological** category, and then within the child as an **intrapsychological** category. This is equally true with regard to voluntary attention, logical memory, the formation of concepts, and the development of volition. (p. 163)

As this quotation makes clear, higher order cognitive functions, which include planning, categorization, and interpretive strategies, are initially social and subsequently are internalized and made available as cognitive resources. This process of creative appropriation occurs through exposure to, and use of, semiotic systems such as languages, textual (and now digital) literacies, numeracy and mathematics, and other historically accumulated cultural practices. In this sense, internalization describes the developmental process whereby humans gain the capacity to perform

complex cognitive and physical-motor functions with progressively decreasing reliance on external mediation and increasing reliance on internal mediation.

The Zone of Proximal Development

The Zone of Proximal Development (ZPD) has had a substantial impact on developmental psychology, education, and applied linguistics. The most frequently referenced definition of the ZPD is "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86).

The ZPD has captivated educators and psychologists for a number of reasons. One is the notion of assisted performance, which, though not equivalent to the ZPD, has been a driving force behind much of the interest in Vygotsky's research. Another compelling attribute of the ZPD is that, in contrast to traditional tests and measures that only indicate the level of development already attained, the ZPD is forward looking through its assertion that what one can do today with mediation is indicative of what one will be able to do independently in the future. In this sense, ZPD-oriented assessment provides a nuanced determination of both development achieved and developmental potential.

With the ZPD, Vygotsky (1978) put into concise form his more general conviction that "human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (p. 88).[3] Vygotsky was particularly intrigued with the complex effects that schooling had on cognitive development. One of Vygotsky's most important findings, and contra Piaget, is that instruction, especially formal instruction in school precedes and shapes development. In this sense, the ZPD is not only a model of the developmental process but also a conceptual tool that educators can use to understand aspects of students' emerging capacities that are in early stages of maturation. When used proactively, teachers using the ZPD as a diagnostic have the potential to create conditions that may give rise to specific forms of future development.

In L2 research, the ZPD concept was used by Aljaafreh and Lantolf (1994) to analyze the relationship between corrective feedback and language learning within learner–tutor interactions in an ESL course. They identified a number of mechanisms of effective help, for example, that mediation should be contingent on actual need, provided following a continuum that begins with implicit hints and moves toward explicit correction as necessary, and that mediation should be removed when the student demonstrates the capacity to function independently. This process requires continuous assessment of the learner's emerging abilities and subsequent tailoring of help to best facilitate progression from other-regulation to self-regulation. As we explain later in this chapter, this insight has been formalized as Dynamic Assessment, a framework for integrating teaching and assessment.

In a study that builds on conversation analysis of classroom discourse, Ohta (2001) describes the interaction cues to which peers orient in dyad work to provide developmentally appropriate assistance to one another. A key finding in this research is that differences in learner abilities are not fixed or located solely within individuals. While some instances show one participant consistently providing assistance to another, there are often expert–novice reversals over the course of one and multiple sessions. Reiterating Donato's (1994) notion of a collective expert, Ohta (2001) observes that "when learners work together . . . strengths and weaknesses may be pooled, creating a greater expertise for the group than of any of the individuals involved" (p. 76). Swain (2000) has made similar claims about what she termed "collaborative dialogue," and more recently, through the development of the process she has termed "languaging" (Swain et al., 2009). In these works, Swain (2000) extends her earlier formulation about communicative output "to include its operation as a socially constructed cognitive tool. As a tool, it serves second-language learning by mediating its own construction, and the construction of knowledge about itself" (p. 112).

What Counts as Evidence?

Sociocultural research is grounded in the **genetic method,** an approach to scientific research proposed by Vygotsky in which the development of individuals, groups, and processes is traced over time. Consequently, single snapshots of learner performance are not assumed to constitute adequate evidence of development. Evidence must have a historical perspective. This is not necessarily an argument for the exclusive use of long-term longitudinal studies. While development surely occurs over the course of months, years, or even the entire life span of an individual or group, it may also occur over relatively short periods of time, where learning takes place during a single interaction between, for example, a parent and child or tutor and student. Moreover, development arises in the dialogic interaction among individuals (this includes the self-talk that people engage in when they are trying to bootstrap themselves through difficult activities such as learning another language) as they collaborate in ZPD activity (Swain et al., 2009). Evidence of development from this perspective is not limited to the actual linguistic performance of learners. On the face of it, this performance in itself might not change very much from one time to another. What may change, however, is the frequency and quality of mediation needed by a particular learner to perform appropriately in the new language (see also the following discussion of Dynamic Assessment). On one occasion a learner may respond only to explicit mediation from a teacher or peer to produce a specific feature of the L2 and on a later occasion (later in the same interaction or in a future interaction) the individual may only need a subtle hint to be able to produce the feature. Thus, while nothing has ostensibly changed in the learner's actual performance, development has taken place, because the quality of mediation needed to prompt the performance has changed.[4]

Development within the ZPD is not just about performance per se; it is also about where the locus of control for that performance resides—in someone else or in learners themselves. As learners assume greater responsibility for appropriate performances of the L2, they can be said to have developed, even when they exhibit little in the way of improvement in their overt performance. This means that evidence of development can be observed at two distinct levels: overt independent performance and at the level where performance is mediated by someone else. This second type of evidence will go undetected unless we keep in mind that development in the ZPD is understood as the difference between what an individual can do independently and what he or she is able to do with mediation, including changes in mediation over time. Finally, because SCT construes language as a cultural tool used to carry out concrete goal directed activities, tasks such as traditional language tests designed to elicit displays of a learner's linguistic knowledge offer only limited evidence of development. In sum, evidence of development in a new language is taken to be changes in control over the new language as a means of regulating the behavior of the self and of others in carrying out goal-directed activity.

Common Misconceptions about SCT

Because of space limitations, we will focus only on misconceptions that relate to the ZPD, easily the most widely used and yet least understood of the central concepts of SCT (Chaiklin, 2003). There are two general misconceptions about the ZPD. The first is that the ZPD is equivalent to scaffolding (or assisted performance) and the second is that it is similar to Krashen's notion of $i + 1$ (e.g., Krashen, 1982). Both assumptions are inaccurate. Scaffolding, a term popularized by Jerome Bruner and his colleagues nearly four decades ago (Wood, Bruner, & Ross, 1976), refers to any type of adult–child (expert–novice) assisted performance. Scaffolding, unlike the ZPD, is thought of in terms of the amount of assistance provided by the expert to the novice rather than in terms of the quality, and changes in the quality, of mediation that is negotiated between expert and novice (Stetsenko, 1999).

With regard to misconceptions about equivalences between ZPD and Krashen's $i + 1$, the fundamental problem is that the ZPD focuses on the nature of the concrete dialogic relationship between expert and novice and its goal of moving the novice toward greater self-regulation through the new language. Krashen's concept focuses on language and the language acquisition device, which is assumed to be the same for all learners with very little room for differential development (e.g., Dunn & Lantolf, 1998; Thorne, 2000). Krashen's hypothesis claims that language develops as a result of learners comprehending input that contains features of the new language that are "slightly" beyond their current developmental level. As researchers have pointed out, there is no way of determining precisely the $i + 1$ of any given learner in advance of development. It can only be assumed after

the fact. In terms of the ZPD, development can be predicted in advance for any given learner on the basis of his or her responsiveness to mediation. This is what it means to say that what an individual is capable of with mediation at one point in time, he or she will be able to do without mediation at a future point in time. Moreover, as we mentioned in our discussion of the ZPD, development is not merely a function of shifts in linguistic performance, as in the case of Krashen's model, but is also determined by the type of, and changes in, mediation negotiated between expert and novice. This principle is illustrated in the study described in the following section.

An Exemplary Study: Poehner (2009)

A persistent issue in the L2 field, as in educational research more generally, concerns the role of assessment and its relation to teaching. Standardized tests are frequently employed on a large scale in educational systems to inform high-stakes decisions such as admission to a program of study, fulfillment of requirements for graduation, or professional licensing. With the steady increase of such testing practices critical voices have emerged which challenge the use of tests as a means of enforcing policy decisions and restricting access to opportunities for many populations. These critiques are frequently accompanied by calls for assessment to be realigned with educational objectives and better integrated with teaching and learning. In this context, Dynamic Assessment (DA) provides a powerful framework for integrating assessment and teaching as a dialectical activity aimed at diagnosing and promoting learner development.

DA derives from Vygotsky's conceptualization of the ZPD, which he frequently illustrated using the example of two children whose independent performance of age-level tasks is similar but who respond quite differently when offered prompts, models, feedback, and leading questions. Vygotsky interpreted the children's varied responsiveness to mediation as indicating psychological abilities that are in the process of emerging but are not yet within their independent control. Since Vygotsky's time this insight has been formalized into a set of assessment procedures collectively referred to as DA (Haywood & Lidz, 2007). The lion's share of DA has been conducted with learners with special needs and immigrant and minority children as these populations tend to perform poorly on conventional assessments.

The aim of DA is to move beyond judging learner performance as correct or incorrect and to reveal the processes underlying performance so as to provide a more nuanced picture of learner abilities. Typically, insights are shared with teachers and other assessment stakeholders so that learners may be placed in appropriate learning contexts and instructional interventions designed to provoke development. The work of Reuven Feuerstein (e.g., Feuerstein, Feuerstein, & Falik, 2010) stands out in that he, like Vygotsky, understood that diagnosing and promoting development are activities that follow the same dialectical principles. Activity that seeks to co-construct a ZPD with learners may foreground an assessment function

or a teaching function depending upon the particular context and purpose behind the activity but both assessment and teaching are necessarily implicated in the activity. It is this view of DA that has been brought into the L2 field (see Lantolf & Poehner, 2004) and that we detail in the following case study.

Poehner (2009) reports the implementation of DA principles by Tracy (pseudonym), a primary school L2 Spanish classroom teacher. As the sole Spanish teacher in the school, Tracy was granted considerable latitude to develop her own curriculum at each grade level, and this included the creation of instructional materials, sequencing of lessons, and assessments of learning. She first encountered DA through a professional development initiative and became interested in exploring how it might help her better understand her learners' abilities and attune her instruction accordingly. Although she was interested in pursuing a DA-based pedagogy, the specific constraints of her instructional context compelled her to opt for a scripted rather than open-ended approach to mediation. In particular, Tracy had only 15 minutes per day with each of two classes, each with approximately 20 students. Tracy carefully prepared an inventory of mediating prompts that she could administer when learners experienced difficulties with the day's learning activities.

Adhering to the general principle that mediation should be sufficiently explicit to be of value to learners but not so explicit that it deprives learners of the struggle necessary for development, Tracy prepared six to eight prompts arranged from most implicit (pause to allow learners to detect and correct errors) to most explicit (provide the correct response with an explanation). Additional prompts included repeating a learner's response with a questioning intonation; repeating the part of a response that contained an error; employing metalinguistic terms to direct learner attention to the nature of the error; and offering a choice between two forms.

To maintain a record of learner performance, Tracy created a grid where she recorded the number of prompts offered to every student during specific interactions over the course of a week as well as a space for notations on the nature of learner problems. The grid used during instruction allowed Tracy to efficiently generate a record to which she could refer to track the level of mediation specific individuals required and how this changed over time as well as how much support the class in general needed. This approach to DA was highly systematic and addressed a shortcoming frequently associated with formative assessment practices. As Poehner and Lantolf (2005) explain, research into formative assessment reports that insights gained into learner abilities are often unreliable as individual teachers are not consistent in how they assess learners, offer feedback, and document this process and its outcomes.

Poehner (2009) also argues that Tracy's approach creates the potential to understand ZPD activity at both the individual and group level. By designing activities that were sufficiently challenging that none of the students was able to complete them independently, the instructor was able to establish a context in which all learners could benefit from the mediation she prepared. Moreover, she

orchestrated activities that allowed one student at a time to attempt to complete tasks while the rest of the class observed. In this way, Tracy offered mediation to each student in turn but in the social space that included all class members as secondary interactants. According to Poehner, this approach cannot guarantee that all students will attend to a teacher's interaction with another student, but this may occur, especially when students understand that they, too, will have a turn at the tasks. He argues that Tracy was in fact conducting a form of group Dynamic Assessment or G-DA.

In support of this claim, Poehner (2009) documents an activity that required students to mark substantive-modifier agreement for number and gender. During the class session Poehner describes, three learners attempt the task. The first requires extensive interaction with the teacher as he initially fails to mark either gender or number agreement. Tracy ultimately offers the learner a choice between two forms of an adjective and although the student makes the correct selection, it is not clear whether he was guessing or he in fact understood why number concord was necessary. The second and third learners to carry out the activity performed successfully with only minimal mediation. The second learner was able to partially self-correct and then required a level two prompt (repetition of the learner's response with a questioning intonation). The third learner provided an acceptable response on her first attempt. While she did not need any prompting, her intonation indicated that she needed teacher confirmation of her response. Poehner interprets this to mean that while the third learner is closest to full independent performance, she may not yet have complete control over substantive-modifier concord in Spanish. To perform in a fully self-regulated manner requires appropriate self-evaluation.

Poehner (2009) acknowledges that it is possible that these three learners simply happened to be in different places developmentally such that the first required a level six prompt, the second a level two prompt, and the third required no prompting at all. He postulates, however, that this progression may not have been coincidental but might reflect the fact that the second learner had benefited from observing Tracy's interaction with the first student and that the third learner benefitted from watching two teacher–student interactions. In other words, the learners were not necessarily starting from the beginning each time but were building upon previous interactions. While further research is needed, this study has helped to initiate inquiry into mediation that is sensitive to individual learners' needs in instructional formats such as teacher-fronted group and whole-class interaction.

Explanation of Observed Findings in SLA

In this section we consider if and how SCT addresses the observed phenomena in SLA raised by the editors in Chapter 1. As a preamble to the discussion, however, we would like to point to a fundamental difference between the observed phenomena taken as a whole and how SCT approaches the learning process. It is clear

that the 10 phenomena taken together are predicated on a theoretical assumption (in our view, and in the view of many other researchers, scientific observations, as Vygotsky, 1997, insightfully stated, are never theory-free) that separates individuals from the social world. In other words, the phenomena assume a dualism between autonomous learners and their social environment represented as linguistic input—a concept closely linked to the computational metaphor of cognition and learning. SCT is grounded in a perspective that does not separate the individual from the social and in fact argues that the individual emerges from social interaction and as such is always fundamentally a social being (Vygotsky, 1994). This includes not only obvious social relationships but also the qualities that comprise higher order mental activity that are rooted in semiotically mediated social interaction. With this as a background we will briefly address the given observations as they pertain to an SCT perspective of L2 development.

Observation 1: Exposure to input is necessary for SLA. Since the social world is the source of all learning in SCT, participation in culturally organized activity is essential for learning to happen. This entails not just the obvious case of interaction with others, but also the artifacts that others have produced, including written texts. It also includes Ohta's (2001) "vicarious" participation in which learners observe the linguistic behavior of others and attempt to imitate it through private speech. However, as our discussion of DA makes clear, development may be optimally guided when intentional effort is made to sensitize interactions to learners' emergent needs.

Observation 2: A good deal of SLA happens incidentally. Here we believe a bit of clarification is in order. From the perspective of SCT, what matters is the specific subgoal that learners form in which the language itself becomes the intentional object of their attention in the service of a higher goal. Thus, looking up a word in a dictionary, guessing at the meaning of a word when reading a text for comprehension, and asking for clarification or help are subgoals that subserve higher order goals such as writing a research paper, passing a test, or finding one's way through an unknown city. This process reflects the tool function of language; that is, the use of language to achieve specific concrete goals. Thus, what is called incidental learning is not really incidental. It is at some level a function of intentional, goal directed, meaningful activity. Moreover, as we explain in the next section, SCT compels us to place a premium on the explicit presentation of linguistic knowledge to intentionally provoke L2 development.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure; *Observation 9: There are limits on the effects of instruction on SLA.* To consider these observations, it is important to distinguish between learning in untutored immersion settings and highly organized educational settings. The evidence reported in the L2 literature supports the developmental hypothesis position in the case of untutored learners. There is also research that shows that learners follow the same paths in classroom settings (see Chapter 9). The question we have about this research is that as far as we are aware the teaching did not take account of the ZPD. In other words, it provided a uniform

intervention for all learners and did not engage learners in the type of negotiated mediation demanded by the concept of ZPD. A current project (Zhang, 2014; also Lantolf & Poehner, 2014) has uncovered evidence that instruction organized in accordance with principles of SCT and that is sensitive to learners' ZPD can, in fact, impact the sequence that classroom learners follow when acquiring features of a second language.

Observations 5: Second language learning is variable in its outcome; *Observation 6: Second language learning is variable across linguistic subsystems.* As we have shown in our discussions of the ZPD and DA, variability in the development of any given learner as well as across learners is a characteristic of L2 acquisition. In addition, the evidence shows that learners variably acquire different subsystems of a new language depending on the type of mediation they receive and the specific goals for which they use the language (see Lantolf & Aljaafreh, 1995; for a discussion of L2 variability that takes into account both SCT and a dynamic systems theory perspective, see de Bot, Lowie, Thorne, & Verspoor, 2013).

Observation 8: There are limits on the effect of a learner's first language on SLA. From an SCT perspective it is important to distinguish form from meaning when addressing this observation. While L1 formal features may have a limited effect on L2 learning, it is clear with regard to observations on variability that L1 meanings continue to have a pervasive effect in L2 learning (see Negueruela, Lantolf, Jordan, & Gelabert, 2004). In addition, as was discussed in regard to L2 private speech, L2 users have a difficult time using the new language to mediate their cognitive activity, not withstanding high levels of communicative proficiency.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. In this case it is important to distinguish between use of the L1 to mediate the learning of the L2 and the effects of L1 on L2 production. Because our first language is used not only for communicative interaction but also to regulate our cognitive processes, it stands to reason that learners must necessarily rely on this language in order to mediate their learning of the L2. However, there is also evidence showing that social speech produced in the L1 and the L2 each impact L2 learning. In a continuing series of studies, Swain and her colleagues have documented how classroom learners of second languages, including immersion learners, push linguistic development forward by talking, either in the L1 or L2, about features of the new language (Swain & Lapkin, 2002; Swain, Lapkin, Knouzi, Suzuki, & Brooks, 2009).

Explicit and Implicit L2 Knowledge

Recently, Paradis (2009) and Ullman (2005) have argued that the distinction between implicit and explicit knowledge is not supported by neurological systems of the brain. Instead, they point out that the brain comprises two memory systems: procedural and declarative. Among other things, the former underlies the kind of knowledge that people have of their native language as acquired in immersion

settings and which is not usually available to conscious inspection per se. The latter system, on the other hand, supports lexical knowledge and other kinds of explicit information that people generally learn through intentional and conscious instruction (see Chapter 8).

According to Paradis (2009) as we mature into our teenage years and beyond, learning through the procedural system declines, while learning through the declarative system increases. Leaving aside, because of space constraints, many of the complexities and subtleties of the processes entailed in the respective models proposed by Paradis and Ullman, we wish to highlight two components that are directly relevant for the SCT position. The first is that there are no neurological pathways connecting the procedural and declarative systems, which means that declarative knowledge cannot convert into procedural knowledge, no matter how much practice one engages in (NB: neither researcher rules out the possibility of developing the procedural system in immersion settings but it requires extensive and intensive experiences—experiences that are not likely to occur in the educational setting). The second is that the declarative system, with appropriate practice, can be accessed smoothly and rapidly, although perhaps not as rapidly as the procedural system. What this means is that explicit and systematic instruction can result in functionally useful knowledge of a second language that learners can access for spontaneous spoken and written communicative purposes.

SCT does acknowledge a distinction between implicit and explicit knowledge, including knowledge of language. Implicit knowledge, which Vygotsky (1987) discusses under the rubric of *spontaneous concepts,* is largely nonconscious and appropriated from participation in the everyday activities of a community. Explicit knowledge, which Vygotsky (1987) discusses under the rubric of *scientific concepts,* is primarily learned through intentional and systematic instruction generally associated with formal education. The bulk of SCT research for the past decade has largely focused on the intentional (or as Vygotsky put it, artificial) development of second-language ability through systematic explicit instruction. The framework through which this type of instruction is carried is called Systemic Theoretical Instruction (STI). Again, concern with development through explicit instruction does not deny the possibility, as argued by Ullman and Paradis, that spontaneous development of the procedural system is possible in immersion settings where implicit knowledge may be accessed.

STI, as its name suggests, is concerned with rendering such theoretical knowledge accessible to learners in a principled, systematic manner. While differences exist across specific approaches to STI, they share a commitment to identifying the central concept within an academic discipline and maintaining this as the focus of instruction. A crucial tenet of STI is that the concept not be "broken-down" or "simplified" as this risks distorting it. Rather, the concept must be presented in a manner that is age-appropriate for learners but that maintains its integrity. Additional concepts are introduced as study continues, and the interrelations among concepts, including their connection to the central organizing concept, are made explicit.

STI is also marked by the use of schemata, images, and models to introduce concepts to learners. In a material form, the concepts are more easily referenced and manipulated by learners than are verbal explanations alone. STI also prompts learners to verbalize their understanding of a concept and how they use it as they carry out practical activities guided by the concept. As learners internalize the meaning of the concept through appropriate forms of practice, they are less dependent on external symbolic tools to orient their actions.

L2 STI seeks to promote learners' conceptual understandings of language, and this means that teaching as well as the knowledge that learners acquire is explicit in nature. To be sure, this implies that learners who have developed an L2 through schooling are psychologically functioning with the language in qualitatively different ways from how they function in their L1, which they acquired primarily in everyday contexts and perhaps even how they acquire L2s in immersion settings (see Paradis, 2009). More specifically, this means that while L1 knowledge remains largely implicit for most individuals, this is not the case for knowledge of an L2 developed in school. What matters, however, is not simply that L2 knowledge is explicit but, following Karpov (2003), that the quality of knowledge must be systematic and theoretical to provide an appropriate basis for action that generalizes across various domains. We refer interested readers to Lantolf and Poehner (2008, 2014) for discussion of specific L2 STI studies.

Conclusion

In this chapter we have outlined the primary constructs of SCT, namely, mediation and regulation, internalization, and the ZPD. Additionally, we have considered Dynamic Assessment and Systemic-Theoretical Instruction and how they inform the study of SLA and the structuring of educational interventions. Mediation is the principal construct that unites all varieties of SCT and is rooted in the observation that humans do not act directly on the world—rather their cognitive and material activities are mediated by symbolic artifacts (such as languages, literacy, numeracy, concepts, and forms of logic and rationality) as well as by material artifacts and technologies. The claim is that higher order mental functions, including voluntary memory, logical thought, learning, and attention, are organized and amplified through participation in culturally organized activity. This emphasis within the theory embraces a wide range of research including linguistic relativity, distributed cognition, and cognitive linguistics. We also addressed the concept of internalization, the processes through which interpersonal and person–environment interaction form and transform one's internal mental functions, and the role of imitation in learning and development. Finally, we discussed the ZPD, the difference between the level of development already obtained and the cognitive functions comprising the proximal next stage of development that may be visible through participation in collaborative activity. We emphasized that the ZPD is not only a model of developmental processes, but also a conceptual and pedagogical

tool that educators can use to better understand aspects of students' emerging capacities that are in early stages of formation.

Because of its emphasis on praxis, SCT does not rigidly separate understanding (research) from transformation (concrete action). While SCT is used descriptively and analytically as a research framework, it is also an applied methodology that can be used to improve educational processes and environments (see Lantolf & Poehner, 2008, 2011, in press; Thorne, 2004, 2005). SCT encourages engaged critical inquiry wherein investigation into psychological abilities leads to the development of material and symbolic tools necessary to enact positive interventions. In other words, the value of the theory resides not just in the analytical lens it provides for the understanding of psychological development, but in its capacity to directly impact that development. Though certainly not unique among theoretical perspectives, SCT approaches take seriously the issue of applying research to practice by understanding communicative processes as inherently cognitive processes, and cognitive processes as indivisible from humanistic issues of self-efficacy, agency, and the effects of participation in culturally organized activity.

Discussion Questions

1. Both Sociocultural Theory (Lantolf, Thorne, and Poehner) and the framework presented by Gass and Mackey are "interactional" in nature. How are they different?
2. What is mediation? What is its purpose, and what tools do learners use?
3. The authors of this chapter see Sociocultural Theory primarily as way to understand classroom language learning. How could Sociocultural Theory account for language learning outside of the classroom?
4. Consider the Dynamic Assessment principle of providing mediation that is initially implicit and only becomes more explicit as necessary. How does this relate to discussions of feedback as Gass and Mackey describe in Chapter 10?
5. Systemic-theoretical instruction moves away from the presentation and practice of grammar rules and argues instead for the presentation of linguistic concepts ways to construct meaning. In what ways is this different from the functionalist approach Bardovi-Harlig presents in Chapter 4?
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Notes

1. Scholars working in Vygotsky-inspired frameworks also use the term Cultural-Historical Activity Theory (or CHAT). However, most research conducted on L2 learning within the Vygotskian tradition has used the term sociocultural, and for this reason, we

use this term throughout the chapter. It is also important to note that the term sociocultural has been used by researchers who do not work directly within the theoretical perspective we are addressing in this chapter. These researchers use the term sociocultural to refer to the general social and cultural circumstances in which individuals conduct the business of living.

2. In this chapter, we restrict our discussion to symbolic artifacts, in particular, language. For a more complete discussion of mediation, see Lantolf and Thorne (2006).
3. Elsewhere Vygotsky (1981) remarks that "social relations or relations among people genetically underlie all higher functions and their relationships" (p. 163).
4. This should not be interpreted to mean that the amount of external mediation a learner requires will diminish in a predictable and systematic manner, as has been assumed in some cases (e.g., Erlam, Ellis, & Batstone, 2013). Rather, it is the quality of mediation rather than a quantifiable amount that will evidence change as learners move toward greater self-regulation. Moreover, this shift is not predicted to be the same for every individual, with some making more rapid gains than others and some showing gradual rather than dramatic improvement.

Suggested Further Reading

Lantolf, J. P., & Beckett, T. (2009). Research timeline for sociocultural theory and second language acquisition. *Language Teaching, 42*, 459–475.

This article presents a critical survey of SCT research conducted on L2 learning.

Lantolf, J. P., & Poehner, M. E. (2008). *Sociocultural theory and the teaching of second languages.* London, England: Equinox.

This volume, focusing exclusively on issues of L2 teaching and pedagogy, includes chapters addressing Systemic-Theoretical Instruction, Dynamic Assessment, and instructional initiatives framed by the ZPD and related constructs.

Lantolf, J. P., & Poehner, M. E. (2014). *Sociocultural theory and the pedagogical imperative in L2 education: Vygotskian praxis and the research/practice divide.* London, England: Routledge.

The authors elaborate a reading of Vygotsky that brings to light his commitment to a Marxian perspective on theory and practice, according to which the proper role of theory and research is to orient practical activity while practical activity provides the ultimate test of theory. The implications of this perspective for SLA research and L2 education are treated in detail. Dynamic Assessment and Systemic-Theoretical Instruction are presented as two essential forms of Vygotskian praxis.

Lantolf, J. P., & Thorne, S. L. (2006). *Sociocultural theory and the genesis of second language development.* Oxford, England: Oxford University Press.

This book presents an in-depth introduction to Sociocultural Theory and to L2 research and pedagogical interventions carried out within this framework.

Poehner, M. E. (2008). *Dynamic assessment: A Vygotskian approach to understanding and promoting second language development.* Berlin, Germany: Springer.

This volume offers the only book-length treatment of L2 Dynamic Assessment (DA), detailing its origins in Vygotsky's writings and the development of DA approaches in psychology and education before elaborating a DA framework for integrating teaching and assessment in L2 classrooms.

Thorne, S. L. (2005). Epistemology, politics, and ethics in sociocultural theory. *Modern Language Journal, 89,* 393–409.

This article describes the history of Vygotsky-inspired cultural historical research, provides a select review of L2 investigations taking this approach, and outlines recent conceptual, theoretical, and methodological innovations.

van Lier, L. (2004). *The ecology and semiotics of language learning: A sociocultural perspective.* Boston, MA: Kluwer Academic.
Van Lier insightfully combines Vygotskian theory with detailed discussions of semiotics and ecological approaches to language and L2 development.

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12

COMPLEXITY THEORY

Diane Larsen-Freeman

The Theory and Its Constructs

Complexity theorists are fundamentally concerned with describing and tracing emerging patterns in dynamic systems in order to explain change and growth. As such, Complexity Theory (CT) is well-suited for use by researchers who study second language acquisition (SLA), and it is not surprising, therefore, that its influence has been increasing. In fact, the famous physicist Stephen Hawking (2000) has called the 21st century "the century of complexity." This chapter begins with an overview of the constructs within CT, and then turns to how they apply to second language acquisition, or second language development, as an adherent of CT would prefer to call it (Larsen-Freeman, 2011).

CT has a broad reach. It is transdisciplinary in two senses of the term: first, in that it has been used to inform a variety of disciplines, for example, epidemiology in biology, dissipative systems in chemistry, stock market performance in business—and more germane to our interests—investigations of language (e.g., Bybee & Hopper, 2001), language change (e.g., Kretzschmar, 2009), language evolution (e.g., MacWhinney, 1999), language development (e.g., Larsen-Freeman, 2006b), discourse (e.g., Cameron, 2007), and multilingualism (e.g., Herdina & Jessner, 2002).

The second way that it is transdisciplinary is that complexity contributes a new cross-cutting theme to theory development, comparable to prior revolutionary transdisciplinary themes such as structuralism and evolution (Halliday & Burns, 2006). Complexity introduces the theme of **emergence** (Holland, 1998), "the spontaneous occurrence of something new" (van Geert, 2008, p. 182) that arises from the interaction of the components of a complex system, just as a bird flock emerges from the interaction of individual birds. Since a bird flock

cannot be understood from examining a single bird, the search for understanding a phenomenon shifts from reductionism, or explaining the phenomenon by describing its simpler components, to understanding how complex order emerges from interacting components. Furthermore, this order emerges "without direction from external factors and without a plan of the order embedded in an individual component" (Mitchell, 2003, p. 6). In other words, complex systems are **self-organizing.**

It is important to add that saying that order emerges does not mean that the resulting pattern remains static, just as a bird flock is not fixed. In this regard, complex systems are also known as dynamic systems. Calling them such highlights their ceaseless movement: they attain periods of stability, but never stasis. They are about becoming, not being (Gleick, 1987, p. 5). Complexity theorists study change through time, sometimes continuous change, sometimes sudden. Dynamic systems are represented as trajectories in state space (de Bot, 2008). As the systems evolve, they undergo phase transitions, in which one more or less stable pattern gives rise to another. One way to think of phase transitions is to observe a pot of water on a stove. As the water heats, it changes from a seemingly inert phase to a roiling phase. Provided that complex systems are **open,** that is, they interact with their environment (and depending on the type of system, they exchange information, matter, or energy with it), they will show the emergence of order. Think of an eddy in a stream. The water molecules that comprise it are constantly changing because it is an open, dynamic system. However, the whorl remains more or less constant—a pattern emergent in the flux.

Complex systems are also **adaptive.** An adaptive system changes in response to changes in its environment. Successful adaptive behavior entails the ability to respond to novelty. For example, a human being's adaptive immune system lacks centralized control and does not settle into a permanent, fixed structure; for this reason, it is able to adapt to combat previously unknown invaders.

Complex dynamic systems exhibit **nonlinearity,** which means that an effect is not proportionate to a cause. In a nonlinear system, a small change in one parameter can have huge implications downstream. This sensitivity has been called the "butterfly effect," to make the point that a small change, such as a butterfly's flapping its wings in one part of the world, can have a big impact on the weather elsewhere.

In short, complexity theorists seek to explain the functioning of emergent, complex, dynamic, open, adaptive, and nonlinear systems (Larsen-Freeman, 1997). The position taken here is that these attributes also characterize language use and development. For instance, Gleick (1987) observes that in a complex dynamic system, "the act of playing the game has a way of changing the rules" (p. 24). Gleick is not a linguist, and he was not writing about linguistic rules; nonetheless, the connection between dynamically playing the game and system change applies. Language is a meaning-making system; when it is used meaningfully (playing the game), it changes.

The game is played over multiple timescales: over long periods of time in the evolution of language, on an intermediate timescale in the spread of linguistic innovations within a speech community and the formation of dialects to distinguish communities, and, on the shortest time scale, in on-line processing of linguistic stimuli, leading to the acquisition of language in newborns and the development of a second language. Thus, CT offers us a way to unite language use, evolution, and development or acquisition: Real-time language processing, evolutionary change in language structure, and developmental change in learner language are all reflections of the same dynamic process of language usage, albeit at different timescales (Bybee, 2006; Larsen-Freeman, 2003).

Now turning to language development, the focus on dynamism and change that CT motivates is significant because, as Elman (2003) notes, often studies of language development focus on behaviors that occur during development without considering what precedes or follows them or the mechanisms of change themselves. As for the nonlinearity of the process, Elman points out that "the processing mechanisms that underlie [language development] . . . are fundamentally nonlinear. This means that development itself will frequently have phase-like characteristics, that there may be periods of extreme sensitivity to input ('critical periods')" (p. 431).

Importantly, also, the concept of emergence problematizes the deep-seated assumption that learning is a matter of assembling an internal model of an external reality (Davis & Simmt, 2003, p. 142). Instead, language patterns are seen to be continually emerging. They can conform to linguists' categories of regularities, such as canonical grammatical structures, but they need not. They can be, but need not be, the patterns linguists describe. They may be sequences of a few words or an intonation contour, such as the one Peters (1977) observed her Vietnamese participant Minh using. Minh would also use "fillers," which straddle the boundary between phonology and morphosyntax, as place-holders to fill out not yet analyzed parts of his phrases. Sometimes learners' patterns are an amalgam of old and new, the most obvious instance being the use of two or more languages in a single utterance. They can also be formulaic in one language, for example, "Nice to meet you," even when the pragmatics of the occasion would call for "Nice to see you again." As with other language users, learners have the capacity to create their own patterns and to expand the meaning potential of a given language, not just to conform to a ready-made system.

CT adopts a sociocognitive view of second language development. **Iteration** is key to cognitive processing. Through encountering repeated instances of patterns, learners, with their capacious memories, adaptively imitate them, an innovative and recursive process that involves perceiving and transforming a pattern in accordance with co-textual and contextual constraints to meet the user's goals (Macqueen, 2012). One vehicle for iteration and adaptation is the social process of **co-adaptation,** where each partner in a conversation adjusts to the other over and over again (Larsen-Freeman & Cameron, 2008), much as in reciprocal

child-directed speech between a child and the child's caregiver (van Dijk et al., 2013). Not only is co-adaptation reciprocal in the moment, but it is also adjustable, (i.e., the tendency to adapt may increase or decrease as a function of learning or progress made by the learner over time) (van Dijk et al., 2013). Thus, some of the multiple timescales that were alluded to above obtain in language development. The adaptation that takes place locally between conversation partners in the short term is self-similar to the process of adaptation in learning the language in the long term (van Dijk et al., 2013).

The dynamic patterns emerging in learner language are the consequence of the learner adaptation to a specific context, which includes the learners' conversation partners. The patterns are variegated and "softly assembled" by learners (Thelen & Smith, 1994). Soft assembly refers to the fact that the patterns are "created and dissolved as tasks and environments change" (Thelen & Bates, 2003). It might be helpful to think in terms of Levi-Strauss's "bricolage," reusing available materials to solve new problems (Lévi-Strauss, 1962), or what Becker (1994) called reshaping prior texts to new contexts. Similarly, Makoni and Makoni (2010) accord speakers' agency in using "bits and pieces" of languages. Nowhere is this improvisation more evident than in learner language where monolingual and multilingual learners draw on the language resources of their different languages to respond to the demands of the situation. Rather than thinking in terms of transfer from one language to another, then, CT inspires the thinking that a multilingual system expands the language resources from which a multilingual may draw, the use of one language affects the use of another, and thus the influence between languages is bidirectional (Herdina & Jessner, 2002; Pavlenko & Jarvis, 2002).

Thus, adapting patterns sometimes means appropriating the language others use in a Bakhtian dialogic sense. At other times, it means innovating by analogy or recombination. Learner language can thus be seen as an ensemble of interacting elements (Cooper, 1999), constantly changing. An important point is that learners transform their knowledge (Larsen-Freeman, 2013a); they do not merely copy or transfer it, nor do they implement knowledge in the form in which it was received, or in which it was delivered through instruction.

New forms are not mere additions to learners' system; they change the system itself (Feldman, 2006). As they do so, there is a great deal of variability in a learner's language resources. It is an important feature of self-organizing growth that it is ordered, but not invariant (Verspoor, Lowie, & van Dijk, 2008). The language resources of a learner are not fixed internal representations but rather continuously assembled in real time, depending on the real-time interactions between person and context-specific properties (van Geert, Steenbeek, & van Dijk, 2011). Furthermore, the learning trajectory is not necessarily linear because the learner's language resources are constantly under construction and in flux as usage environments change (Hopper, 1998). Even when the conditions of learning remain steady, from a target-language perspective, learners' performance both regresses and progresses. In other words, development is not unidirectional.

In an adaptive system, learners are not passive recipients of input. From a CT perspective, then, it is better to think in terms of **affordances,** or opportunities for learning that take place, rather than input (van Lier, 2000). In other words, what a learner makes use of in a particular instance is determined by the "reciprocal relationship between an organism and a particular feature of its environment. An affordance affords action (but does not trigger or cause it). What becomes an affordance depends on what the organism does, what it wants, and what is useful for it" (van Lier, 2000, p. 252). As such, CT is cognizant of, and seeks to avoid, what William James called "the psychologist's fallacy": the expectation that the observer can register the truth about an event. Instead, CT recognizes the unique perspective of the learner (Nelson, 2013).

Learners are not passive in another sense. Although feedback in a dynamic system is a stimulus for adaptation, from a CT perspective, learners do not need to depend on others for negative feedback. They can generate their own feedback through anticipation (Spivey, 2007), something called *predictive error* (Jaeger & Ferreira, 2013) or **statistical preemption**: "If learners consistently witness one construction in contexts where they might have expected to hear another, the former can statistically preempt the latter" (Johnson, Turk-Browne, & Goldberg, 2013, p. 361). Neuroscientists who model the brain as complex network suggest that every sensory input, every use of a word, simultaneously strengthens certain, and weakens other, connections in a neural network (Globus, 1995). Neural network models are thus constantly being updated both by negative evidence that something doesn't exist and positive evidence that it does.

A view of language as a complex adaptive system (Ellis & Larsen-Freeman, 2009) counters the tendency to portray learner language as being an incomplete and deficient version of the target language. Indeed, implicit in this understanding of language as a self-modifying, emerging system is that the developmental change process is never complete (Larsen-Freeman, 2006a), and neither is its learning. Learner language "is the way it is because of the way it has been used, its emergent stabilities arising out of interaction" (Larsen-Freeman & Cameron, 2008, p. 115).

Provided that the system remains open, a learner's language resources grow in the learner's quest for increased functionality, which also motivates change in other biological systems (Givón, 2002). For language learners this means choosing to do more—to make more meaningful distinctions in more pragmatically appropriate ways, resulting in a multiplicity of (competing) forms and the ability to express increasingly nuanced messages.

This picture that I have painted so far is primarily of natural second language development. It is necessary to recognize that although second language development proceeds at least partially implicitly, instruction that recruits and directs learners' attention explicitly, especially to differences between languages (Marton, 2006), can make the process whereby increased functionality is achieved more efficient. Such instruction would teach adaptation through iteration (Larsen-Freeman, 2013b) by changing the conditions of a particular task or activity each

time it is conducted. It would also involve meaningful practice. It would acknowledge that instruction calls for teaching learners not just language—in other words, it would acknowledge the individual differences among learners, which call for differentiated instruction. Finally, it would provide for appropriate feedback.

What Counts as Evidence?

Because complex systems operate on many different levels from the inner workings of the brain to the interactions of different speech communities and on many different timescales from nanoseconds to millennia, different sources count as evidence, including those ranging from the brain scans in neuroscience to pattern detection in corpus analysis to tracing the evolution of patterns in historical linguistics. However, because CT is a theory of change, data gathered in longitudinal studies of learner language are particularly prized, as they are in other approaches. Such studies yield data in which dynamic patterns are revealed and examined through both qualitative and quantitative means (Verspoor, de Bot, & Lowie, 2011).

Second, probabilistic trends in second language data, such as frequently occurring patterns in longitudinal corpora of learner speech or writing, can provide useful signposts for tracing the trajectory of a dynamic system. However, because of the sensitivity of the system, one, perhaps unanticipated, pattern can trigger a turning point and cause the system to veer in a different direction. These unanticipated patterns are important because they can initiate a phase shift in the learner's language resources. At this point, evidence that counts is identified through retrospection or **retrodiction,** which is the prediction that one will find evidence of past events, which one has no knowledge of at the time of retrodiction (Dörnyei, 2011; Larsen-Freeman & Cameron, 2008).

Of course, not all factors in a complex system can be identified, let alone controlled for. This makes true experiments, in which the aim is to control all factors but one, an unpromising method for producing evidence in support of complex systems. This problem is compounded by any nonlinear phase of the system and the fact that each factor does not make a uniform contribution over time. Therefore, Byrne and Callaghan (2014, pp. 6–7) point out the inadequacy of commonly employed statistical techniques for the study of complex systems. Forgoing the usual statistical means used to generalize does not mean that generalizability is impossible. Case studies such as Eskildsen's (see later) provide evidence that may not reveal much about a population of language learners, but they do have a direct bearing on theory (Van Geert, 2011, p. 276). In other words, generalizability from single case studies can relate to how they link to an underlying theory.

Evidence also comes from computer simulations of complex systems. From a restricted complexity perspective (Morin, 2008), formalisms can be used to model complex systems. Evidence stemming from such models always needs to be held

accountable to "authentic data," and such models are limited in that they are decontextualized; however, such simulations have been useful in investigations of language phenomena by allowing the exploration of different hypotheses. To cite two examples, Ellis with Larsen-Freeman (2009) used a simple recurrent network to model the emergence of verb-argument constructions as generalized linguistic schema, and Caspi and Lowie (2013) built a model that supports the hypothesis that complex interactions between levels of vocabulary knowledge account for the gap between reception and production in second language vocabulary use and learning. Moss (2008) adds that combining the precision of modeling with the richness of narrative scenarios holds promise in providing evidence in the study of complex dynamic systems.

Common Misunderstandings

A possible source of confusion is that the genesis of CT lies in the physical sciences. For this reason, some might find it inapplicable to more human concerns, such as language development. However, this concern can be put to rest once it is clear that the explanatory power of the theory extends beyond the physical sciences. Byrne and Callaghan (2014) assert "that much of the world and most of the social world consists of complex systems and if we want to understand it we have to understand it in those terms" (p. 8). In its transdisciplinarity, then, CT is a general framework for understanding, and object theories, such as a theory of language development, must be consistent with its constructs.

The other, perhaps most prevalent, misunderstanding is that "complex" means "complicated." It does not. A complex system may be made up of many heterogeneous components, but what is of interest is the complex, ordered behavior that arises from their interactions. In other words, "complex" relates to the emergence of order and structure from the interactions of components while the system is simultaneously interacting with its environment.

An Exemplary Study: Eskildsen (2012)

Eskildsen's study was two-pronged—using both a longitudinal case study and Conversation Analysis (CA). This already makes it exemplary in light of Mason's (2002) observation that combinations or blends of methodologies would seem to be particularly appropriate to the study of complex systems, allowing different levels and timescales to be investigated (Larsen-Freeman & Cameron, 2008). This is exactly what transpired in this study. The longitudinal study focused on two adult Spanish speakers (Carlos and Valerio) learning English negation over 2 1/2 and 3 years, respectively, and the CA allowed Eskildsen to address the locally contextualized and situated nature of L2 learning. The longitudinal data came from the Multimedia Adult English Learner Corpus (MAELC) of audiovisual lessons recorded in classrooms. Eskildsen traced the development of the learners'

English negatives, calculating type/token frequencies for the different negative patterns over time for the purpose of tracing Carlos's and Valerio's learning trajectories.

One finding from this data-rich study suggests that the two learners do not operate on the basis of an early general *no* + verb/phrase rule, contrary to what other researchers have reported. Instead, Carlos's learning trajectory was characterized by "(1) an initial high frequency of a recurring exemplar of the target construction (*I don't know*); (2) a gradual increase in the use of other exemplars of the target-like pattern, *subject don't verb;* and (3) a concomitant gradual waning of the non-target-like pattern, *subject no verb*" (Eskildsen, 2012, p. 342). Valerio, too, showed a high usage of the multiword expression, *I don't know,* but contrary to Carlos, Valerio initially used the *subject don't verb* target-like pattern more often than the non-target-like pattern, *subject no verb.* Later, however, the *subject no verb* came to dominate before it finally almost disappeared by the end of the study. Eskildsen concluded from this first study that the learners' pattern of acquisition is "much more dynamic, which is both pattern- and learner-specific" (p. 353). He added that the data for both learners supported a view of learning of English negation from recurring expressions toward an increasingly schematic, dynamic inventory of linguistic resources.

Next, to address the locally contextualized and situated nature of L2 learning, Eskildsen employed CA to zoom in on Valerio's use of *you no verb.* This pattern was selected because of the surprising finding that the target-like *don't* pattern was initially much more frequent in the longitudinal data before giving way to this non-target-like counterpart. What Eskildsen learned when he examined the interactional contexts in which the non-target-like form was deployed was that the *you no verb* construction was used by Valerio to achieve a specific purpose, namely, to instruct his fellow students on the instructional task at hand. More precisely, Valerio used the lexically specific pattern *you no write* to help his classmates follow the teacher's instructions for accomplishing a particular task.

> The usage events which prompted this locally heavy use of *you no write* may have laid the foundation for what was to become a seemingly statistical feature of Valerio's linguistic inventory, namely the preference for *you no verb* at the cost of a more target-like *do*-negation pattern. (p. 366)

His use of this particular pattern at this particular time, then, allowed Valerio to achieve his interactional goal. "In sum, the data in this second set of analyses suggested a fundamental coupling of linguistic development and interactional requirements; interaction and learning, in other words, cannot be kept apart" (p. 366), reinforcing the earlier claim that the learner's system changes in playing a meaningful game.

A methodological implication of this study is that a deeper appreciation of the data often requires qualitative explanations that the quantitative counts cannot

provide, as the constructions counted are, to varying degrees, contingent on interactional environments. To get to the core of the relation between such environments and the emergent patterns, a focus on local detail, in addition to tabulating type-token ratios, needs to be undertaken. To restate this point more broadly, both quantitative and qualitative analyses need to be conducted—advice complexity theorists in the social sciences would support. A further lesson is that

> what the linguist or the analyst calls negation does not seem to be learned as a rule-governed syntactic phenomenon to be deployed across diverse linguistic patterns in a broad-sweeping manner, but seems to emerge in different patterns in different ways at different points in time along, rather than across, constructional lines. (p. 365)

In other words, Eskildsen paints a portrait of the organized complexity that led to the development of CT (Weaver, 1948).

Explanation of Observed Findings in SLA

Observation 1: Exposure to input is necessary for SLA. It goes without saying that learners have to be exposed to ambient language to cultivate their language resources. However, the term "input" is problematic, dehumanizing the learner, overlooking the learner's agency, metaphorizing him or her as a computer, and necessitating all manner of terminological qualifications in terms of "intake," "uptake," and "output." It also downplays or even overlooks the meaning-making nature of language. Finally, it draws a line between the learner and the environment, which is antithetical to a CT perspective. In contrast, the concept of affordance reunites the two. Affordances are realized in the interaction between organisms and objects in the environment (Bærentsen & Trettvik, 2002). In this way, affordances are opportunities for action in the ecosocial environments (as perceived by learners) that can motivate agents to act and co-act (Zheng & Newgarden, 2012).

A way to word this is to say that the learner's language resources develop from experience, afforded by the learner's perception of the environment. The language of the environment or ambient language does, therefore, play a role in their shape. But the point is that it does not determine them, nor does it define the learning trajectory. If it did, there would be no way to account for the individual developmental paths that learners take (Larsen-Freeman, 2006b).

Observation 3: Learners come to know more than what they have been exposed to in the input. First, complex systems are sensitive to initial conditions. Second language learners are not blank slates. All come with knowing one other language, and some come with knowing several, which should, if nothing else, help to narrow the hypothesis space for learning. Learners can use inference to go beyond the language data to which they have been exposed (e.g., Todeva, 2010). Indeed, there are some powerful claims about the ability of learners of all ages to extract the organizational

structure of sequences from the language and to generalize these learned patterns to novel instances through statistical learning (Aslin & Newport, 2012). In other words, those universal characteristics of language, such as structure dependence, may well be extractable from ambient language sequences and not built in.

Second, learners come to be able to use more than what they have been exposed to because they are creative. However, the creativity does not reside in the linguistic system; rather, it is in the learners' relationship with the environment. In other words, the creativity is not a property of the linguistic system itself, but rather is a property of agents' behavior in co-regulated interactions (Shanker & King, as cited in DeBot, Lowie, & Verspoor, 2007, p. 10). Through analogizing and recombining, learners create new patterns, presumably by cobbling them together at a particular time for a particular purpose, using what language resources are accessible in the moment.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. Perceiving humans interacting with their environment are superb pattern detectors. Certain patterns are more detectable due to their frequency and salience. Because we are meaning-making beings, we will be attracted to those patterns that afford the most communicative utility. Thus, patterns that are both semantically redundant and nonsalient are likely to develop later. Attested stages could also be due to developmental constraints, such as markedness, or processing constraints (see Chapter 9). Presumably learners have many demands competing for their attention; therefore, it should not be surprising that they cannot attend to everything at once.

There is more to the story of stages of development, however. For instance, in the Eskildsen study, discussed earlier, it is clear that the stages of acquisition of syntactic structures previously reported are not followed in lockstep. An explanation for this from a CT perspective is that learners do not perceive learning affordances uniformly. For instance, the *no+verb/phase* of Spanish speakers can be said to result from the interaction between what the learners can perceive at that time and the ambient language in which "no" in English is used as a negative particle, albeit not functioning in the same way as it does in Spanish.

The uniqueness of the sequence of stages can also be explained from a social perspective. Eskildsen pointed out that the favored structures allow the learners to perform certain social functions. Because his L1 encouraged the adoption of a particular form and because he was motivated to communicate a particular message, Valerio made use of the resources he perceived in the language he was learning, despite their ungrammaticality from a target-language perspective. Eskildsen's study demonstrated that one's language resources are locally constituted, and therefore do not always conform to the attested stages.

Observation 5: Second language learning is variable in its outcome. Iteration in a complex system introduces heterogeneity; it generates variability (Larsen-Freeman, 2012). Pavlenko and Jarvis (2002) write that "the evidence of bidirectional transfer underscores the unstable nature of "native-speakerness" (p. 210). If

language use by native speakers is variable, there is no reason that the outcome of second language learning should be any less so. Grammar books can be written summarizing norms of usage, but no single user conforms to the norms. They are idealized abstractions from the collective:

> A language is not a single homogeneous construct to be acquired; rather, a complex systems view . . . foregrounds the centrality of variation among different speakers and their developing awareness of the choice they have in how they use patterns within a social context. (Larsen-Freeman & Cameron, 2008, p. 116)

For instance, Eisner and Macqueen (2006) have shown how context influences the pronunciation of phonemes. Indeed, it might be better said that complex systems "have a set of potential states rather than a single determined state" (Byrne & Callaghan, 2014, p. 19). The existence of variability in language use is not a nuisance from a CT perspective, but instead is very useful. As Larsen-Freeman and Cameron (2008) have observed, "when we make use of genres in speaking or writing, we use the stabilized patterns but exploit the variability around them to create what is uniquely needed for that particular literacy or discourse event" (p. 190).

Awareness of variability also allows us to interpret the speech of others. Eisner and Macqueen (2006) note that when we listen to others speaking, we need to adjust our interpretation of their differences in articulation. Interestingly, they claim that "the variability in the speech signal that is introduced by speaker idiosyncrasies continues to be problematic for automatic speech recognizers, but is usually handled with remarkable ease by the human perceptual system" (p. 1950). This is so because perceptual representations of phonemes are flexible and adapt rapidly to accommodate idiosyncratic articulation in the speech of a particular speaker. In addition to creating options for speakers, and for allowing them to interpret the speech cues of others, variation gives speakers the resources to adapt their speech to that of others, and by so doing, achieve either social congruence or distance (Larsen-Freeman, 2012).

Observation 6: Second language learning is variable across linguistic subsystems. In a CT approach to language development, variability across linguistic subsystems is taken as central, and the

> heterogeneity is partly explicable due to the system's 'sensitivity to initial conditions'. Seemingly unpredictable differences in the behaviour of systems, or of elements within systems, can be caused by tiny differences (sometimes imperceptible or apparently insignificant) in their very initial stages. (Tasker, 2013, p. 137)

As Hirsh-Pasek, Golinkoff, and Hollich (1999) have shown for L1 acquisition, syntactic complexity, phonological complexity, and frequency may be separate but

dynamically interacting forces shaping acquisition. This implies that any account that focuses on one aspect only cannot but provide an oversimplification of reality. Only an account that incorporates the dynamic interaction of all factors can inform an appreciation of the actual complexity (de Bot et al., 2007, pp. 18–19).

Larsen-Freeman's (2006b) L2 study bears out Hirsh-Pasek et al.'s finding for L1. The ESL learners in this study clearly charted their own distinct paths through state space when it came to the development of grammatical complexity, lexical complexity, fluency, and accuracy in their writing over time. By considering changes in interactions among components of language, a dynamic approach to language development considers variability as indicative of change processes, not merely measurement error (Van Geert & Van Dijk, 2002).

Observation 7: There are limits on the effects of frequency on SLA. Years ago, Larsen-Freeman (1975, 1976) reported a correlation between frequency of occurrence of grammatical morphemes in English speakers' speech and their accuracy order in ESL learner language. Since then, a frequency effect has been observed to be influential in language processing (Ellis, 2002), and frequency, working in conjunction with other factors, has been seen to increase the salience of a form, thus presumably helping to attract learners' attention to it (Goldschneider & DeKeyser, 2001). From a CT perspective, the way it would be stated today is that the frequency of forms in the language of the environment forms a deep attractor in state space.

However, from the same perspective, there are also limits to the effects of frequency in SLA. First of all, often frequency is determined when researchers consult a large corpus of natural language use. If acquisition were determined by frequency of forms in this manner, then articles and prepositions would be the first acquired since corpora show that *the* and *of* are the two most frequently occurring forms in English. This is clearly not the case. Therefore, SLA cannot only be about frequency matching (Larsen-Freeman, 2002). A view from CT is fundamentally learner centered. Frequency in a general corpus, even one constructed from second language learner speech, is not necessarily the frequency with which a particular learner experiences the form. Perceptions about language are state dependent, and therefore local, not universal. When a learner becomes aware of a new form or has a framework into which a new form fits and has a need for the form, the new form becomes salient to the learner; otherwise, it is noise.

Second, embedded in this position is another limitation on frequency. Most often, attributions of frequency (my own included) are attributions based on structure. However, language exists for meaning making. Heightened frequency of a construction over time leads to its becoming ambiguous (Zipf's principle of economy) and semantically bleached (Bybee, 2010). Thus, often it is the less frequent, more irregular, more marked constructions that are more meaningful and useful to the learner.

Finally, increasing frequency is a linear measure; however, there are periods of nonlinearity, where increasing frequencies will seem to have no effect or, conversely, a radical one. One example is with type/token ratios. We know that high token frequency promotes entrenchment, where little change in performance is

evident. Increasing type frequency, on the other hand, can stimulate a fundamental shift in the learner's language resources, in keeping with the preceding caveats (Ellis & Larsen-Freeman, 2006). Thus, according to CT, frequency plays a complex role, always relative to learner perception.

Explicit and Implicit Learning

Language learners can learn implicitly. Even neonates can tally probabilistic patterns in the language spoken to them (Saffran, Aslin, & Newport, 1996), and infants and adults demonstrate this ability for tone sequences (Saffran, Johnson, Aslin, & Newport, 1999). Babies can use statistical learning "to detect units within continuous, dynamic events," and "the ability to segment these units is critical not only for interpreting meaning in the flux and flow of events, but also for language learning" (Roseberry et al., 2011, p. 1424).

With older second language learners, for whom it is a challenge to associate meaning with forms, let alone learn to use the forms appropriately, the issue of learning implicitly becomes more complicated, and research results have been mixed (Hama & Leow, 2010; Williams, 2005). Nevertheless, the case for implicit learning remains strong as successful second language development in untutored immigrant populations attests.

Segmenting speech into units can also be learned explicitly when learners' attention is drawn to them so that the learner perceives them. From a CT perspective, there are different paths to the same outcome; therefore, more important than the simple dichotomy between explicit and implicit learning is the contribution of either to learner perception. In a complex system, the present level of development is critically dependent on what preceded it. Learning is motivated by an awareness of difference. It is therefore the learner's perception of contrasts that matter (Marton, 2006). The perception of contrasts can be learner-generated or can be promoted by others. However, the response by a learner depends on the learner's history. The assumption cannot be made that both the learner and the other are operating on the same system, so attempts to promote awareness may not always afford an immediate opportunity for learning. That said, humans are always learning to adapt, even when there is a mismatch between the learner and available affordances. Learning is therefore continuous and always self-referential (Larsen-Freeman, in press), and there are multiple paths to the same outcome. We learn how to learn, and this is what is important in second language development.

Conclusion

CT inspires a view of language that is not a fixed code but is rather an open and dynamic meaning-making system, the learning of which is a sociocognitive process. In the moment, embodied learners soft assemble their language resources co-adapting to the environment. As they do so, their language resources change.

Learning is not the taking in of linguistic forms by learners. Instead, the language resources of learners are emergent, mutable, and self-organizing. Their development is self-referential, not an act of conformity. Development is spurred by learners' quest for increasing functionality, enabled by the learners' awareness of difference, made perceptible by the affordances in the environment, and by a continuing dynamic adaptation to a specific, but ever-changing, context.

Discussion Questions

1. Larsen-Freeman describes one of the themes of complexity theory as "emergence." What characteristics does this theory share with usage-based theories (Chapter 5) that are also often described as emergentist?
2. Complexity theory rejects standard experimental design as "unpromising." Critics of this theory would claim that without imposing control on some of the factors in a learning context, it is impossible to interpret research findings. After reading this chapter, what is your view?
3. In what sense is variation "useful" from the perspective of complexity theory?
4. Compare the constructs of input and affordance.
5. How do the impact and importance of frequency differ in complexity theory, usage-based approaches, and skill theory?
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Suggested Further Reading

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The newest book that treats complexity from a social realist perspective.

De Bot, K. (2008). Introduction: Second language development as a dynamic process. *The Modern Language Journal, 92,* 166–178.
A special issue of the *Modern Language Journal,* with contributions from various researchers on the value of seeing language development dynamically.

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Introduces Complexity Theory and applies it to language, language development, discourse, and classroom interaction.

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13

SECOND LANGUAGE LEARNING EXPLAINED? SLA ACROSS 10 CONTEMPORARY THEORIES

Lourdes Ortega

As a field, Second Language Acquisition (SLA) is vibrant. It began in the late 1960s, with key initial developments during the decade of the 1970s. Most scholars agree that the coming of age as an autonomous discipline happened some time at the end of the 20th century, after less than 40 years of exponential growth. Since then, a prodigious expansion in research and theorizing has occurred that continues unabated at the time of this writing. The field of SLA is also decidedly interdisciplinary, both in its origins and its development, a quality that is felt in the epistemological diversity of its theories as well. SLA interconnects with four neighboring fields, some of them also relative newcomers in academia: language teaching, linguistics, child language acquisition, and psychology. In more recent years, it has also developed ties with other disciplines, notably bilingualism, cognitive science, education, anthropology, and sociology. Given this vibrant disciplinary landscape, the second decade of the 21st century is an opportune time to reflect on the theories in SLA that offer the most viable explanations about humans' capacity to learn additional languages (henceforth L2) later in life, after having learned—from birth to roughly age four—the first language (in the case of a monolingual upbringing) or languages (in the case of a bi/multilingual upbringing).

The editors of this collection, VanPatten and Williams, offer 10 observations based on well-established empirical findings in SLA (see Chapter 1). They reason that these agreed upon "observed phenomena" need to be explained by any viable theory of second language acquisition, or at least incorporated in them in some formal fashion. For the sake of economy, the ten facts can be combined into five central areas that have occupied the attention of most SLA researchers to date: (a) the nature of second language knowledge and language cognition, (b) the nature of interlanguage development, and the contributions of (c) knowledge of the first language (L1), (d) the linguistic environment, and (e) instruction. Table 13.1

TABLE 13.1 Ten Observations That Every SLA Theory Needs to Explain

Construct	*Observations*
Knowledge and cognition	*# 2. A good deal of SLA happens incidentally.*
	# 3. Learners come to know more than what they have been exposed to in the input.
Interlanguage	*# 4. Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure.*
	# 5. Second language learning is variable in its outcome.
	# 6. Second language learning is variable across linguistic subsystems.
First language	*# 8. There are limits on the effect of a learner's first language on SLA.*
Linguistic environment	*# 1. Exposure to input is necessary for SLA.*
	# 7. There are limits on the effects of frequency on SLA.
	#10. There are limits on the effects of output (learner production) on language acquisition.
Instruction	*# 9. There are limits on the effects of instruction on SLA.*

Source: From Chapter 1.

presents these areas and the ten associated observations that VanPatten and Williams offer in their Chapter 1.

In keeping with the overall purpose of the present collection to introduce uninitiated readers to key SLA theories, I have two goals in this closing chapter. First, I hope to help readers review their understanding of the 10 contemporary theories of SLA gathered in this book. To do so, I will contrast and compare the position each theory takes with regard to the five key areas outlined in Table 13.1. The comparison for each area is summarized in Figures 13.1 through 13.5. In each figure, the theories or approaches are ordered slightly differently from their chapter order in the book, so as to more conveniently show commonalities and differences among them visually. My second goal is to pique readers' intellectual curiosity and encourage them to pursue further study of SLA. In the hope of achieving this goal, I conclude the chapter with a small glimpse of some of the exciting but complex challenges that theories in SLA will likely have to tackle in the future.

The Nature of Language Knowledge and Language Cognition

Each of the theories featured in this book offers a different take on the nature of L2 knowledge, depending on the view of human language cognition that they espouse. Figure 13.1 offers a summary of the key differences and similarities in this area across the 10 theories.

The linguistic theory of Universal Grammar is affiliated with the field of generative Chomskyan linguistics and therefore adopts a linguistic view of language cognition. It offers the following logical argument. If L2 learners possess abstract knowledge of ambiguity and ungrammaticality that could have never been derived from the linguistic input available in the environment or from their

FIGURE 13.1 The nature of language knowledge and language cognition in 10 SLA theories.

Theory	*Cognition*	*Learning*	*Representation*
Universal Grammar Theory	Linguistic: nativism, modularity	Implicit abstract deduction	Symbolic and unconscious
Usage-based approaches	Psychological: general cognitive architecture	Implicit induction, association, analogy, abstraction	Unconscious
Skill Acquisition Theory		Explicit deduction, automatization	Declarative, then procedural
Declarative/Procedural model	Neurobiological: general cognitive architecture	Both explicit deduction and automatization in parallel, with inverse degree of reliance dependent on age and context	Declarative and procedural memory representations at once, with redundant competitive, and inhibitory effects
Input Processing Theory	Underspecified	Explicit/implicit interface?	UG?
Processability Theory		Unspecified	Functional universals
Concept-oriented approach			
Interaction framework		Explicit/implicit interface?	Both conscious and implicit
Vygotskian Sociocultural Theory	Sociocultural: relational, situative, mediated	Conscious, goal-driven, mediated	Conscious, intermental, then intra-mental
Complexity Theory	Sociocognitive: orderly, dynamic, self- and co-adaptive	Adaptation and transformation driven; oriented toward arising affordances	Sensitive to initial conditions, ever open-ended, subject to change that is retrodictable rather than predictable

L1 knowledge alone, we must assume that the knowledge was already there, in some initial form at least, independent from experience. That is, the theory is committed to nativism. Furthermore, it is also committed to the idea that learners are constrained in their learning task (in the positive sense of "guided") by this preexisting initial grammatical knowledge they possess. Another theoretical commitment is to modularity. In other words, in this theory it is posited that language is distinct from other forms of cognition, a separate faculty, an organ of the mind. (In the specialized literature the terms language-specific and domain-specific are also used to refer to this same notion.) Finally, in Universal Grammar, language knowledge is thought to be symbolic, that is, rule based. This symbolic knowledge is posited to be formal, highly abstract, and unconscious or tacit, represented in the mind in the form of principles and parameters (in Universal Grammar) and features and functional categories (in more recent versions of Chomskyan theory). Consequently, the theory predicts that core grammatical knowledge (of a first or second language) unfolds incidentally by deduction from the innate abstract knowledge that predates any linguistic experience. The instantiated rules of the specific language, once acquired, remain implicitly represented.

In sharp contrast stand two theories that also make the nature of L2 knowledge central to their explanations: usage-based approaches and Skill Acquisition Theory. Both have their roots in the field of contemporary cognitive psychology and thus both offer a psychological view of cognition. In both theories, language is thought to be learned and used through the same cognitive architecture humans have at their disposal for the acquisition and use of other kinds of knowledge (e.g., knowing about history and biology; or knowing how to cook, how to play the piano, tennis, or chess; or knowing how to solve mathematical equations or do computer programming). Usage-based approaches explain language learning as, by and large, an implicit inductive task. Human language capacities are thought to result from the extraction of statistical patterns from the input. This extraction is fueled by an innate general predisposition of the brain to learn and be shaped by experience, and it is further pushed by communicative needs as the organism interacts with the environment. The extraction of associative patterns is also driven implicitly and ineludibly by the human brain's predisposition toward probabilistic, statistical learning:

> Every time the language learner encounters an exemplar of a construction, the language system compares this exemplar with memories of previous encounters of either the same or a sufficiently similar exemplar to retrieve the correct interpretation . . . [and] the learner's language system, processing exemplar after exemplar, identifies the regularities that exemplars share, and makes the corresponding abstractions. (Chapter 5)

Usage-based approaches are, therefore, committed to incidental learning and unconscious representations. Additional attention via conscious effort at explicitly

cracking the language code can help, but the bulk of language learning is statistical and implicit. By contrast, Skill Acquisition Theory focuses on the prototypical case when a skill or expertise is approached through formal instruction as the starting point, for example when people avail themselves of a manual or a tutor to get started with learning tennis, computer programming, chess—or a foreign language. Therefore, the theory is committed to conscious processing, deliberate learning, and explicit representations, with an interface that allows for this explicit knowledge eventually to give rise to expert performance. As DeKeyser puts it in Chapter 6, learning to become an expert (in language as in anything else) is viewed as a process of turning knowledge into behavior, or "turning 'knowledge that' into 'knowledge how.'" It should be clear, then, that usage-based approaches and Skill Acquisition Theory, while sharing the same basic psychological view of language, differ greatly in the relative importance they accord to implicit and explicit knowledge in explaining SLA.

Together with usage-based approaches and Skill Acquisition Theory, the declarative/procedural model presents also a strong cognitive bent but has its roots in neurobiology rather than psychology. It therefore shares with the other two proposals several important premises about the nature of language knowledge and cognition, while at the same time making some distinct predictions. In agreement with usage-based approaches and Skill Acquisition Theory is this model's orientation to study language as part of general cognition: Language processing and language learning are said to be served by the same neurobiologically based (declarative and procedural) memory systems that also serve memory for all other kinds of knowledge. Indeed, the declarative/procedural model is explicitly agnostic on the issue of modularity, because as Ullman concludes in Chapter 8, at least provisionally on the basis of the available empirical evidence, "at this time there is no convincing evidence for *domain-specific* circuitry for language." The recognition of important roles in language acquisition for both explicit and implicit learning modes and resulting explicit and implicit knowledge is also a shared position. However, the declarative/procedural model offers a much more detailed explanation for how implicit and explicit knowledge are served by different systems in the brain. Two predictions are particularly noteworthy for their empirical specificity. One prediction is that there will be differential relative involvement of both systems in language learning, with relative degree of reliance on the procedural memory system for younger ages and in contexts of naturalistic-immersive use, and on the declarative memory system for older ages and in contexts of instructed use. The second prediction is the posited existence of redundant, competitive, and inhibitory effects for the two memory systems on the resulting implicit and explicit knowledge of language. In the end, all three approaches (usage-based, Skill Acquisition, and declarative/procedural) allow for an interface position with regard to the explicit/implicit knowledge issue, but they posit different relationships and balances in that interface, with the declarative/procedural model offering the greatest degree of specificity in this regard.

Four other SLA theories in this book also hold a psychological view of cognition, but they are much less specific about the assumptions they may make regarding the nature of language knowledge and the architecture of cognition. For one, they are ambiguous as to whether language cognition should be understood in psychological or linguistic terms. For example, Input Processing Theory assumes that Universal Grammar knowledge probably constrains learners' hypotheses (see VanPatten, 1998), and both Processability Theory and the concept-oriented framework have explicitly tried to accommodate some version of linguistic nativism in their models, although they do so by drawing specifically on functional rather than formal linguistic constructs. In terms of the nature of knowledge representation, Processability Theory and the concept-oriented framework appear to side with implicit knowledge, and they remain silent as to the mechanisms that might make learning happen. On the other hand, Input Processing Theory and the interaction approach seem to give implicit knowledge a privileged place in acquisition while assuming an explicit/implicit knowledge and processing interface. However, neither addresses directly the issue of how the interface may work.

Two theories, Vygotskian Sociocultural SLA Theory and Complexity Theory, stand out in that, in both, cognition is viewed as social and language is seen as emerging out of local, dynamic interactions. In both theories, the lines between environment and mind are blurred, in Sociocultural SLA Theory because the individual emerges from the social, which is the source for all learning, and in Complexity Theory because environment and agent are thought to continually interact and transform each other.

Sociocultural theorists posit that human cognition arises from the material, social, cultural, and historical contexts in which human experience is embedded. Learning (including language learning) is explained via mediation processes by which the mind appropriates and internalizes knowledge from the social world, whereby the dualism between individual mind and social environment is rejected: "the individual emerges from social interaction and as such is always fundamentally a social being" (Chapter 11). Cognition, therefore, is fundamentally sociocultural: It arises out of human relations to others, via cultural tools (including language) that mediate between us and our environment, and out of the specific events we experience. Indeed, in this theory the goal is to explain learning as a sociocultural accomplishment served by higher order cognition, whereby consciousness, agency, and intentionality are central to learning.

Complexity Theory intersects with Sociocultural Theory in its humanization of learners as conscious, intentional agents. But it also shares a good deal of usage-based tenets in that it precludes innate, built-in knowledge and attributes the emergence of linguistic knowledge to general cognitive mechanisms (e.g., analogy, statistical learning) that act on the socially gated ambient language. It is different from all other theories, however, in its emphasis on the orderly but dynamic interconnection among nested complex systems contributed by the learner and the environment, and in its concept of agentive self-adaptation and leveraging of

affordances by learners, who constantly and creatively co-adapt as they interact with other human, eco-social, and linguistic complex systems.

The Nature of Interlanguage

VanPatten and Williams (Chapter 1) single out three agreed upon facts regarding interlanguage (cf. Table 13.1), in essence making systematicity and variability paramount in disciplinary understandings of interlanguage. How do the 10 SLA theories in this book address the systematicity and the variability observed in interlanguage? Figure 13.2 summarizes the range of positions on this issue.

Universal Grammar understands systematicity as a natural property of linguistic knowledge. Since all human languages are systematic, interlanguages must be too.

FIGURE 13.2 The nature of interlanguage in 10 SLA theories.

Theory	*Systematicity*	*Variability*
Universal Grammar Theory	Principles, parameters, features and functional categories	No theoretical status, only performance and processing effects
Usage-based approaches	Systematicity, variability, and dynamicity expected in all complex systems	
Skill Acquisition Theory	Taken for granted	Experiential, cognitive, and developmental sources
Declarative/Procedural model	Not addressed	Expected sources of variability: Age, context/input, linguistic phenomena, and individual differences in neuro-functioning
Input Processing Theory	No theoretical emphasis on either	
Processability Theory Concept-oriented approach	Two sides of the same phenomenon, both derived from functional constraints on processing and/or communication	
Interaction framework	Congruent with Processability and concept-oriented views	Congruent with Skill Acquisition views
Vygotskian Sociocultural theory	No theoretical emphasis	Central to activity and social cognition
Complexity Theory	Focus on linguistic development via the study of longitudinal learner production but no theoretical emphasis on systematicity	Variability central to linguistic development. Inter-individual variability fully expected, which makes individual rather than group analysis a must. Intraindividual variability is precursor of all developmentally meaningful change.

It is also natural to expect that there will be differences between the grammatical core of a language and everything else (pragmatics, vocabulary, and so on), since only certain properties of a language are thought to fall within the scope of the universal abstract linguistic knowledge that all humans share as a species. The theory leaves room for the possibility that certain variability is the result of a quality of indeterminacy that may be typical of L2 grammars (e.g., the fact that a learner may reject an ungrammatical string some times and accept it as grammatical other times). However, much of the variability is considered to be uninteresting theoretically, on the grounds that it stems from simple shortcomings of performance, often due to processing effects that are thought to be unrelated to genuine L2 grammatical knowledge (e.g., the typical experience when a learner can remember to use a rule while writing but forgets to use it in her speech).

Usage-based approaches take for granted that systematicity and variability are two properties of language just as they are of all complex, adaptive, emergent systems. In addition, they introduce a third construct, dynamicity (see Larsen-Freeman, 2002), to explain how systematicity is emergent and how systematicity and variability can co-exist and arise out of the brain's interaction with its environment. By comparison, Skill Acquisition Theory focuses little on systematicity (or dynamicity, for that matter) and concentrates instead on explaining variability. Also noteworthy is that this theory finds the locus of variability in three sources that are external to the language system per se. A first source of variability is posited to be experiential. Namely, between-learner variability will arise from differing L2 experiences, as different learners are exposed to (or seek on their own to be exposed to) different amounts, qualities, and sequences of declarative knowledge and deliberate practice. A second source from which variability will arise is predicted to be psychological: Certain cognitive abilities differ greatly among people. (SLA research on this kind of variability is also known under the rubric of "individual differences".) A third source of variability pertains to the same learner across contexts and conditions and can be considered cognitive-developmental. Namely, the same learner's performance will vary depending on whether communicative and cognitive stressors are present and overload the learner's current performance capacities. That is, this kind of variability is an indication that performance has not yet become automatic in that particular area for that learner.

The declarative/procedural model does not directly investigate linguistic development. However, it predicts variability of L2 outcomes resulting from a number of conspiring factors that interact, including the timing of learning (younger versus older), the context of L2 learning (naturalistic-immersive versus instructed) because of the concomitant differential quality and quantity of input each context implies, and the nature of the linguistic phenomena being learned (rule-based complex phenomena versus idiosyncratic and irregular phenomena).

Explaining interlanguage systematicity as well as variability is a major goal of both Processability Theory and the concept-oriented approach. Processability Theory, in particular, has been instrumental in establishing the basic findings for

developmental sequences in a number of L2 word order phenomena. This theory posits that learners are constrained (which in this theory is used in the sense of limited) in systematic ways by what grammatical information they can process syntactically at a given point in development. To process the L2 syntactically in this theory means to hold forms together in working memory for comparison and exchange of grammatical information. Variability is explained as the other side of the same coin, in that these same processing constraints will also determine the sets of alternatives (or variants) that are available to learners (their hypothesis space) at any given point in development. The concept-oriented approach, on the other hand, makes interesting but broader predictions about the interplay between systematicity and variability in interlanguage development, along the additive progression from the realm of pragmatic resources (e.g., gesture, knowledge of the world and the context), onto lexical resources (e.g., adverbs as a means to convey time), and finally to the morphosyntactic or grammatical dimension (e.g., verbal morphology as a means to convey time). Existing nonlinguistic concepts and the need to express them linguistically pushes the system to arrive at increasingly more complex solutions along the pragmatic-lexical-grammatical cline. Input Processing Theory does not appear to make systematicity or variability central to its explanations, although it offers principles that are consistent with the prediction that interlanguage development will not be haphazard but systematic, in many instances predicted by the initial parsing strategies learners employ to comprehend the input.

The interaction approach makes broad use of the functionalist explanations for systematicity that the concept-oriented approach and Processability Theory have put forth, and is simultaneously interested in the second and third sources of individual variability posited in Skill Acquisition Theory. Proponents of the interaction approach find it theoretically important to understand the cognitive-developmental variability that is associated with communicative and cognitive stressors operating during communication (e.g., different interlocutors or interlocutors of same versus different gender) and with requirements of task performance (e.g., a complex versus a simple task). The rationale is that such context and task factors might be manipulated externally to enhance processes during interaction that may eventually facilitate development. A second area of increasing theoretical importance in this approach is individual differences in cognitive resources. This focus is natural among interactionists, given that since the early 1990s they have viewed attention as a possible major explanatory construct for L2 learning, and given that it is well established in psychology that humans vary greatly in their attentional capacities.

In Sociocultural Theory, variability is a theoretically important phenomenon because actions and learning are thought to come about from situative engagement with others and out of affordances from specific contexts. Thus, it is thought that no universal cognitive abilities can be studied in disembodiment from the context and the people out of which they come about. The Zone of Proximal

Development, the intentional goals that drive learners, and the type of mediation via tools (including language and others) available to them in any given event, all conspire to create variability. Moreover, this variability is theoretically interesting because it helps explains why some learners may acquire certain dimensions of language expertise but not others, and why some learners may be unsuccessful in their apparent efforts to learn the L2. Therefore, the design and method of what socioculturalists call the genetic method is favored in order to capture variability, as is the individualized measurement method of learner-tailored tests (Swain, 1993).

Finally, in the area of interlanguage as in most areas of examination, Complexity Theory (although placed at the bottom of Figure 13.2) occupies an interesting in-between position between usage-based approaches and Sociocultural Theory. The usage-based view of interlanguage development is by and large espoused by Complexity Theory as well. Indeed, these two theories make linguistic L2 development into a central disciplinary object of interest. For this reason, in both, but particularly in empirical work inspired by Complexity Theory, longitudinal designs and the quantitative-descriptive measurement of qualities of learner production are commonly found. However, an important difference is that emergent systematicity is emphasized by usage-based approaches, whereas in Complexity Theory, variability takes center stage in at least two ways. First, interindividual variability is considered normal and fully expected, because complex systems' dynamic co-adaptation makes it theoretically untenable to expect that individual development will follow generalized group norms. Thus, interlanguage analyses focus on individual trajectories rather than groups. In the theorizing of interlearner variability as a central phenomenon to be grappled with, Complexity Theory is most congruent with Sociocultural Theory. Second, periods of intense intralearner variability are thought to be precursors of developmentally meaningful change. Therefore, an extensive, theory-specific suite of nontraditional analytical methods has been devised by the neighboring Theory of Dynamic Systems (Verspoor, de Bot, & Lowie, 2011), and Complexity Theory scholars make use of these new methods to capture, measure, and theoretically interpret intraindividual variability.

The Role of the First Language

The 10 theories presented in this book afford diverse roles to the L1 in their explanations of additional language learning, as depicted schematically in Figure 13.3.

Three theories afford the L1 a privileged role in their explanations of SLA. Universal Grammar theory views the L1 as potentially the initial point of departure for L2 acquisition. Indeed, some within this theory posit a large influence for the L1 in the early stages of L2 acquisition, although several other possibilities are also considered and empirically pursued (for an accessible explanation of the range of positions, see Mitchell, Myles, & Marsden, 2013, pp. 83–94). In the end, however, all Universal Grammar proponents agree that it is impossible to speak of

FIGURE 13.3 The role of the first language in 10 SLA theories.

Theory	*Roles*	
Universal Grammar Theory	Initial state?	Privileged role
Usage-based approaches	Central role in research designs L1-tuned learned attention that can bias/block L2 learning	
Skill Acquisition Theory	Taken for granted/not addressed	
Declarative/Procedural model		
Input Processing Theory	UG/L1 ambivalence	
Processability Theory	Lesser influence	
Concept-oriented approach		
Interaction framework	Taken for granted	
Vygotskian Sociocultural Theory	Mediating role as cognitive tool for learning	
Complexity Theory	One of the resources that learners bring to the task, a complex system in and of itself	

L1 influence as a wholesale phenomenon. As White puts it in Chapter 3, in some areas the contribution of the L1 is fleeting, in others long-lasting, and yet in others it may be permanent. Since one important goal in this theory is to determine whether Universal Grammar knowledge still guides L2 acquisition in ways that are fundamentally similar to the ways in which it is posited to guide L1 acquisition, it is imperative to tease out the relative contribution of L1 rules versus innate universal linguistic biases across core areas of linguistic knowledge. Thus, studies are set up to investigate groups of learners from carefully chosen L1 backgrounds and always by reference to baselines of monolingual native speakers of the L1 and L2 involved. Therefore, the L1 holds a privileged role in this theory not only in theoretical terms but also in terms of actual research practices.

Usage-based approaches also accord the L1 a privileged role in SLA, but they do so based on a different rationale from that of the Universal Grammar approach: "L1-tuned learned attention limits the amount of intake from L2 input, thus restricting the endstate of SLA" (Chapter 5). In other words, as a result of early years of development, experience, and socialization, the brain's neurons are tuned and committed to the L1, and any subsequent language learning (of a second, foreign, or heritage additional language beyond the first) is biased by this "learned attention." The framework posits that we humans are hard-pressed to change habits and routines that serve us well. It is as if with the flashlight of our L1 we were looking in the wrong L2 places for cues about what we are supposed to learn now. Certain cues will be frequent and salient, redundant, and meaningful enough that they will be attended to after sufficient L2 experience. More subtle features of the L2 input, however, may completely remain outside our flashlight beam, perhaps irreparably so.

The place of the L1 in the remainder theories of SLA is more modest. Input Processing Theory currently holds an ambivalent stance, since there is no theoretical or empirical determination at this point in the development of the theory as to whether the strategies that learners employ to parse and comprehend the input ought to be considered L1-filtered or guided by linguistic universal knowledge (see Chapter 7). In Processability Theory and the concept-oriented framework, the L1 is thought to exert a lesser influence by comparison to robust functional and developmental universal forces. In Skill Acquisition Theory and the interaction approach, on the other hand, a selectively predictable influence is taken for granted, but without being crucial to any of the explanations proposed. Complexity theory agrees that the L1 is important because learners are not blank slates and come with prior knowledge of already known languages. Without making any specific predictions for how the L1 may influence development, it stipulates it is one of the resources that learners bring to the task, and itself a complex system. The declarative/procedural model does not make any predictions regarding roles that either declarative or procedural memory for L1 features might play when establishing and consolidating memories for L2 phenomena.

By contrast to all other theories in this book, in Vygotskian Sociocultural Theory the L1 can take on a unique and positive role. The first language is a mediating tool, voluntarily used by learners to achieve self-regulation and to enable collaborative engagement in L2 learning events on occasions when using the L2 for higher level mental activity would be developmentally premature. In essence, the use of the L1 during L2 learning events is viewed not as a subconscious influence that cannot be avoided, but as a strategy through which learners can achieve goals otherwise unavailable to them in the L2—for example, to discuss the L2 as an object of reflection, to understand an L2 grammar concept more deeply, or to clarify how to tackle a difficult L2 task. The L1, in these ways, can contribute to (rather than interfere with) L2 learning.

Contributions of the Linguistic Environment

What are the putative contributions to L2 learning of the linguistic environment to which learners are exposed and through which they interact with others? Each theory stipulates a different weight and role for input, input frequency, and output in explaining additional language learning. This is summarized in Figure 13.4.

Let us first examine the roles each theory accords to L2 input. In Universal Grammar theory, input is thought to play only a limited, if necessary, part in acquisition: that of triggering values of knowledge that predate any experience with the linguistic environment. Once some relevant part of the linguistic input triggers, for example, our knowledge that the language we are learning is head-final (as in Japanese, where we say "the house to" instead of "to the house" or "I movies like" instead of "I like movies"), our preexisting knowledge should get reorganized in a domino effect, and a series of other knowledge pieces that

FIGURE 13.4 The role of the linguistic environment in 10 SLA theories.

Theory	*Input*	*Frequency*	*Output*
Universal Grammar Theory	Triggers deduction of knowledge	No theoretical status	
Declarative/Procedural model	Different quantities and qualities of input are expected in different contexts calling for differential reliance on declarative vs. procedural memory systems	Repeated exposure more important for procedural memory and single exposure fast learning possible for declarative memory	No theoretical status
Usage-based approaches	Associative learning is input-driven	Utmost influence, subconscious tallying leads to chunking and schematization	Confined roles, beneficial only for. . . . . . . summoning consciousness
Skill Acquisition Theory	One ingredient only, necessary but not sufficient	Frequency of exposure/practice is important in automatization	. . . developing fluency
Input Processing Theory	How learners processes input during comprehension is important	Degree of meaningfulness more important	. . . raising awareness of input misinterpretations
Processability Theory	Developmental constraints or functional processing principles determine what can get processed, which in turns is reflected in production	Nature of the grammatical information exchange required more important	. . . only a reflection of what is processable
Concept-oriented approach		Subconscious tallying of prototypicality of form–function mappings	. . . general pressure to communicate intended meanings drives acquisition
Interaction framework	One ingredient only, necessary but not sufficient	Important but in combination with other factors	Causal role: can lead to development
Vygotskian Sociocultural Theory	One ingredient only	No theoretical status	Important as social participation (collaborative dialogue, languaging, private speech)
Complexity Theory	Associative learning is input driven, but also driven by learner perceptions of affordances in ambient language and agentive, creative coadaptation	Important, but overridden by learner perceptions and agentive, creative co-adaptation	Language use can spur growth but only if meaning making and agentivity are engaged

"cluster" together around the given value "head-final" should also get selected. Moreover, the input itself is thought to be underdetermined and impoverished by comparison to whatever L2 knowledge the language acquisition device ends up building. At the opposite extreme, usage-based approaches posit that language learning is input-driven. Every time constructions and exemplars in the linguistic input are experienced by the learner (through listening, reading, or both), neural connections are fired and strengthened, and memory traces are established until networks of associations emerge into a complex system. That is, of all ingredients of acquisition, input is posited to play the most central role in this framework.

Input is important for the declarative/procedural model, although only as a macrovariable seen as inherent to the two prototypical contexts for learning: naturalistic-immersive versus instructed. This theory predicts that exposure to input quantities and qualities typical of naturalistic-immersive contexts will engage procedural memory system optimally, whereas input quantities and qualities typical of instructed contexts will lend themselves to optimal involvement of the declarative memory system.

In the remaining theories presented in this book, the linguistic input plays intermediate positions between the two extremes of minimal to maximal importance. All of them maintain the need for exposure to L2 input, but each lends an increasingly larger role to other ingredients of the learning process.

In three theories—Input Processing Theory, the concept-oriented framework, and Processability Theory—it is how the learner processes the input, rather than the input per se, that is regarded as essential to explain acquisition. The specific theoretical details differ greatly among them, however. Input Processing Theory affords input a rather central role but, most importantly, exactly what part of it feeds into learning (i.e., becomes intake) is determined by comprehension, processing, and parsing strategies that the learner brings with her or him and through which the input is perceived. The concept-oriented framework predicts that two strategies brought to the task of input processing by learners, the one-to-one principle and the multifunctionality principle, figure prominently in shaping how learners are able or unable to use the L2 input for developing new resources for meaning-making during language production. Processability theory predicts that L2 learners' limited capacity for what can be held momentarily in memory determines what abstract grammatical information in the input (as described in Lexical-Functional Grammar) can be held simultaneously and compared mentally in order to build a formal and meaningful representation of any utterance. Somewhat ironically, despite the important role accorded to input in both the concept-oriented approach and Processability Theory, in the end both find their strongest evidence and make their most interesting predictions with regard to language production, not input: What gets processed or learned is best reflected in what can be generated in L2 production at a given time in development.

Skill Acquisition Theory, the interaction approach, and Sociocultural Theory go much further in construing the input as only one of several ingredients of SLA,

necessary but not sufficient, and perhaps not even the most crucial one. Thus, both skill learning and interactionist explanations lend more importance to other ingredients of the environment, such as explicit grammar explanation and deliberate practice (in Skill Acquisition Theory), or interaction, feedback, and pushed output (in the interaction approach). In Sociocultural Theory, on the other hand, the input plays an important but general role for language learning insomuch as learners choose to engage with it actively, for example, through goal-oriented vicarious participation when they observe others using the language and through creative imitation of others' utterances in private speech. However, social participation in optimal learning events is thought to be more crucial for acquisition than the linguistic environment per se. These sociocultural views of the roles of the linguistic input resonate with the position espoused by Larsen-Freeman in her characterization of Complexity Theory in Chapter 12. Although with regard to the input, once again, Complexity Theory largely sides with the empirical pursuit and interpretations made by usage-based approaches, Larsen-Freeman firmly rejects the computer metaphor of language learning implied in SLA discussions of input and output. In its place, she invokes two concepts: the "ambient language" and "affordances." She argues that the input, better called ambient language, is not a static frame that simply provides learners with linguistic material for learning. While input is crucially important, it is not determining or defining of developmental trajectories. Instead, it is learner perceptions and creative co-adaptation to their ambient language that Larsen-Freeman views as critical for learning, for which the concept of affordances is needed, defined as "opportunities for action in the ecosocial environments (as perceived by learners) that can motivate agents to act and co-act."

Naturally, since frequency is a feature of the linguistic input (referring in essence to the statistical properties of the input), only SLA theories that stipulate a central role for input afford frequency a high explanatory power. All such theories, however, agree that the workings of frequency in L2 learning can only be understood as a force that affects acquisition in interacting with several others, rather than alone.

In usage-based approaches, the statistical properties of the input are of foremost importance in explaining SLA. As humans process language input, they unconsciously compute the relative frequencies with which they encounter forms, constructions, and exemplars, the relative frequency of the surrounding linguistic contexts in which they appear, and the likelihood of the meanings they can refer to. Language knowledge gradually emerges in the learner by constantly tuning itself through every repeated experience to approximate the statistical properties of the experienced linguistic environment. However, different kinds of frequency are distinguished and their differential effects are investigated in dynamic interaction with other moderating factors, such as salience, prototypicality effects, and L1-tuned attention. To these factors that modulate frequency effects, Complexity theory adds that the learners' own agentivity in selecting (or not) aspects of the

ambient language as affordances overrides frequency. Once again, Complexity Theory essentially agrees with usage-based approaches but raises the same caveat for conceiving of roles for output in L2 learning as it does for theorizing input and frequency: Output may well be facilitative or even crucial, but far from its roles being autonomous, what is critical for learning is learner perceptions and adaptive productive use of language and their motivations as "agents to act and coact" in ways that involve meaningful language use. Learners are language users, that is, meaning makers by definition. When they use language productively, they do so agentively to "expand the meaning potential of a given language, not just to conform to a ready-made system."

More than sheer frequency of occurrence of language forms in the ambient language, iteration, or the repetition of similar language usage events and meanings across changing tasks and activities, may be important for L2 development. Skill Acquisition Theory would approve of this notion of iteration, acknowledging as it does the importance of frequent exposure and repeated practice for enabling automatization and thus predicts that higher frequency forms in the input will be proceduralized earlier than rarely occurring ones. The declarative/procedural model posits different relative importance of frequency for the two different memory systems. Repeated exposure and thus high frequency is important in procedural memory, but fast learning out of single exposure is thought to be possible in declarative memory. Put differently, learning with involvement of the procedural memory system should be (gradual and) frequency-dependent, whereas learning with involvement of the declarative memory system should be (fast-paced and relatively) frequency-independent.

Work carried out within the concept-oriented framework also affords an important role to the statistical and distributional properties of the input in ways that are compatible with usage-based approaches. The relative frequency of form–function mappings in the input is predicted to influence the directions in which learners expand their linguistic repertoires. This is particularly well captured in the distributional bias hypothesis (e.g., Andersen, 1990), which posits that certain morphological markings (e.g., imperfective *-ing*) are prototypically experienced in the input in combination with certain lexical meanings (e.g., actions that imply duration, such as *run, walk,* or *sing*). The hypothesis predicts that this bias in the input will be reflected in learners' development. For example, *-ing* may appear first in learner's utterances containing activities like *run* ('Look, a rabbit is running on the grass!') and only later can spread to contexts containing accomplishments like *run a marathon* ('Look, that man is running the marathon barefoot!').

In Input Processing Theory and Processability Theory, objective frequency out there in the linguistic input is thought to explain less than other input features to which learner perception appears to orient, such as the semantic load or degree of meaningfulness (in Input Processing Theory) or the nature of the grammatical information exchange required (in Processability Theory). On the other hand, in the interaction approach, frequency is understood as only one of a number of

important influences, several outside the scope of input proper. In explanations proposed by Universal Grammar and Vygotskian Sociocultural Theory, frequency has no theoretical status.

Finally, let us review the place that L2 output holds across the theories. Most of the linguistically and psychologically oriented theories afford output a rather confined role. In Universal Grammar, learner output does not have a theoretical status, as it occupies no place in the explanations proposed or the evidence sought. On the cognitivist front, on the other hand, theories often construe output as beneficial for L2 learning, but without playing any major causal part in acquisition processes. Thus, usage-based approaches hold that output is facilitative in promoting self-awareness and conscious processes that enhance learning or in fostering fluency and hence reinforcing chunking and automatization processes that normally happen tacitly during the processing of the input. Skill Acquisition Theory views output as deliberate practice, a special kind of language production activity in which explicit declarative knowledge about language is put to use, first effortfully and slowly, and later (with sufficient reiteration and deliberate effort) more fluently and accurately. Without being embedded in the right combination and sequencing of explicit rule explanation and deliberate practice, however, output cannot contribute to learning. Output is afforded an even more limited role in Input Processing Theory, since comprehension (meaning extraction) is seen as the driving force in language learning. Output may promote fluency or at most allow for extra opportunities to realize that something in the input has been misinterpreted or misanalyzed (if, for example, a lack of understanding caused by such input miscue is revealed during interaction). Processability Theory, in turn, stipulates an even smaller role for output, in that it predicts that it simply mirrors development (hence the best evidence for acquisition can be gleaned from production data), but can never cause it or drive it. The declarative/procedural model does not make any theoretical predictions related to output.

Only 3 of the 10 SLA theories lend output some theoretical prominence. The concept-oriented framework explains language learning as driven by a general pressure to communicate intended meanings. Acquisition proceeds when the means available to the learner do not suffice for conveying the desired functions and concepts in their messages. Vygotskian Sociocultural Theory also affords an important role to output, albeit a more general one. This theory reconceptualizes output broadly as social participation and identifies an important learning potential for the productive use of language through collaborative dialogue, languaging, and imitation in private speech.

The interaction approach is unique in that it accords to output the status of an acquisition catalyst, an acquisition-expanding force with interlanguage-stretching capabilites. When learners produce language for and with others, they can rely less on lexical and contextual cues (which often suffice during comprehension) and are forced to draw more on morphosyntactic cues. In addition, they may become more aware of gaps and holes in their linguistic resources, which may motivate them

to look for solutions in the available input provided by others, either immediately upon experiencing difficulties or on a later occasion, when opportune timing and resources allow it. It is also through imperfect attempts to produce messages that mutual understanding may be obscured to the point that meaning needs to be negotiated (although of course, depending on the circumstances, mutual understanding could be faked or abandoned altogether!). If meaning is negotiated, language is often broken down into more manageable segments, new forms are offered, and implicit and explicit corrections are issued from well-intentioned (or alternatively, ill-predisposed) interlocutors. In the interaction approach, output drives acquisition: We learn a language by speaking it, literally, and syntax emerges out of communication, a suggestion first made by Evelyn Hatch it in the beginnings of the field (Hatch, 1978).

The Role of Instruction

How does instruction interact with natural L2 learning processes? And what are the limits of what can be achieved, and what can be not, with instruction? Of the 10 SLA theories in this book, some make claims as to whether instruction is necessary or sufficient, beneficial or detrimental, whereas only a few go further to make specific proposals as to what features are needed for the design of optimal L2 instruction. The positions are presented schematically in Figure 13.5.

In three theories, instruction plays no substantial role in L2 learning. Universal Grammar is consistent with this view. Much of a language may be teachable (e.g., vocabulary, stylistic choices, pragmatic preferences), but its morphosyntactic core (i.e., the facts of language that are most important for formal linguistic SLA) is not. The concept-oriented framework and Processability Theory also share the view that L2 instruction can play no large role, although the forces thought to overpower instructional influences are developmental-functional rather than formal. Given this view of instruction as peripheral, proponents within these three theories rarely pronounce themselves about the "how" of optimal instruction. However, in his work, Pienemann (see Lightbown & Pienemann, 1993; Pienemann, 1984) has addressed the "what" of optimal instruction by proposing that instruction should target a level above learners' current developmental stage, or else it can have negligible and possibly detrimental effects. In the view of Processability Theory, therefore, optimal instruction is instruction that is congruent with the current developmental level and readiness to learn of each individual learner.

In usage-based approaches, instruction can play a beneficial role, albeit one that is subordinated to input-driven, implicit statistical pattern induction. Instruction can be aimed at stimulating the dynamic interface between explicit and implicit learning and at destabilizing L1-tuned learned attention. While beneficial if it does so, however, it can never be considered "sufficient" for L2 learning. Proponents of this framework typically do not specify particular pedagogies, but they offer general principles for optimal instruction. One is that the L2 input that is brought into classrooms needs to be as abundant, rich, and authentic as possible.

FIGURE 13.5 The role of L2 instruction in 10 SLA theories.

Theory	*Effects*	*Optimal features*	*Instructional design*
Universal Grammar Theory	No effect possible on subconscious core knowledge	None offered	None offered
Usage-Based approaches	Beneficial but not sufficient; supports conscious building of analogies and counters L1-tuned learned attention	Explicit instruction that summons consciousness and fosters implicit (bottom up) and explicit (top down) learning interfaces, dynamic interface	None that is theory-specific
Skill Acquisition Theory	Necessary springboard and starting point prior to automatization	When it helps explicit knowledge to become proceduralized	Cycles of carefully sequenced explanation and deliberate practice
Declarative/Procedural model	Typical/expected choice for adults, it stimulates reliance on explicit learning at the expense of implicit learning	None offered	None offered
Input Processing Theory	Beneficial when it targets unproductive processing strategies that are driven by comprehending meaning and bypass grammatical intake	Comprehension exercises designed to short-circuit unproductive parsing strategies and replace them with productive ones	Input Processing Instruction
Processability Theory	Limited effects, cannot override functional-universal forces	Consider developmental learner readiness when choosing targets (the "what" of instruction)	None offered
Concept-oriented approach		None offered	None offered
Interaction framework	Beneficial	Attention attracted to language form in the course of meaningful task performance	Focus on form, task-based language teaching
Vygotskian Sociocultural Theory		Metalinguistic, metacognitive, explicit orientation: Learning environments should foster meaningful events and other-assistance and deep understanding of (grammar) concepts mediated by visual artifacts and verbalization or languaging, all aligned to Zone of Proximal Development	Systemic-theoretical instruction (aka concept-based instruction)
Complexity Theory	Beneficial if learner-centered	Learner-centered, capitalizing on agentivity, creativity, meaning making; cultivate differentiated instruction and self-referential goals; attend to learner perception of affordances; support learners' awareness of differences; teach adaptation by iterative language use over changing activities	None that is theory specific

Another principle is to seed instruction with any kind of feedback (implicit or explicit) or other elements that help summon awareness, since conscious attentional control may help offset the effects of L1-learned attention. Grammar explanations can help, particularly when followed by strategically sequenced exemplars that make hidden patterns more salient to learners (see Ellis, 1993). Repetition and practice are thought to be beneficial, too.

In the declarative/procedural model, instruction is viewed as an unremarkably common choice for adults and one that stimulates reliance on explicit learning, likely a good thing, although potentially at the expense of needed redundant implicit learning:

> Explicit, classroom-like instruction of the grammar may encourage learning in declarative memory, perhaps at the expense of learning in procedural memory. Conversely, the lack of explicit instruction, as often occurs in immersion contexts, may encourage learning in procedural memory. These predictions should hold for both L1 and L2 learners. (Chapter 8)

The remaining 5 theories of the 10 presented in this book take the position that instruction can optimize natural learning processes and may be even necessary when the goal is truly advanced levels of proficiency. Proponents in each have articulated full proposals for the design of optimal instruction and have addressed the "how" of instruction.

Proponents of Skill Acquisition Theory firmly believe that optimal instruction should consist of cycles of explanation and deliberate practice of the various parts of language and language skills to be taught. Learners first need to be given explicit grammar explanations, often pedagogically simplified, and always accompanied by good examples of the phenomenon being explained. This is because they must process this knowledge consciously, until they understand the rules well. This must be followed by carefully planned "deliberate practice" activities that enable learners to apply the rules they have newly committed to declarative memory to further examples and cases, first slowly and with high degrees of error, but gradually more fluently and accurately. Thus, learners who are found to make little progress in one (or all!) areas of the L2 may lack the relevant declarative knowledge or they may engage in insufficient, non-deliberate, or ill-sequenced practice for those areas. It is through the provision of relevant explanation and practice in the specific areas targeted by instruction that learners can be eventually propelled to advanced levels of L2 competence. However, it is not grammar explanations alone or practice per se that fuels learning, but the fact that the two instructional elements are sequenced in specific ways and that the learners apply themselves in the conscious processing of knowledge and further practice the target performances through deliberate and conscious efforts (see DeKeyser, 2007).

Input Processing theorists claim that optimal instruction should strive to alter how learners process the input during meaning-based comprehension. To this

end, they have developed a special type of instruction called Processing Instruction (see VanPatten, 2004), designed to afford high-quality opportunities to process certain aspects of the L2 input in the context of meaningful comprehension exercises, under conditions that short-circuit unproductive (L1 or universal) parsing tendencies. In this way, learners are primed to employ more appropriate parsing strategies in the target language. For example, L2 Spanish learners may be given practice with non-canonical (object-verb-subject) word order examples like "A Juan lo besó María" ("As for Juan, Maria kissed him"), immediately after being warned it would be misguided to assume that "Juan" is the doer of the kissing, just because their L1 English creates the expectation that the first noun in the string will most likely be the doer of any action. (It should be noted that explanations that draw explicit attention to L1-L2 parsing mismatches are thought to help, but they are not posited to be necessary.) With sufficient practice on how to parse strings using Spanish morphological cues rather than word order, learners' internal parsing strategies are expected to attune themselves to the appropriate cues for extracting meaning and making Spanish-sensitive syntactic interpretations. (Farley, 2005, offers good suggestions for how to design a variety of input processing exercises across several target languages.)

In contrast to the sentence-level meaningful practice that is prioritized in pedagogies based on Skill Acquisition Theory (via explicit instruction that provides declarative knowledge and opportunities for well-sequenced practice) and Input Processing Theory (via interventions that seek to affect implicit processing), the interaction approach favors task-based activities that afford learner practice with discourse-level language performance and subtly attract their attention to the specific formal features that need to be learned. That is, this approach conceives of instruction as externally orchestrated opportunities to attend to relevant features of the target language in context, precisely when they are embedded unobtrusively in the task at hand, during meaningful comprehension and production activities, often in collaboration with peers or other interlocutors. A wide array of pedagogical techniques are posited to be facilitative, ranging from most implicit (e.g., recasts) to most explicit (e.g., collaborative negotiation of language problems in group dictation exercises called dictogloss). Instruction is not expected to alter natural constraints and paths of development but to optimize them, and it is posited to be possibly necessary for the development of very advanced L2 capabilities. Currently debated within this approach is what counts as "unobtrusive" attentional manipulation and whether optimal instruction should seek changes in knowledge and processing at more explicit or more implicit levels (see Doughty & Williams, 1998).

Sociocultural Theory also construes instruction as clearly facilitative: "instructional interventions [can be] designed to provoke development" (Chapter 11). This theory specifies a type of educational design called Systemic Theoretical instruction, which is unlike the instruction proposed by any other theory in that it decidedly targets the metalinguistic, metacognitive, and explicit dimensions of learning. Instruction should promote rigorous understanding and internationalization

of new concepts (language concepts, in the case of L2 learning) and should be designed to foster a social and material environment in which two additional things happen: (a) learners are encouraged to negotiate participation in meaningful activities by means of different kinds of mediation and (b) the quality of assistance from teacher and peers should be orchestrated so as to gauge the appropriate current level, aligned developmentally and contingent to individual learner needs. In this sense, appropriate L2 instruction should work within each learner's Zone of Proximal Development and seek to expand it by enabling qualitative changes in the types of assistance and mediations called for. If these two conditions attain, learners can accomplish valued goals, first through assisted participation and later on their own, to the point that instruction will have helped individuals learn to use the L2 to self-regulate. Another unique aspect of instructional design in Sociocultural Theory is the "pedagogical imperative" (Lantolf & Poehner, 2014) to unite theory and praxis, that is, to pursue theoretical-conceptual understanding as well as meaningful transformation of learners' material and symbolic worlds.

Finally, Complexity Theory might agree on many of the specifications for optimal instruction offered by usage-based approaches, but it resonates with Sociocultural Theory in adding the caveat that learners, and not any external instruction, are the agents of their own creative soft-assembling to the affordances they perceive in their environments, including the affordances they leverage from formal instruction. It can be surmised from this position that instruction will be good if it (a) capitalizes on learner agentivity and creativity, (b) considers meaning-making as central motivation for language, (c) addresses self-referential goals and is attuned to learners' own perception of affordances, and (d) supports learners' awareness of differences.

Some Future Challenges for SLA Theories

The 10 contemporary theories that readers find in this book (plus the early ones also reviewed by VanPatten and Williams in Chapter 2) are the most widely cited and discussed in the history of SLA to date. They attest to the three characteristics of the field mentioned earlier: youth, strength, and interdisciplinarity. In this final section, I forecast some areas that I believe will likely attract keen attention in future SLA work. In my opinion, future work that ventures in these directions has the best potential to improve disciplinary explanations about additional language learning.

First, I predict that in the future SLA theories will expend continued efforts in incorporating views of language cognition and L2 knowledge that are plausible, in the sense of compatible with cutting-edge knowledge about the workings of human cognition gleaned in the field of cognitive science. Some of the current theories in SLA fare better than others on this account. For example, usage-based approaches, Skill Acquisition Theory, and the declarative/procedural model offer fine-grained specifications of language cognition that draw on contemporary,

plausible models of cognition. Several alternatives to traditional Universal Grammar, such as Autonomous Induction Theory (Carroll, 2001; O'Grady, 2005), have originated precisely as attempts to accommodate cutting-edge knowledge of psycholinguistic processing into formal linguistic theories of language acquisition. However, in many SLA theories, a lack of specification of the assumed cognitive architecture is apparent. Indeed, this weakness was identified many years ago as a major obstacle for theory development, in a well known 1990 special issue of *TESOL Quarterly* devoted to exploring the proper scope and form of SLA theories. In it, Schumann (1990) noted that claims like the "one-to-one principle" or the "noun-first principle" (p. 681) are useful in expressing observed, external behavior into predictive laws, but they are implausible direct descriptions of any underlying cognitive process or mechanism. Almost three decades later, the need for better specification of the cognitive architecture assumed in each SLA theory remains urgent.

Discussions regarding the contributions of the linguistic environment and instruction to L2 learning can be particularly muddled by the problem of underspecification regarding the nature of L2 knowledge that is posited in each theory. One illustrative case is the ongoing debate about recasts among proponents of the Interaction approach (see Chapter 10). It remains unclear in these exchanges whether the learning benefits of recasts that are under dispute (e.g., see exchange by Goo & Mackey, 2013; Lyster & Ranta, 2013) stem from metalinguistic (conscious) or psycholinguistic (subconscious) levels of processing. If the latter case is to be assumed, valid evidence would have to come from two sources, online processing data and gains resulting from experimental manipulations. By contrast, a commitment to benefits that are metalinguistic and metacognitive in nature would demand that critical evidence be found in learner reports of awareness and documentation of incorporation of recasts in the immediate discourse. Without a theoretically guided agreement on what kinds of evidence can settle the debate, little progress, whether theoretical or empirical, can be made.

The psychologically oriented SLA theories presented in this book assume an explicit-implicit interface to some extent. Therefore, this area will likely attract much work in the future and stands to benefit greatly from interdisciplinary influences from cognitive science. Several fundamental questions that need to be pursued are as follows: What constitutes explicit versus implicit knowledge of an L2? How does each type of knowledge originate? How and when do they interface with each other? What are the relative contributions of each to L2 learning? Interesting research has begun in recent years (e.g., see R. Ellis et al., 2009). However, in the future it will be important to investigate the nature and contributions to L2 learning of explicit and implicit knowledge from a wider range of theoretical SLA frameworks. The first challenge in this direction would be to specify appropriate empirical strategies for investigating the relative roles for implicit and explicit knowledge that can (or cannot) be postulated by a range of theoretical approaches beyond the ones currently engaged in this area. To be sure, each SLA theory

will frame the questions regarding explicit and implicit knowledge differently, in ways that are congruent with the rest of the constructs and the view of cognition entailed in each. However, at this stage of our disciplinary knowledge it would be problematic for any theory of SLA to discard a priori one or the other type of knowledge as irrelevant for explaining L2 acquisition. For one, it is undeniable that L2 learners across formal and informal contexts encounter multiple opportunities to learn from implicit, bottom up, and subconscious processing and they also seize opportunities for learning from explicit, top down, and conscious processing. In addition, all learners experience a "curious disjunction of knowledge" (Chapter 2), so pervasive and striking that the phenomenon begs better theoretical understanding across all possible perspectives.

A second area that will hopefully attract future attention involves the need to theorize experience in explanations of SLA. As DeKeyser notes in Chapter 6, different learners are afforded (or seek on their own to obtain) different amounts, qualities, and sequences of experience in and with the L2. Differential experience is thought to be connected to one of the most salient "facts" to be explained by any SLA theory, namely, the large variability and heterogeneity in L2 learning processes and outcomes. Of course, all theories of SLA acknowledge this fact and all admit that variable L2 outcomes are related in part to variable life experience for different learners across different contexts. However, most SLA theories are typically ill-equipped to deal with this reality in theoretically rigorous ways. As a consequence, they trivialize learner experience as anecdotal and outside the systematic scope of empirical documentation, divested as they see it from any theoretical status.

Among the 10 theories gathered in this book, there are two exceptions to this charge. Sociocultural Theory (Chapter 11) is specifically designed to investigate cognition and learning as embedded in and taking its source from experience and context, not divested or abstracted from them. Complexity Theory (Chapter 12) also shows clear leanings toward accounting for the social experiences of learners in a theoretic-central fashion. However, additional theories are available that have been adapted to SLA from the fields of anthropology, education, and sociology. Many of them have been termed "alternative" in the context of SLA, as the ones gathered in Atkinson (2011). Whether one considers them traditional or alternative, they draw on social understandings of cognition that are germane to the concerns in Sociocultural Theory (Chapter 11) and Complexity Theory (Chapter 12), and they hold great potential to help SLA researchers understand a range of social influences on L2 learning processes and outcomes, beyond the dimensions of cognition and language traditionally investigated in current SLA theories. The reason is that they have been designed specifically to deal with social experience as an object of study, rather than as random noise that needs to be eliminated from theory development. In other words, these theories were designed originally to theorize human social experience in their respective fields. In addition, they offer social respecifications of a number of constructs that are key

in SLA thinking, including *grammar* in systemic-functional linguistic theory (e.g., Schleppegrell, 2004), *interaction* in Conversation Analysis for SLA (e.g., Kasper & Wagner, 2011), and *learning* in Language Socialization Theory (e.g., Duff & Talmy, 2011) and Identity theory (Norton & McKinney, 2011).

Explanatory constructs that cut across this new family of SLA theories are agency, power, and identity. At the risk of simplifying grossly, just as certain SLA theories have helped us understand that the linguistic environment may be less important than how language usage events are processed and perceived by learners, these other theories help us understand ways in which social experience may be important to understand, not as externally documented experience or fixed environmental encounters, but as experience that is lived, made sense of, negotiated, contested, and claimed by learners in their physical, inter-personal, social, cultural, and historical context. If in the future SLA researchers recognize the importance of theorizing learner experience, it may be possible to achieve a balance between linguistic, cognitive, psychological, and social explanations in our theories. Encouraging in this regard are recent disciplinary discussions promoting epistemological bridges between cognitive and social orientations in the study of language learning and teaching (Hulstijn et al., 2014).

The final area for future theoretical development that I would like to forecast here pertains to the need for a complete reevaluation of SLA theories in light of what we know about bilingualism and the nature of bilingual competencies (Ortega, 2013, 2014). Ironically, the field of SLA takes as prototypical the idealized case of the individual who already possesses a mature monolingual grammar and subsequently begins learning an L2 with the goal to add on a monolingual-like command of the additional language. This bias is in part reminiscent of the same monolingual orientation in the field of child first language acquisition, which exerted a strong disciplinary influence on SLA during its formative years. Luckily, increasingly more empirical studies are available that illuminate the (very common case, worldwide) of bilingual first language acquisition from birth (see synthesis in De Houwer, 2009).

The burgeoning research in the neighboring field of child bilingual acquisition has exposed this monolingual bias and has left SLA theories vulnerable to serious critique on this count. In addition, Vivian Cook, one of the earliest SLA voices to raise these concerns (e.g., Cook, 1991), notes that the best psycholinguistic bilingual processing evidence tells us L2 competence is fundamentally different from the linguistic competence of a monolingual. To use Cook's terminology, L2 users are not two monolinguals in one. Instead, they possess a psycholinguistically distinct form of multicompetence. The validity of key notions in the field of SLA (e.g., interlanguage and ultimate attainment) is called into question when the monolingual native speaker is no longer held to be the norm. Consider, for example, how radically vacuous certain theoretical and empirical statements are, if we substitute the notion of "target-like" for the notion of "monolingual-like." Thus, saying that "a given learner has failed to develop target-like competence in a given

area of the L2" or that "most L2 learners fall short of the target norm" makes little sense, if what we think we are saying is that a given learner has failed to develop *monolingual* competence in a given area of the L2 or that most L2 learners fall short of the *monolingual* norm. After all, the impossibility for bilinguals to reach levels that are isomorphic with monolinguals would be a non-issue in a world in which bilingualism would be considered the default state of the human language faculty.

A bi/multilingual turn may be imminent in the near future. It would allow two fundamental reorientations in the field (Ortega, 2013). First, it would help reconceptualize L2 development as the development of late bilingualism, whose most natural comparison and counterpart is from-birth or very early-timed bilingual development. Second, it would make the field of SLA connect with the broader landscape of disciplines that study other kinds of language acquisition, all of which (together with L2 acquisition) vary along the two parameters of timing of learning and number of languages learned. If this sea change happens, I predict it will open up novel ways of framing the object of study and new premises from which to pose research questions, design studies, and interpret finding. A bilingual turn can thus only greatly enrich SLA and its future theory-building efforts.

Explaining how people learn languages later in life, above and beyond the mother tongue(s) they learn from birth, is the central task of the field of SLA. Scholarship in this area attracts keen interest and even fascination. This broad intellectual appeal is not surprising, given that speaking more than one language and being comfortable with more than one culture has become great personal and socio-economic assets to people from all walks of life and from all over the world. In close to 50 years of vibrant existence, SLA has produced a surprisingly varied and healthy number of theories that explain convincingly particular phenomena in L2 acquisition, sometimes in ways that are similar across theories, on occasion in ways that differ from (and sometimes even contradict) other theories. Naturally, most progress has been made in the areas where most effort and attention has been directed to date, namely the acquisition of a linguistic system, traditionally defined as morphology and syntax of the L2. In the future, we can look forward to further theoretical development, innovation, and expansion. Future SLA thinking that continues to be interdisciplinary and reaps the benefits of advances in cognitive science, social theories, and bilingualism will be of essence in improving our explanations for the human capacity to learn additional languages later in life.

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GLOSSARY

Adaptive: Adaptive systems change in response to their changing environments.

Affordances: In Complexity Theory, as applied to second language development, affordances are learning opportunities that learners perceive to exist in the environment.

Attention: The orientation of mental powers.

Automaticity: (1) The end point of the process of automatization, characterized by the capacity to carry out a task at high speed, with a low error rate and minimal interference from or with other tasks or new task conditions. The latter is sometimes referred to as robustness. (2) The extent of routinized control over (linguistic) knowledge.

Automatization: The gradual improvement that occurs in speed, error rate, and effort required that occurs as a function of task practice. The (virtual) end point is automaticity. Sometimes automatization is used in the sense of mere speed-up, but usually in this broader sense; for some (e.g., Segalowitz), it is only used to refer to changes as a result of practice that are beyond mere speed-up.

Basal ganglia: A group of highly interconnected structures deep in the brain. The basal ganglia include the caudate nucleus and other structures (e.g., the putamen and globus pallidus).

Broca's area: A classical brain language area in the frontal lobe that is generally considered to include the opercular part and the triangular part of the inferior frontal gyrus (these correspond largely to Brodmann's areas 44 and 45, respectively). The area is named for the French scientist Paul Broca, who first suggested its involvement in language in the 1800s.

Co-adaptation: A reciprocal social process whereby speakers adjust their language resources to their interlocutors

Comprehensible input: Input that is slightly above the level of the learner's current proficiency.

Construct: Within a theory, a clearly defined feature or mechanism. For example, in atomic theory, a proton is a feature and particle attraction is a mechanism. Both are constructs within the theory.

Construction: Central notion of Construction Grammar. Constructions are pairings of form and meaning or function that range from morphemes to words and abstract syntactic frames.

Content words/content lexical items: Lexical items, or words, such as nouns, most verbs (not auxiliaries and modals), adjectives, and adverbs, that are used to express an object, process, or some nongrammatical meaning.

Contingency: When the presence and/or specific realization of a form A depends on the presence and/or specific realization of another form B, then A is contingent on B. Contingency can vary in strength. Some cues (like lightning → thunder) are highly predictive and so have a high contingency, and other cues are less reliable (summer days → fine weather).

Corpus (pl. corpora): A large and structured collection of transcribed spoken and/or written language data in digital format.

Cultural artifacts: Physical objects and symbolic systems developed by human societies over the course of their history that mediate (see mediation) their social and psychological behavior. Physical artifacts include tools (e.g., hammers, saws, shovels, bulldozers, computers) and symbolic systems (e.g., language, numbers, art, music, literature, sanctioned social behaviors). Artifacts mediate through their use and not as objects in themselves—hammering, not hammers; counting, not numbers; communicating, not language. It is important to remember that cultural artifacts have psychological impacts on how people think.

Declarative knowledge: Knowledge that can be explicitly expressed ("declared"), such as a law of physics, a grammar rule, or a historical fact, as opposed to knowledge that can only be performed (procedural knowledge), such as how to swim or speak fluently. Sometimes called factual knowledge, or knowledge *that* as opposed to knowledge *how* (procedural knowledge).

Declarative memory: Under the D/P Model, this is the memory system in the brain that is rooted in medial temporal lobe structures and underlies knowledge of facts and personal experiences. Knowledge learned in this system can be explicit or implicit.

Developmental problem: One of the two core issues to be addressed by a theory of SLA. It focuses on the question of why learners follow a specific path in their L2 acquisition process.

Developmental trajectory: Relates to the path L2 learners follow in their acquisition process. This includes the developmental dimension, which is characterized by universal stages L2 learners pass through, and the variational dimension, which captures individual learner variation within the constraints of processability. The PT hierarchy of processing procedures generates specific predictions for developmental trajectories.

Distributed versus massed practice: Large versus minimal spacing between successive instances of practicing a rule or retrieval of an item.

Double dissociation: The demonstration that two experimental manipulations have different effects on two dependent variables. For example, grammar is impaired from a lesion to brain structure X but not Y, while lexical abilities are impaired from a lesion to structure Y but not X. Or grammar is associated with brain activation in structure X but not Y, and vice versa for lexical processing.

Dynamic assessment: A type of assessment based on the Zone of Proximal Development (*see* Zone of Proximal Development) used to diagnose individual and group abilities and at the same time provoke development of new abilities. It can be used in summative and formative contexts of assessment.

Effortful comprehension: Real-time nonfluent comprehension that causes a hearer (usually a second language learner) to miss information in a speech stream.

Emergence: The spontaneous occurrence of something new that arises when the components of a complex system interact.

Emergentism: A system is emergent if it is some way more than sum of the properties of the system's parts.

Endstate: The final grammar achieved by a learner. No further acquisition occurs beyond this point (with the exception of vocabulary). Often referred to as *ultimate attainment*.

Exemplar: Exemplars are specific examples of a category. The word "house," for instance, is an exemplar of the category NOUN in English.

Explicit learning: Explicit learning is the learning of information in a conscious and often effortful manner.

Feature unification: A central component of LFG. The mechanism of feature unification ensures that the different parts of a sentence fit together by merging the features that are present in the lexical entries. Feature unification allows for the matching of features that are conceptually related even if they occur in different

parts of the sentence. This mechanism accounts, for instance, for agreement, such as in 'The monkeys are in the forest,' as the feature 'number = plural' in the lexical entries of 'monkeys' and 'are' is unified.

Form–meaning connections: The matching of a linguistic form (such as a word, a morpheme, or a structure) to a function/meaning/concept (such as an action, a time reference, person, number, and so on). Same as *function-to-form mapping*.

Functional load: The information value of a linguistic form in context.

Genetic method: The approach to scientific research proposed by Vygotsky in which development of individuals, groups, and processes is traced over time. The goal is to discover the contributions of cultural artifacts to psychological development. The research can entail different temporal scales, including ontogenesis, whereby children are studied in either natural or laboratory settings to trace their ability to incorporate and eventually internalize (*see* Internalization) cultural artifacts into their psychological behavior; the history of a society or even human culture as a whole as artifacts are created, modified, and abandoned over long stretches of time. It also includes the reverse process, whereby adults with cerebral impairment lose their ability to regulate their mental behavior.

Grammaticality judgments: Judgments made regarding the possibility or impossibility of certain sentence types. Grammaticality judgment tasks typically include grammatical and ungrammatical sentences which participants are asked to assess.

Higher mental processes: Mental processes built on the foundation of lower mental processes (see lower mental processes) as a consequence of the appropriation and internalization of cultural artifacts that in turn convert the lower processes from involuntary to voluntary, or mediated processes, and organize them into a unified rational system of human consciousness.

Hippocampus: A brain structure in the medial temporal lobe that underlies learning in declarative memory.

Hypothesis: A singular testable idea generated by a theory or by a set of observations.

Hypothesis space: Specifies the scope of the structural hypotheses at a given stage of development. The structural options are constrained by the processing procedures available to the L2 learner. The concept of Hypothesis Space represents both the developmental and the variational dimension of SLA and defines the variation occurring in the learners' interlanguage.

Implicit learning: Implicit learning is the learning of information without the intent to learn it, usually in an unconscious manner.

Input Hypothesis: A position that holds that what is needed for learning is input that is slightly above learners' current knowledge of the second language.

Interface/noninterface theories of SLA: Theories that claim that explicit knowledge can or cannot become implicit knowledge, respectively.

Internalization: The process through which forms of mediation are appropriated, or made one's own. This often occurs under mediation (*see* Mediation) in the ZPD (*see* Zone of Proximal Development), frequently involves private speech (*see* Private speech), and results in self-regulation (*see* Regulation).

Interpsychological [function]: The process whereby mental ability is distributed between two individuals or between and individual and a cultural artifact that is used as an external form of mediation. Thus, behavior under mediation in the ZPD (*see* Zone of Proximal Development) is interpsychological, and so is the activity of looking up a word in a dictionary or consulting a grammar in an L2. The concept captures the notions of other- and object-regulation. *See* Intrapsychological [function].

Intrapsychological [function]: The process whereby mental ability is located under the control of the individual (i.e., self-regulation). It results from the internalization of cultural artifacts. *See* Interpsychological [function].

Island constraints: Constraints of UG that place limits on how far *wh*-phrases can move. The idea is that certain syntactic domains form units such that nothing can move out of them. Island constraints are often subsumed under the Subjacency Principle.

Iteration: Repetition that is not exact, which takes place when the results of one procedure are applied to the results of a previous application.

Learned attention: People learn to attend to the cues that are relevant to a problem-space, and this increases speed of acquisition and automaticity of processing. While selective attention benefits acquisition, it can also lead to distortions of knowledge that are evident when the learner transfers to novel problem-spaces. Learners continue to attend to the old cues, even when these are no longer optimal, and can ignore relevant new cues, especially when they are lacking in salience.

Lexical mapping: The principles specified in LFG that govern the linking between the arguments of a verb (e.g., 'agent', 'patient', and 'theme') and the corresponding grammatical functions (e.g., 'subject' and 'object'). The correspondence between arguments and functions can be linear, as in 'John threw the ball', where the agent is mapped onto the subject ('John'), or nonlinear, as in the passive sentence 'The ball was thrown by John'. In this case, the theme is linked to the subject ('the ball') and the agent is mapped onto the adjunct ('John').

Linearization problem: Addresses the question of how speakers order the information they intend to express. The mapping of conceptual material onto linguistic form does not necessarily take place in a linear fashion, as in the sentence 'Before he went home, he had dinner'. In this case, propositional content needs to

be stored in memory. The linearization problem also applies to the morphosyntactic level, as in 'Peter sees a dog'. Here grammatical information needs to be stored in memory to achieve subject-verb agreement.

Linguistic competence: The underlying unconscious and abstract knowledge of language that native speakers and L2 learners attain, represented by a grammar.

Logical problem: The claim that learners come to know more than what they were exposed to along with the question of how this is possible. Also referred to as the *poverty of the stimulus* or the *learnability problem*.

Lower mental processes: Those mental processes governed by the endowed neurological organization of our brains, including involuntary attention, memory, perception, and awareness of the environment. These serve as the foundation on which higher mental processes are constructed.

Mediation: The central concept of sociocultural theory to which all other theoretical concepts are directly or indirectly connected. It argues that all forms of higher human mental processes (*see* Higher mental processes) result from participation in and appropriation of social relationships (e.g., family life, school, work) and cultural artifacts (*see* Cultural artifacts) that intervene between people and their relationship to each other and the objective world.

Metalanguage: Language used to talk about language.

Model: A description of a set of processes. Models describe how something occurs; they are not required to explain why something occurs.

Morphological stage: The last stage in the development of temporality in which learners begin to use verb morphology to indicate temporal (time) relations.

Multifunctionality: Multiple forms for one meaning or multiple meanings for one form.

Multiple Constraints Hypothesis: Relates to the initial L2 mental grammatical system. It focuses on the question of what kind of grammatical information is initially present and what grammatical resources early learners can draw on at the beginning of their L2 acquisition process. The Multiple Constraints Hypothesis proposes specific constraints at the semantic and syntactic levels of linguistic representation.

Negotiation (of) for meaning: The attempt made in conversation to resolve a lack of understanding.

Nonlinearity: When an effect is not proportionate to a cause

Noticing: Detection involving cognitive registration.

One-to-one principle: One form-one meaning

Open: An open system interacts with its environment. Depending on what type of system it is, it exchanges information, matter, or energy with its environment.

Output Hypothesis: A position that holds that output (language production) is a significant factor in second language learning.

Parsing: The moment-by-moment implicit computation of sentence structure during real-time comprehension.

Power law: The law invoked to describe the specific way reaction time and error rate decline as a function of practice for a wide variety of skills. "Power" refers to the exponent in the mathematical equation describing the learning curve.

Practice: In a narrow sense, activities engaged in repeatedly with the goal of becoming better at them (often called deliberate practice); in a wider sense, activities that make an individual draw on procedural knowledge, whether or not the goal is to improve that knowledge (e.g., speaking a foreign language because somebody just addressed you in that language).

Private speech: A form of speech that appears social in form but is psychological in function. That is, it often appears as a conversational turn with an interlocutor; however, it is directed not at another person but at one's self and functions to regulate psychological behavior (i.e., trying to figure out a difficult math problem or to remember a word or learn a new linguistic feature of an L2). Private speech may be completely externalized and thus audible. It may also be whispered, or even subvocal.

Proceduralization: The process of creating procedural knowledge by merging declarative knowledge with more encompassing procedural rules (more recently often called productions). This takes place when learners repeatedly engage in a task that calls on the broad procedural rules and the relevant declarative knowledge. Production compilation (combination of rules or productions frequently used together into one production) is also part of this process.

Procedural knowledge: Knowledge that can only be performed, such as how to swim, to do mental arithmetic, or to speak fluently. Sometimes called task knowledge, or also knowledge *how* as opposed to knowledge *that* (declarative knowledge).

Procedural memory: For the D/P Model, the memory system in the brain that is rooted in frontal/basal ganglia circuits and underlies motor and cognitive skills such as riding a bicycle. This knowledge seems to be entirely implicit.

Processability hierarchy: A central construct in PT. It is based on the notion of transfer of grammatical information within and across phrases. The hierarchy consists of five specific processing procedures that are ordered hierarchically and are implicationally related. The hierarchical arrangement of these procedures accounts for the developmental path L2 learners follow in SLA.

Processing: The connection or linking of form and meaning during real-time comprehension. The connection can be local (at the word level) or sentential (the interpretation of an entire sentence).

Processing instruction: A pedagogical intervention or technique that manipulates input in certain ways to counteract the (potential) negative effects of various input processing principles.

Prototype: A prototype is the most typical member of a category, and it is created by combining the most representative attributes of that category.

Rational analysis of cognition: Rational analysis is an empirical program that attempts to explain the function and purpose of cognitive processes. Unlike traditional cognitive science, in which the cognitive system is often treated as an arbitrary assortment of mechanisms with likewise arbitrary limitations, rational analysis views cognition as intricately adapted to its environment and the problems it faces.

Reaccess: The process through which earlier forms of development are called upon, either intentionally or unintentionally, in carrying out specific activities. Thus, individuals who may be able to regulate their own psychological or social behavior (see Regulation), at times, find it necessary to seek support (i.e., mediation) from others (i.e., other-regulation) or from cultural artifacts (i.e., object-regulation) during difficult activities.

Regulation: The human ability to intentionally control our own social and/or psychological behavior (i.e., self-regulation) or the behavior of others (i.e., other-regulation), or to subject their behavior to that of others (also other-regulation) or to cultural forms of mediation (i.e., object-regulation).

Retrodiction: Predicting that one will find evidence of past events to explain current performance.

Reverse-order reports: Events that are not in the order in which they happened.

Scaffold(ing): Communicative support provided by another speaker's turn on which a learner can build a contribution.

Self-organizing: When order in a complex system emerges on its own, without direction from an external force or without a preexisting plan.

Spacing of practice: The time interval between different instances of practicing the same rule or retrieving the same item.

Spatial resolution: The precision of a measurement with respect to space. A neurocognitive method with high spatial resolution, such as fMRI, allows one to localize neural activity accurately in the brain.

Statistical preemption: Learners can generate their own negative feedback when they come to expect one form in a particular context yet witness another.

Stimulated recall: A research methodology in which, following completion of a task, individuals are asked to verbalize what they were thinking at the time of the original task. A stimulus (such as a video of the participant engaged in the task) is provided.

Systemic-Theoretical Instruction: An approach to education developed by P. Gal'perin and his colleagues based on Vygotsky's theory. It privileges explicit systematic conceptual knowledge of any subject domain and links it to concrete practical activity whereby the conceptual knowledge mediates this activity.

Temporal resolution: The precision of a measurement with respect to time. A neurocognitive method with high temporal resolution, such as ERPs, allows one to track the actual time course of brain activity.

Theory: A set of statements or laws designed to explain observable phenomena and make predictions about other phenomena.

Transfer: The transfer of first language knowledge to second language use.

Truth-value judgments: Judgments made regarding the appropriateness of a sentence in a given context. Participants pay attention to the meaning of the test sentences rather than the form.

Universal Grammar (UG): A system of linguistic principles and parameters, placing limitations on the form of grammars. UG is assumed to be part of a biologically endowed language faculty (i.e., innate). Principles of UG are generally true across languages, whereas parameters allow for constrained variation from language to language.

Unmarked alignment: The default mapping principle. In this case, the correspondence between arguments, grammatical functions, and surface structure constituents is entirely linear. For instance, in the sentence 'John played the piano', the most prominent argument—the agent—is mapped onto the subject function, which is realized as the initial noun phrase in constituent structure.

U-shaped learning: U-shaped learning denotes one frequent developmental path when new cognitive skills are developed. Imagine a curve shaped like the letter "U" in a graph, with the x-axis depicting time and the y-axis depicting the learner's level of skill. Learners often start out with seemingly high levels of skill but then go through a phase in which their proficiency plummets before it rises again. U-shaped learning characterizes the learning of new words, high-level mathematic algorithms, and even the building muscle strength, among many other skills. Early high levels of performance often reflect memorized, unanalyzed responding; middle lower levels of performance reflect the development of analyzed systematic responding (whereby irregular responses are now overgeneralized).

***Wh*- movement:** Syntactic movement of a *wh*-phrase (containing an expression like *who, which, what*) to the initial position in the clause, typically in questions and relative clauses.

Working memory: The metaphoric "computational space" available to listeners and readers during the act of comprehension; allows for temporary information storage and manipulation.

Zone of Proximal Development: The activity whereby individuals and groups, interacting under the systematic and planned (e.g., schooling), or unsystematic and unplanned, mediation (*see* Mediation) of other individuals and groups take part in tasks that they cannot perform alone and at the same time appropriate the cultural artifacts available in their community.

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