SCALE IN RESEARCH ON GRAND CHALLENGES

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ABSTRACT

Scalar terms, such as "local" and "global," "big" and "small" are fundamental in how academics and practitioners make sense of and respond to grand challenges. Yet, scale is so taken-for-granted that we rarely question or critically reflect on the concept and how it is used. The aim of this paper is to identify scale as an important concept in research on grand challenges and to point out why taking scale for granted can be problematic. In particular, I suggest that to date most research on grand challenges sees scale as a fundamental ontological feature of the world. Yet, scalar categories and hierarchies are not as self-evident and given as they may seem. Moreover, taking scale as an ontological fixed category limits our ability to make sense of, theorize and respond to grand challenges. As an alternative, I suggest seeing scale as an epistemological frame that participants employ in their everyday practices to make sense of, navigate and develop solutions to grand challenges. The chapter concludes with a research agenda for studying scale as socially constructed in practice.

Keywords: scale; grand challenges; ontology; epistemology; micro; macro

INTRODUCTION

Scale is a fundamental category of how academics and practitioners make sense of, navigate and respond to grand challenges (George, Howard-Grenville, Joshi, &

Tihanyi, 2016). It is already implied in the very word "grand" challenges, describing issues such as climate change, inequality and poverty (see also Pradilla, Bento da Silva, & Reinecke, 2022, this volume) as issue of large-scale or global importance. In recent years, the use of scalar terms, such as "global" and "local," "large" and "small," have proliferated in organizations, in public discourse, in politics and in academia. In addition, the idea of scale is at the origin of one of the most heated discussions in organization and management scholarship, that is, the debate between micro and macro levels of analysis. Thus, it is about time to reflect on the use of the concept and what barriers and opportunities it might present to academic scholarship.

In the most abstract sense, scale is simply a measure of the relative size, extent or degree of something and can thus be used to refer to time scales, geographic space, volumes of goods, number of people, levels of analysis and so forth (Marston, Jones, & Woodward, 2005). Here, I define scale how it is commonly used in research on grand challenges, that is, as a relative measure of geographic and jurisdictional space (e.g., local, regional, national and global) (Ferraro, Etzion, & Gehman, 2015) or number of people and organizations impacted (George et al., 2016).

Scale is such a taken-for-granted category in how we think about organizational and management issues that we rarely question or critically reflect on the concept itself. Thus, the first aim of this paper is to identify scale as an important category in how we make sense of, theorize and respond to grand challenges. For example, scale is embedded in the very definition of grand challenges as "global," "large-scale" and "system-wide" problems (Ferraro et al., 2015; George et al., 2016; Jarzabkowski, Bednarek, Chalkias, & Cacciatori, 2019) and is implicated in discussions about whether grand challenges need to be addressed at the global level through a central authority and transnational agreements (Schüssler, Rüling, & Wittneben, 2014; Wright & Nyberg, 2016) or at the local level through situated experimentation and adaptation (Ferraro et al., 2015). Scale is so deeply embedded in how we think about grand challenges that the local, national and global appear to exist as given and pre-determined ontological realities. This is also consequential for how we design and conduct research on grand challenges, for example, the need for collecting data at multiple levels of analysis (Jarzabkowski et al., 2019).

The second aim of this paper is to problematize this taken-for-granted use of the concept of scale. Scalar categories and hierarchies are not as self-evident and given as they may seem. For example, the idea of small wins (Weick, 1984; Wickert & de Bakker, 2018) suggests that "big" societal issues can be recast as smaller ones (e.g., recasting the global problem of water pollution as cleaning up a local lake). This indicates that scalar categories participate in the construction of the problem rather than being pre-defined. In addition, different accounts of grand challenges construct scale differently. Sometimes the global level is constructed as the most powerful and decisive one; at other times, the local level is seen as more significant to tackling grand challenges because it affords experimentation and local adaptation. Finally, traditional scalar thinking assumes that power and authority are located at the top and from there flow down to impact the bottom, that is, local actions. This thinking can present obstacles to tackling

grand challenges. For example, individuals may feel they can't do anything about "big" problems, small-scale solutions are marginalized because they can't match the global scale of the problem, and global solutions frequently get stuck in trying to satisfy the concerns of all stakeholders.

Against this background, the third aim of this paper is to outline an alternative way of engaging with the concept of scale. In particular, I suggest seeing scale as a category that is socially constructed in practice, that is, as an epistemological frame used by ordinary social actors to apprehend the world. For example, we can investigate how a group of stakeholders involved in strategizing on a grand challenge use the frames of "national" and "city" to make sense of the problems they are facing and to devise solutions to them (Pop & Seidl, 2019). I draw on human geography (Jones, 1998; Marston et al., 2005; Moore, 2008) that has a long history of examining scale as a category itself and uncovering its socially constructed nature. I will show how this approach allows us (1) to see how scalar categories and hierarchies are not fixed, but more flexible and fluid than previously thought; (2) to theorize how scalar categories and hierarchies are implicated in defining problems and solutions to grand challenges and what consequences these constructions have for collective action; and (3) to respond differently by developing "new spatial grammars" (Bulkeley, 2005) and alternative scalar constructions which may help to tackle grand challenges, in new ways. As Cameron and Hicks (2014, p. 60) argue, "bricolage, manouverability and a willingness to take action in the first place are […] only possible when thinking and action are not limited by a hierarchical scalar imaginary."

IDENTIFYING SCALE AS AN IMPORTANT CATEGORY IN RESEARCH ON GRAND CHALLENGES

Scalar categories and hierarchies are implicated in research on grand challenges in four important ways: (1) defining what grand challenges are; (2) responding to grand challenges; (3) taking action on grand challenges; and (4) conducting research on grand challenges. First, scale is used in all definitions of grand challenges, indicating how central the concept is to understanding grand challenges. According to George et al. (2016, p. 1880; emphasis added), grand challenges are "formulations of *global* problems that can be plausibly addressed through coordinated and collaborative effort." They are "barrier(s) that, if removed, would help solve an important societal problem with a high likelihood of *global* impact through *widespread* implementation" (George et al., 2016, p. 1881; emphasis added). At the same time, as a grand challenge plays out globally, it comprises a set of nested local challenges within and across organizations (Jarzabkowski et al., 2019). For example, inequality is a global problem that manifests locally in a variety of different ways (Mair, Wolf, & Seelos, 2016; Tilly, 1998). Climate change is a global challenge, but also a local problem in the flooding of rivers and coastal regions, wild fires and droughts. Thus, as Krauss (2012, p. 150) puts it, "climate change is simultaneously constructed as a universal and localized as a

particular." This indicates that grand challenges play out at multiple levels of scale, ranging from global to local.

In the above description, scale is primarily used as a vertical measure in terms of levels (Marston et al., 2005). The vertical measure implies a hierarchical ordering of geographic or jurisdictional space, ranging from localities and municipalities, to regions and departments, to nations and the international global community. Scale can also be used as a "a horizontal measure of 'scope' or 'extensiveness'" (Marston et al., 2005, p. 420), for example, describing grand challenges as "*system-wide* problems that extend beyond the boundaries of a *single* organization or community" (Jarzabkowski et al., 2019, p. 121) and as *large-scale* problems that affect many people and communities. Most research – and here research on grand challenges is no exception – does not clearly distinguish between vertical and horizontal measures of scale (Marston et al., 2005).

What is important is that both vertical and horizontal measures of scale imply nested levels and a hierarchical ordering of the relations between levels. Levels are nested in terms of a linear progression from local, regional, national to global and from small to large. The hierarchical ordering often implies that the global level is at the top and the local at the bottom, as "as if society really had a top and a bottom" (Latour, 1996, p. 371). For organization and management research this has meant that studies of local phenomena have been accused of "micro-isolationism" (Seidl & Whittington, 2014) and of little relevance outside academic circles, while studies of macro-level dynamics and processes are accused of lacking practical relevance. The micro/macro debate seems to be at an impasse. In addition, traditional scalar thinking assumes that top levels are endowed with more authority and decision-making power than lower levels. Similarly, changes on the large-scale are seen as more powerful and important than on the small-scale because they impact a greater number of people, communities and geographies.

These scalar categories and their assumptions are central in discussions of how to respond to grand challenges. In particular, there is disagreement about what is the most appropriate level at which to tackle grand challenges. Some argue that because of their scale, grand challenges need to be tackled on the global level by means of a central authority (e.g., Wright & Nyberg, 2016), meta-organization (e.g., Berkowitz & Grothe-Hammer, 2021, this volume) or transnational agreements (e.g., Schüssler et al., 2014). For example, Wright and Nyberg (2016, p. 1656) argue that "meaningfully responding to many of the grand challenges facing the world requires systemic intervention based around central authority." Similarly, Schüssler et al. (2014) describe the importance of field-configuring events, such as the United Nations (UN) Climate conference, in transnational policy-making on climate change. In contrast, others argue that because grand challenges are so complex, attempts at solving them at the global level paralyze people (Weick, 1984), create problems of the commons (Olson, 1965; Ostrom, 1990), prevent effective collaboration (Bowen, Bansal, & Slawinski, 2018), and make it impossible to identify in advance how to best proceed (Ferraro et al., 2015). Distributed actions at the local level are thus seen as more effective because they enable small wins, rapid experimentation,

learning and adaptation, and sensitivity to local contexts. For example, Ferraro et al. (2015) describe how in the United States in the absence of top-down commitment, there have been numerous "bottom up" state and regional policy initiatives to reduce greenhouse gas (GHG) emissions. Similarly, Calderon (2017) shows how across the world local communities, cities, firms and regions have taken action to address climate change. Recognizing the importance of both global efforts and local actions, Ostrom (2012, p. 353) argues for "polycentric systems" where actors at various levels take action. In this context, multi-stakeholder partnerships try to coordinate actions across multiple scales (Pinkse & Kolk, 2011). For a review of how different forms of organizing address grand challenges, please see Danner-Schröder and Kaufmann (2021, this volume).

Scale is also important when participants take action on grand challenges. In particular, two processes, that is, scaling down and scaling up, stand out. Scaling down or localizing refers to moving down from higher levels to lower levels, that is, from the global challenge to local problems and/or local solutions. For example, Krauss (2012) describes how climate scientists need to scale down from global climate models to coastal regions of the North Sea to identify the local effects of climate change. Similarly, Wright and Nyberg (2016) describe how Australian firms localize climate change in specific firm practices, for example, by identifying local opportunities to reduce GHG emissions. In this process of scaling down, larger problems are recast as smaller ones for which people can identify tangible solutions that quickly produce visible results – this is what Weick (1984) refers to as small wins. For example, the head of the US Environmental Protection Agency in the 1970s did not attempt to clean up all aspects of the environment, but narrowed "his practical agenda for the first year or two to 'getting started on water pollution'" (Weick, 1984, p. 42). Similarly, Wickert and de Bakker (2018, p. 63) describe how CSR managers proceeded with a series of small wins instead of overwhelming other organizational members with an issue "that is perceived as overly complex and unwieldy and may fill people with anxiety."

In turn, scaling up refers to moving up from lower/smaller levels to higher/larger levels, for example, when local experiments and solutions are turned into large-scale changes. Scaling up has long been an important idea in social entrepreneurship research (e.g., Alvord, Brown, & Letts, 2004; Perrini, Vurro, & Costanzo, 2010). Seelos and Mair (2017), for example, emphasize that if social enterprises want to achieve impact, they need to prepare for and engage in scaling up. The authors examine the efforts of the NGO Gram Vikas that started out with a water and sanitation program in a few villages in rural India and then scaled up to 1,140 villages (Mair et al., 2016; Seelos & Mair, 2017). Here, scaling up refers to providing effective solutions to more people. In turn, Ferraro et al. (2015) identify a slightly different way of scaling up. They suggest that through distributed experimentation "different prototypical solutions [emerge and can be combined] in ways that complement their differential strengths and weaknesses" (Ferraro et al., 2015, p. 378). Another important means of scaling up are additional stakeholders that bring with them additional knowledge and resources to pursue larger successes (Ferraro et al., 2015; Weick, 1984). In order to scale up faster, Porter, Tuertscher, and Huysman et al. (2020, p. 277) suggest that engaging

other stakeholders that operate at different scales can be useful to "building upon local knowledge and developing global solutions."

Lastly, scale is also a key concept in conducting research on grand challenges. Some argue that the fact that grand challenges operate at multiple scales is an opportunity because this means scholars can study a grand challenge at every scale – from the individual, to the firm, to the inter-organizational and even transnational scale (Howard-Grenville, Buckle, Hoskins, & George, 2014). Others highlight that scale can also perplex scholars – as Krauss (2012) puts it, how to localize climate change in specific instances, while at the same time keeping a hold of the "bigger picture"? To deal with this conundrum, Jarzabkowski et al. (2019) suggest two strategies for studying grand challenges: (1) collecting data from multiple stakeholders and multiple sites – this allows the "local immersion into specific manifestations of the problem while also looking at global variation" (Jarzabkowski et al., 2019, p. 122), and (2) using zooming in and zooming out (Nicolini, 2009) as an analytical technique to shift between local contexts and the wider systemic nature of the grand challenge. These methodological techniques then may also help in better theorizing the connection between different levels of analysis (Cloutier & Langley, 2020).

PROBLEMATIZING SCALE

Existing research on grand challenges takes scale for-granted by assuming that local, regional, national, and global "exist" as fundamental ontological realities. However, the current literature already indicates that scale may not be as self-evident as it seems. For example, Latour (1983) describes how scientists reverse the scale of a problem, that is, they transform the large-scale or macro-problem of anthrax disease – a common disease of livestock in the nineteenth century – to small-scale experiments in the lab. Similarly, the idea that "big" problems can be recast as smaller ones (Weick, 1984; Wickert & de Bakker, 2018) and that different accounts of grand challenges appear to construct scalar categories differently indicates that scale is not as fixed and pre-determined as previously thought.

Moreover, traditional scalar thinking significantly limits our ability to tackle grand challenges. Assumptions about authority and power flowing from the top to the bottom can present obstacles and barriers to effectively tackling grand challenges (Cameron & Hicks, 2014). For example, individuals may take no action at all, assuming that their local actions can't do anything about the global problem and thereby emotionally detaching from the problem (Gatzweiler, Frey-Heger, & Ronzani, 2021, this volume). In this way, scalar assumptions disempower individuals and local communities. Similarly, local solutions may be marginalized and neglected because they cannot match the global scale of the problem. At the same time, negotiations at the global level often stall and achieve little impact because of the impossibility to satisfy the interests and concerns of all stakeholders; yet, a global solution is often seen as the only way to cope with a global challenge, such as climate change (Ostrom, 2012). In other words, both local and global efforts can easily get stuck because of traditional scalar thinking.

Traditional scalar assumptions also lead to defining "impact" in rather narrow terms. Greater impact is typically associated with "global initiatives" (compared to "local initiatives") and being able to scale up (Seelos & Mair, 2017). Assumptions such as these may thus "act as a brake on political possibilities" (Cameron & Hicks, 2014, p. 57) because they prevent a willingness to take action in the first place and they are blind to openings and possibilities outside traditional scalar thinking.

OFFERING AN ALTERNATIVE: SCALE AS SOCIALLY CONSTRUCTED IN PRACTICE

An alternative way of engaging scale is to see it as an epistemological concept that participants use to make sense of and respond to grand challenges. Such an approach can be found in human geography that has a long-established interest and tradition in examining "the processes of scale-making, rescaling and the politics of scale" (Moore, 2008, p. 204). In the 1980s, human geographers started to examine how "scales are not preexisting, stable structures of the social world but they are instead socially constructed" (Papanastasiou, 2017a, p. 41). As a result of this research, various scholars have called for examining scale as an epistemological frame that is deployed by ordinary social actors as a way of apprehending and knowing the world (Jones, 1998; Moore, 2008; Papanastasiou, 2017a, 2019). They argue that by taking scale for granted, academics have turned what used to be an epistemological concept in everyday practice into an ontological concept that is seen as a fundamental feature of our social world (Jones, 1998; Moore, 2008).

In research on grand challenges, the article by Bowen et al. (2018) illustrates how scale may turn from an epistemological frame in practice to an ontological feature of the world. The authors analyze how a consortium of 12 Canadian oil sand companies address three environmental issues: tailing ponds, water pollution and fresh-water usage, and GHG emissions. In the research setting, these issues were referred to as local, regional and global issues, respectively. Bowen et al. (2018) assume that these scales are an ontological feature of the issue, given and pre-determined. Thus, they theorize that the scale of the environmental issue influenced the effectiveness of the organizing rules that the consortium used and thereby shaped how the companies were able to respond to these issues. In particular, they find that the organizing "rules were more effective for smaller scale issues than larger scale ones" (Bowen et al., 2018, p. 1428) and that "issues of different scale alter the balance between collaboration and competition" (Bowen et al., 2018, p. 1426). In their account, Bowen et al. (2018) thus use scale as the independent variable to explain outcomes of collective action (the dependent variable).

In turn, examining how scale was used as an epistemological frame in the negotiations of the consortium might have revealed a different picture. Instead of a priori assuming that these environmental issues were inherently local, regional and global, the authors could have looked at how the companies used the concepts of local, regional and global to make sense of the issues they were facing.

For example, the author's empirical account suggests that the water issue *became framed* as a regional issue because scientists emphasized that three regional river basins were affected by water pollution and water usage and "critics saw the water issue as regional without clearly demarcated boundaries" (Bowen et al., 2018, p. 1422). Yet, this construction of water as a regional issue was not at all given. As the informants of the research argued "water is an area that you deal with everywhere in the world. You deal with it around the globe" (Bowen et al., 2018, p. 1423). Thus, water could have also easily been constructed as a global issue and therefore seen as more difficult to tackle. Similarly, the informants of Bowen et al. (2018) saw GHG emissions as a global issue and hence found it difficult to tackle. In contrast, there are many examples in which GHG emissions become seen as a local or regional issue that needs to be addressed by local or regional initiatives. Examining how the companies used local, regional and global as scalar categories in their negotiations may have led to the opposite conclusion, that is, that scalar constructions are the *outcome* of competitive and collaborate dynamics rather than the *antecedents* to these. Rather than arguing that scale alters the balance between collaboration and competition, we might see how the balance between collaboration and competition on particular issues shapes scalar constructions.

The study by Mair et al. (2016) on inequality helps to further demonstrate the importance of scale in defining problems and solutions to grand challenges. The authors studied inequality in villages in rural India where patterns of inequality are deeply entrenched and shaped by the caste system, class and gender. Mair et al. (2016) produce very useful insights about how to tackle inequality, but they do not examine the use of scale in this process.

A closer reading of their study, however, reveals that the construction of the village as a central level for taking action was key to enabling this process. In rural India, access to water and sanitation is typically controlled by individual households, in particular the powerful elites in the village. In turn, the water and sanitation program that the NGO Gram Vikas proposed involved a "100% inclusion" rule that required all households in the village to participate in the program. Initially, there was resistance to this rule, but Gram Vikas was able to convince local leaders to participate in the program by showing them that their wish for pure and clean water could only be fulfilled if all households in the village had access to proper sanitation and clean water (Mair et al., 2016, p. 2033). In this way, they constructed the water and sanitation issue as a village-level problem that can only be solved by a village-wide solution that cut across all social, religious and economic groups. The new scalar category was further institutionalized through forming a Village General Body that served as a basis for organizing meetings and making decisions. It also enabled villages to access resources and funds at higher levels, such as the government level. Thus, while inequality is often seen as a system-wide problem (Mair et al., 2016; Tilly, 1998), here the construction of the village as an important level for authority and decision-making enabled transforming deeply entrenched patterns of inequality.

The study by Pop and Seidl (2019) indicates that scale as an epistemological frame is not only an important device in how participants make sense of grand challenges, but also that there is flexibility in how participants employ scalar terms

and categories. In their study of two Smart City initiatives in Northern Europe, the authors show how "national, local, big city vs small city" (Pop & Seidl, 2019, p. 28) were important frames through which participants made sense of the Open Data approach "which is considered a wicked problem in itself" (Pop & Seidl, 2019, p. 25). For example, in one initiative, participants initially discussed Open Data at the level of the municipality, but at one point a participant shifted to seeing it as national issue: "When we think of open data in the municipalities, we should think it nationwide. So it is the whole country that has to go through the process" (Pop & Seidl, 2019, p. 16). This shift to the national scale was consequential because it meant that instead of working with all municipality data, participants agreed to focus on a few selected data points. As Pop and Seidl (2019) argue, making sense of grand challenges is inherently difficult because neither their full scope nor their detailed nature can ever be fully understood. Thus, scale as an epistemological frame is an important device that participants employ to make sense of problems and develop solutions (other important sensemaking devices for grand challenges include, for example, temporality (see Stjerne, Wenzel, & Svejenova, this volume), metaphors (see Schoeneborn, Vásquez, & Cornelissen, this volume) and values (see Kroeger, Siebold, Günzel-Jensen, Saade, & Heikkilä, 2021, this volume)).

Shifting from scale as a fixed ontological category to scale as an epistemological frame used in practice also reveals that scalar categories and hierarchies may change over time. As the human geographer Jones (1998, p. 26) argues, the

> construction [of scale] is continually contested – in fact, scale is the result of contestation, and how it is resolved at one moment may be quite different from how it is resolved at some later time. Scale is therefore both historically specific and subject to change.

For example, Papanastasiou (2017a) describes how in the context of England's educational policy, scalar categories and their relations changed significantly over time. Initially, individual schools were controlled by and accountable to local authorities such as city councils, which in turn were accountable to the central government. In 2000, England's government introduced a new policy that "clos[ed] down failing secondary schools and reopen[ed] them as academies. Academies [...] receive funding directly from central government [...and] have greater individual autonomy, becom[ing] free from local authority 'control'" (Papanastasiou, 2017a, pp. 45–46). Thus, the new policy endowed the individual school level with greater power and autonomy vis-à-vis the local authority level and it changed the relation to the national level. However, the Northwestern City Council (a pseudonym), that Papanastasiou (2017a) studied, again changed scalar categories and hierarchies when they implemented the policy. In particular, the local authorities deliberately dissolved the boundaries of scale between the individual school and the local city authority, constructing it as one composite rather than different levels. In doing so, they also constructed the local authority as the most important level of authority and decision-making and the national scale as distant and disconnected. Thus, within a short time frame, scalar categories and hierarchies changed significantly through struggles over educational policy.

Investigating how scale is used as an epistemological frame in practice reveals how alternative scalar constructions outside traditional scalar thinking are

possible. For example, in Papanastasiou (2017a), constructing the local authority level as the most powerful and important level is directly opposed to the scalar hierarchy that is commonly taken-for-granted. In a similar vein, Cameron and Hicks (2014) provide an example where the organizers of a large renewable energy project in Australia overcame the obstacles created by traditional scalar thinking by constructing alternative scalar relations: The organizers encountered a major impediment when they were not able to secure government funding. According to traditional scalar thinking, this obstacle would have put an end to their initiative because large infrastructure projects should be funded by government-level funds. However, the organizers were able to reimagine their strategy by reconceptualizing the relations with local individual households: they decided to collect all necessary funds through a vast number of local members.

By not taking scalar categories and hierarchies for granted, we are able to see "countless alternate political possibilities and actualities [that] transpire beneath the radar" (Woodward, Jones, & Marston, 2010, p. 272). For example, it becomes possible that a 15-year-old Swedish girl, Greta Thunberg, actively criticizes government and world leaders for their failure to take action on climate change – something that according to the traditional scalar hierarchy is not possible. It also becomes possible that in Switzerland a group of retired senior women sues the Swiss government for not taking sufficient action to prevent climate change. If we look closely, we are likely to see many more examples of sidestepping traditional scalar thinking.

Examining scale as socially constructed in practice also help us to reimagine what "impact" may mean in tackling grand challenges. For example, Cameron and Hicks (2014, p. 61) suggest that "impact scale can also operate outside of a scalar hierarchy." They show that impact can also be achieved by a multiplicity and diversity of disparate and disconnected actions, what they refer to as "a geography of ubiquity" (Cameron & Hicks, 2014, p. 62). These small-scale endeavors tackle climate change in localized ways, but through their ubiquity they build a significant response. Here, impact is not achieved through "scaling up" but through "multiplying" and "broadcasting," such as, inspiring others by writing and talking about a local model of tackling climate change. In other words, impact is not achieved by coordinating and accumulating actions into a larger-scale solution but by initiating and fostering disparate and disconnected actions. If we want to understand how organizations can make a difference in tackling grand challenges we also need to see and develop a language for generating impact beyond traditional scalar thinking.

Taken together, the previous examples suggest that considering scale as socially constructed in practice has the potential to contribute to research on grand challenges in three ways: (1) It allows us to *see differently* because it shows that scale in grand challenges is not fixed and pre-determined, but more flexible and fluid than previously thought (e.g., Papanastasiou, 2017a, 2017b; Pop & Seidl, 2019). (2) It allows us to *theorize differently* because instead of using scale as the independent variable to explain grand challenges with, we can begin to uncover how scalar categories, their construction and use are implicated in defining problems and devising solutions to grand challenges (e.g., Mair et al., 2016). (3) And it allows us

to *respond differently* because we can take actions that sidestep traditional scalar thinking and we can reimagine how to achieve impact in tackling grand challenges (e.g., Cameron & Hicks, 2014).

METHODOLOGICAL CONSIDERATIONS

Seeing scale as an epistemological concept in everyday practices directs our attention to how scale shapes the way we see, know, think and act in the world. We can ask how issues, people, places, events, actions and social relationships get classified in scalar terms (e.g., as global, local, regional, etc.) and what are the consequences of such classifications. This requires that the researcher put aside their own a priori assumptions about whether something is small- or large-scale, micro and macro, and instead attend to the way participants use scalar concepts in practice. Actor-network theory exemplifies such an approach. As Latour (1996, p. 371) argues, actor-network theory

> is ideally suited to follow the change of scales, since it does not require the analyst to partition her world with any a priori scale. The scale, that is, the type, number and topography of connections, is left to the actors [i.e., the participants] themselves.

If researchers want to understand how participants employ scalar categories in their work, they need to get close to this work through, for example, case studies, interviews or ethnography. For example, Papanastasiou (2017a) employs a case study approach to study England's educational policy and to analyze how participants use scalar categories and arguments in their policy work. She describes how she

> did not identify and code "national scale" by exclusively considering any instance that her informants uttered the word "national." Instead, [her] analysis took an interpretive approach to understand the "national" as being associated [… with] a range of categories and concepts. "Central Government," "the Department for Education" and "National Inspectors" are all examples of categories and institutions which actors use[d] when they refer[ed] to their conception of a national scale. (Papanastasiou, 2017a, p. 47)

Concepts and categories were grouped together or distinguished from each other (e.g., the individual school, the local authority and the national government) when the use of these concepts and categories indicated that they occupied similar positions in a scalar hierarchy that people invoked in their everyday practice.

Scholars may also investigate the scalar constructions inside the firm that are implicated in tackling grand challenges. Many companies have a corporate level at which strategies are developed, but these then need to be translated to specific practices within business units and regional offices. For example, Wright and Nyberg (2016) describe how some companies establish carbon councils at the business unit level, while others introduce centralized sustainability teams at the corporate level that provide knowledge and expertise to other units in the company. Thus, we can expect that organizational members also use scalar categories, such as business units, corporate level or department level, in their efforts to tackle issues related to grand challenges.

Finally, letting go of scale as an ontological fixed category also means that instead of collecting data at different levels of analysis or investigating the interactions between different levels, scholars direct their attention to the relationships and interactions among different "sites" without presuming that the world is structured and organized in a scalar hierarchy. For example, Cameron and Hicks (2014) studied the relations between and interactions of the Australian renewable energy initiative with multiple other sites by "put[ing] to one side the assumptions about flows of power and influence that characterize scalar thinking" and instead "explore[ing] the site-specific relationships that comprise several grassroots renewable energy initiatives" (Cameron & Hicks, 2014, p. 58).

A RESEARCH AGENDA: SCALE AS AN EPISTEMOLOGICAL CATEGORY IN TACKLING GRAND CHALLENGES

Managers, employees and other stakeholders in organizations use scale as an epistemology frame to apprehend the world. I have argued here that by studying how practitioners employ scale to make sense of, construct and respond to grand challenges, we can see differently, theorize differently and respond differently to grand challenges. It also allows us to ask new questions of grand challenges. In particular, I highlight three areas that are particularly promising: (1) how scale shapes the construction and response to grand challenges; (2) how scalar categories and hierarchies may change over time; and (3) alternative constructions of scale that help to overcome the limits of traditional scalar thinking. Table 1 summarizes the differences between seeing scale as an ontological feature of the world and seeing it as socially constructed in practice.

1. How Scale Shapes the Construction of and Response to Grand Challenges?

The starting point for this paper was the observation that scale plays an important role in describing grand challenges, in identifying possible ways to solve grand challenges and in accomplishing change. Yet, scale is not a fixed, pre-determined category but becomes defined through the interactions of various actors. As a result, in practice, scale can be used in more flexible and fluid ways than previously thought. Future research can thus investigate how practitioners use scalar categories and hierarchies to frame problems and to design and implement solutions. What strategies do they employ to make sense of grand challenges in scalar terms? How are scalar categories and hierarchies shaped by the interests and concerns of specific actors?

In addition, Fraser (2010) and Papanastasiou (2017b, 2019) draw attention to the skills, efforts, and innovations involved in constructing scale, what they refer to as "scalecraft." Thus, we can examine how practitioners may have more or less expertise and experience in crafting scale. What practices and strategies for employing scale are more successful and which ones are less successful in tackling issues? Lastly, scalar categories and hierarchies are also often built into

Table 1. Scale in Research on Grand Challenges.

	Scale as an Ontological Feature of the World	Scale as Socially Constructed in Practice
Conceptualization of scale	• The scale of issues is fixed and pre-determined	• Scale as an epistemological category deployed by participants as a way of apprehending and tackling grand challenges • Scale can be used more flexibly and fluidly than previously thought
Research methods	• Collecting data at different levels • Zooming into the local level and zooming out to the global level	• Collecting data on how people construct, employ, maintain and alter scalar categories in their everyday work • Study relationships and interactions between different sites without presuming that the world is structured and organized in a scalar hierarchy
Theorizing	• Use scale (as independent variable) to describe and explain grand challenges with • Reinforce traditional scalar categories and hierarchies, for example, global at the top and local at the bottom	• Explain scalar categories and hierarchies as outcomes of struggles to tackle grand challenges • Identify alternative scalar constructions
Research questions	*Developing solutions for grand challenges* • What is the appropriate level at which to take action to tackle grand challenges? • How to localize global problems in corporate practices and concrete actions? *Collaboration across scales* • How do problems change as they are translated across levels? • How can actors operating on different levels of scale collaborate and coordinate their actions? *Achieving impact* • How do actions at the local level connect to changes on the global level? • How are local solutions scaled up for large-scale change?	*How scale shapes the construction of and response to grand challenges* • How is scale implicated in the construction or definition of a grand challenge? How is it implicated in designing a solution? • How are scalar categories and hierarchies built into technologies, models and measurement tools? What is the consequence for how practitioners tackle grand challenges? *The enactment of scalar categories and hierarchies over time* • How do scalar categories and hierarchies change over time as participants take action on grand challenge? • Are there rhythms, jumps or returns as scalar constructions change over time? *Alternative constructions of scale* • How do practitioners overcome obstacles and barriers created by traditional scalar thinking? • What alternative scalar constructions and hierarchies emerge that do not follow the traditional scalar constructions?

technologies, models and measurement tools, such as global models of climate change, local models of extreme weather events and so forth. How is scale built into these models and measurement tools? And what is the consequence for how people engage with grand challenges?

2. The Enactment of Scalar Categories and Hierarchies Over Time

Once we shift to seeing scale as an epistemological frame employed in practice, it becomes apparent that scalar categories and hierarchies are also subject to change over time. As Jones (1998, p. 26) pointed out, how scale "is resolved at one moment may be quite different from how it is resolved at some later time." Thus, we can ask: How do scalar categories and hierarchies change over time as participants take action on a grand challenge? For example, both Wright and Nyberg (2016) and Grodal and O'Mahony (2017) identify a process of translation through which ambitious goals and strategies for grand challenges are translated into action in terms of specific corporate practices and inter-organizational initiatives. Grodal and O'Mahony (2017) show that when scientists took action to tackle the grand challenge of molecular manufacturing, gradually the ambitious goals were replaced by more short-term projects and initiatives. These processes of translating goals and strategies into action and taking action over time can involve not only redefining problems and solutions, but also redefining the scalar categories and their relations themselves, as the example by Papanastasiou (2017a) above showed. In addition, there may be patterns and rhythms in how issues, actors and actions are scaled, rescaled and rehierarchised over time. Identifying these patterns may be useful in understanding how responses to grand challenges unfold over time.

3. Alternative Constructions of Scale

A very promising area for research is investigating alternative scalar constructions that defy the assumptions of traditional scalar thinking. By uncovering alternative scalar categories and relations, management research can contribute to identifying opportunities and possibilities for overcoming obstacles and barriers that are created by traditional scalar thinking. For example, Bulkeley (2005) investigates a transnational municipal network that challenges accounts of environmental governance along a traditional scalar hierarchy from the municipality to the state and international regimes. She explores a "new spatial grammar" (Bulkeley, 2005, p. 875) that such networks employ.

Management scholars have started to explore new forms of organizing, such as crowdsourcing (Brunswicker, Bilgram, & Fueller, 2017; Porter et al., 2020), that are increasingly used to encourage collaborative problem-solving on societal issues; yet, the implications for scalar constructions in such forms of organizing has not yet been explored. For example, it appears that crowdsourcing initiatives sidestep the traditional scalar hierarchy by connecting individuals and participants from different organizations, irrespective of the level at which they ostensibly operate. Porter et al. (2020) describe how a crowdsourcing initiative connected individuals, entrepreneurs, small, medium and large private firms, governmental institutions, NGOs, and industry associations. Such initiatives are likely to

create different kinds of connections, knowledge and solutions than other forms of organizing, such as the UN Climate conference where traditional scalar hierarchies in terms of international agreements, nation states, and other organizations still play a greater role. Thus, future research can explore how new forms of organizing (Danner-Schroeder & Kaufmann, 2021, this volume) create alternative scalar constructions and how this impacts taking action on grand challenges.

CONCLUSION

If the aim of management research is to contribute to a better understanding of grand challenges and how these problems can be tackled, then shifting from taking scale for granted to how it is constructed, employed and altered in practice can reveal new and important insights. Making this shift entails three important moves: (1) recognizing that scalar categories and relations are socially and materially constructed in action and interaction; (2) being sensitive to how scalar categories and relations change over time; and (3) being open for alternative scalar constructions that defy the assumptions of traditional scalar thinking. These three moves allow management scholars to adopt a more reflective and critical stance toward scale.

As numerous scholars have pointed out (Cameron & Hicks, 2014; Law & Urry, 2004), social research is a generative and performative practice. For example, Law and Urry (2004, p. 390) argue that "social inquiry and its methods are productive: they (help to) make social realities and social worlds. They do not simply describe the world as it is, but also enact it." This means that by adopting scale as a taken-for-granted ontological category, we are reinforcing the assumptions of traditional scalar categories and hierarchies. Yet, Law and Urry (2004, p. 390) continue, "if social investigation makes worlds, then it can, in some measure, think about the worlds it wants to help to make." Thus, we have a choice in how we want to engage and enact scale. For example, by shifting to identifying and creating alternative constructions of scale we can participate in bringing new realities into being.

ACKNOWLEDGMENTS

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