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Abstract

"Metacognitive theories," an article Gregg Schraw and I published in *Educational Psychology Review* in 1995, has been cited in over a thousand scholarly publications. In this follow-up, dedicated to Gregg and written after his recent death, I provide a brief overview of our 1995 article and then reflect on it in four ways. First, I consider the development of the concept of metacognition prior to 1995, including its emergence and use in previous writings by each co-author. Then, I turn to the collaboration itself, including the interplay of complementary conceptions and the construction of new ideas. Third, I consider the article's citation history and the role it has played in the subsequent literature. Finally, I discuss research on metacognition since 1995, including subsequent work on epistemic cognition by each of the co-authors.

Keywords: Metacognition, Self-regulation, Epistemic cognition, Metacognitive theories, Collaborative theorizing

In September 2016, I was shocked to learn of the death of Gregg Schraw. Gregg had been my colleague in the University of Nebraska-Lincoln (UNL) Educational Psychology Department from 1990 until

2000, when he moved to the University of Nevada, Las Vegas (UNLV). I had not seen him in years but had been meaning to contact him about the fact that "Metacognitive theories," an article we had co-authored in 1995 (Schraw and Moshman 1995), was on track to reach 1000 citations in the next few months. I thought we might collaborate on some sort of follow-up, reflecting on our earlier collaboration and the role of the resulting article in the literature.

I heard about Gregg's death from Matt McCrudden. Matt subsequently invited me to contribute a brief remembrance to a collection of appreciations he was editing (McCrudden 2016) and also encouraged me to write the longer article I had in mind.

Here, I provide a brief overview of the 1995 article and then reflect on it in four ways. First, I consider the development of the concept of metacognition prior to 1995, including its use in previous separate writings by Gregg and by me. Second, I focus on the collaboration itself, including the interplay of complementary conceptions and the construction of new ideas. Third, I consider the article's citation history, including some analysis of how it was cited over the years. Finally, I consider research on metacognition since 1995, focusing especially on Gregg's subsequent work and some of my own, noting in particular our independent emphasis on epistemic cognition.

I dedicate this article to Gregg and wish we could have written it together.

Overview of "Metacognitive Theories"

Metacognitive theories are defined in the abstract of "Metacognitive theories" as "systematic frameworks used to explain and direct cognition, metacognitive knowledge, and regulatory skills." After a brief introduction, the article proceeds in four parts.

The first part of the article provides a synthesis of the literature on metacognition. This is neither a comprehensive review of empirical findings nor a systematic overview of theoretical controversies or positions. Rather, the aim is to identify and systematize a consensus taxonomy within which theoretical discussion and empirical research can proceed.

A basic distinction is made between "knowledge of cognition" (i.e., "metacognitive knowledge") and "regulation of cognition" (i.e.,

"metacognitive control processes"). Knowledge of cognition "refers to what individuals know about their own cognition or about cognition in general." This consists of *declarative knowledge* (knowing about things), *procedural knowledge* (knowing how to do things), and *conditional knowledge* (knowing why and when). Regulation of cognition "refers to metacognitive activities that help control one's thinking or learning." Three "essential" and widely recognized regulatory skills are *planning* (selection of strategies and allocation of resources), *monitoring* ("on-line awareness of comprehension and task performance"), and *evaluation* ("appraising the products and regulatory processes of one's learning").

The second part of the article introduces the concept of *metacognitive theories*, which are defined as "theories that integrate one's knowledge about cognition and regulation of cognition." That is, a metacognitive theory is "a relatively systematic structure of knowledge that can be used to explain and predict a broad range of cognitive and metacognitive phenomena." Metacognitive theories are "a distinct and important subset of metacognitive knowledge" in that they "integrate a wide range of metacognitive knowledge and experiences" and "permit explanation and prediction of cognitive behavior."

Three types of metacognitive theory are proposed. *Tacit theories* "are those acquired or constructed without any explicit awareness that one possesses a theory." *Informal theories* are to some degree explicit but still fragmentary, with "emerging recognition and control of constructive processes." *Formal theories* are "highly systematized accounts ... involving explicit theoretical structures." The ordering of the three types accurately suggests a developmental sequence, but formal theories are associated less with age than with advanced education and expertise.

The third section "explores in more detail the origins of metacognitive theories." It suggests that "cultural learning, individual construction, and peer interaction all play important roles in the emergence of metacognitive theories" and that "their influence is interactive rather than simply additive." It particularly highlights the role of peer interaction as a "process of social construction that differs in part from both cultural transmission and individual construction."

The final section considers implications for assessment and education. It acknowledges the great challenge of developing "methodologies for detecting and representing people's metacognitive theories."

It argues that although "many effective educational programs" provide students with "metacognitive knowledge and regulatory skills," many "fall short of helping students (a) to understand the structure of theories, and (b) to use theories to systematize self-knowledge and apply that knowledge to self-regulation." After suggesting some potential approaches, the article notes that some degree of metacognitive theorizing is possible "from the time a child enters school regardless of his or her skill level" and concludes that "schools should actively promote metacognitive theorizing among all students."

Metacognition: The Concept and the Term

The concept underlying what we now call "metacognition" is very old and diffuse, with complex and inconsistent terminology. Overlapping concepts include reflection, attribution, perspective taking, and theory of mind (Miller 2012; Tarricone 2011).

John Flavell and Ann Brown are commonly credited with creating the modern terminology and conceptualization of metacognition in the late 1970s. The new trend was noted and consolidated in a classic article by Flavell (1979). Both were cited in our article, as were Deanna Kuhn and Michael Pressley, also major early contributors.

We began our 1995 article with this sentence: "Hardly anyone questions the reality or importance of metacognition." That may seem a bold claim, given that the term "metacognition" had been in use for less than two decades, but I believe it was and remains accurate. The field of metacognition was already growing rapidly and has continued to do so. Pina Tarricone's (2011) *The Taxonomy of Metacognition* documents the extraordinary conceptual scope and complexity of the field, which continues to expand.

Gregg came to Nebraska in 1990, having just completed his Ph.D. in educational psychology. By 1995, he had already established himself as a productive researcher with strong interests in both theory and assessment. He brought both of these interests to his early work on metacognition. One theme of his research was the complex relation of metacognitive knowledge to cognitive self-regulation (Schraw 1994). A related concern was whether self-regulation is to some degree a general skill applicable across domains. Without denying that

metacognition is to some degree domain-specific, Gregg and students provided empirical evidence and theoretical arguments for the existence and importance of a general monitoring skill (Schraw et al. 1995). On the assessment side, Gregg and a student developed an inventory to assess metacognitive awareness (Schraw and Dennison 1994). His collaborations with graduate students were already drawing many to the field of metacognition.

My early work as a developmental psychology graduate student in the 1970s concerned scientific reasoning, which I saw, from a Piagetian perspective, in metacognitive terms, even before that became the standard language. This work led to an invitation from Deanna Kuhn to contribute a chapter to a small volume she was editing entitled, *Intellectual development beyond childhood*. Citing a recent article entitled, "If you want to get ahead, get a theory," which showed that children use theories (to varying extents) to guide empirical inquiry (Karmiloff-Smith and Inhelder 1974–1975), I argued that adolescents (to varying extents) use metatheoretical knowledge to guide their theorizing. I called my chapter, "To *really* get ahead, get a metatheory" (Moshman 1979).

In the 1980s, turning to logical reasoning, I studied the development of fundamental conceptions about the nature of logic, such as validity of inference as a logical property of arguments distinct from the truth of premises and conclusions (Moshman and Franks 1986). Such conceptions, I argued, develop through reflective processes that generate a universal sequence of metalogical stages, each an explicit reconstruction of the logic implicit in the previous stage (Moshman 1990).

In the early 1990s, I turned to more general analyses of reasoning and rationality, including the crucial role of metacognition. Continuing at first to use the term "reasoning" broadly to include automatic processes, I initially proposed the term "metareasoning" to distinguish reasoning that is guided by metacognition (Moshman 1994a). Substantially reconsidering my conceptualization and terminology, however, I soon reconceived reasoning, in contrast to automatic inference, as intrinsically metacognitive (Moshman 1995). This was associated with formulating a constructivist account of rationality as "metasubjective objectivity" (Moshman 1994b). As our collaboration began, I had been working with metacognitive terms and concepts for two decades but had not contributed as directly as Gregg to the mainstream literature on metacognition.

Collaborative Theorizing

Despite our rather different theoretical backgrounds, Gregg and I readily found common ground in our thinking about metacognition. Gregg was much more familiar than I was with the educational psychology literature, which highlighted individual differences, measurement, and the learning of metacognitive skills, but I was in general agreement with his interpretations of that literature. Correspondingly, I was much more familiar with the developmental psychology literature, which highlighted questions of long-term qualitative change in metacognitive knowledge and associated self-regulation, but Gregg was in general agreement with my metacognitive conceptualization of developmental processes and outcomes. After I recommended Robert Campbell and Mark Bickhard's monograph on the reflective construction of developmental stages (Campbell and Bickhard 1986), he said it had the most influence on his thinking of anything he ever read.

Thus, it seemed that we were theoretically compatible but different enough in expertise and theoretical background to complement each other well. Our collaboration on a broad conceptualization of metacognition could be expected to yield a product that was at least the sum of our expertise, and perhaps something more.

The "something more" that provided the basis for the article was our collaborative conceptualization of advanced metacognitive knowledge as metacognitive theories. The conception of knowledge as organized into theories came from the developmental literature, where knowledge is routinely conceptualized as theoretical in nature (Karmiloff-Smith and Inhelder 1974–1975) and concepts such as theory of mind (Miller 2012) have long played a central role. The application of that conception to the rich educational psychology literature on metacognitive knowledge and self-regulation was made possible by Gregg's broad and sophisticated grasp of that literature.

Our collaboration moved slowly at first because we were both busy with other projects and responsibilities. Then, in March 1993, I received a letter from Steve Benton, editor of *Educational Psychology Review*. Having taken responsibility for the young journal after the tragic death of its founding editor John Glover, he was soliciting new contributions. He specifically invited me to plan and edit a special issue on constructivism. I responded in April 1993 that I would prefer

to send Steve the result of the substantial project on metacognition that I was working on with Gregg, whom I described as "my neighbor across the hall." That was fine with Steve, so Gregg and I stepped up the pace of our writing and editing, though it still took many months to complete and submit the manuscript.

It would make this story more interesting if I could report that shortsighted reviewers, in their ignorance and arrogance, failed to see the merit of our work and needlessly complicated the route to publication. Those reviewers, I might have hoped, would see the present article and regret their evil ways. But, actually, the anonymous reviewers for *Educational Psychology Review* were very positive and their suggestions for revision, which we received in June 1994, were entirely reasonable. The revised manuscript was accepted for publication in November 1994, contingent on some final minor revisions, and was published in the final issue of 1995.

Citation History

As of April 2017, according to Google Scholar, "Metacognitive theories" had been cited over 1100 times. Annual figures showed that the citation rate had increased steadily over the years from 4 citations in 1997 (the first year it was cited) to 13 in 2001 to 28 in 2005 to 50 in 2009 to over 100 citations in 2013 and each year since.

Examination of specific citations shows that, since the beginning, the article has been cited not only in journals and books in the field of educational psychology, as would be expected, but also regularly in other areas of psychology, especially cognitive and developmental psychology, and other areas of education, especially science education. Geographically, the article has been cited in nations spanning the globe. About 30% of the citations each year have been in journals or books published in languages other than English. Dozens of languages, most of which I cannot recognize, are represented, with no single language accounting for more than a small proportion of these citations.

"Metacognitive theories" presented itself as a "framework for understanding people's theories about their own cognition." It provided no new data. Its proposal that people have metacognitive theories, far from being a bold new theory, was formulated in a manner inclusive

of earlier theories and research and thus was not controversial. The article was largely a consensus framework for conceptualizing the literature in a way that served as a basis for further research, including further theorizing. It has been commonly cited (often along with other publications such as Flavell 1979) as a taxonomy within which researchers can efficiently place their own research or a source of authoritative definitions and distinctions to get them started in reviewing the literature or providing theoretical interpretations.

Subsequent Research

After the publication of "Metacognitive theories," Gregg and I began work on a potential follow-up, originally entitled "Constructing metacognitive theories." In spring 1996, Deanna Kuhn contacted me about the possibility of organizing a symposium on metacognition for the spring 1997 meeting of the Society for Research in Child Development in Washington, D.C. After I talked with Gregg about that, he took the lead in organizing the symposium, which ultimately included, in addition to Gregg's presentation of our work, presentations by Kuhn, John Flavell, and Michael Pressley, with Robert Campbell as discussant.

Although we continued our work after the SRCD symposium, we never completed a manuscript for submission to a journal. The main problem was the increasing scope, complexity, and theoretical ambition of the project, which expanded to include multiple types of knowledge, levels of knowledge, constructive processes, and educational contexts. Although each of these four dimensions was distinct from the others, they were not entirely orthogonal and the potential interactions increasingly boggled our minds. We worried that our draft manuscript, written mostly by Gregg, was growing beyond what most journals would be willing to publish. I do not recall that we ever made a decision to stop working on this but we each had other demands on our attention.

And so we went our separate ways, academically and geographically. Gregg's work in the late 1990s continued to reflect his general interest and expertise in measurement and his specific concern for improving assessment in the rapidly advancing study of metacognition (Schraw and Impara 2000). In addition, continuing his earlier work

on domain-generality, he and a student also provided substantial further evidence that learners, to varying degrees, use domain-general metacognitive knowledge to monitor their comprehension (Schraw and Nietfeld 1998). And, further, arguing that metacognitive knowledge is multidimensional, domain-general, and teachable, he directly addressed the promotion of metacognition (Schraw 1998).

In 2000, Gregg left for UNLV, where he spent the rest of his highly productive career. He continued to publish on the measurement of metacognition, especially with regard to metacognitive monitoring and calibration (Schraw 2009a, b; Schraw et al. 2013). He also continued his work on the promotion of metacognition in education, including science education (Schraw et al. 2006). Much of his later work concerned epistemological beliefs (more on this below).

Gregg was also the co-author, with Roger Bruning and others, of multiple editions of a highly successful text applying cognitive psychology to education (Bruning et al. 2011). No such text could possibly avoid addressing metacognition, but this one, no doubt reflecting Gregg's influence, provides exceptional coverage throughout of metacognitive awareness and self-regulation, especially in relation to strategic and effective learning. It also includes an entire chapter on the role of students' and teachers' beliefs about matters of intelligence and knowledge.

My work after 1995 continued to focus on the development of reasoning and rationality, especially in adolescence and beyond, and the promotion of such development. Metacognition continued to be central in my conceptions of reasoning, rationality, and developmental progress. My adolescent development text highlighted metacognition throughout. The expanded third edition (Moshman 2011) devoted a chapter to "Metacognition and Epistemic Cognition."

Perhaps the most important trend in the study of metacognition since 1995 has been the extraordinary increase in interest, especially within educational psychology, in advanced forms of metacognition variously referred to as "epistemological beliefs," "personal epistemologies," or "epistemic cognition." I cannot speak for Gregg but I think he would have agreed; his later work focused increasingly on epistemological beliefs and personal epistemologies (Brownlee et al. 2011; Olafson and Schraw 2010; Schraw et al. 2002). Both of us contributed to the 2016 *Handbook of Epistemic Cognition* (Brownlee et al. 2016;

Moshman and Tarricone 2016), which valiantly attempts to capture the rapidly emerging theories, methods, and research findings in this area and to promote further progress.

Gregg's work on epistemic cognition strongly reflected his expertise and ongoing interest in measurement (Olafson and Schraw 2010; Schrawet al. 2002). Substantively, much of his later research concerned the epistemological worldviews of teachers, including individual differences, changes over time, and the relation of such worldviews to teaching practices (Brownlee et al. 2016; Olafson and Schraw 2010).

My own recent work on epistemic cognition has been mostly theoretical, critical, and integrative. As the various strands of epistemological study and discussion proliferated, I became increasingly concerned that the emerging literature was diffuse and incoherent. "Epistemology" and related terms are used so vaguely and variously across diverse theories and research programs that they often provide little more than fancy new ways to talk about metacognition. The main focus of my own work in this area has been to provide a coherent synthesis of its diverse literatures, beginning with a definition of epistemic cognition as "knowledge about matters of epistemology—that is, knowledge about the justification and truth of beliefs" (Moshman 2015).

Conclusion

This article about the article "Metacognitive theories" can be considered "meta" to "metacognitive theories." Although "Meta-metacognitive theories" seems awkward and ambiguous to me, I seriously considered calling this article "Metacognitive metatheories." I liked the sound of that but decided against it because this too seemed ambiguous and perhaps too mysterious or too cute. Gregg might have agreed. Alternatively, he might have liked "metacognitive metatheories," explained what it meant, and convinced me to go with it. Unfortunately, I will never know, unless there is an alternate universe in which he and I write this article together.

Gregg was always a pleasure to work with, as many have noted (McCrudden 2016). He was unfailingly supportive of students and

colleagues and strongly committed to the field of educational psychology. He never doubted that better metacognitive theories are widely attainable and good for everyone. This would have been a better article had he been able to co-author it with me — and much more fun to write.

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