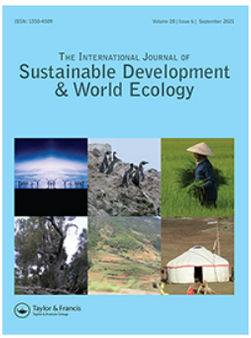


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# Wicked problems: a mapping review of the literature

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**ABSTRACT**
The term 'wicked problems' is today widely used in the sustainability literature, but there is no consensus on its theoretical underpinnings or its utility for research. This paper reports on a mapping review of the wicked problems literature for which we analyzed a sample of 55 papers regarding 1. whether and how the term 'wicked problems' is used as a theoretical concept, 2. what meanings are associated with the concept, 3. what epistemological assumptions are stated, and 4. what rhetorical functions the concept performs. The results indicate that the concept is not always consistently applied as a theoretical concept; that authors ascribe many different meanings to the concept; that authors use diverse epistemological assumptions that are not always made explicit; and that the concept performs a wide range of rhetorical functions. The results provide a vocabulary that enables sustainability researchers to more clearly position their work in the dispersed wicked problems literature.

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**KEYWORDS**
Wicked problems; review; theoretical visibility; epistemology; rhetorical function

## Introduction

The term 'wicked problems' is today widely used in sustainability research as well as in many other disciplines, but there is no consensus on its theoretical underpinnings nor its utility for research. The term was first introduced in 1967 in a seminar at the University of California Architecture Department in Berkeley, USA. In that seminar, design professor Horst Rittel suggested that

> the term 'wicked problem' refer [*sic*] to that class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing. The adjective 'wicked' is supposed to describe the mischievous and even evil quality of these problems, where proposed 'solutions' often turn out to be worse than the symptoms. (Churchman 1967)

Six years later, Horst Rittel and Melvin Webber (1973) published a seminal paper on wicked problems and since then, the number of research papers in which the term 'wicked problem' is used has grown exponentially (Head 2019). For the years 1973–2001, a Scopus search (conducted in January 2020) on 'wicked problem' returns less than ten papers per year; by 2017, this number has increased to over 200 papers yearly. The number of citations for papers mentioning 'wicked problems' has also grown approximately exponentially (Figure 1). Despite the increasing use of the term, the research community is divided with regard to its definition and value. Some researchers argue that wicked problems is a useful concept since it can be used to highlight limitations of reductionistic approaches for addressing complex societal and environmental problems (Xiang 2013; Lönngren 2017). Others argue that the term is ambiguous and often used rhetorically rather than analytically (Noordegraaf et al. 2019; Peters and Tarpey 2019; Termeer et al. 2019; Turnbull and Hoppe 2019).

The first author experienced this division of the research community throughout her PhD research on teaching with wicked problems in engineering education (Lönngren 2017). Among engineering educators, reactions to the concept were often very positive and the concept seemed to facilitate constructive and critical discussions about limitations of traditional problem-solving approaches that are often taught in engineering education: approaches where students learn to use given algorithms to find correct solutions to well-defined 'story problems' (Jonassen et al. 2006). In other contexts, including environmental and sustainability education research networks, she was confronted with strong negative reactions to the wicked problems concept. For example, an anonymous reviewer for the European Conference of Educational Research harshly criticized a submitted abstract on the grounds that the term wicked problems is unscientific 'jargon' (Anon 2016). The first author also experienced frustration about a lack of solid theoretical descriptions of the wicked problems concept and she struggled to develop a coherent understanding of the wicked problems literature. Driven by this lack of a solid theoretical foundation for wicked problems and the

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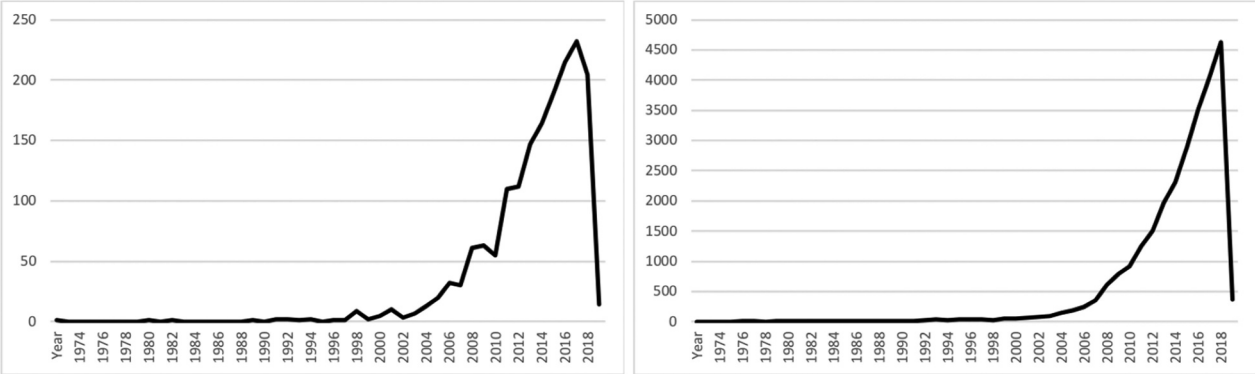


**Figure 1.** Number of papers (left) and citations (right) per year identified through a Scopus search on 'wicked problem' in January 2020.

polarization in the research community about the value of the concept, we have reviewed a diverse sample of research articles in which the term 'wicked problem' is used. Based on this review, we provide a map of the different kinds of research that are described in the wicked problems literature. More specifically, we address the following research questions:

(1) What is the theoretical status of the wicked problems concept?
(2) What range of meanings is associated with the wicked problems concept?
(3) What epistemological assumptions underlie descriptions of wicked problems?
(4) What rhetorical functions does the wicked problems concept perform?

By addressing these questions, we contribute to developing a better understanding of the various ways in which the wicked problems concept is used in the literature and we provide sustainability researchers with a vocabulary that can help them to more clearly position their work in the highly dispersed wicked problems research landscape. We also discuss the potential utility of the concept for different types of research.

## Background

The single most cited (>5000 times) publication on wicked problems is Rittel and Webber's seminal paper from 1973 in which the authors argued that problems in social policy are fundamentally different from problems in the natural sciences. They described natural science problems as 'tame problems' that are well-defined and that can be addressed through linear, reductionistic problem-solving approaches. Social science problems, on the other hand, were described as 'wicked' and as sharing the following ten characteristics:

(1) There is no definitive formulation of a wicked problem.
(2) Wicked problems have no stopping rule, i.e. there is no point in time at which the process of addressing a problem is completed.
(3) Solutions to wicked problems are not true-or-false, but good-or-bad.
(4) There is no immediate and no ultimate test of a solution to a wicked problem.
(5) Every solution to a wicked problem is a 'one-shot' operation.
(6) Wicked problems do not have an enumerable or exhaustively describable set of potential solutions, nor is there a well-described set of permissible operations for addressing wicked problems.
(7) Every wicked problem is essentially unique.
(8) Every wicked problem can be considered to be a symptom of another problem.
(9) The analyst's world view is the strongest determining factor for explaining differences in descriptions of wicked problems and preferences for how they should be addressed.
(10) The planner has no right to be wrong.

This description of wicked problems has been criticized for resting on a flawed assumption of wicked and tame problems as fundamentally different classes of problems – and thus for perpetuating an equally flawed assumption of ontological differences between social and natural sciences (Turnbull and Hoppe 2019). Rittel and Webber's description has also been criticized for being analytically imprecise, which has resulted in 'overuse' and 'conceptual stretching' of the concept (Peters and Tarpey 2019, see also Alford and Head 2017). In fact, several authors have argued that wicked problems is often used as a *rhetorical* (rather than analytic) concept to support certain political agendas – such as drawing attention and resources to a specific problem or to excuse failure to adequately address a problem (e.g. Grint 2005; Peters 2017; Turnbull and Hoppe 2019). Finally, researchers have argued that describing problems as 'wicked' may lead to paralysis and discourage stakeholders from attempting to address these problems (Noordegraaf et al. 2019; Termeer et al. 2019).

Despite this criticism, the use of the term 'wicked problems' in the research literature has increased exponentially since 1973 (Head 2019). While the concept continues to be used most often in literature on policy, public administration, and management, it is today also widely used in the sustainability literature as well as other disciplines such as education, economics, computer science, and health care (Norton 2012; Crowley and Head 2017; Termeer et al. 2019; see also the literature sample for this review in Appendix 1). The concept has also spread to many different research institutions. Despite this apparently broad uptake, the concept is almost exclusively used in highly developed countries in Europe and North America and almost all of the peer-reviewed literature on wicked problems is written in English (Xiang 2013; Scopus search in October 2019). In conclusion, the wicked problems literature seems to be highly dispersed across disciplines and institutions in several (but far from all) parts of the world.

Possibly influenced by the dispersed uptake of the concept, it seems to be used in many different ways and for different rhetorical purposes. However, we could not find any detailed analysis of these different ways of using the concept in the wicked problems literature – which makes it difficult for researchers to clearly position their work in relation to the broader body of work on wicked problems. To address this gap, this paper reports on the results from a mapping review of the peer-reviewed research literature on wicked problems. Based on a systematic analysis of carefully selected abstracts (n = 201) and full papers (n = 55), we aim to provide a map of the different ways in which the wicked problems concept is used in the peer-reviewed research literature. We particularly focus on the theoretical status of the concept (RQ1), the range of meanings that is associated with it (RQ2), epistemological assumptions in the literature (RQ3), and the rhetorical functions that the concept performs in the literature (RQ4). In the next section, we describe the focus of our review, methods of data selection and analysis, as well as analytic frameworks and procedures. Next, we describe and interpret the results in terms of our four research questions and, finally, discuss limitations, implications, and opportunities for future research.

## Methods

### *Configurative mapping review*

Gough and Thomas (2017) describe two main types of research literature reviews: aggregative and configurative. *Aggregative reviews* aim to develop an 'extensive and exhaustive' synthesis of *all* previous research that is relevant for a specific research question. Such reviews aim to summarize and evaluate all findings from previous research. *Configurative reviews*, on the other hand, aim to synthesize data with a focus on 'the range and nature of concepts found' (*ibid.*). For configurative reviews, it is often not necessary (nor feasible) to include *all* previous research. Rather, selection of texts for inclusion in a configurative review can be based on principles such as '"maximum variation", "intensity" (information-rich), "extreme/deviant case", "confirming" or "disconfirming", and "politically important"' (Brunton et al. 2017). For the research reported in this paper, we have conducted a configurative review. Our review can also be described as a *mapping review*, which aims to 'map out and categorize existing literature on a particular topic, identifying gaps in research literature from which to commission further reviews and/or primary research' (Grant and Booth 2009).

### *Sampling strategy*

To select abstracts and papers for this review, we employed a combination of random, purposive, and pragmatic sampling of titles that the research community, through peer-review, has accepted as valuable contributions to knowledge. We first used random sampling to counteract potential bias. We then added purposively selected titles to maximize variation in our sample and to ensure that we had included papers that are particularly relevant to answering our research questions. In that process, we privileged titles with high impact (frequently cited) and titles that explicitly discussed wicked problems as a theoretical concept (rather than merely mentioning or applying it).

For pragmatic reasons, we decided to retrieve titles from a single database. Three large databases are often used in literature reviews: Google Scholar (GS), Scopus, and Web of Science (WoS). Of these three databases, GS has been reported to provide the most comprehensive results, especially in the social sciences and humanities. However, most titles that are only identified by GS (and not Scopus or WoS) are non-journal titles and titles with few citations that typically have a lower research impact (Martín-Martín, Orduna-Malea, López-Cózar 2018; Martín-Martín et al. 2018b). Based on a comparative citation analysis of highly cited papers in GS, Scopus, and WoS, Martìn-Martìn, Orduna-Malea, and López-Cózar conclude that 'if GS is used for research evaluations then its data would be unlikely to produce large changes in the results, despite the additional citations found' (2018). Since we had decided to privilege peer-reviewed titles with high impact in the research community, we concluded that it was not necessary for this configurative mapping review to retrieve titles via GS. Of the remaining two databases, Scopus has been found to be more comprehensive than WoS, particularly for social sciences and humanities (*ibid.*) and we therefore decided to use Scopus for this study.

A possible limitation of selecting titles only from Scopus is that it may introduce a slight bias against literature from the social sciences, humanities, and literature and arts (Martín-Martín et al. 2018a). In fact, while literature from the social sciences is well-represented in our sample (Appendix 1), literature from the humanities and literature and arts seems to be missing. Selection through Scopus also introduces a bias against non-English literature (*ibid.*) and, in fact, all of the papers in our sample are written in English. This lack of non-English titles may also be due to difficulties in translating the term 'wicked problems' into other languages. Finally, our decision to privilege highly cited papers also means that we introduced a slight bias for older publications, but newer publications are still well-represented in our sample.

## Data selection and analysis

Our data selection and analysis proceeded through five phases (Figure 2). We first selected and analyzed 201 abstracts (phases 1–2) to develop a broad understanding of the literature, then selected and summarized 55 full papers (phases 3–4), and finally performed an in-depth analysis of the 55 paper summaries (phase 5).

### Phase 1: search and select abstracts

We performed a Scopus search with the search terms *'wicked problem*' AND 'wicked issue*'*, which resulted in 1.547 peer-reviewed titles (2019–02-27). From these, we selected 100 random titles plus all titles that had been cited at least ten times at the time of retrieval (n = 107). After excluding duplicates and titles for which we did not have access to an abstract, our selection for the first round of analysis (phase 2) included 201 abstracts.

### Phase 2: categorize abstracts

We imported the selected abstracts into MaxQDA software for qualitative analysis. The first author then categorized the abstracts according to publication type (book chapter, journal paper, …); publication date (1991–2000, 2001–2010, …); subject areas (policy and governance, environment and sustainability, …); whether they explicitly discussed wicked problems as a theoretical concept; and how the concept was used (as a main topic, background concept, …). The aim of this categorization was to develop a general understanding of the wicked problems literature and thus to provide a basis for purposive selection of full papers for further analysis.

### Phase 3: select full papers

To allow for an in-depth analysis of full papers, we again combined purposive, random, and pragmatic principles to select titles from both sets of abstracts (most cited and random). Aiming to include the most influential titles, we purposively selected the 20 most cited titles. From the set of randomly selected abstracts, we purposively selected all six papers that explicitly discussed wicked problems as a theoretical concept since we considered these papers to be particularly relevant for addressing our research questions. Striving for maximum variation in representing different ways of using the wicked problems concept, we selected five papers in which the concept was foregrounded as a main topic and five papers in which the concept was used as a theoretical background or mentioned in a side-comment. Finally, to avoid losing important variation in our sample that we had not identified in our analysis of the abstracts, we included all 19 titles for which we could not identify the relevance of the wicked problems concept without having read the full papers. For pragmatic reasons, we excluded eight titles for which we did not have access to the full texts through our institutions' library services. Excluding these titles did not result in an exclusion of any of the paper categories identified in phase 2. This selection process resulted in a sample of 55 titles for further analysis, including 51 journal articles, two conference papers, and two book chapters (see Appendix A for a list of included papers).

### Phase 4: summarize full papers

The first author read all 55 papers and summarized each paper in a separate text document (approximately 1–2 pages each, see Appendix B for an example). The information in each of the summaries was organized under the following headings:

- Main topic/argument of the paper (single sentence);
- Paper content (bullet list of all major topics that were addressed in a paper, often including verbal quotes);
- Ways of using the wicked problems concept (bullet list, often including verbal quotes);
- Alternative concepts (bullet list);
- Theoretical perspectives & epistemological assumptions (bullet list, often including verbal quotes);
- Tentative ideas for thematic categories for further analysis (bullet list); and
- Exemplar quotes that may highlight important characteristics of the paper (bullet list of verbal quotes).

### Phase 5: code paper summaries

We then imported the paper summaries into MaxQDA software as a new project. Thus, the categories used during phase 2 were not carried over to this phase. Instead, the analysis of the paper summaries was guided by the following analytic frameworks and

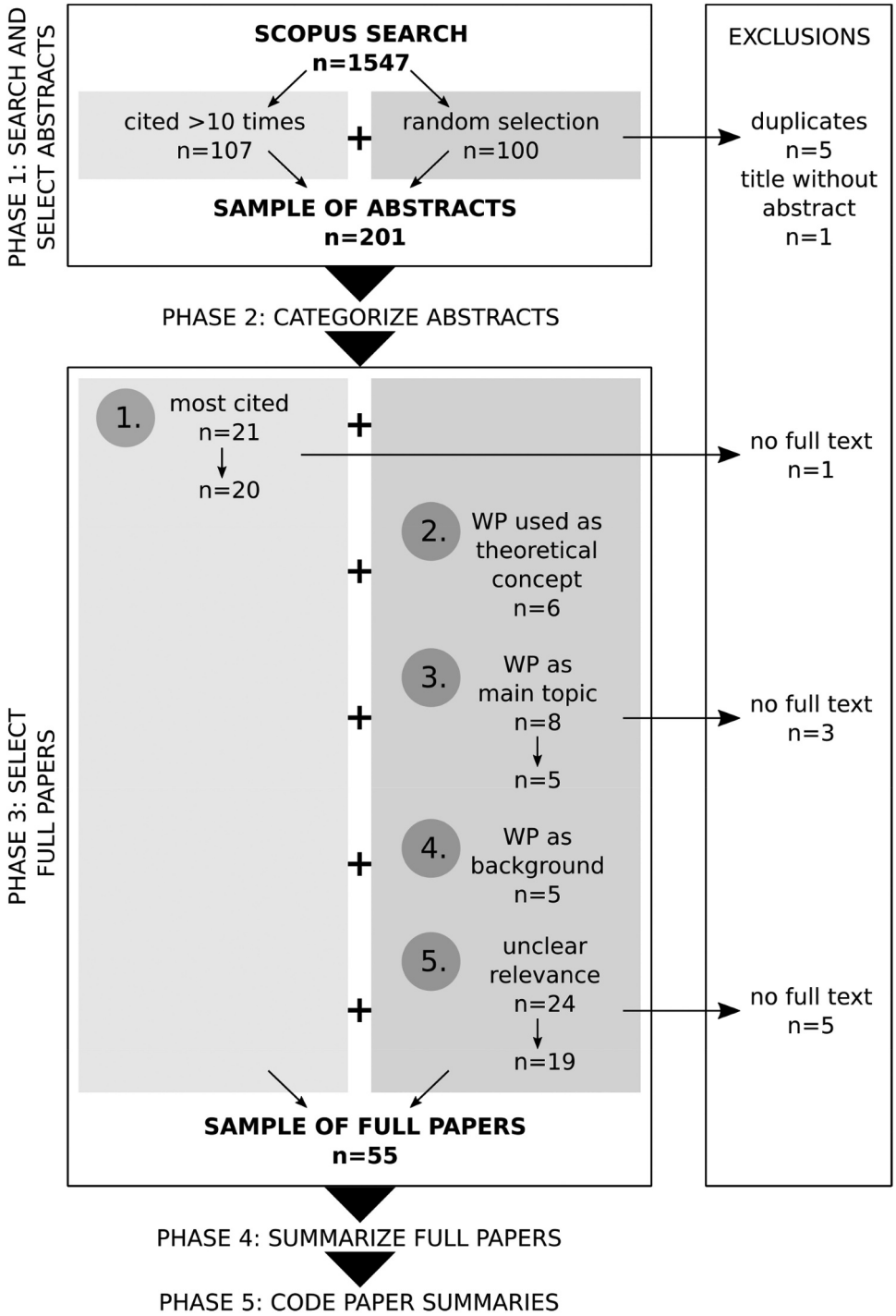


**Figure 2.** Overview over data selection and analysis process.

procedures: For RQ1, four codes were used that directly matched four of the five levels in Bradbury-Jones et al.'s (2014) typology of theoretical visibility (see below). For RQ2, we created codes for all alternative concepts that were listed in the paper summaries. For RQ3 and RQ4, the first author first performed inductive thematic coding for epistemological assumptions (RQ3) and rhetorical functions (RQ4) that she could identify in the paper summaries. She then used the 'creative coding' function in MaxQDA to performed abductive axial coding by visually rearranging and clustering similar codes in a mind map and constructing overarching categories. Whenever the first author had doubts about how to categorize (parts of) a paper summary, she consulted the full papers. In the next section, these analytic frameworks and procedures are described in detail.

## Analytic frameworks and procedures

On a general theoretical level, this review is informed by a social constructivist understanding of wicked problems: rather than assuming an ontological distinction between wicked and tame problems, *we view wicked*

*problems as a theoretical concept that is socially and intertextually constructed in the body of literature on wicked problems* (Ison et al. 2015). There is no 'true' definition of what wicked problems are, but the collective description in the literature can provide a better understanding of what wicked problems are constructed to be and how the concept may be useful for different types of research (Sohlberg and Leiulfsrud 2017). Therefore, we focus on variation in how the concept is used in the literature in terms of theoretical status (RQ1), range of meanings (RQ2), epistemological assumptions (RQ3), and rhetorical functions (RQ4).

### Theoretical status

The wicked problems concept has been described as lacking a firm theoretical and conceptual base (Turnbull and Hoppe 2019). This is problematic since theoretical perspectives strongly influence what questions researchers address, what methods they use, and what conclusions they draw from their research (Mertz and Anfara 2015). To explore how and to what extent the lack of a conceptual base manifests itself in the literature, we analyzed the theoretical status of the wicked problems concept in our sample (RQ1). For this purpose, we used Bradbury-Jones et al.'s (2014) *typology of levels of theoretical visibility*. Arguing that visibility of theoretical perspectives should be seen as an important quality criterion for qualitative research articles, Bradbury-Jones et al. introduced a five-point typology in which higher levels indicating higher visibility (Table 1). However, one of these levels, 'retrospectively applied', is difficult to identify in published reports since authors seldom admit to having used theory in such a way (*ibid.*); this level was therefore excluded from our analysis.

### Range of meanings

The wicked problems concept is often described as an ambiguous or 'generic' concept that 'has come to be applied indiscriminately' (Alford and Head 2017; see also Peters 2017; Turnbull and Hoppe 2019). Articles on wicked problems are published in a wide range of journals and disciplines and by researchers who are scattered over many institutions across North America, Europe, and Australia (Xiang 2013; McCall and Burge 2016). To explore the range of meanings that are ascribed to the concept (RQ2) in such different contexts, we analyzed the range of alternative concepts that are used concurrently (and often synonymously) with wicked problems. More specifically, we systematically searched the selected full papers for mentions of alternative concepts and coded them in our analysis.

### Epistemological assumptions

Our analysis of epistemological assumptions that underlie descriptions of wicked problems (RQ3) is informed by an on-going debate in the wicked problems literature about what assumptions *should* underpin research on wicked problems. This debate is mainly focused on the appropriateness of realist versus constructivist approaches (Termeer et al. 2019): researchers who use *realist* approaches describe wicked problems as a special class of problems that exists in the world (irrespective of whether or not we experience and describe a problem as wicked) and that can be identified through 'objective measures of the underlying characteristics' (Peters 2017); researchers who use *constructivist* approaches argue instead that describing a problem as 'wicked' is a way of framing the problem and that, therefore, the same problem could also be framed differently, for example as a tame problem (e.g. Grint 2005; Ison et al. 2015; Turnbull and Hoppe 2019). Acknowledging this ongoing debate, we used 'realist' and 'constructivist' as initial codes in our analysis of epistemological positions. As the analysis progressed, we inductively added codes as we encountered additional positions in the literature ('pragmatist', 'critical', 'post-structuralist').

We first coded *explicit* statements about epistemological positions. This was possible, for example, when authors explicitly described their position as 'critical realist' or when they described wicked problems as 'social constructions' rather than ontological entities. In many papers, however, such explicit statements were absent and we therefore analyzed statements that *implicitly* conveyed assumptions about the nature of wicked problems and of knowledge about wicked problems. For example, several authors argued for a need for post-normal science. Since post-normal science is typically associated with constructivism, we interpreted this type of argument as an implicit statement of a constructivist epistemology. In other cases, authors cited scholars that in the wider literature are strongly associated with specific epistemological approaches, such as John Dewey (associated with pragmatist approaches) and Paolo Freire (associated with critical approaches). Further, in line with Turnbull and Hoppe's critique of essentializing and ontological descriptions of wicked problems, we interpreted such descriptions as implicit realist assumptions. If we were not able to identify explicit or implicit statements about epistemological positioning in a paper, we coded that paper as 'unclear epistemological assumptions'.

### Rhetorical functions

Several scholars (especially those who use constructivist approaches) argue that wicked problems is often used rhetorically, for example aiming to draw attention and resources to certain problems or to excuse failure to

**Table 1.** Operationalization of Bradbury-Jones et al.'s (2014) typology of levels of theoretical visibility for our analysis of the theoretical status of the wicked problems (WP) concept.

| Level of theoretical visibility | Description | Operationalization for our analysis |
|---|---|---|
| 5. Consistently applied | Theory is used explicitly and it is highly visible in the text: 'one can "see" the theory and its relationship to the methodology' (p. 139) | • 'WP' is mentioned in all major sections of the text.<br>• 'WP' is mentioned many times in the text.<br>• The authors signal that 'WP' is used as a theoretical concept. |
| 4. Retrospectively applied | 'Theory is applied at the end of a study as a means of making sense of research findings or as a post-hoc activity to strengthen the theoretical thrust of a piece of work' (p. 138). This level is difficult to identify in published research reports. | Since it is unclear how to identify this level, we chose to exclude it from our analysis. |
| 3. Partially applied | At this level, 'researchers may explicitly locate their study within a particular theory but then seem to abandon efforts to link, apply or interpret their findings in that context. Theory is used only partially throughout the research process in relation to the research aims, interview questions or data analysis' (p. 138). | • 'WP' is mentioned in some, but not all, major sections of the text (e.g. it is used in the introduction, but not in the results or discussion sections). |
| 2. Implied | Theory is mentioned in some part(s) of an article (mainly in the introduction and/or discussion), and 'reference might be made to theorists in the field' (*ibid*., p. 138), but authors do not explain how the theory has been used in the study and how it has influenced analysis and/or results. | • 'WP' is mentioned in some or all sections of the text, but it is not explicitly related to methods and/or results. |
| 1. Seemingly absent | 'No mention of theory is made and reference to key theorists in the field is absent' (p. 138). Theory may well have been used, but no use of theory is actually described in the research report. | • The term 'WP' is mentioned, but it is not introduced or described as a theoretical concept; it is used as an ordinary word.<br>• no references are made to WP literature. |

adequately address a problem (e.g. Grint 2005; Peters 2017; Turnbull and Hoppe 2019). In fact, Turnbull and Hoppe (2019) argue that the concept was originally introduced as a rhetorical concept since it was used to question a then-dominant reductionistic approach to addressing policy problems. Turnbull and Hoppe suggest that Rittel and Webber's seminal paper

> had value as a political intervention in scholarship rather than as the basis of an intellectual research program. (…) [It] was primarily—and no more than—an invocation for a community of rationalistic researchers to critically reflect on their paradigm. (…) Viewed historically, [Rittel and Webber's] contribution can be explained as but one part of the much wider questioning of the systems view. (*ibid*., pp. 319-320)

Based on these arguments in the wicked problems literature, as well as arguments in the broader sociological literature about the need to explore how theoretical concepts are used and what functions they fulfill (e.g. Sohlberg and Leiulfsrud 2017), it seems important to explore how authors use the wicked problems concept to construct different kinds of rhetorical statements. Therefore, we analyzed which *rhetorical functions* the concept performs in the included papers (RQ4). Billig's description of rhetoric as 'discourse which is argumentative and which seeks to persuade' (Billig 1997, in Wetherell et al. 2011) served as a guide for identifying what function the wicked problems concept performs in and for each of the papers. Aiming to identify and describe general trends in the literature, we performed this analysis at an overarching level rather than aiming for a detailed discourse analysis (which however would be a very relevant focus for future research!)

## Results

### *RQ1: what is the theoretical status of the wicked problems concept?*

To address RQ1, we used Bradbury-Jones et al.'s (2014) typology of levels of theoretical visibility (Table 1). We found that in most of the papers (n = 32, Table 2), the wicked problems concept is *consistently applied* and it is highly visible throughout the paper. In many of these papers, consistent application is evident through a high number of mentions of the concept in the paper overall (up to 80 times) and through mention of the concept in all sections of the paper. In some papers, the authors also explicitly state the importance of the concept for their paper. For example, Dorado and Ventresca (2013) state that 'the conceptualization of complex social problems as "wicked" is fundamental to advance our articulation of crescive conditions.' This category is likely to be overrepresented in our sample due to our sampling strategy to privilege frequently cited papers and papers that explicitly discuss wicked problems as a theoretical concept.

In 13 papers, the wicked problems concept was *partially applied*. In several of these papers, the concept is mentioned in the abstract and described in the introduction or background section, but it is not

**Table 2.** Number of papers coded for levels of theoretical visibility.

| Level of theoretical visibility | n papers | % of papers in the sample |
|---|---|---|
| Consistently applied | 32 | 58 |
| Partially applied | 13 | 24 |
| Implied | 7 | 13 |
| Seemingly absent | 3 | 5 |

mentioned again later in the paper (e.g. Kettl 2006; Lazarus 2009; Cascetta et al. 2015).

In seven papers, the use of wicked problems as a theoretical concept is merely *implied*. For example, in Allen et al. (2011), the concept is used only in the abstract and the conclusion and there is no description of whether or how the concept has influenced the analysis and/or results of the research.

Finally, in three papers, the term 'wicked problem' seems to be used as an ordinary word (as in phrases like 'a wicked sense of humor') rather than as a theoretical concept. According to Sohlberg and Leiulfsrud (2017), theoretical concepts are 'words with a specific kind of power, (…) words loaded with theoretical meaning.' In our analysis, we identified five ways in which authors signal that the term 'wicked problem' is used as a theoretical concept: First, and most obviously, some authors explicitly identify 'wicked problems' as a 'concept' or 'term'. For example, Rayner (2012) writes: 'I use the term "uncomfortable knowledge" to bridge two separate but related theoretical concepts: "wicked problems" and "clumsy solutions"'. Second, many authors mark the term with quotation marks or italicize it, especially when the term is first introduced and described. For example, Pries-Heje and Baskerville (2008) introduce wicked problems in the following way: 'Managers frequently face ill-structured or "wicked" problems.' The authors then proceed to describe the characteristics of wicked problems. Later in the same paper, the authors italicize *wicked problems* – in the same way as they italicize other theoretical concepts, such as *design theory nexus* or *method fragment*. Third, in most papers, the authors provide some form of description or definition of the term and thus indicate that the term is used as a theoretical concept (Swedberg 2016). Fourth, in some papers, the term wicked problems is preceded by the adjective 'so-called', which, in this context, indicates an 'explicit recognition that a special term [i.e. a theoretical concept] is being used' (Vandelanotte 2007). For example, Ferlie et al. (2011) state: 'The Network Governance model of public management (…) endorses such networks theoretically as a policy response to so-called "wicked problems"' (see also Waldring 2017, who uses 'so-called' both preceding 'wicked problems' and 'second generation professionals'). Finally, almost all of the papers include references to wicked problems literature (e.g. Rittel and Webber 1973), which indicates that the term is connected to a broader scholarly discussion about wicked problems as a theoretical concept.

In the three papers coded as using 'wicked problems' as an ordinary word, none of the five ways of signaling the use of wicked problems as a theoretical concept are used. In terms of Bradbury-Jones et al.'s terminology, this means that a focus on wicked problems as a theoretical concept is *seemingly absent*. For example, Sørensen and Torfing (2009) state that 'governance through the formation of networks composed of public and private actors might help solve wicked problems and enhance democratic participation in public policy-making.' However, the term 'wicked problems' is used only once in the whole paper, without any references to wicked problems literature, and there is no use of either quotation marks, italicization, or a preceding 'so-called' to indicate that the term is used as anything other than an ordinary word.

### *RQ2: what range of meanings is associated with the wicked problems concept?*

To explore the range of meanings of the wicked problems concept in our sample, we analyzed what *alternative concepts* are used concurrently with it. We identified 116 concepts (see Appendix C), of which 74% (n = 86) are only used in one of the reviewed papers, 21% (n = 24) are used in two papers, and only 11% (n = 6) are used in more than two papers: 'intractable problems' (n = 11), 'complex problems' (n = 8), 'wicked issues' (n = 5), 'ill-defined problems' (n = 4), 'messy problems' (n = 3), and 'messes' (n = 3). There is thus a lot of variation in the use of alternative concepts, which may be one reason for the lack of convergence in the literature (Xiang 2013; Turnbull and Hoppe 2019). In fact, if the wicked problems concept is taken to be synonymous with all these 116 concepts, it becomes relevant to ask what wicked problems are *not* (Swedberg 2016).

An *emerging* consensus about what wicked problems are can possibly be discerned in the co-articulation of wicked problems with alternative concepts that include the term 'complex': 26 of the 116 alternative concepts include the term 'complex' (e.g. as in 'complex problems' or 'complex challenges') and in 67% of the reviewed papers, at least one concept with the term 'complex' is mentioned. We identified three additional clusters of alternative terms: 17 of the alternative concepts include at least one of the terms 'social', 'societal', or 'socio'; ten include at least one of the terms 'sustainability', 'ecology', or 'environment'; and eight include the term 'policy' (Table 3). This observation is consistent with the fact that, even though the wicked problems concept was developed in the context of social policy research, and even though it still seems to be widely used in that context (Termeer et al. 2019), it has clearly also been taken up in many other research contexts, most notably in sustainability and environmental research (Norton 2012; Crowley and Head 2017; Termeer et al. 2019). Researchers who use the concept need to be aware of, and relate to, the wide range of meanings that are given to it in different contexts.

### *RQ3: What epistemological assumptions underlie descriptions of wicked problems?*

As mentioned above, there is an on-going debate in the wicked problems literature about which

**Table 3.** Overview over most common terms that are used in alternative concepts and how they are used in the reviewed papers.

| Terms included in alternative concepts | Most commonly used concepts with this/these term(s) | n concepts with this/these term(s) (% of 116 concepts) | n papers containing concepts with this/these term(s) (% of 55 papers) |
|---|---|---|---|
| 'complex' | 'complex problems'; 'complex challenges'; 'complex issues'; 'complex situations'; 'complex social problems' | 26 (22%) | 37 (67%) |
| 'social', 'societal', or 'socio' | 'complex social problems'; 'social messes'; 'societal problems'; 'socio-ecological systems' | 17 (15%) | 21 (38%) |
| 'sustainability', 'ecology', or 'environment' | 'socio-ecological systems'; 'sustainability issues'; 'sustainability problems' | 10 (9%) | 13 (24%) |
| 'policy' | 'policy problems'; 'wicked policy problems' | 8 (7%) | 10 (18%) |

*epistemological assumptions* (mainly realist versus constructivist) should be considered appropriate for research on wicked problems. In line with this debate, we found that most of the papers in our analysis (n = 30, 55%) use constructivist and/or realist approaches. A smaller number of papers use pragmatist (n = 15, 27%), critical (n = 4, 7%), and/or a post-structuralist (n = 1, 2%) approaches (Table 4). These results are consistent with McCall and Burge's (2016) observation that authors use the concept together with very diverse (and sometimes incompatible) theoretical perspectives. We conclude that there does not seem to exist a consensus on what epistemological assumptions *can* or *should* be used in research on wicked problems. In the absence of such a consensus, authors cannot assume that readers will share their assumptions and authors should therefore clearly position their research by explicitly stating their epistemological assumptions.

In our sample, epistemological positions are made *explicit* in 17 papers. For example, Ison et al. (2015) explicitly state their constructivist assumptions: 'We argue that "wicked" or "tame" problems are framing-choices that can be made by a practitioner rather than a class of problem that exists independently of its social construction'. Similarly, Helbo Jespersen and Hasle (2017) make their combined critical and realist assumptions explicit when they put forward 'realistic evaluation' as a tool for integrating general scientific knowledge with local contextual knowledge: 'The realistic evaluation has a scientific theoretical foundation in critical realism'.

In 34 of the papers, we were able to infer epistemological positions from *implicit* statements. For example, Exworthy and Hunter (2011, our italics) seem to take a realist perspective when they argue that challenges in addressing health inequalities arise 'from *the nature* of health inequalities *themselves*,' but they make no explicit mention of their epistemological orientation. In seven papers, we were not able to identify explicit or implicit epistemological assumptions (e.g. Ferro et al. 2013; Bates et al. 2017). This lack of clarity about epistemological positioning in some of the literature may be another reason for the ambiguity and lack of convergence in the wicked problems literature (Xiang 2013; Turnbull and Hoppe 2019).

Interestingly, in many papers (n = 22), several epistemological positions are used side by side (Table 4).

**Table 4.** Epistemological positions in the reviewed papers.

| Epistemological position(s) | | n papers | % of papers |
|---|---|---|---|
| CONSTRUCTIVIST | Constructivist only | 14 | 25 |
| | Constructivist & any other | 15 | 27 |
| | *Total constructivist* | *29* | *53* |
| REALIST | Realist only | 8 | 15 |
| | Realist & any other | 14 | 25 |
| | *Total realist* | *22* | *40* |
| PRAGMATIST | Pragmatist only | 4 | 7 |
| | Pragmatist & any other | 11 | 20 |
| | *Pragmatist total* | *15* | *27* |
| CRITICAL | Critical only | 0 | 0 |
| | Critical & any other | 4 | 7 |
| | *Total critical* | *4* | *7* |
| POST-STRUCTURALIST | Post-structuralist only | 0 | 0 |
| | Post-structuralist & any other | 1 | 2 |
| | *Total post-structuralist* | *1* | *2* |
| REALIST & CONSTRUCTIVIST | | 8 | 15 |
| *Total papers with a single epistemological position* | | *26* | *47* |
| *Total papers with several epistemological positions* | | *22* | *40* |
| *Total papers with unclear epistemological assumptions* | | *7* | *13* |
| *Total papers with explicitly stated assumptions* | | *17* | *31* |
| *Total papers with implicitly stated assumptions* | | *34* | *62* |
| *Total papers with both explicitly & implicitly stated assumptions* | | *3* | *5* |

While some of these combinations may be expected (such as combining critical and realist approaches), others may appear counter-intuitive. For example, eight papers combine constructivist and realist approaches within the same paper. While it has been suggested that some forms of constructivism and realism should be viewed as compatible and complementary (Barkin 2003; Mouritzen 2016), we have not found any discussion about this issue in the wicked problems literature. In fact, we suspect that many authors who use the wicked problems concept are not aware of the fact that they are using several epistemological positions concurrently. This suspicion is based on the observation that constructivist and realist perspectives are only combined in papers in which epistemological assumptions are not made explicit and could only be inferred implicitly. Even in Rittel and Webber's original (1973) paper on wicked problems, constructivist and realist assumptions are used side by side without any discussion about whether, or how, this combination is permissible and fruitful. For example, *constructivist* assumptions are evident in the description of the ten characteristics of wicked problems, for instance in the assertion that values and world views influence problem understanding and solution evaluation. At the same time, Rittel and Webber's 'strict, ontological demarcation of wicked and tame problems' (Turnbull and Hoppe 2019) suggests a *realist* perspective that 'combines reductionist thinking about problems with the decontextualization of policy analysis via this "view from nowhere"' (*ibid*., p. 320). Such uncritical combinations of potentially incompatible epistemological positions in the early literature on wicked problems may have contributed to the current confusion about theoretical, epistemological, and ontological foundations of the concept and may be yet another reason for the lack of convergence in the literature (Xiang 2013; Turnbull and Hoppe 2019).

## RQ4: what rhetorical functions is the wicked problems concept used to perform?

We identified two overarching rhetorical functions that the wicked problems concept performs in the reviewed papers (Table 5): In 22 papers, the concept is used to *challenge existing, dominant approaches to addressing wicked problems*; in nine papers, it is used to *support alternative approaches*; and in 23 papers, it is used to both challenge existing approaches and support alternative approaches that could be used to replace the existing approaches. We identified only one paper in which the concept is not used to perform either of these two rhetorical functions: in Allen et al. (2011), the concept seems to be used as a form of *hedging* as the authors warn the reader not to expect unrealistic outcomes when applying adaptive management to problems for which the approach is not suited: 'Adaptive management is not a panacea for the navigation of "wicked problems" as it does not produce easy answers, and is only appropriate in a subset of natural resource management problems where both uncertainty and controllability are high.' In the following two sections, we describe several subtypes of rhetorical functions for each of the two overarching functions.

**Table 5.** Rhetorical functions of the wicked problems concept (see Appendix D for detailed coding results).

| Rhetorical function | n papers | % of papers |
|---|---|---|
| Challenge existing, dominant approaches:<br>1. challenge the dominant solution approach to a specific (type of) problem<br>2. challenge a dominant understanding of a type of problems as ultimately solvable<br>3. challenge the dominance of a specific group in addressing a problem | 22 | 40 |
| Support alternative approaches:<br>1. argue for the usefulness of a specific solution approach<br>2. argue for the usefulness and value of a specific scientific discipline<br>3. showcase success stories or good examples<br>4. argue for the usefulness of a specific theoretical perspective<br>5. argue that an otherwise controversial approach should be considered appropriate<br>6. argue that a certain group of social actors should be acknowledged as having important skills or resources for addressing wicked problems<br>7. call for action within a specific social community | 9 | 16 |
| Both of the above | 23 | 42 |
| Neither of the above | 1 | 2 |

### Challenge existing, dominant approaches

We identified three subtypes of rhetorical functions that are used to challenge existing, dominant approaches to addressing wicked problems. First, the concept is used to *challenge a dominant solution approach* to a specific problem or type of problem. This is for example the case in Rittel and Webber's (1973) original paper in which they criticized the then-dominant systems analysis approach to problems of social planning. Another example is found in Sørensen and Torfing (2009), who argue that 'stubborn insistence on predefined ends and old-fashioned means will tend to strait-jacket the governance network and prevent mutual learning and policy innovation.'

Second, the concept is used to *challenge a dominant understanding of a type of problems* as ultimately solvable. For example, Quiñonez (2012) states that his paper aims 'to bring attention to the policy contradictions that are now inherent in publicly financed dental care' and Tatham and Houghton (2011) stress the need to 'broaden the recognition among those engaged in the practice of humanitarian logistics, and especially those operating at the strategic/policy-making level, that the problems are, indeed, wicked.'

Third, the concept is used to *challenge the dominance of a specific group* in addressing a problem, for

example when only experts are involved without consulting the broader public: 'Scientists must be prepared to admit their limitations' (Ludwig 2001), or when scholars from a specific discipline perceive themselves to be capable of addressing any (wicked) problem they might encounter: 'With arrogant confidence, the early systems analysts pronounced themselves ready to take on anyone's perceived problem' (Rittel and Webber 1973).

### *Support alternative approaches*

We identified seven subtypes of rhetorical functions that are used to support alternative approaches to addressing wicked problems. First, the concept is often used to argue for the *usefulness of a specific solution approach*. For example, Kazlauskas and Hasan (2009) argue for the usefulness of knowledge management as 'an ideal candidate topic' for addressing wicked problems. Similarly, Pries-Heje and Baskerville (2008) argue that the design theory nexus 'offers a unique problem-solving approach that is particularly useful for addressing ill-structured or wicked problems'. In many cases, the concept seems to be used to highlight the societal relevance of an *already existing* approach. This rhetorical function becomes particularly visible in Kapetanios' paper: Kapetanios (2008) describes collective intelligence as an 'emerging solution framework for wicked and messy problem' and asks: 'Is there any potential waiting to be discovered [for collective intelligence]?' Descriptions of this kind could be an indication of the wicked problems concept being *retrospectively applied* (Bradbury-Jones et al. 2014). Further exploration of this possibility could contribute to clarifying how retrospective application of theory manifests in research articles and thus to developing Bradbury-Jones et al.'s typology of theoretical visibility. Retrospectively applying theory is problematic since theory then is 'introduced as an afterthought' rather than guiding the research throughout the research process (Bradbury-Jones et al. 2014). Similarly, using the wicked problems concept to support an existing solution approach may be problematic since 'defining the concepts [problems] through the mechanisms for solution tends to undervalue the nature of the problems themselves' (Peters 2017).

Second, the concept is used to argue for the *usefulness and value of a specific scientific discipline*. For example, Kazlauskas and Hasan (2009) argue for the societal relevance of information systems research, stating that 'the Information Systems community can make a valuable contribution to a critical global problem.' Addressing the wicked problem of climate change, this community can 'find a new relevance [for the field] as part of the solution.'

Third, the concept is sometimes used to *showcase success stories or good examples* of work that aimed at, and presumably succeeded in, addressing a wicked problem. For example, van Bueren et al. (2003) argue that 'the [zinc debate] case demonstrates that breakthroughs in the joint action problem are possible' and Roberts (2004) describes 'the wonderful example of the World Trade Center deliberations' as a successful attempt to 'prevent wicked problems from becoming crises'.

Fourth, in some articles, the wicked problems concept is used to argue for the *usefulness of a specific theoretical perspective*. For example, Scherrer and Doohan (2011) argue that their paper 'highlights an urgent need for working within (rather than on) indigenous ontologies in order to overcome the continuing embeddedness of colonizing practices in reductionist indicator-based approaches'. Similarly, Alrøe and Noe (2012) argue for the need of constructivist and perspectivist theories for addressing wicked problems. Other authors argue for the usefulness of, for example, postnormal science approaches (Batie 2008), social constructivism (Grint 2005), narrative inquiry and action research (Langley 2012), and pragmatism (Weber and Khademian 2008). These calls for a wide range of specific theoretical perspectives provide yet another illustration of the large diversity in epistemological, but also ontological and methodological, assumptions in the wicked problems literature.

Fifth, in one of the papers in our sample, the concept is used to argue that *an otherwise controversial approach should be considered appropriate*: Lazarus (2009) argues that 'the potentially catastrophic consequences of failing to reduce greenhouse gas emissions over the longer term' should be seen as 'an especially legitimate basis for imposing lawmaking restraints notwithstanding their undemocratic effects'. More specifically, Lazarus argues for the need of precommitment strategies in lawmaking to reduce the risk of catastrophic consequence of global warming – even though such strategies may 'allow the views of existing majorities to trump the views of future majorities who may well view sound public policy very differently' and thus may be viewed as 'antidemocratic' (*ibid*., p. 1194). This approach is remarkable with regard to recent debates about the potential value of undemocratic, totalitarian societal systems for addressing climate change (see e.g. Stehr 2016).

Sixth, some authors seem to use the concept to argue that *a certain group of social actors should be acknowledged as having important skills or resources for addressing wicked problems*. For example, Waldring (2017) argues that second-generation immigrants should be viewed as particularly competent in addressing ethnic school segregation since they 'are familiar with different social systems' and thus able to '[build] bridges between the specific needs of ethnic-minority pupils and school organizations.'

Seventh, some authors use the concept to *call for action within a specific social community*. For example, Batie (2008) argues that 'applied economics needs to

become better acquainted with wicked problems', Sørensen and Torfing (2009) call for a 'new type of public manager', and Redford et al. (2013) call on conservation biologists to engage in respectful dialogue with the synthetic biology community.

## Discussion

We have reported on the results of a configurative mapping review of the literature on wicked problems. Our aim was to provide a map of different ways in which the wicked problems concept is used in the literature. We hope that this map will provide researchers with a vocabulary that can help them to more clearly position their work in the highly dispersed wicked problems literature. We now turn to exploring implications of the results in terms of the utility of the wicked problems concept for different types of research that are conducted in various disciplinary contexts. We do so by exploring the utility of the concept for three overarching functions of theoretical concepts that have been identified in the sociological literature: concepts as *descriptive/analytic tools*, *sensitizing/creative tools*, or *critical/emancipatory tools*. We also identify directions and implications for future research on/with wicked problems.

### *Utility of the wicked problems concept as a descriptive/analytic tool*

Theoretical concepts may be used as descriptive tools to 'express or sum up some insight about social life in a clear and precise manner so that they also can be used in future research' (Swedberg 2016). This is common, for example, in research that aims to objectively describe or explain some aspects of social reality. Concepts may also be used as analytic tools, which is common in research that aims to develop measurable variables. Those variables can then be used to analyze causation and predict future developments (Sohlberg and Leiulfsrud 2016; Flemmen 2017). This type of research requires theoretical concepts that are comprehensive, carefully and narrowly defined, and clearly linked to other concepts (Gibson-Graham 2014; Swedberg 2016).

Our review supports Turnbull and Hoppe's claim that the wicked problems literature lacks a firm theoretical and conceptual base (Turnbull and Hoppe 2019): there is a large degree of variation in how the concept is used with regard to theoretical status, range of meanings, epistemological assumptions, and rhetorical functions. We conclude that, if the concept is to be used as a descriptive/analytic tool, researchers need to provide a clear definition and a detailed description of how they operationalize the concept. Researchers also need to position their use of the concept within the varied landscape of the wicked problems literature. We hope that this review can facilitate that process.

### *Utility of the wicked problems concept as a sensitizing/creative tool*

Not all research requires – or even benefits from – using theoretical concepts that are narrowly defined and clearly operationalized. For example, Wright (2015) suggests that less well-defined concepts may be particularly valuable tools at early, explorative stages of research projects since they are 'open to possibilities, to surprises' and 'very suggestive and easily made into your own' (Swedberg 2016). Such 'sensitizing concepts' (Blumer 1954; Flemmen 2017) can stimulate creativity and 'help us to look in a specific direction without locking us into a certain understanding of the phenomenon" (Flemmen 2017). Thus, theoretical concepts can serve as sensitizing tools for creative exploration and discovery (Swedberg 2016; Flemmen 2017).

Due to its multi-faceted and evocative nature, the wicked problems concept should be particularly valuable for exploratory research as it may provide a starting point for reflection rather than a definitive terminology. In fact, using the concept in this way may be more in line with common descriptions of wicked problems that argue for the need of conflictual, decentralized, and multi-perspectival approach to addressing wicked problems. Narrowly defined and clearly operationalized theoretical concepts, on the other hand, reduce opportunities for engaging multiple perspectives and negotiating alternative problem framings and solution approaches. Therefore, our review does not aim to narrow the scope of how the wicked problems concept is used in the research community. Rather, it provides a map that helps researchers to navigate the broad range of conceptualizations in the literature, render diverse perspectives visible, and thus engage in collaborative and creative exploration of wicked problems.

### *Utility of the wicked problems concept as a critical/emancipatory tool*

As described above, this review is informed by a social constructivist perspective. From this perspective, development of theoretical concepts is viewed as 'a form of discursive action' through which social phenomena are interactively constructed and negotiated (Gergen and Zielke 2006) so that concepts can be used as critical and emancipatory tools to 'provoke debate, transform social reality, and ultimately serve to reorder social conduct' (Gergen 1978). More concretely, theoretical concepts can be used to, for example, question practices, unite communities, legitimate action, and coordinate activities (Gergen and Zielke 2006).

Rittel and Weber used the wicked problems concept as a 'political intervention in scholarship' (Turnbull and Hoppe 2019) to critique the then-

dominant reductionistic approach to addressing policy problems. The concept has thus historically been useful as a critical tool and our analysis of the rhetorical functions of the concept suggests that it continues to be used for this purpose. However, the first author also noticed that the concept evokes different reactions in different disciplinary contexts: while it seems to serve a critical function in engineering education research and practice, it is sometimes seen as outdated in social science contexts, including environmental and sustainability education research (Lönngren 2019). Similarly, Sohlberg and Leiulfsrud (2016) have argued that theoretical concepts tend to 'rapidly become outdated' when theoretical development continues towards greater differentiation. Thus, some theoretical concepts may only be effective as a critical/emancipatory tool for a limited period of time in a given research field. In the social policy literature, for example, the wicked problems concept has been used for more than four decades and there have been ample discussions in the field of the (in)appropriateness of reductive approaches to social planning. As these discussions have matured, the concept may have lost some of its critical potential. In fact, several scholars in social policy research have suggested that the concept needs to be updated or replaced (Termeer et al. 2019). In other disciplines, however, such as engineering education for sustainable development, the concept has been introduced more recently and general discussions about reductionism and instrumentalism in problem solving are still actively pursued. Thus, in that context, the concept is still very useful for stimulating debate and critical reflection (Lönngren 2017).

### *Implications and future research*

We have suggested that the wicked problems concept may be particularly valuable as a sensitizing/creative or critical/emancipatory tool. We have also suggested that the concept *can* be used as a descriptive/analytic tool, but that it then needs to be clearly defined and positioned in the landscape of the wicked problems literature. Several researchers have already explored ways of more clearly defining and nuancing the concept. For example, Alford and Head (2017) propose an analytic typology of different types of wicked problems, including dimensions of variation such as cognitive complexity and irreconcilability of stakeholder perspectives. Other scholars argue that the concept should be revised to more explicitly focus on the ways in which problems are embedded and addressed in local contexts (Noordegraaf et al. 2019). However, these efforts are not (yet) coordinated across the literature. Thus, if the aim is to develop a concept that is widely accepted and adopted in a highly diverse and interdisciplinary research community, a more concerted effort will be needed. If that is the aim, it could also be valuable to clarify the use of alternative concepts such as 'complex problems' or 'social messes' and how they relate to the wicked problems concept and to explore what wicked problems are *not*, which would make it possible to more clearly define the boundaries of the concept's meaning(s). Further, a bibliometric analysis of the entire wicked problems literature could explore citation patterns on a large scale and thus contribute to identifying possible clusters of wicked problems research. Finally, our review can provide a background for discipline-specific reviews of the wicked problems literature that aim to explore discipline-specific needs for theory development.[1]

We also found that the reviewed articles employed very diverse epistemological perspectives and we therefore suggest that researchers not only describe how they use the concept, but also clearly state their epistemological assumptions. In some of the reviewed articles, several epistemological perspectives are used together without an explicit discussion of whether and how these perspectives could be compatible or complementary for a given study. Future research should explore the permissibility and value of using several epistemological perspectives in research on/with wicked problems. It may well be that, under certain conditions, new combinations of epistemological perspectives can increase the sensitizing/creative and critical/emancipatory potential of wicked problems research and thus stimulate theoretical and practical innovation (c.f. discussions in the literature on environmental problems and international relations, e.g. Blühdorn 2000; Klein 2002; Barkin 2003; Mouritzen 2016). Yet, these conditions need to be clarified and substantiated.

Our results further show that the wicked problems concept can perform a wide range of rhetorical functions. We hope that our description of these functions increases sustainability researchers' awareness of the performative potential of the concept and offers them a vocabulary to be precise and transparent about their aims and purposes. Scholars may also use our description to critically evaluate theoretical and practical claims made in the wicked problems literature or even intentionally use the wicked problems concept for specific rhetorical purposes in order to increase the critical/emancipatory potential of their work.

## Note

1. The authors are currently working on such a review for the field of environmental and sustainability education research.

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## Appendix A. Papers and book chapters included in the review. Conference papers and book chapters are italicized

| Author(s), year | Title | Journal/book title/conference | Citation count (2019–02-27) |
|---|---|---|---|
| Policy, Management, Administration, Governance, Legislation (general) | | | |
| Rittel and Webber (1973) | Dilemmas in a General Theory of Planning | Policy Sciences | 5489 |
| Fischer (1993) | Citizen participation and the democratization of policy expertise: From theoretical inquiry to practical cases | Policy Sciences | 231 |
| [a]Hudson and Henwood (2002) | The NHS and social care: The final countdown? | Policy and Politics | 57 |
| Roberts (2002) | Keeping public officials accountable through dialogue: Resolving the accountability paradox | Public Administration Review | 94 |
| van Bueren et al. (2003) | Dealing with wicked problems in networks: Analyzing an environmental debate from a network perspective | Journal of Public Administration Research and Theory | 233 |
| Roberts (2004) | Public deliberation in an age of direct citizen participation | American Review of Public Administration | 283 |
| Kettl (2006) | Managing boundaries in American administration: The collaboration imperative | Public Administration Review | 142 |
| Weber and Khademian (2008) | Wicked problems, knowledge challenges, and collaborative capacity builders in network settings | Public Administration Review | 384 |
| Lazarus (2009) | Super wicked problems and climate change: Restraining the present to liberate the future | Cornell Law Review | 240 |
| Sørensen and Torfing (2009) | Making governance networks effective and democratic through metagovernance | Public Administration | 320 |
| [a]Exworthy and Hunter (2011) | The challenge of joined-up government in tackling health inequalities | International Journal of Public Administration | 31 |
| [a]Ferlie et al. (2011) | Public policy networks and "wicked problems": A nascent solution? | Public Administration | 96 |
| [a]Mingers (2011) | Soft OR comes of age – but not everywhere! | Omega | 80 |
| Levin et al. (2012) | Overcoming the tragedy of super wicked problems: Constraining our future selves to ameliorate global climate change | Policy Sciences | 303 |
| [a]Ferro et al. (2013) | Policy making 2.0: From theory to practice | Government Information Quarterly | 62 |
| Head and Alford (2015) | Wicked problems: Implications for public policy and management | Administration and Society | 219 |
| [a]Crowley and Head (2017) | The enduring challenge of 'wicked problems': Revisiting Rittel and Webber | Policy Sciences | 1 |
| Environmental management, Sustainability | | | |
| Ludwig (2001) | The era of management is over | Ecosystems | 254 |
| [a]Wang (2002) | Wicked problems and metaforestry: Is the era of management over? | The Forestry Chronicle | 18 |
| [a]Carroll et al. (2007) | Managing fire danger in the forests of the US inland northwest: A classic "wicked problem" in public land policy | Journal of Forestry | 35 |
| [a]Warburton and Norton (2007) | Towards a knowledge-based ethic for lethal control of nuisance wildlife | The Journal of Wildlife Management | 56 |
| Jentoft and Chuenpagdee (2009) | Fisheries and coastal governance as a wicked problem | Marine Policy | 233 |
| Allen et al. (2011) | Adaptive management for a turbulent future | Journal of Environmental Management | 195 |
| [a]Scherrer and Doohan (2011) | Capturing intangible cultural impacts of tourism on aboriginal land in Australia's Kimberley region | Tourism Recreation Research | 5 |
| [a]Redford et al. (2013) | Synthetic biology and conservation of nature: Wicked problems and wicked solutions | PLOS Biology | 51 |
| [a]Xiang (2013) | Working with wicked problems in ecological systems: Awareness, acceptance, and adaptation | Landscape and Urban Planning | 72 |
| [a]Neff and Larson (2014) | Scientists, managers, and assisted colonization: Four contrasting perspectives entangle science and policy | Biological Conservation | 16 |
| [a]Ison et al. (2015) | Institutionalising social learning: Towards systemic and adaptive governance | Environmental Science and Policy | 35 |
| Policy, Management, Administration, Governance, Legislation (diverse disciplinary foci) | | | |
| [a]Jackson and Sam (2007) | "Yes, prime minister" and the dilemmas of sport policy | Sport Management Review | 4 |
| [a]Stichler (2009) | Wicked problems in designing healthcare facilities | Journal of Nursing Administration | 4 |
| [a]Tatham and Houghton (2011) | The wicked problem of humanitarian logistics and disaster relief aid | Journal of Humanitarian Logistics and Supply Chain Management | 36 |
| [a]Quiñonez (2012) | Wicked problems: Policy contradictions in publicly financed dental care | Journal of Public Health Dentistry | 4 |
| [a]Rayner (2012) | Uncomfortable knowledge: The social construction of ignorance in science and environmental policy discourses | Economy & Society | 98 |
| [a]Cascetta et al. (2015) | A new look at planning and designing transportation systems: A decision-making model based on cognitive rationality, stakeholder engagement and quantitative methods | Transport Policy | 69 |
| [a]Helbo Jespersen and Hasle (2017) | Developing a concept for external audits of psychosocial risks in certified occupational health and safety management systems | Safety Science | 4 |
| Economy, Business, Leadership | | | |
| Grint (2005) | Problems, problems, problems: The social construction of 'leadership' | Human Relations | 350 |

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(Continued).

| Author(s), year | Title | Journal/book title/conference | Citation count (2019–02-27) |
|---|---|---|---|
| Batie (2008) | Wicked problems and applied economics | American Journal of Agricultural Economics | 181 |
| Camillus (2008) | Strategy as a wicked problem | Harvard Business Review | 203 |
| [a]Frame and Brown (2008) | Developing post-normal technologies for sustainability | Ecological Economics | 109 |
| [a]Dorado and Ventresca (2013) | Crescive entrepreneurship in complex social problems: Institutional conditions for entrepreneurial engagement | Journal of Business Venturing | 63 |
| Science, Engineering, Design, IT | | | |
| [a]Coyne (2005) | Wicked problems revisited | Design Studies | 117 |
| *France and Rumpe (2007)* | *Model-driven development of complex software: A research roadmap* | *Future of Software Engineering (conference)* | *641* |
| *[a]Zimmerman et al. (2007)* | *Research through design as a method for interaction design research in HCI* | *SIGCHI Conference on Human Factors in Computing Systems (conference)* | *520* |
| [a]Kapetanios (2008) | Quo Vadis computer science: From Turing to personal computer, personal content and collective intelligence | Data and Knowledge Engineering | 35 |
| Pries-Heje and Baskerville (2008) | The design theory nexus | MIS Quarterly | 137 |
| *[a]Beacham and Shambaugh (2010)* | *Translating design thinking for scientists* | *Psychology of Thinking (book title)* | *1* |
| [a]Kazlauskas and Hasan (2009) | Web 2.0 solutions to wicked climate change problems | Australasian Journal of Information Systems | 5 |
| [a]Kastenhofer (2011) | Risk assessment of emerging technologies and post-normal science | Science, Technology and Human Values | 20 |
| [a]Sadowski et al. (2013) | An experiential, game-theoretic pedagogy for sustainability ethics | Science and Engineering Ethics | 10 |
| *[a]Sousa-Poza (2013)* | *A narrative of [complex] situations and situations theory* | *Managing and Engineering in Complex situations (book)* | *3* |
| [a]Bates et al. (2017) | Doing good in HCI: Can we broaden our agenda? | Interactions | 6 |
| Education | | | |
| [a]Borko et al. (2009) | Wicked problems and other thoughts on issues of technology and teacher learning | Journal of Teacher Education | 73 |
| [a]Langley (2012) | Women reaching women: a story of change. The role of narrative in building trust and commitment during an action research project | Educational Action Research | 1 |
| [a]Waldring (2017) | Practices of change in the education sector: Professionals dealing with ethnic school segregation | Ethnic and Racial Studies | 2 |
| Philosophy | | | |
| [a]Alrøe and Noe (2012) | Observing environments | Constructivist Foundations | 7 |

[a]from random selection

## Appendix B. Exemplar paper summary (Alrøe and Noe 2012).

Main topic/argument:

Constructivist and perspectivist theories are needed to address wicked problems (WPs), but we need to be clear about different constructions of the environment in different constructivist and perspectivist theories.

Paper content:

- aim of the paper: clarify conceptions of environment in constructivist approaches
- argue for a need to distinguish between inside and outside perspectives on the environment, I.e. perspectivism
- focus on how 'the environment' is constructed in different constructivist approaches
- three constructivist theories: biosemiotic theory of meaning, biological theory of autopsies and cognition, autopoietic theory of social systems: contradict each other with regard to how they view 'environment'
- two logics of observation: distinction, representation

Ways of using the wicked problems concept:

- mentioned in abstract with short definition, in quotation marks
- existence of WPs provides argument for the need of constructivist and perspectives theories
- Luhman's theory of social systems suggested as approach to wicked problems
- environmental sustainability problems = WPs
- definitions of WPs in introduction, citing R&W, Norton 2012
- WPs require transdisciplinary cooperation
- WPs require theoretical perspectives that understand society as material, not purely communicative: learning as an organic, embodied process
- WPs require theoretical perspectives that combine social, technological and biological systems
- describe theoretical perspectives that can be used to address WPs, provide concrete examples

Alternative concepts:

- complex systems
- complex environmental problems
- environmental sustainability problems

Theoretical perspectives & epistemological assumptions:

- constructivist and perspectivist (inside, outside, transcendental) approaches are needed to address WPs
- Kant, Peirce's semiotics
- situatedness of cognition
- phenomenology, Husserl
- focus on meaning, communication, relations

Tentative thematic categories:

- focus on philosophy/connecting WPs and philosophy
- provide definition of WPs
- describe implications for addressing WPs/discuss concrete examples of how results are useful for addressing WPs

Exemplar quotes:

- 'There is a need for explicitly constructivist and perspectivist theories to address' WPs.
- 'The aim of this paper is to clarify the conceptions of environment in constructivist approaches'

## Appendix C. Number and percentage of papers in which alternative concepts are used concurrently with the wicked problems concept

| Alternative concept | Number of papers | Percentage of papers |
|---|---|---|
| intractable problems | 11 | 20 |
| complex problems | 8 | 15 |
| wicked issues | 5 | 9 |
| ill-defined problems | 4 | 7 |
| messy problems | 3 | 5 |
| messes | 3 | 5 |
| big problems | 2 | 4 |
| complex challenges | 2 | 4 |
| complex issues | 2 | 4 |
| complex situations | 2 | 4 |
| complex social problems | 2 | 4 |
| ill-structured problems | 2 | 4 |
| intractable situations | 2 | 4 |
| policy problems | 2 | 4 |
| post-normal problems | 2 | 4 |
| recalcitrant problems | 2 | 4 |
| social messes | 2 | 4 |
| societal problems | 2 | 4 |
| socio-ecological systems | 2 | 4 |
| super wicked problems | 2 | 4 |
| sustainability issues | 2 | 4 |
| sustainability problems | 2 | 4 |
| trans-scientific problems | 2 | 4 |
| tricky problems | 2 | 4 |
| uncontrollable problems | 2 | 4 |
| undisciplined problems | 2 | 4 |
| unmanageable problems | 2 | 4 |
| unstructured problems | 2 | 4 |
| wicked planning problems | 2 | 4 |
| wicked policy problems | 2 | 4 |
| 'doing good' | 1 | 2 |
| (seemingly) impossible problems | 1 | 2 |
| 21st-century problems | 1 | 2 |
| adaptive challenges | 1 | 2 |
| aggressive problems | 1 | 2 |
| asymmetrical criteria problems | 1 | 2 |
| collective action problems in sustainability ethics | 1 | 2 |
| complex adaptive systems | 1 | 2 |
| complex all the way down problems | 1 | 2 |
| complex and cross-cutting policy problems | 1 | 2 |
| complex and messy problem situations | 1 | 2 |
| complex environmental problems | 1 | 2 |
| complex policy issues | 1 | 2 |
| complex public problems | 1 | 2 |
| complex real-world issues | 1 | 2 |
| complex real-world situations | 1 | 2 |
| complex systems | 1 | 2 |
| complex technological issues | 1 | 2 |
| complex unordered problems | 1 | 2 |
| complex, fragmented and multi-layered societies | 1 | 2 |
| complicated environmental problems | 1 | 2 |
| contested problems | 1 | 2 |
| critical global problems | 1 | 2 |
| deep-seated social problems | 1 | 2 |
| detrimental situations | 1 | 2 |
| difficult-to-solve issues | 1 | 2 |
| engrained social problems | 1 | 2 |
| environmental sustainability problems | 1 | 2 |

(*Continued*)

(Continued).

| Alternative concept | Number of papers | Percentage of papers |
|---|---|---|
| ethical issues | 1 | 2 |
| global challenges | 1 | 2 |
| governability issues | 1 | 2 |
| great planning disasters | 1 | 2 |
| hard problems | 1 | 2 |
| highly complex and contentious issues | 1 | 2 |
| incorrigible problems | 1 | 2 |
| inescapable issues | 1 | 2 |
| intractable disputes | 1 | 2 |
| intractable problem situations | 1 | 2 |
| intransigent problems | 1 | 2 |
| longstanding and complex sociopolitical and economic issues | 1 | 2 |
| lowland real-life swamps | 1 | 2 |
| malignant problems | 1 | 2 |
| metagovernance dilemmas | 1 | 2 |
| modern public policy problems | 1 | 2 |
| most complex challenges | 1 | 2 |
| multi-perspective problems | 1 | 2 |
| multifaceted and multilayered policy problems | 1 | 2 |
| nasty problems | 1 | 2 |
| open-ended problems | 1 | 2 |
| planning-type problems | 1 | 2 |
| policy-making 'tragedy' | 1 | 2 |
| practical problems | 1 | 2 |
| problematic social situations | 1 | 2 |
| problematique | 1 | 2 |
| problematizing alternative concepts | 1 | 2 |
| problems encountered in complex situations | 1 | 2 |
| problems of social policy | 1 | 2 |
| resource dilemmas | 1 | 2 |
| serious and complex societal problems | 1 | 2 |
| so-called environmental problems | 1 | 2 |
| social and economic problems | 1 | 2 |
| social issues | 1 | 2 |
| social problems | 1 | 2 |
| social system problems | 1 | 2 |
| social-planning problems | 1 | 2 |
| societal issues | 1 | 2 |
| soft problems | 1 | 2 |
| soft, complex problems | 1 | 2 |
| strategic problems | 1 | 2 |
| strategy issues | 1 | 2 |
| swamp | 1 | 2 |
| systemic challenges | 1 | 2 |
| thorny problems | 1 | 2 |
| truly complex problems | 1 | 2 |
| type III problems | 1 | 2 |
| unconventional problems | 1 | 2 |
| under-constrained problems | 1 | 2 |
| unpredictable problems | 1 | 2 |
| untamed problems | 1 | 2 |
| very difficult interrelated social and technical problems | 1 | 2 |
| vicious problems | 1 | 2 |
| wicked environmental problems | 1 | 2 |
| wicked public problems | 1 | 2 |
| wicked situations | 1 | 2 |
| wicked sustainability problems | 1 | 2 |
| wickedly complex problems | 1 | 2 |

## Appendix D. Detailed coding results for rhetorical functions of the wicked problems concept

| Rhetorical function | Number of papers | Percentage of papers |
|---|---|---|
| Challenge existing, dominant approaches (total) | 45 | 82% |
| 1. challenge the dominant solution approach to a specific (type of) problem | 40 | 73% |
| 2. challenge a dominant understanding of a type of problems as ultimately solvable | 24 | 44% |
| 3. challenge the dominance of a specific group in addressing a problem | 5 | 9% |
| Support alternative approaches (total) | 31 | 56% |
| 1. argue for the usefulness of a specific solution approach | 17 | 31% |
| 2. argue for the usefulness and value of a specific scientific discipline | 3 | 5% |
| 3. showcase success stories or good examples | 12 | 22% |
| 4. argue for the usefulness of a specific theoretical perspective | 9 | 16% |
| 5. argue that an otherwise controversial approach should be considered appropriate | 1 | 2% |
| 6. argue that a certain group of social actors should be acknowledged as having important skills or resources for addressing wicked problems | 1 | 2% |
| 7. call for action within a specific social community | 7 | 13% |