



Inside the Creative Sifter: Recognizing Metacognition in Creativity Development

ABSTRACT

The parallels between cognitive development and creativity are neglected in the literature. Piaget's information transformations are personalized, meaning individual constructions can involve creativity. Vygotsky's work considers the implications and interactions of social influences, conventions, and personal implications for creative development. The Cognitive-Creative Sifting Model is proposed to focus attention on these and other connections between cognitive development and creativity. Other common methods of assessing creativity are compared to the proposed model. It is argued that the model provides a foundation to evaluate individual creative potentials more holistically. Specifically, the conceptual elements of metacognition are described and their role in the development of creativity is suggested. It is argued that future researchers should pay particular attention to the interaction effects metacognition has with traditional measures of creativity focused on ideation and product evaluation.

Keywords: creativity, cognitive development, metacognition, assessment.

The process of creation is a cognitive process. Perceiving, learning, thinking, and remembering—this is the stuff of creativity. The creative process involves the acquisition of knowledge and skills, the transformation of knowledge into new forms, and the rendering of these forms into a shareable product. Each stage in the process entails cognition. It seems appropriate, therefore, to inquire about a cognitive model of creativity. (*Armbruster, 1989, p. 177*)

Employing a cognitive approach to creativity, either in theory or experimentally, is not a new, or particularly novel, practice in psychology. Specifically focusing on the metacognitive aspects is more unique. Definitions of creativity need better framing and we ought to be mindful that the evaluation of such a multifaceted concept ought to include multifaceted measures. The former is prevalent in the research literature concerning creativity (e.g., Plucker, Beghetto & Dow, 2004), while the latter notion has been mostly only implicitly expressed despite the multitude of approaches that exist. Like other areas of educational psychology, researchers tend to have specific methods to which they are partial. A holistic view is not typical. Openness to such diverse methods, including the trait aspects of creative potential, holds “both scientific and practical interest” (Eysenck, 1993, pp. 171–172).

In this paper, the primary cases made are twofold and intertwined. First, creativity is a developmental cognitive process. Secondly, the metacognitive aspects of creativity have theoretical basis in this cognitive development. Thus, the assessment of creativity could be enhanced by giving greater consideration to the measurement of metacognitive skills. Methods in this vein are needed to facilitate a holistic view that evaluates intrapersonal interpretations as well as moment-to-moment and relatively small, or foundational, sparks of creativity. At the heart of the argument lies an understanding of the intersection of cognitive development and developmental views of creativity and the role played by metacognition in both.

The present work argues that the current state of creativity study and assessment generally focuses on either the generation of ideas (e.g., divergent thinking assessments) or the end result of creative endeavors (e.g., consensual assessment technique). This neglects the cognitive processing that occurs in the interim and the interaction effects these cognitive aspects may demonstrate with more traditional measures of creativity. It is argued these cognitive skills are developed and change over time in an individual resulting in changes in the quality and quantity of creative production.

TABLE 1. Summary of Previous Theory and Relevance to Cognitive-Creative Sifting Model

Previous Work	Connection to Present Work
Piaget—Information Transformations	May be only internal (inside the “sifter”)
Piaget—Assimilation	Schema within an individual (inside the “sifter”); Rigid use of present “sifter”
Piaget—Accommodation	Schema within an individual (inside the “sifter”); Openness to using the “sifter” differently
Eysenck; Cropley; Kaufmann & Beghetto—Balancing divergent/convergent	Monitoring the chosen uses of (different) sifters
Runco—“personal logic”	Openness to radical/illogical ideation as an issue of cognitive sifting
Forgeard & Mecklenburg—motivation	Relates to an “inside the sifter” issue, but not explicitly cognitive
Perkins—desire to be novel	Typically considered part of ideation, but may be related to internal unseen processes
Smolucha—cognitive development	Development of internal cognitive sifters critical of creative potential
Sternberg, Kaufman, & Pretz—Propulsion Model	Informs/describes the connection of cognitive sifting to final creative product
Simonton—Blind Variation/Selective Retention	Focuses on the nature of the sifting results
Beghetto & Kaufman—“mini-c”	Focus on “interpretations” suggests cognitive sifting
Flavell—metacognition	Processes occur unseen—inside the filter

Key works in the fields of cognitive development and creativity have repeatedly gone to the precipice of explicitly making the case for a similar view. A summary of these connections is provided in Table 1. I take the view that the field misses an obvious and fruitful area of research by not making the leap. In this paper, I highlight classic and more contemporary theories in terms of their contributions to the present conceptual framework employed. Ultimately, I articulate a new model for conceiving of creativity as an appropriate outgrowth of the present theoretical and research base in creativity.

PIAGET, TRANSFORMATIONS, AND CREATIVITY

To think is to act on the object and transform it. (*Piaget, 1973, p. 90*)

A PIAGETIAN FRAMEWORK

Piaget implies that the essence of thinking comes through an individual’s journey in the processing of information. Taken most generally, transformations refer to the process of moving from any state of understanding or conceptualization to another. These processes can be seen as foundational to cognitive development (Runco, 1996). Information transformations occur all along an individual’s developmental continuum including during one’s initial perceptions of a topic, subject, or even broader domain (Sawyer, 2003). Transformational capacity is important in many learning processes such as problem-solving. It is less frequently applied in the creativity field, however, as many definitions of creativity in the literature (e.g., Plucker et al., 2004) include components of originality and/or usefulness in their conceptions. This may be viewed as short-sided, since, as will be discussed later, some personal components of creativity are perfectly useful and original to the individual and no one else. Significance to the field may not be a defining characteristic in all cases as suggested by Runco’s (1996) “personal creativity” and Beghetto and Kaufman’s (2007b) “mini-c” creativity. These transformations may never be externalized. For example, a student working on a math problem may come up with multiple ways to solve a problem (i.e., come up with different possible information transformations), but only expresses one on his/her homework. There is value in an awareness of the unchosen processes and the reasons for such a course of action. Unchosen strategies may be misinterpreted later as novel approaches for the individual when finally outwardly manifested.

In another Piagetian connection, applying assimilation and accommodation to discussions about the nature of creativity gives rise to meaningful connections. Assimilation involves the processing and incorporating of information into cognitive, value, or belief systems or into structures already in place within the individual. Assimilation is critical to creativity because high degrees of originality necessitate it (Runco, 2003b). In other words, taking a divergent or unique approach to a situation or problem or task is likely to require that the individual holds firms to their own (at least temporarily fixed) underlying convictions. Accommodation involves the adjustment of these convictions or cognitive structures to fit the information with which one is presented. Accommodation may also be involved in creativity, but only to the extent to which some relatively small problem in a process requires attention (i.e., the “a-ha” moment at which insight occurs). In such cases, the broader creative schema would not be reworked as part of the creative process as a spark of insight is typically focused on one convergent problem or concern. Runco further suggests that we consider the link between an individual’s interests and assimilation while also noting the research literature associating high levels of creativity and intrinsic motivation.

In addition, just as the work of Piaget suggests cognitive and learning development theorists ought to recognize the interplay of assimilation and accommodation as processes, one can make a similar connection when suggesting that creativity development theorists ought to recognize the importance and interplay of divergent and convergent processes in creativity. Parents, teachers, and others should strive to strike the appropriate level and types of cognitive stimulation to maximize development. Most recently, Kaufman and Beghetto (2013) have articulated the need for this balance in the creativity field, noting a “Goldilocks’ Principle” in reference to the 1837 fairy tale work “The Story of the Three Bears” by Robert Southey. This echoes earlier work in the field relating divergent and convergent thinking in the context of creativity (e.g., Cropley, 1999; Eysenck, 1993).

THE IMPORTANCE OF THE PERSONAL

Typically, the writing of Piaget focused on transformations involving logical processes. Creativity does not have to involve logic, but may involve personal interpretations that could be described as personal logic (Runco, 1996). Furthermore, many theorists have focused on the externalization of ideas or an analysis of products as critical elements for creativity (Gardner, 1993; Plucker et al., 2004). However, there is no reason that the transformations of information that people go through have to be socialized endeavors. In truth, the processes could be completely intrapersonal in nature. This is aligned with a view of creativity that begins with “mini-c” in the Beghetto and Kaufman (2007a,b) Four-C model of creativity.

More specifically, the element of personal choice should also be considered to the extent that people with the same abilities of informational transformation may have different ends in mind based on personal preference or skill level. One individual may choose products that are conventional relative to the domain, while another may be more willing to take a risk on something new or outside what is typical. This risk-taking may be linked to motivational factors related to the individual (intrinsic or extrinsic, creative or otherwise) or to more global understandings about the context and potential influence of the work (Forgeard & Mecklenburg, 2013)

Personal choices also may be influenced by the value systems of the subject or their immediate surroundings (Runco, 1996). A high level of creativity in an individual, as judged by others, may be influenced by their desire to be original or novel. Perkins (1984) suggests this desire is more pronounced in truly creative people. Abra (1997) makes the case that there is a natural, even evolutionary, drive and motivation to innovate. Innovations can be described as transformations that become externalized beyond the original creator (Sawyer, 2012). This potential for externalization can be, and is, evaluated and studied by creativity researchers, but, to the extent that these decision-making processes are unseen, it is one of many in a range of developmental processes with opportunities for new focus in creativity assessment.

VEYGOTSKY, CREATIVITY AS A DEVELOPMENTAL PROCESS, AND MINI-C

Development never ends its creative work. (*Vygotsky, 1998, p. 194*)

VEYGOTSKY, CREATIVITY, AND CREATIVE POTENTIAL

Moran and John-Steiner (2003) pointed out that, while Vygotsky’s work in the field of creativity is scattered throughout his writings, if one evaluates the bits and pieces through his overall framework, meaningful connections emerge. Smolucha (1992) provided the most thorough compilation of Vygotsky’s beliefs on the

topic of creativity by translating and analyzing three key papers in the broader context of developmental theory. One central notion from Vygotsky's work is the view of creativity and imagination as important across all walks of life and disciplines: from the arts to the sciences (Lindqvist, 2003). Perhaps, more important, however, is the focus on the development of creative imagination as a higher order cognitive process and the subsequent implications for research on how "more people may learn how to maximize their creative potential" (Smolucha, 1992, p. 66). These elements of Vygotsky's work provide the underpinnings for connections and concepts in the work of Csikszentmihalyi (1996) and Beghetto and Kaufman (2007b). They also point to the importance of internal cognitive structures and processes as a focus for the enrichment of creativity.

An important distinction between the work of Vygotsky and Piaget is that the former involves more asynchrony and overlap in developmental processes. It can be argued that this lack of distinct steps is more consistent with the creative process than a linear Piagetian view of developmental stages. If one makes an analogy to the origins of life, it can be said that Piaget viewed creativity in a more spontaneous, internal, or creationist way, while Vygotsky looked at it as more developmental, social, or evolutionary. Finally, a Piagetian view may lend itself to studies of big-C creativity or creative eminence (e.g., Gardner, 1993; Simonton, 1994) given its individualistic focus, but Vygotsky's view of creativity challenges researchers and theorists to move beyond that paradigm. Vygotsky's work provides a gateway to investigations of creative potential rather than empirical studies focused almost exclusively on end products as measures. It should be noted that, despite these differences, Smolucha and Smolucha (1992) suggested the fruitful research areas that could come from finding common ground in these theories on the nature of creative development. Ayman-Nolley (1992) concurred with regard to the suggestion of combining of theories but, in the same spirit as this paper, also noted the "challenge that Vygotsky put forth is to explore the various qualitatively different, but interrelated, components of creativity (e.g., imagination, realistic thinking, reasoning, emotional motivation, social milieu, life experiences) in order to be able to understand and foster its development." (p. 84). This laundry list of "interrelated components" articulated by Ayman-Nolley lies in the realm of the cognitive and/or metacognitive.

Researchers ought to be vigilant when evaluating creative potential. Insofar as the premise underlying use of the phrase "creative potential" implies that there exists some creative product just waiting to get out, how can we set some objective standard for measurement? There is a certain circularity of reasoning when trying to distinguish ambiguous from unambiguous acts of creativity (Runco, 2003a,b). One could argue that the takeaway from an awareness of this circularity might be to focus on non-product-oriented means of assessing creativity or creative potential. Noting the incompleteness of product-based assessment, Runco (2003a) explained, "Productivity is, then, an objective indicator but only sometimes indicative of creativity," (p. 138).

Both the Propulsion Model of Creativity (Sternberg, Kaufman & Pretz, 2001) and Blind Variation-Selective Retention (BVSR) model (Simonton, 2011) serve to elucidate the issue of ambiguous versus unambiguous creativity. The Propulsion Model categorizes acts of creativity relative to an overall process, but may not capture the role of the individual in that process. The BVSR model argues for the importance of studying connections from A to B to highlight a dynamic creative process, but still lacks resolution of the question of what goes in internally within an individual. Granted, neither of these theories was conceived to deal with such individual issues, but together they serve as an excellent example of a creativity field on the right track, yet dancing around more fundamental issues of creative potential related to cognitive functioning.

MEASURING CREATIVITY AS A DEVELOPMENTAL PROCESS

Theories that view creativity as a developmental process will require unique methods of measurement if the goal of researchers is to define distinct stages in this development. The primary problem lies in devising ways to record creativity in the making with a mind toward finding critical elements (Moran & John-Steiner, 2003). While, in truth, it is probably not possible to completely delineate different portions of the process, microgenetic methods may offer the best data (Sawyer, 2003). These methods involve repeated observations of individuals over time with the goal of observing changes and ultimately gaining insights into specific developmental processes or markers. They are commonly used in human learning and cognitive development studies (Kuhn, 1995; Siegler & Crowley, 1991). With adequate experimental design, they can shed light on the emergence of creativity in numerous different domains such as languages, literature, music, and the sciences (Beghetto & Kaufman, 2007a). As a side benefit, this work may also provide insights into which elements of creativity are domain specific and which are not. These methods do, however, carry with them the drawback that they primarily gain meaning only when the creative product or other externalization occurs that the experimenter can record. That is to say, they may not be particularly predictive.

Examining creativity through the lens of development can add richness to the study of creativity by putting creative products in their broader context, rather than making them the ultimate focus (Sawyer, 2003). Tunnel vision on products diminishes the importance of smaller insights and intellectual labors that occur over time. Again, this points out a potential benefit of microgenetic methods that take multiple snapshots of an individual's progress over time.

THE PLACE OF MINI-C IN DEVELOPMENT AND LEARNING

Personal aspects of creativity are particularly important in the case of children and their ambiguous creative potential (Runco, 2003b). One theory of creativity as developmental that may benefit from the use of microgenetic assessment and support a valuation of creative potential is the Four-C Model (Beghetto & Kaufman, 2007b). In this model, the authors argue for the inclusion of professional-c (pro-c) and mini-c creativity along with the more traditional Big-C (eminent creativity) and little-c (everyday creativity) conceptions. At times, they have argued for the framework both as a classification system based on levels and a more developmental stage approach, with the latter typically carrying more weight in their conclusions. A framework of this kind is not intended to diminish the value of creativity of the highest order, but simply to broaden the conceptions of creativity (Beghetto & Plucker, 2007). The more overarching goal in the Four-C literature seems to be an effort to push our conceptions of creativity beyond products without regard for potentials and their development. Even when Beghetto and Kaufman describe their model in terms of classification, the focus is always on the individual creator rather than some artifact of the creator's greatness (Kaufman & Beghetto, 2009; Kaufman, Beghetto, Baer & Ivcevic, 2010).

At the base level of the Four-C model lies mini-c. There are a handful of fundamental supporting arguments for the utility of a mini-c concept in creativity. First, as stated earlier, from a Piagetian perspective, it can be argued that all knowledge construction involves some measure of transformative and interpretative thought. Next, the concept explicitly removes the product as a requirement for the designation of a creative act, though logically it can be claimed that nearly every product that comes into existence was, at some point, simply an idea in the creator's mind. Denoting these ideas as mini-c clarifies their place in a scheme in which creativity is considered developmental.

Mini-c creativity is defined as "the novel and personally meaningful interpretation of experiences, actions, or events" (Beghetto & Kaufman, 2007b, p. 73). The use of the word interpretation suggests some components of creativity may be intrapersonal and involve some level of internal processing. Mini-c may distinguish from other forms of creativity by the notion that the judgment of novelty and meaningfulness are intrapersonal evaluations. As has been discussed previously, creativity as a developmental process can be seen as a Vygotskian, or socio-cultural enterprise. One could make the case, then, that mini-c does not fit under this framework of creativity as it relies on ideas being personally meaningful. However, that view would miss a critical element. All development has its spark, no matter what the later stages look like. These bursts of mini-c creativity are accessible by all individuals, even those with underlying mental defects. This makes the mini-c level of creativity foundational in nature and an important consideration in the field (Beghetto & Kaufman, 2007a).

Perhaps, the most far-reaching effects of a broader conception of mini-c creativity would come in the areas of teaching and learning. Beghetto and Kaufman (2007a) point out that many students may only accomplish the little-c level of creativity in spurts. Considering the significance of these flashes of creativity as a sign of potential for further development would be fostered by a conception of mini-c among educational stakeholders. If the conception of creativity among educational stakeholders mirrors that of the research base (i.e., focused on ideation and external production), important development may be missed. One can hope that the stakeholders are monitoring cognitive development of the students. Learning to characterize certain developments in the context of creativity would be a start. This would potentially, in turn, support both creativity development and development of underlying cognitive processes in a given domain. Whether one adopts a Vygotskian or Piagetian view of development and learning, the intellectual advances that can be termed mini-c creativity are a core component of personally meaningful learning.

THE COGNITIVE-CREATIVE SIFTING MODEL

This paper advocates the Cognitive-Creative Sifting Model (see Figure 1) as a process-based framework for viewing creativity. The model suggests creativity is related to one's ability to generate ideas in the first place and to one's ultimate production. However, the CCS model also suggests the processing of the raw ideas into products is a function of the internal cognitive processes of the individual (represented by the

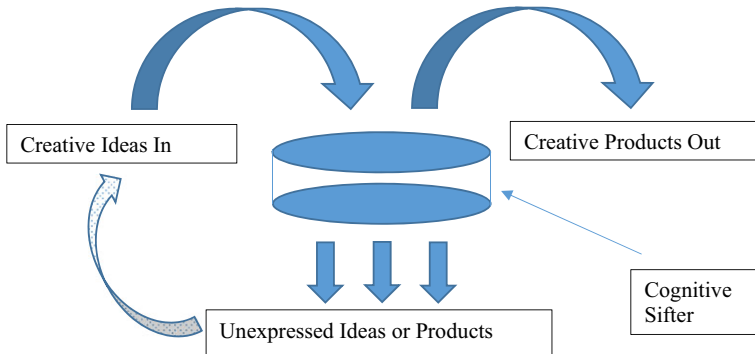


FIGURE 1. Cognitive-creative sifting model.

sifter). Individuals work through and evaluate ideas—“sifting” out those less desirable ones until a final choice emerges and (might be) externalized. Some ideas may not make the cut at one time, but they are not lost. They may be recycled later as new “creative ideas in.” Individuals will vary in the number and effectiveness of their cognitive filters which, in turn, impacts their ability to generate creative products. Thus, to evaluate creative potential we ought to measure the quantity and quality of an individual’s cognitive filters. Empirically, the model would predict an interaction effect between ideation and these filter measures on the creative production outcomes.

The CCS Model builds on foundations of previous theoretical work in the fields of creativity and cognitive development. At the same time, it fills in meaningful gaps and provides new directions for assessment of creativity and creative potential. For example, internal information transformations have a place in the creative process, but may never be externalized. In the CCS model, consideration is given to both the fact that these internal-only processes exist *and* to the importance of processes going on “inside the sifter” that may influence the quantity and quality of externalizations. Similarly, Piaget’s concepts of assimilation and accommodation are also “inside the sifter” issues. No doubt, Runco’s “personal logic” falls in roughly the same place. Work on these sorts of “thinking” issues has been common for decades and recent pushes have stressed the importance of these skills in different domains (Gopnik, 2012). The CCS Model can be seen as suggesting both an extension of the ideas to the creativity domain (if one considers it domain specific) or, to broader terms, as suggesting an overarching importance of such skills, their measurement, and their development. Both offer new research opportunities.

Discussions of the importance of creativity and imagination as conceived by Vygotsky are ubiquitous. However, the CCS Model extends the work of Vygotsky conceptually by suggesting a lack of explicit focus on internal cognitive structures misses an opportunity to identify students and other individuals most capable of reaching the levels of creative potential we might traditionally identify with ideation instruments. The model also helps us keep our eye on the prize (identifying creative potential) when issues of ambiguity in the creative process generate a fog or distract us from development. The focus on internal cognitive processes suggested by the model may help identify potential in a way more holistic than snapshot-type methods such as microgenetic procedures that require externalizations.

METACOGNITION AND CREATIVITY

Metacognitive knowledge . . . can lead you to select, evaluate, revise, and abandon cognitive tasks, goals, and strategies in light of their relationships, with one another and with your own abilities and interests with respect to that enterprise. (Flavell, 1979, p. 908)

...creativity [is] manifested in the intentions and motivations to transform the objective world into original interpretations, coupled with the ability to decide when this is useful and when it is not.

(Runco, 1996, p. 4)

Once one generates a model suggesting the importance of a focus on internal cognitive processes in the study of creativity, an important question naturally follows: what internal cognitive processes are salient to the study of creativity? Metacognition should be considered one such process. It is well established in the cognitive development literature and demonstrates cognitive-creative connections beyond those generally elucidated previously.

DEFINING METACOGNITION

Clarity in what is meant by the term metacognition is important for appreciating the implications of viewing creativity as related to metacognitive processes. While a number of scholars were working on similar concepts in the 1970s, the most prolific and prominent was John Flavell. According to his view, metacognition was related to four interrelated areas: metacognitive knowledge, metacognitive experiences, goals/tasks, and actions/strategies (Flavell, 1979). Metacognitive knowledge is further subdivided into knowledge of persons (either intrapersonal or interpersonal), knowledge of task, and knowledge of strategies. Knowledge of persons was conceived “everything that you could come to believe about the nature of yourself and other people as cognitive processors” (p. 907). This relates to creativity and the CCS model sifter in that individuals consider the value of various options to themselves and others. For Flavell, task knowledge relates to perceptions of how a task falls on a series continua such as “abundant or meager, familiar or unfamiliar, redundant or densely packed, well or poorly organized,” among others which allow an individual to conceive a given (creative) task’s place in the individual’s own understanding (p. 907). Knowledge of strategies functions in a similar manner. Importantly, an individual may have to use all three types of metacognitive knowledge in a single setting or situation. The interplay of persons, tasks, and strategies is always going on inside the sifter. The implications of this for creative tasks have been largely under-researched. This is noteworthy and troubling given that a simple word change from “cognitive” to “creative” in the Flavell quote at the opening of this section still makes such intuitive sense given previous discussion in this work.

PRACTICAL CONNECTION TO CREATIVITY

Student development of creativity may be fostered by promoting skills of ideational code-switching (Beghetto, 2007; Beghetto & Kaufman, 2007a). This term refers to the ability of an individual to translate internal interpretations of information into external representations. In linguistics and language learning, code-switching involves taking cues from one’s environment with regard to when language is (or is not) being understood—thus increasing the efficacy of communication. This concept can be applied more broadly to ideas, specifically creative ones. Individuals can work to develop ideas of more creative value by learning to register cues (see Flavell’s metacognitive knowledge) from their surroundings and use the input gained to evaluate those ideas. Students in an English class, for example, might develop these skills when discussing emotive language in poetry. The more they learn about their audience, the more precise language they can use to evoke the desired emotion. Classroom teachers can facilitate these sorts of student interactions that encourage the development of creativity via cognitive skills. More broadly, in the literature, this fostering of creativity has been referred to as a focus on creative cognition (Cropley, 1999). Ward, Saunders and Dodds (1999) even studied the concept specifically in a sample of gifted adolescents. Beghetto and Kaufman (2009) concurred that this sort of focus may be of particular importance in programs of advanced academics. They have suggested that creativity and learning ought to be conceived of as important streams that combine as “intellectual estuaries,” providing numerous opportunities for development. Furthermore, conceptions of creativity and giftedness will continue to evolve in terms of assessment tools, becoming more dynamic and responsive to the developmental needs of students (Kaufman, Kaufman, Beghetto, Burgess & Persson, 2009).

Whether gifted or not, students, like all people, constantly filter new information through their past experiences and previous knowledge in the learning process (Beghetto & Kaufman, 2007b). These transformations and interpretations are not only at the heart of mini-c creativity but they are also metacognitive in nature. The specific types of transformations that one engages in may be a matter of personal preference in terms of cognitive strategies (Runco, 1996). A self-awareness of these preferences can be seen as an essential part of metacognition. Similarly, John-Steiner’s work (1997) on the topic of inner speech writing can be seen as related to metacognition as well. The creator is constantly revising and making new meaning based on an understanding of their current state. Importantly, creativity theorists seem to use much of the same rhetoric describing creative processes as Flavell did describing metacognitive ones.

Though it takes different forms in the creativity realm and does not explain the process, reasoning, plays a role in creativity development (Runco, 2006). Fasko (2006) points out that studies explicitly connecting the concepts of reasoning and creativity are scarce, but some do exist in the literature (e.g., Niu, Zhang & Yang, 2007). A clear link exists between creativity and learning (Beghetto & Plucker, 2006). Creative processes give students an opportunity to demonstrate the difference between memorization and deeper understanding. If one is willing to concede that there is cognitive processing involved in creativity, then by extension there must be some measure of metacognition involved. This has been articulated, to varying degrees, in the literature (Cropley, 1999; Feldhusen, 1995; Isaksen & Treffinger, 1985; Pesut, 1990; Sternberg, 1988).

Armbruster (1989), using Wallas' stages of creativity (1926), systematically pointed out the ways in which metacognition impacts the creative process. For example, during "preparation" creative individuals are more likely to have knowledge of potential cognitive restructurings. In addition, creative people may be more in tune with "sparks" of creativity. This relates to the "illumination" described by Wallas. Lastly, Armbruster highlighted the metacognitive connections related the "verification" stage:

In sum, creative individuals seem to be especially adept at the conscious metacognitive skills that are required during the verification stage. They may be unusually sensitive to both internal and external standards and particularly able to revise the creative product accordingly. Creative individuals may also be especially good at improving these abilities with experience and practice. (*pp. 180–181*)

The proposed CCS model and the justification of its utility throughout this work echo Armbruster's argument. She suggested metacognition and creativity as a potentially fruitful area of research nearly 25 years ago. However, empirical research in this area remains relatively thin. Feldhusen and Goh (1995) suggested that skills in metacognition add to the effectiveness and efficiency by which one can think creatively. Like Armbruster, they concluded these skills can be learned with proper instruction.

One important component of this instruction may be to teach students limits for using their creativity. Making them aware of when to use discretion may foster their long-term creativity by avoiding incidents that can detract or distract from their ongoing development (Runco, 2003b, 2006). The concept of "creative metacognition" describes the skill a person can develop that helps them to appreciate when, and to what degree, internal interpretations should be externalized (Kaufman & Beghetto, 2013). This may be a function of individual's knowledge of self or the field or, simply, the context of a given situation. This explicitly parallels Flavell's types of metacognitive knowledge. Kaufman and Beghetto's formulation accounts for the ongoing debate regarding the domain-general or domain-specificity of creativity (e.g., Plucker & Beghetto, 2004) which can be seen as tandem to the focus in education on balancing progress related to skills and increases in content knowledge. This work serves as a call for more openness to the potential applications for the assessment of creativity via means more traditionally seen as cognitive in nature and privy to the psychometricians who work in the realm of achievement and intelligence testing.

TOWARD NEW FORMS OF CREATIVITY ASSESSMENT

An individual's knowledge of self and particular aspects of his or her own world is the ultimate medium of creative behavior, for knowledge determines decisions as much as opportunities. In fact, it is the basis of one's knowledge that one can perceive and identify one's opportunities. (*Albert, 1990, p. 19*)

Traditional creativity studies have focused primarily on the main effects of variables like divergent thinking when more meaningful results may come from examining interaction effects with factors such as problem finding and evaluation skills (Runco, 2003b). Table 2 provides a sampling of the sorts of assessments used in the creativity field. Some studies have suggested that the assessment of skills in information transformation may be a better predictor outright of creative thinking than divergent thinking assessments (Bacheler & Michael, 1991; Guilford, 1983; Subotnik, 1988). Along the same lines of investigating interactions, taking a developmental view of creativity and using microgenetic methods may aid in identifying some demarcation between divergent and convergent thinking in the creative process (Sawyer, 2003). Despite these few instances to the contrary, there remains a general focus "outside the sifter" when assessing creativity. Table 2 serves to highlight this.

TABLE 2. Types of Creativity Assessment and Relation to CCS Model

Assessment (Example Reference)	Connection to Present Work
Alternative Uses Test (Guilford, 1967)	Test of divergent production; "CII"
Consensual Assessment Technique (Amabile, 1982)	External rating of "CPO"
Creative Achievement Questionnaire (Carson, Peterson & Higgins, 2005)	Self-report of "CPO"
Creative Behavior Inventory (Hocevar, 1980)	Self-report of "CPO"
Creative Functioning Test (Smith & Carlsson, 1987)	Task completed; focus on flexibility, and novel responses; "CII" focus
Creative Personality Scale (Gough, 1979)	Self-report of adjectives describing personality; internal/unseen focus; perhaps related to "CS"
Remote Associations Test (Mednick, 1962)	Task completed; requires knowledge/intuition; related to "CS" but not metacognitive
Runco Ideational Behavior Scale (Runco, Plucker & Lim, 2001)	Self-report of "CII"
Torrance Test of Creative Thinking (Torrance, 1974)	Divergent thinking test; "CII"
Wallach-Kogan Creativity Tests (Wallach & Kogan, 1965)	Divergent thinking test; "CII"

Notes. "CII" = Creative Ideas In; "CPO" = Creative Products Out; "CS" = Cognitive Sifter.

Some, like Mumford (2003), have suggested strict standards for evaluating creativity. Given that the measurement of non-product-based creativity will always struggle with problems of subjectivity, it may be that researchers need to change the methods of measuring creativity to simply maximize objectivity (Runco, 2003a,b). This opens the door to more diverse measures and potentially to more applications with a broader range of subjects vis-à-vis their level of creativity. This is of particular importance to those attempting to foster creativity and/or talent development programs for young and school-aged children in which raw potential may be much more prevalent than explicit performance. Runco (2003a, p. 140) has gone so far as to say that one will never have a complete picture of creativity without examining its development and underlying genesis: "you do not understand the butterfly unless you (also) watch the caterpillar."

Plucker et al. (2004) noted the problematic nature of a narrow view of creativity as focused in small segments of the population (i.e., on those with high creative *achievement*). It may be the case that a wide distribution of creativity in populations hints at the importance of studying ambiguous generalized cases (i.e., creative *potentials*). A focus on only unambiguous cases or eminent creativity does not provide a normal distribution which may limit generalized applications of scientific findings. A wide distribution of creativity would allow for the study of more diverse populations, more control of more extraneous variables, and more investigations across disciplines (Beghetto & Plucker, 2007). Creativity, at times, may be "mundane and everyday," but that does not diminish its essence as creativity (Runco, 2003b, p. 319). One can argue that the study of everyday creativity should focus on the moment-to-moment interpretations that lead individuals to creative ideas (Runco, 1996).

The Kaufman and Beghetto mini-c conception of creativity (Beghetto & Kaufman, 2007a, 2007b; Kaufman & Beghetto, 2009) stresses the need to investigate the link between intrapersonal development and interpersonal expressions, but to maintain their noteworthy distinction during assessment. Previously in the same vein, Runco (2003b) made a similar claim by arguing that the personal cognitive constructions involved in the process of creativity ought to be distinguished from outward performance in an effort to maintain discriminant validity. Put another way, measures of creative potentials ought to be distinct from the evaluation of creative products. This is consistent with earlier discussions here regarding the persistence of conflicting views between those partial to product-oriented evaluation of creativity and those who seek to find potential and/or monitor its internal development. The tools to bring these seemingly incompatible types of assessments together already exist in part (e.g., metacognitive inventories and diagnostic tools). Researchers simply must choose to employ them in studies of creativity.

MOVING FORWARD: TESTING THE ROLE OF METACOGNITIVE “SIFTING” ON CREATIVITY

By taking the steps of connecting the concept of metacognition with a personal and developmental view of creativity, while employing either Vygotsky's or Piaget's theory of cognitive development and learning, one can find the possibility of meaningful measurement of (potential) creativity in individuals by way of metacognitive assessment. This scheme would presuppose that what creativity researchers on both sides of the assessment spectrum truly want are measures that are predictive of future creative ability or output. Product-oriented researchers can be criticized for a lack of predicting *future* creativity while those researchers will in turn criticize the potential-oriented group for lacking means by which to evaluate the predictions that are made—or at least the objectivity of the predictions.

One could retort that (a) microgenetic methods or dynamic assessments have the potential to show growth over time and (b) many in the creativity as developmental vein just want to learn how pathways of creativity come to be. They might argue that this sort of assessment already provides a middle ground. However, those methods are merely a scheme for taking snapshots of developmental levels. By design they fail to be predictive. Said another way, when researchers are just monitoring and looking out for creative bursts, they lose track of the practical matter for an institution (e.g., school)—predicting the likelihood of whether or not a given burst will ever occur at all. Certainly, there is a place for microgenetic methods and similar techniques. This case has been previously articulated in this work. Researchers must keep in mind, though, that these are a mapping of the journey that a developing creator *might take* while an equally important focus, gaging the willingness or likelihood of a person going on the journey at all, gets neglected.

The CCS model provides a conceptual framework that overtly acknowledges there is more to creativity than simply coming up with ideas and generating products. I would argue there is a chasm of difference. The metacognitive filter(s) involved are almost exclusively unseen, but ripe for exploration empirically in the context of creativity. Results from an instrument which measures both knowledge and regulation of cognition, in the spirit of Flavell's work, could be used in concert with measures of ideation and those measuring both quality and quantity of creative production. If measuring metacognition via instruments such as the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) can be shown to predict levels of learning development and there exists an interaction effect between metacognition and creativity, it is certainly possible that such instruments could provide a basis for evaluating the prospect of an individual to develop creatively. This would serve as a starting point, giving clarity to the foundational research question of whether the CCS model has any relevance to the field in the first place. Once confirmed, a myriad of possibilities for future research would emerge, including everything from connections to intelligence theories and other psychological constructs to finding applications providing schools with relatively simple and meaningful diagnostic tools for identifying creative potential and its propensity to flourish in individuals. Creativity ought to be valued and it ought to be considered a process of development like other unseen cognitive processes. In this way, the Cognitive-Creative Sifting Model makes explicit what has been written about for decades and gives us a tangible framework for exploring the mysterious world of creative development and sifting through our own ideas about the relation of cognitive processes and creativity.

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