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Cultivating Metacognition In Each Of Us: Thinking About "Thinking" In Interdisciplinary Disaster Research

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Perspective

Cultivating Metacognition in Each of Us: Thinking About "Thinking" in Interdisciplinary Disaster Research

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Although there is an emerging literature on interdisciplinary disaster research (IDR), one of the overlooked aspects relates to our thinking itself: how to actively think about our thinking—metacognition—while embarking on our interdisciplinary journeys. This article argues that metacognition has an instrumental value both for IDR projects and for individual researchers involved in IDR. For IDR projects, metacognition can help:

(1) overcome disciplinary barriers in IDR by revealing cognitive abilities and inabilities for each team member through identifying what is hindering or enabling individuals and the group to transcend disciplinary boundaries toward true integration across the disciplines;
(2) deal with "wicked" problems that characterize disaster contexts in a more effective and creative manner;
(3) oversee team functioning; and
(4) monitor and evaluate progress toward meeting project goals and objectives.

For individual researchers, metacognition can help them grow intellectually, and understand the fallacies and limitations in their thinking. It can also encourage them to live an authentic and unified life as an individual. The article concludes with guidance on how individual researchers, principal investigators of IDR projects, and institutions such as universities and funding agencies can cultivate metacognition. To our knowledge, this is the first article that introduces metacognition as a tool for enhancing our thinking on IDR.

KEY WORDS: Disaster research; interdisciplinary research; metacognition; team science; thinking

1. INTRODUCTION

How can we improve our thinking in interdisciplinary disaster research (IDR) *without thinking about our thinking*? How can we broaden our very own discipline-based thinking? How can we transcend disciplinary boundaries? In this article, we highlight the importance of *metacognition*, often referred to as thinking about our thinking, in IDR. To our knowledge, this is the first article that introduces metacognition as a tool for researchers and institutions interested in enhancing their thinking in interdisciplinary research on risk, hazards, and disasters.

There is an emerging literature on IDR. This literature emphasizes the importance of conducting interdisciplinary research on disasters in part because disasters are caused by a complex set of geographical, geological or atmospheric, social, economic, political, and cultural factors, and in part because

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dealing with disasters needs to involve diverse stakeholders with a range of interests at different levels of analysis (e.g., individual, group, organizational, community, state, federal, global) (Cutter, 2003; Davidson, 2015; Hogan & Marandola, 2005; Ingham, Hicks, Islam, Manock, & Sappey, 2011). The literature also states that we have not yet achieved the level of interconnectedness that we need across disciplines in disaster research (Davidson, 2015; Faber et al., 2014; Ismail-Zadeh, Cutter, Takeuchi, & Paton, 2017). As noted by Faber et al. (2014), "information and methods are exchanged, but a full integration into a common shared language and system of axioms is missing" (p. 601).

Davidson (2015) attributes the difficulty of moving toward a truly interdisciplinary approach in disasters to two sets of barriers:

(1) *institutional barriers* that tend to reward disciplinary work more than interdisciplinary work, such as universities' policies on publications, hiring, tenure and promotion; and
(2) *disciplinary barriers* that make interdisciplinary work challenging for researchers, such as differences in terminologies, frameworks, and methodologies used in different disciplines.

Several other publications reiterate the importance of these barriers in interdisciplinary research in general (Campbell, 2005; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2005; Reich & Reich, 2006) and in IDR (Faber et al., 2014; Ismail-Zadeh et al., 2017) specifically. There are also *research-context related barriers* that make IDR more difficult compared to interdisciplinary research in nondisaster contexts. The need to collect perishable data urgently in the aftermath of disasters, for instance, runs counter to the often time-intensive nature of interdisciplinary research itself (e.g., for developing a shared language and achieving true integration) (Bracken & Oughton, 2006; Davidson, 2015; Faber et al., 2014).

However, the literature on IDR and on interdisciplinary research is not all pessimistic. Those writing in this area acknowledge that there are also factors that enable IDR. These factors can be *external* ones, such as the "wicked" nature of problems (i.e., ill-defined and unique with no definitive and immediate solutions and no end points) (Rittel & Webber, 1973) we face in disaster contexts that can be better handled with through interdisciplinary perspectives, the availability of funding that requires interdisciplinarity, and new technological developments that facilitate interdisciplinary collaboration in disaster contexts (e.g., between computer scientists and disaster researchers) (Davidson, 2015; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2005). Factors that enable interdisciplinary research can also be *internal* ones, such as intellectual curiosity, the desire for intellectual growth, the desire to conduct meaningful research to solve pressing problems, and aspirations to collaborate with certain researchers or to disseminate research findings (Davidson, 2015; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2005; Siedlok & Hibbert, 2014).

Extant literature also offers guidance on how to overcome some of the barriers that hinder interdisciplinary research. Available guidance focuses on universities, suggesting that they change their reward systems (Davidson, 2015; Petrie, 1976). Other contributions focus on interdisciplinary teams themselves, encouraging team members to develop a shared language (Bracken & Oughton, 2006) and shared meanings (Hardy, 2018), to use a conceptual framework that clearly defines the research styles, theories, and underlying philosophy of knowledge involved in the interdisciplinary project (Khagram et al., 2010), and to develop friendly and collegial relations (Campbell, 2005). Other publications focus on individual researchers, inviting them to acculturate to different disciplines (Reich & Reich, 2006) and to recognize that there are several and equally valuable ways of knowing (i.e., epistemological pluralism) (Miller et al., 2008).

Although there has been real progress in this area, one of the overlooked aspects in IDR literature relates to our thinking itself. How can we actively think about our thinking—metacognition—while embarking on our interdisciplinary journeys? This question drives this article. We argue that metacognition has an instrumental value both for IDR research projects and for individual researchers involved in IDR. For IDR projects, metacognition can help:

(1) overcome disciplinary barriers in IDR by revealing cognitive abilities and inabilities for each team member through identifying what is hindering or enabling individuals and the group to transcend disciplinary boundaries toward true integration across the disciplines;

(2) deal with "wicked" problems that characterize disaster contexts in a more effective and creative manner;
(3) oversee team functioning; and
(4) monitor and evaluate progress toward meeting project goals and objectives.

For individual researchers, metacognition can help them grow intellectually, and understand the fallacies and limitations in their thinking. It can also encourage them to live an authentic and unified life as an individual.

The remainder of the article is structured in three sections. The next section introduces the concept of metacognition. This is followed by a discussion on why metacognition is a useful tool in IDR for research projects and individual researchers. The article concludes with guidance for disaster researchers, principal investigators (PIs) of IDR projects, and institutions, including universities and funding agencies, interested in cultivating or promoting IDR.

2. WHAT IS METACOGNITION?

How we think, reflect on the self, and build self-knowledge and awareness are by no means new topics of inquiry. They have fascinated scholars throughout history, especially philosophers (Cassam, 2014; Dewey, 1991; Gertler, 2010; Schön, 1983). The term metacognition, however, was introduced in the 1970s by Flavell (1976), a developmental psychologist, in the context of young children's learning. Since then, our ability to think about our thinking has captivated scholars from across various disciplines, including education (Hacker, Dunlosky, & Graesser, 1998; Mahdavi, 2014; McGuire, 2015), law (Preston, Stewart, & Moulding, 2014), medicine (Colbert et al., 2014), nursing (Fonteyn & Cahill, 1998), neuroscience (Grimaldi, Lau, & Basso, 2015; Shimamura, 2000), languages (Victori and Lockhart, 1995), and engineering (Lawanto, 2010).

Metacognition is indeed a "somewhat fuzzy" concept, as acknowledged by Flavell (1981) himself. The term's name "derives from" its "cognition about cognition quality" (p. 37). In Flavell's (1976) terms, metacognition is "one's knowledge concerning one's own cognitive processes and products or anything related to them"; and it involves "active monitoring and consequent regulation and orchestration of… [information processing] in relation to the cognitive objects or data on which they bear, usually in the service of some concrete goal or objective" (p. 232). To put it differently, metacognition is like an invisible mentor who is housed in a compartment of our brain. This mentor gathers knowledge about our thinking, looks inside our brain to monitor what our brain is doing or not doing, recognizes the limits of our knowledge, and helps us develop specific strategies to think better.

Flavell's definition highlights three different components of metacognition. The first component relates to metacognitive knowledge: our self-knowledge or beliefs about our thinking abilities or inabilities. According to Flavell (1979), metacognitive knowledge is "not fundamentally different from other knowledge" that we store in our long-term memory and activate deliberately or unintentionally (p. 907). Just like any other knowledge, it may or it may not be accurate and may "fail to be activated when needed" (p. 908). An example of metacognitive knowledge is a researcher's acquired belief that she is a visual learner.

The second component relates to ongoing monitoring and evaluation of our cognitive processes (e.g., our knowledge) to further our learning. It is through this component that we recognize what we know or do not know, whether or not what we know is for what we want to know, and what we need to do to close the gaps in our understanding. As an example, when the same researcher starts to question what types of visuals (e.g., flow charts) better enable her understanding, she is monitoring and evaluating her metacognition.

The third component has to do with action. It is about undertaking concrete strategies, based on our knowledge and ongoing monitoring, to further our thinking. Let us assume, for instance, that the same researcher, based on her metacognitive knowledge and monitoring, is aware that she learns better when she draws a flow chart. After attending a project presentation, if she draws a flow chart of the presentation, she is using metacognitive strategies.

Metacognition does not "take place in a vacuum"; it is "highly influenced by one's goals, motivations, perceptions of ability, attributions, and beliefs, as well as context, such as social and cultural norms" (Mahdavi, 2014, p. 532). Although we have a "privileged" access to our self-knowledge (Gertler, 2010), our metacognition is a product of us as well as of the context within which we are situated. As noted by Fleck (1981, p. 47), the source of one's thinking:

> is not within himself but is to be found in his social environment and in the very social atmosphere he "breathes." His mind is structured, and necessarily so,

> under the influence of this ever-present social environment, and *he cannot think in any other way*. [emphasis in original]

It is also important to note the difference between metacognition and cognition—metacognition is thinking about thinking, whereas cognition is a general term for thinking. In other words, metacognition is a subset of cognition. As expressed by Lories, Dardenne, and Yzerbyt (1998), "metacognition is a fundamental aspect of human cognition. Not only do we have cognitive activities but it would seem that they can apply to themselves: we have cognitions about cognition" (p. 1).

3. WHY DO WE NEED METACOGNITION IN INTERDISCIPLINARY DISASTER RESEARCH?

In this section, we offer examples of various ways that metacognition can help advance IDR. We first explain the potential benefits of metacognition for IDR projects, followed by a discussion of its benefits for individual researchers themselves.

3.1. Benefits of Metacognition for IDR Projects

There are four major areas where we think metacognition can offer benefits for IDR projects. These areas relate to overcoming disciplinary barriers, handling problems in disaster contexts, managing projects, and monitoring and evaluating project outcomes.

3.1.1. Overcoming Disciplinary Barriers

We argue that metacognition can help researchers overcome disciplinary barriers in at least two main ways. First, while metacognition is an internal process and it is mostly about self-reflection on our own thinking processes, it can shed light on the thinking abilities and inabilities of "the other." This quality of metacognition is especially important for IDR teams within which a number of researchers, who belong to different "thought collectives" (Fleck, 1981), need to work together. In his book *Genesis and Development of a Scientific Fact*, Fleck (1981), a microbiologist, introduced the idea of a "thought collective." He defined thought collective as a "*community of persons mutually exchanging ideas or maintaining intellectual interaction*" (p. 39, emphasis in original). He noted that individuals who form these thought collectives cultivate a particular "thought style" as a result of a series of understandings and misunderstandings. Although the members of a particular thought collective (e.g., public administration scholars) understand each other well, they have a harder time understanding the members of another thought collective (e.g., civil engineering scholars). Fleck added, "the individual within the collective is never, or hardly ever, conscious of the prevailing thought style, which almost always exerts an absolutely compulsive force upon his thinking and with which it is not possible to be at variance" (p. 41). We suggest that metacognition of "the other" in IDR projects can help members of the research team see each other's understandings and misunderstandings that are associated with their thought collectives. For instance, if a member of an IDR project team with a public administration background realizes that an engineer in the team misunderstands her use of the term "resilience," then she can ask her colleague what he understands from the term "resilience" and explain what she means by the term "resilience." Such a clarification can help deal with *disciplinary barriers* mentioned earlier (Davidson, 2015).

Second, metacognition can enable researchers to achieve actual interdisciplinarity. By interdisciplinary research, we refer to the definition set forth in a National Academies' report (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2005, p. 2):

> a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.

Davidson (2015) notes that IDR to a large extent remains multidisciplinary, where each researcher (if research is conducted in teams) works on her own piece of research using disciplinary tools she is familiar with, which are put together at the end without true interdisciplinary integration. Using metacognition can encourage us to ask questions such as: "Are we really moving away from our disciplines? Are we crossing any disciplinary boundaries? Are we achieving the interdisciplinary thinking we hoped to achieve? Why or why not?" These questions can be posed throughout the entire research process from formulating the problem to collecting and analyzing the data. They can help us transcend the disciplinary

boundaries, and create new, integrated perspectives in the context of disasters.

3.1.2. Addressing Problems in Disaster Contexts in Creative Ways

Existing literature demonstrates a close link between metacognition and problem solving (Davidson, Deuser, & Sternberg, 1994; Hargrove & Nietfeld, 2015; Jaušovec, 1994; Preston et al., 2014; Swanson, 1992). Jaušovec's (1994) study, for instance, found that college students solved problems in a more proficient manner when they used more sophisticated metacognitive skills and monitored their own performance. Having better problem-solving skills is especially important for IDR given the *wicked* nature of problems (Rittel & Webber, 1973) research teams face throughout disaster preparedness, response, recovery, and mitigation phases. For instance, in the aftermath of Hurricane Katrina, there was debate about whether all areas of New Orleans should be rebuilt. Different stakeholders viewed the problem from different perspectives. Some saw it through the lens of geographical vulnerability of areas in floodplains while others saw it through the lens of the social, economic, and political vulnerability of affected populations. Still others viewed the rebuilding decisions through the perspective of history and as a racialized issue, through corporate interests and from the perspective of the oil and gas industry, or through the perspective of culture and the arts. In turn, proposed solutions to the "New Orleans problem" depended on how this wide range of actors defined the problem and at what level (e.g., individual, household, and community level). We offer this as an example because we believe that if members of an associated IDR project were to use metacognition, they could be more effective in defining such a wicked problem. Although they may not be able to solve the problem, *per se*, they would enhance their potential to tackle the problem and would more clearly see their inabilities and abilities in the process.

Furthermore, metacognition can introduce creativity into IDR projects. In fact, a growing literature suggests a close link between metacognition and creativity (Armbruster, 1989; Crotty & Brett, 2012; Feldhusen & Goh, 1995; Hargrove, 2013; Hargrove & Nietfeld, 2015; Pesut, 1990). Feldhusen and Goh (1995) presented metacognitive skills as "crucial elements of creative thinking and production" (p. 243). Jaušovec's (1994) study found that college students with more sophisticated metacognitive skills not only performed better in problem solving in general, but also were better in solving open-ended, creative problems. In another study on college students, Hargrove (2013) observed that students who were introduced to metacognitive skills in their freshman year finished their degrees with higher levels of creative thinking than their peers. Similarly, an emphasis on metacognition in IDR research can help us come up with more creative solutions to the "wicked" problems we study. For instance, while trying to measure repopulation levels after a disaster, if a group of researchers rely on their metacognition more, they can see the differences in their "thought styles," question their assumptions, work with "the other" to correct misunderstandings, appreciate perspectives of "the other," and have a more open and creative mind for measuring repopulation.

3.1.3. Managing Projects

Metacognition can help teams understand how individuals function as a team, identify the aspects where the team is doing well or not well, and explain why this is the case. Once the team understands its strengths and weaknesses and identifies the driving reasons, it can take concrete steps to build on the team's strengths and address its weaknesses. For instance, if the PI of a newly formed IDR team on sea level rise notices that members of his team do not trust one another yet, he can arrange fieldtrips to areas that will be affected by this problem the most. These fieldtrips can help promote a stronger bond between team members.

3.1.4. Monitoring and Evaluating Projects

Metacognition can allow IDR teams to actively monitor and evaluate their progress toward meeting the goals and objectives of their research project. Although IDR projects may have clearly defined goals and objectives, the teams may overlook them until project reports to the sponsoring agencies are due. If team members are able to engage in metacognition prior to and while they are undertaking the project, however, they may have a better chance of meeting their goals and objectives. They may be more reflective in terms of seeing how far they are from meeting their project goals and objectives, identifying why they have made the progress they have made to date, and introducing and implementing tools and

strategies to meet their disaster focused goals and objectives.

3.2. Benefits for Individual Researchers

Metacognition's importance for individual researchers involved in IDR pertains to intellectual growth, fallacies in and limitations of thinking, authentic life, and unified life. Each is discussed, in turn, below.

3.2.1. Intellectual Growth

The ability to recognize what we know and what we do not know, how and why we learn, and how we can learn better is essential for intellectual growth. For intellectual growth, however, one needs to hold a "growth" mindset (Dweck, 2006). According to Dweck (2006), there are two basic mindsets about intelligence: a "fixed" mindset and a "growth" mindset. Those who have a fixed mindset believe that their intelligence is predetermined and they cannot do much about it. If a researcher believes, for instance, that she is not good at numbers and will never be good at statistics, then she has a fixed mindset. Those who have a growth mindset, however, think that intelligence can grow through deliberate action. If a disaster recovery researcher uses her metacognitive knowledge that she is not good at numbers and starts auditing statistics classes to be able to join an IDR team that will be measuring recovery quantitatively, then she has a growth mindset. In other words, metacognition, combined with a growth mindset, can enable disaster researchers to recognize, embrace, and overcome intellectual challenges.

3.2.2. Fallacies and Limitations of Thinking

Over the past several years, numerous books (Ariely, 2010; Dobelli, 2013; Gladwell, 2005; Kahneman & Egan, 2011) have been published that highlight that we make simple yet predictable mistakes in our thinking—experts and novices included. As put by Dan Ariely (2010), human beings are "predictably irrational." These books note that mistakes in our thinking are avoidable and that we can make better decisions once we are aware of these mistakes. One could argue that, as individual researchers, we might make these mistakes even more so in postdisaster contexts as our interdisciplinary team feels the pressure to collect perishable data rapidly! Being prone to these mistakes does not, however, mean that we lack the capacity to know what our cognitive fallacies are, and how we can to spot and overcome them. This is where metacognition comes into play.

3.2.3. An Authentic Life

Cassam (2014) defines authenticity as being "true to yourself" (p. 216) and adds that "you can't be true to yourself unless you know yourself" (p. 211). In his words, self-knowledge is "indispensable for authenticity" (p. 216). As a form of self-knowledge, metacognition can help individual researchers think and act in ways that reflect their values or positions. If an individual working on a postdisaster relocation research project believes in speaking up for the marginalized, yet agrees with his team members to collect data only from upper-income groups on their relocation choices, he is not being true to himself. Metacognition can help him understand whether or not his thinking, values, and actions are aligned and actually reflect who he really is.

3.2.4. A Unified Life

According to Cassam (2014), a unified life is one "whose various elements fit together in a rationally and morally coherent way" (p. 211), and "your self-knowledge can regulate your life and maintain its coherence and unity by making it clear to you when a proposed course of action doesn't mesh with your values, projects, or other elements of your life" (p. 220). In that sense, individual researchers' self-knowledge about their thinking abilities can steer them toward unity. Let us assume that an individual researcher's team is proposing to rely more on renewable energy sources to help deal with climate change while the researcher uses coal to heat up her residence. If the researcher relies on her metacognition, she can realize that her personal choice for heating up her residence conflicts with her teams' professional recommendations and may switch to using solar panels toward achieving unity between her professional and personal life.

4. CONCLUDING REMARKS: CULTIVATING METACOGNITION

In this article, we established the collective and individual importance of metacognition for IDR projects and individual researchers, respectively. Although some earlier literature in this area emphasizes the importance of developing a "capacity for

self-assessment" (Reich & Reich, 2006, p. 51) or internal discussion (Faber et al., 2014) in interdisciplinary projects, this is the first article to link IDR with the concept of metacognition. Most of us indeed engage in metacognition on a daily basis. Yet, "lack of hard evidence notwithstanding," Flavell (1979) was "absolutely convinced that there is, overall, far too little rather than enough or too much cognitive monitoring in this world" (p. 910).

In the context of IDR, we argue that to take full advantage of what metacognition has to offer for our projects and for ourselves, we need to make it more visible in our lives by putting it under a microscope, examining it, and finding ways to activate it more. Only then we will be able to transcend the disciplinary boundaries that have been hard to cross despite our sincere efforts, deal with "wicked" problems in effective and creative ways, and be better equipped to manage, monitor, and evaluate our research projects. Only then can we be empowered intellectually, understand the fallacies in our thinking, and live our lives as individuals with authenticity and unity.

The hard part is to figure out how to build on and enhance our metacognition as we embark on our interdisciplinary journeys. We think there is a role for individual researchers, the PI of research projects, and institutions (universities and funding agencies) to play here. Those of us who are *individual researchers* can conduct an evaluation of who we are as researchers and individuals, what we know or do not know and why, where our cognitive strengths and failings lie, and what we can to do to strengthen our processes prior to, while undertaking, and after the completion of IDR projects. Some of us can develop tools that assess metacognition use among IDR teams. Others can compare interdisciplinary integration between teams that actively engage in metacognition and teams that do not. Still others can study the benefits of metacognition in disaster research that is conducted rapidly (e.g., for NSF grants given only for one year) versus over a longer time period (e.g., three- to five-year grants).

The *PIs* of IDR projects can ensure that there is ongoing thinking about the research team's thinking by creating what may be called "Metacognitive Forums." We think such events should be held at least biannually or annually, and perhaps even more frequently depending on the size and complexity of the team and the project. As part of these forums, team members can assess their own thinking abilities and provide feedback to one another on thinking abilities of "the other." The PIs can ask regularly in project meetings about whether the research team is transcending disciplinary boundaries and what the team can do to reach a state of true "interdisciplinarity." They can monitor and evaluate how individuals function as a team and what progress they have made toward reaching their project goals and objectives and share their findings with project members (e.g., through internal project memos). They can help cultivate metacognitive skills with their teams (e.g., by inviting metacognition experts) and ensure that the team members utilize their metacognitive skills in effective and creative ways in the context of IDR.

As for the institutions, *universities* can provide support to researchers interested in pursuing interdisciplinary research by providing training on metacognition and by ensuring that the next generation of researchers—students—are equipped with metacognitive skills through mentoring. They can support independent consultants or university-based scholars who can conduct metacognitive sessions for research teams. *Funding agencies* can go beyond the context of the subject matter for research and acknowledge the importance of metacognitive skills through incentives (e.g., additional funding) designed for teams that specifically focus on cultivating metacognitive skills among their members. They can provide funding for projects that bring together members of funded IDR teams to reflect on their metacognitive processes. They can support projects that are designed to communicate and convey metacognitive strategies that promote IDR. Furthermore, funding agencies can require that members of interdisciplinary projects share the lessons they learned that enable or hinder an interdisciplinary understanding at the time of annual or final project reporting. They can compile these lessons, anonymize them, and share them publicly with researchers through their websites and publications.

In conclusion, we recognize that these and many other possibilities exist for advancing metacognition in IDR. We realize this is a long list of things to do for all of us who understand and appreciate the importance of metacognition in our interdisciplinary pursuits toward the unknown. This will obviously take commitment, time, effort, and, in some cases, additional resources and perhaps even shifts in power structures. But for now, we suggest a first step: Let us all begin to think about our thinking and what we need to do to cultivate and employ metacognition!

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