Metacognitive Development

Deanna Kuhn[1]

Teachers College, Columbia University, New York, New York

Abstract

Traditional developmental research in memory and reasoning, as well as current investigations in such disparate areas as theory of mind, epistemological understanding, knowledge acquisition, and problem solving, share the need to invoke a meta-level of cognition in explaining their respective phenomena. The increasingly influential construct of metacognition can be conceptualized in a developmental framework. Young children's dawning awareness of mental functions lies at one end of a developmental progression that eventuates in complex metaknowing capabilities that many adults do not master. During its extended developmental course, metacognition becomes more explicit, powerful, and effective, as it comes to operate increasingly under the individual's conscious control. Enhancing (a) metacognitive awareness of what one believes and how one knows and (b) metastrategic control in application of the strategies that process new information is an important developmental and educational goal.

Keywords

metacognition; development; knowledge acquisition

Metacognition—that is, cognition that reflects on, monitors, or regulates first-order cognition—was characterized by Flavell in 1979 as a "promising new area of investigation" (p. 906). He appears to have been on the right track. The claim that metacognition is "where the action is" in understanding intellectual performance would meet with approval in many (though not all) circles today. If so, what do we need to know about this construct? The answer is, a great many things, but here I focus on two fundamental questions that have lacked clear answers: Where does metacognition come from and what kinds of it are there? In addition, I examine the relation between metacognition and cognition. Do they work together closely, or is the relation a more distant and formal one, akin to that between metaphysics and physics?

The answer I propose to the first question is that metacognition develops. It does not appear abruptly from nowhere as an epiphenomenon in relation to first-order cognition. Instead, metacognition emerges early in life, in forms that are no more than suggestive of what is to come, and follows an extended developmental course during which it becomes more explicit, more powerful, and hence more effective, as it comes to operate increasingly under the individual's conscious control. Placing metacognition in this developmental framework helps to clarify its nature and significance.

DEVELOPMENTAL ORIGINS OF METACOGNITION IN THEORY OF MIND

Over the past decade, the wave of research on children's understanding of the mind has been valuable in highlighting the earliest forms of metacognition. By age 3, children have acquired some awareness of themselves and others as knowers. They distinguish thinking about an object from actually perceiving it, and begin to refer to their own knowledge states, using verbs such as *think* and *know* (Flavell, 1999). By age 4, they understand that others' behavior is guided by beliefs and desires and that such beliefs may not match their own and could be incorrect. This so-called false belief understanding is a developmental milestone because it connects assertions to their generative source in human knowers. These early years are also a period of rapidly developing awareness of how one has come to know that what one claims is so—that is, awareness of the sources of one's knowledge.

These early metacognitive achievements serve as foundations for much of the higher-order thinking that appears later. Understanding knowledge as the product of human knowing is a critical first step in the development of epistemological thinking, which is metacognitive in the sense of constituting an implicit theory of how things are known and increasingly is becoming recognized as influential in higher-order thinking (Hofer & Pintrich, 1997). Scientific thinking is another form of higher-order thinking whose roots lie in early metacognitive achievements (Kuhn & Pearsall, 2000). Awareness of the sources of one's knowledge is critical to understanding evidence as distinct from and bearing on theories—an understanding that lies at the heart of scientific thinking. In skilled scientific thinking, existing understandings are coordinated with new evidence, and new knowledge is thereby acquired, in a highly deliberate, rule-governed, and therefore metacognitively controlled process.

DEVELOPMENTAL ORIGINS OF METASTRATEGIC AWARENESS AND CONTROL

Are there different kinds of metacognition? A long-standing distinction in cognitive psychology is that between declarative (knowing that) and procedural (knowing how) knowing. If these two kinds of knowing are fundamentally different, perhaps meta-level operations on them also differ. Specifically, I propose, we would expect meta-level operations to have their greatest influence on procedural knowing. Meta-level awareness of strategies for comprehending a chapter in a textbook, for example, may influence comprehension efforts, whereas explicit meta-level awareness of the declarative knowledge gained from the chapter ("knowing that I know") has less obvious effects on the knowledge itself.

I have proposed *metastrategic knowing* as a separate term to refer to metaknowing about procedural knowing, reserving *metacognitive knowing* (addressed in the preceding section) to refer to metaknowing about declarative knowing. Metastrategic knowledge can be further divided into *metatask* knowledge about task goals and *metastrategic* knowledge about the strategies one has available to address these goals (Kuhn & Pearsall, 1998).

How and when does metastrategic cognition originate? Central to Vygotsky's (1962) view of cognitive development is the child's acquisition of voluntary control in initiating or inhibiting actions, with Vygotsky attributing a major role to meta-level awareness in this achievement. More recently, Zelazo and his associates have investigated early origins of what they call executive control in the execution of a simple object-sorting task. To perform the task, an executive function is called on to select which of two previously learned rules (sort by shape or by color) to apply. Three-year-olds, these researchers have found, have difficulty selecting the called-for rule, even though they can easily execute either rule. The requisite executive control of cognitive functions, it is proposed, is acquired gradually and undergoes multiple developmental transitions (Zelazo & Frye, 1998).

META-LEVEL CONSTRUCTS IN THE STUDY OF DEVELOPMENTAL PROCESS

Why do metastrategic and metacognitive functions warrant our attention? One reason is that they help to explain how and why cognitive development both occurs and fails to occur (Kuhn, in press). Developmentalists have long been criticized for failing to address the core question of how change occurs. The picture has changed with the advent of microgenetic methods, in which the process of change is observed directly as individuals engage in the same task repeatedly. The consistent finding of microgenetic studies is that people possess a repertory of multiple strategies of varying adequacy that they apply variably to the same problem. Development, then, rather than constituting a single transition from one way of being to another, entails a shifting distribution in the frequencies with which more or less adequate strategies are applied, with the inhibition of inferior strategies as important an achievement as the acquisition of superior ones (Kuhn, 1995; Siegler, 1996).

This revised conception of the developmental process has important implications in the present context because it suggests a critical role for meta-level processes. If shifts in strategy usage cannot be satisfactorily explained at the level of performance (e.g., frequency of prior use dictates the probability of a strategy's appearance), the explanatory burden shifts from the performance level to a meta-level that dictates which strategies are selected for use on a given occasion. The meta-level directs the application of strategies, but feedback from this application is directed back to the meta-level. This feedback leads to enhanced meta-level awareness of the goal and the extent to which it is being met by different strategies, as well as enhanced awareness and understanding of the strategies themselves, including their power and limitations. These enhancements at the meta-level lead to revised strategy selection. These changes in strategy usage in turn feed back to further enhance understanding at the meta-level, in a continuous cycle in which the meta-level both directs and is modified by the performance level.

Such a model privileges the meta-level as the locus of developmental change. Developmentally, then, increasing meta-level awareness and control may be the most important dimension in terms of which we see change (Kuhn, in press). In addition, the model makes it clear why efforts to induce change directly at the performance level have only limited success, indicated by failures of a newly acquired strategy to transfer to new materials or contexts. Strategy training may appear successful, but if nothing has been done to influence the meta-level, the new behavior will quickly disappear once the instructional context is withdrawn and individuals resume meta-level management of their own behavior.

EXTENDING THE SCOPE OF METACOGNITION RESEARCH

A second reason that metacognition warrants our attention has to do with the phenomena to which it is applied. In the era in which Flavell wrote his 1979 article, almost all the research on metacognitive development was confined to metamemory—the study of what children and adults know about how to remember and about their own memory functions and how such knowledge relates to memory performance. Today, metacognition is conceptualized and studied in a much broader context. Metacognitive and metastrategic functions are being investigated within domains of text comprehension, problem solving, and reasoning, as well as memory. Metacognition in the year 2000, then, is "about" more than it was in 1979.

It thus becomes more feasible to construct and evaluate alternative theories of the role that meta-level processes play in regulating and advancing cognitive development (Crowley, Shrager, & Siegler, 1997; Kuhn, in press). It is a reasonable hypothesis that the nature of strategy-metastrategy relations shows some generality across different kinds of cognition, specifically in the ways in which meta-level processes operate to select and regulate performance strategies. Studies of these phenomena across different kinds of cognitive strategies stand to inform one another.

ENDPOINTS OF METACOGNITIVE DEVELOPMENT

A third reason that metacognition warrants attention has to do with the later rather than early portions of its developmental course. Despite the centrality of knowledge acquisition as a topic of theoretical and practical significance, we lack sufficient research observing individuals engaged in the process of acquiring new knowledge. Microgenetic methods allow us to study this process of "knowledge building" (Chan, Burtis, & Bereiter, 1997) during which existing understandings are modified in the course of their interaction with new information. In addition, we can examine how knowledge-acquisition strategies are themselves transformed in the course of their continuing application. Such studies point to the critical role of metacognitive and metastrategic processes in regulating knowledge-acquisition processes.

Adults show more skill in these respects than do children (Kuhn, Garcia-Mila, Zohar, & Andersen, 1995), but the performance of adults is far from optimum. Their beliefs are frequently modified by the new information they encounter, to be sure, and they may become more certain of these beliefs over time, but they often lack awareness of why they are certain (i.e., of the process of theory-evidence coordination that has transpired), and they apply knowledge-acquisition and inference strategies in a selective way to protect their own, often erroneous, beliefs. Enhancing (a) metacognitive awareness of what one believes and how one knows and (b) metastrategic consistency in application of the strategies that select and interpret evidence is thus both a developmental and an educational (Olson & Astington, 1993) goal.

SUPPORTING METACOGNITIVE DEVELOPMENT

In sum, competence in metaknowing warrants attention as a critical endpoint and goal of childhood and adolescent cognitive development. Young children's dawning awareness of their own and others' mental functions lies at one end of a developmental progression that eventuates in complex metaknowing capabilities not realized before adulthood, if they are realized at all. Linking these diverse attainments within a developmental framework makes it possible to investigate ways in which earlier attainments prepare the way for later ones.

As I suggested in the introduction, much remains to be learned about metacognition. We need to know more about how it develops and how it comes to regulate first-order cognition, or, very often, fails to do so. The fact that such failure is a common occurrence raises what is perhaps the most consequential question in need of more investigation: How can metacognitive development be facilitated?

Flavell (1979) expressed a broad vision in this respect:

> It is at least conceivable that the ideas currently brewing in this area could someday be parlayed into a method teaching children (and adults) to make wise and thoughtful life decisions as well as to comprehend and learn better in formal educational settings. (p. 910)

Although it has yet to be realized, this vision conveys the potential significance of achieving meta-level control of one's knowing processes. A promising approach to fostering metacognitive development focuses on the idea of exercising, at an external, social level, the cognitive forms we would hope to become operative as well at the individual level. One of a number of researchers who have pursued this approach is Brown (1997), whose "community of learners" curriculum relies on

> the development of a discourse genre in which constructive discussion, ques-

tioning, querying, and criticism are the mode rather than the exception. In time, these reflective activities become internalized as self-reflective practices. (p. 406)

There would seem few more important accomplishments than people becoming aware of and reflective about their own thinking and able to monitor and manage the ways in which it is influenced by external sources, in both academic, work, and personal life settings. Metacognitive development is a construct that helps to frame this goal.

Recommended Reading

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Note

1. Address correspondence to Deanna Kuhn, Box 119, Teachers College, Columbia University, New York, NY 10027.

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