A Perspective on Thinking

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ABSTRACT: Research on general thinking abilities—productive, higher order, critical, and creative thinking—has progressed slowly compared with the rapid progress that has been made in the study of cognitive structures and procedures. As alternatives to currently prevailing assumptions, three framing assumptions for the study of thinking are proposed, involving situated cognition, personal and social epistemologies, and conceptual competence. Evidence consistent with these assumptions is outlined, and topics in the psychology of thinking are discussed in relation to the assumptions.

The psychological study of thinking has two parts. One part is concerned with performance on specific tasks. The other part is concerned with broader capabilities of productive thinking, higher order thinking skills, critical thinking, and creativity.

In the past 20 years, there has been major scientific progress in the psychology of thinking concerned with performance on specific tasks, and much less in the psychology of critical, productive, higher order, and creative thinking. The study of complex information processing, pioneered by Newell and Simon (1972), has provided a progressive framework for analyzing the cognitive structures and processes in many tasks, including tasks used in Piagetian research (Siegler, 1976), puzzles such as cryptarithmetic and the Towers of Hanoi (Anzai & Simon, 1979), items used in intelligence tests (Pellegrino & Glaser, 1982; Simon & Kotovsky, 1963; Sternberg, 1977), various kinds of syllogisms (Johnson-Laird, 1983), concept identification (Gregg & Simon, 1967), and tasks used in school instruction, especially in science and mathematics (Anderson, 1982; Greeno, 1978; Resnick, in this issue; Riley & Greeno, 1988).

Research on the topics of productive, higher order, critical, and creative thinking has not been an integral part of the major success of cognitive and developmental psychology during the past 20 years or so. In contrast to the remarkable progress achieved in analyses of specific tasks, research on general thinking capabilities has not led to significant advances in theoretical understanding or a systematic body of empirical knowledge.

Many efforts to enhance children's thinking abilities have been made, and some of these have been evaluated in research studies. Excellent reviews are available by Chipman, Segal, and Glaser (1985); Nickerson, Perkins, and Smith (1985); Resnick (1987); and Segal, Chipman, and Glaser (1985). The dominant psychological idea in these development efforts is that thinking can be viewed as a skill. Successful thinking in specific subject-matter domains uses knowledge that is specific to the domains, as much research has shown. At the same time, it is reasonable to expect that there are aspects of thinking skill that are common across domains, and this possibility has motivated the development of many programs in the attempt to enhance general thinking skills. Evaluations of several of these programs have shown positive results, which encourage the idea that there are teachable components of general thinking ability. At the same time, there has been no perceptible progress toward a coherent account of what makes some of the programs succeed; nor has the research contributed significantly toward a set of principles that would constitute an articulate theory of the characteristics of thinking abilities.

Nickerson, Perkins, and Smith (1985) summed up the situation, at least regarding programs emphasizing cognitive operations, as follows:

> Reviewing the various programs discussed, we are impressed by how easy it is to make up a list of fundamental operations, and also by the fact that the lists produced by different programs differ considerably from one another. Each of these lists can be seen as a theory of the components of intelligence or at least of determinants of intellectual performance. And this is the problem. There are too many of these theories for comfort. To be sure, some themes recur frequently but the differences are substantial. (p. 188)

Some of the causes of this relatively slow progress may be implicit in the theories and framing assumptions that have dominated our scientific inquiry. There are three framing assumptions about thinking and learning that may be responsible for our apparent inability to develop a more adequate theory of thinking. First, the locus of thinking is assumed to be in an individual's mind, rather than in interaction between an agent and a physical and social situation. Second, processes of thinking and learning are assumed to be uniform across persons and situations. Different individuals are more or less capable of critical or creative thinking, and different situations are more or less conducive to learning and thinking, but the activities of thinking and learning are assumed to have approximately the same character wherever and in whomever they occur. Third, resources for thinking are assumed to be knowledge and skills that are built up from simple components, especially through instruction in school, rather than general conceptual capabilities that children may have as a result of their everyday experience or native endowment.

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These framing assumptions are reflected in the research and discussions of thinking, including discussions of creative thinking, where Kogan (1983) has summarized a large body of research about whether individuals think divergently or convergently and where Weisberg (1986) recently debunked several accounts in terms of genius, divergent thinking, mysterious insight, and inspiration and proposed replacing these with an account in terms of information-processing, problem-solving capabilities; motivation; and concentration. Resnick's (1987) discussion characterized higher order thinking as nonalgorithmic, complex, self-regulative, meaningful, effortful, and providing multiple solutions, nuanced judgments, multiple criteria, and uncertainty, all defined in terms of cognitive traits and processes of individuals. Chipman (1986) characterized a consensus among cognitive scientists that successful thinking depends on organization of cognitive activity with a hierarchy of goals and operations.

Alternative Framing Assumptions

A different set of framing assumptions may be needed if we are to make significant headway toward an adequate understanding of thinking and creativity. The three assumptions that I propose are the following.

1. *Situated cognition.* Thinking is situated in physical and social contexts. Cognition, including thinking, knowing, and learning, can be considered as a relation involving an agent in a situation, rather than as an activity in an individual's mind.

2. *Personal and social epistemologies.* Thinking and learning are situated in contexts of beliefs and understandings about cognition that differ between individuals and social groups, and fundamental properties of thinking and learning are determined by these contexts.

3. *Conceptual competence.* Children have strong potential capabilities for cognitive growth that enable complex and subtle processes of construction of knowledge and thinking skills. Thinking, learning, and cognitive growth are activities in which children elaborate and reorganize their knowledge and understanding, rather than simply applying and acquiring cognitive structures and procedures.

These assumptions are too general to allow direct empirical tests. Their acceptance will depend on the theoretical analyses and systematic empirical work that result from their use. At the same time, there are at least three kinds of empirical evidence that are consistent with the assumptions and encourage their further use and development.

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Situated Cognition

We have thought of thinking as a process within an individual's mind, perhaps influenced by a context provided by the situation. Recent ethnographic research suggests a different view, in which thinking is an interaction between an individual and a physical and social situation.

One example is in observations by Scribner (1984) of young men whose job is to fill drivers' orders in a dairy. The task involves different products that come in different-sized containers. Containers are packed in cases; the number of containers per case is different for the different container sizes. The worker gets a form filled out for each driver, in a special notation that shows, for each product, a number of cases and a number of containers that should be added or subtracted.

The task could be done algorithmically; for example, the loader could locate the number of full cases that are specified and either remove the number of containers specified with a negative integer or add a partial case with the number of containers specified with a positive integer. The loaders did better, using partial cases to obtain more efficient solutions. The workers used optimal solutions in more than 90% of the cases that were observed.

These workers' performance was not based on mathematical knowledge of the kind that we might expect individuals to obtain in school. We can imagine giving a word problem in arithmetic about the situation, involving the number of cases and containers needed for the order, the number of containers in a partially filled case, and the question "How many more containers are needed for the order to be filled correctly?" We would expect some pencil-and-paper calculations to occur, and a correct answer would be taken as evidence of the student's knowledge of correct arithmetic operations, as well as his or her ability to apply that knowledge in a problem situation. The workers' cognitive activity seems to require a different kind of characterization. Rather than assuming that there are cognitive structures and procedures that the workers applied, it seems more appropriate to say that they had acquired a capability for interacting effectively with objects in the situation.

Another example was observed by de la Rocha and reported by Lave (1988). De la Rocha conducted an ethnographic study of individuals who had recently joined the Weight Watchers diet program as they prepared food according to the quantitative constraints of the program. At one time the interviewer asked a participant what would happen if he decided to serve three fourths of his day's allotment of cottage cheese, which was two thirds of a cup. Instead of performing a calculation with numerical symbols, the person measured two thirds of a cup of cheese, placed it on the counter, shaped it into an approximate circle, drew horizontal and vertical lines through it, and discarded one of the quarters. As with the dairy workers, this dieter's reasoning involved direct interaction with objects and materials in the situation, rather than arithmetic calculations.

Many examples of situated reasoning about quantities have also been provided in studies of performance by young salesmen and saleswomen in street markets, for example, by Carraher, Carraher, and Schliemann (1985), and by Saxe (in press). Resnick's article in this issue includes an example from Carraher et al., in which a young woman calculated the price of 10 coconuts, each of which cost 35 cruzieros, by mentally adding 105 cruzieros three times and adding 35 more, rather than using a direct arithmetic operation such as multiplying 35 by 10.

The theoretical significance of these examples is the emphasis they place on constructive processes of interaction between cognitive agents and the situations they are acting in, rather than on manipulation of symbols. Information-processing models for at least some of the examples could be constructed, treating the reasoning as means–ends analysis or satisfaction of constraints, analogous to models of Newell and Simon (1972) and others, but such models would involve a shift in focus from the versions that have been developed in information-processing psychology. Models like these have been considered as hypotheses about processes that occur in the minds of individuals. It may be more appropriate to consider them as models of ways in which individuals interact cognitively with objects and structures of situations.

Personal and Social Epistemologies

The second framing assumption that I discuss involves beliefs about the nature of knowledge and learning. Recent evidence shows that individuals have implicit theories of intelligence, knowing, and learning that influence the fundamental nature of the activities of knowing and learning. Further, reflection on characteristics of different situations in which learning occurs supports a conclusion that learning and the knowing that results from learning almost certainly differ in fundamental ways depending on the learning situation.

One set of findings, contributed by Dweck and her associates (Dweck, 1983; Dweck & Leggett, 1988), is concerned with children's implicit theories about intelligence. Psychologists, educators, and others have debated whether intelligence is a fixed trait or a set of acquired skills. It turns out that the issue has not escaped the attention of children. Some children believe that how smart they are is a characteristic that is fixed and over which they have essentially no control. Other children view their intelligence as a result of the intellectual activities they have engaged in and learned from and as a characteristic they can change—especially improve—as they engage in further challenging activities. Children with these different beliefs also differ in their attitudes toward cognitive tasks. Children who consider intelligence as a fixed quantity consider cognitive tasks as occasions in which their intelligence can be assessed and their weaknesses exposed. Children who consider intelligence as a malleable skill consider cognitive tasks as opportunities to become smarter. Not surprisingly, these children are much more favorably inclined to engage in cognitive activities. An implication of Dweck's findings is that different children must understand the outcomes of learning in quite different terms. A child who considers intelligence as a malleable skill probably believes that the outcome of successful learning involves a significant change in his or her general ability to think, whereas a child who considers intelligence as a fixed quantitative trait probably believes that successful learning involves an increased ability to perform in a limited kind of task.

Another important set of findings was contributed by Belenky, Clinchy, Goldberger, and Tarule (1986) in a study of individuals' beliefs and understanding of knowledge and their experiences in learning. Belenky et al. interviewed 135 women who were attending college or taking courses in human service institutions that support women in parenting their children. They asked participants about their experiences in learning and explored their beliefs about what counts as knowledge, along with other questions about relationships with other persons and moral judgments. The results provide a compelling picture of differences among individuals in their beliefs and understandings of what knowledge and learning are. For a few individuals, language itself was not a medium of understanding and representation, and these individuals generally felt themselves to lack intellectual and social power. Some individuals considered knowledge to be a form of received truth, with the expertise of a source being the main warrant for a claim of knowledge. Many individuals, called "subjective knowers" by Belenky et al., tested knowledge claims against a personal, intuitive judgment that made their knowing less passive, but the basis of these judgments was relatively unanalyzed. Some individuals took another epistemological stance, called "procedural knowing," in which knowledge was understood to be the result of an intellectual process. Among procedural knowers, there was an important difference in which some individuals emphasized separate knowing, the content and merit of ideas and information in themselves, whereas other individuals emphasized social connections of knowledge, with knowledge both resulting from and providing a vehicle for connections with other people. Finally, Belenky et al. interviewed a few individuals whose epistemology contained a flexible and integrated combination of many of the views that they found taken by different individuals.

Findings such as Dweck's (1983) and Belenky et al.'s (1986) have profound implications for the psychology of knowing, thinking, and learning. It is untenable, given these findings, to simply ask whether someone knows a fact or understands a principle, because that knowledge or understanding is in a context of the person's beliefs and understandings about what knowledge and understanding are, and these differ fundamentally among individuals. As a part of our scientific work toward a theory of knowing, thinking, and learning, we need to work toward an understanding of the epistemologies that individuals and groups use to characterize and shape their intellectual activities.

An important set of questions for research involves ways in which individuals' epistemological beliefs and understandings are influenced by their experiences and the social situations in which they learn. Belenky et al.

(1986) found plausible relations in their interviews to begin to develop hypotheses about ways in which family interactions during childhood influence individuals' beliefs about themselves as knowing and reasoning persons, but systematic research on the development of epistemological positions in childhood is needed.

The relations between epistemology and social settings of learning have received some attention in research, and examples have been discussed in which different epistemological positions are incorporated and probably communicated to students. In one striking example, Jordan (1987) contrasted the learning that she observed in a group of women working as traditional birth attendants in Mexico with classes that were intended to bring these women's knowledge "up to date." The knowledge of traditional birth attendants is knowledge of a practice, and in their working groups individuals learn the practice in the process of contributing to the group's work, with demonstrations of techniques (e.g., giving massages) that are included in the medical care of pregnant women. Language plays an important role in the process, but it is always embedded in the practical situation and related to real problems of the activity. In contrast, Jordan also observed a workshop attended by several traditional birth attendants sponsored by the Mexican government with teachers from a local hospital, where the curriculum involving anatomy and physiology of reproduction was unrelated to the students' work, and the teaching was done with lectures and diagrams that were largely incomprehensible to the students. Needless to say, the apparent benefits of these classes for the students were negligible (although they did receive certificates, which may have been of some professional value). But the point pertinent to this discussion is that the two learning situations incorporated entirely different assumptions about knowledge that the students were expected to acquire—one involving knowing how to engage in a productive social activity and the other involving knowledge of terms, definitions, and propositions.

Much classroom instruction incorporates an epistemology that is a version of Belenkey et al.'s received knowing, where teachers supply information and show how to perform procedures, and students accept this knowledge, rather than arriving at it through their own constructive intellectual and social activity. Things need not be this way, and many teachers strive for more active participation by their students. A significant example is described by Lampert (1986), who taught elementary school mathematics in a setting where students and the teacher worked together on the task of making sense of mathematical notations and procedures. Fawcett (1938) taught a geometry course in which the class worked together to construct their own versions of geometry, including discussions of the relative merits of different definitions and axioms and use of the principles of deductive inference to consider claims made in everyday discussions such as advertising and political speeches. Schoenfeld (1987) conducted courses in mathematical problem solving in which he acted much more as a leader and coach than is typically the case in mathematics teaching. These examples, and others, illustrate several important pedagogical principles, but the main point for this discussion is that these teachers created social settings in which students could acquire a different kind of knowledge than ordinary classroom instruction teaches. Their effort was not just to teach the same things more effectively, but to have knowing be a product of the students' individual and social intellectual activity. This profound epistemological shift probably is at least as important as any gains in problem-solving performance that their methods, and others like them, might be expected to achieve.

Conceptual Competence and Conceptual Growth

According to the prevailing view, the main resources for thinking are concepts or schemata and procedural skills, which a child either has learned through experience or instruction or has developed through cognitive maturation. The design of most school instruction assumes that the concepts of a domain have to be taught to children through a process of transmission in which the children are treated more or less as potential receptacles of the knowledge. It is recognized that learning requires effort, so there is concern to find ways to motivate children toward learning. There also is concern for students' readiness to acquire new concepts and skills. Considerable attention is given to prerequisites in the form of components of the skill or concept that is to be taught, and some attention has been given to levels of cognitive development that may be required for understanding concepts and procedures.

Recent research in developmental psychology has raised an important new issue concerning conceptual foundations for learning. In several domains, young children have been shown to have significant implicit understanding of principles that are important for understanding in domains such as mathematics and science. This implicit understanding provides a form of conceptual competence that may be an important resource for meaningful learning of concepts and cognitive procedures. The results also support a view of learning in which students elaborate, modify, and reorganize concepts that they have initially, rather than simply acquiring knowledge.

An example in the domain of mathematics is in research by Gelman and her associates. Preschool children are able to perform successfully on tasks requiring modified versions of counting procedures (Gelman & Gallistel, 1978) and can judge whether a puppet's performance in counting is correct, even when nonstandard procedures are used (Gelman & Meck, 1986). These results show that young children have significant implicit understanding of principles of counting, including set membership, cardinality, one-to-one correspondence, the order of numerals, and the irrelevance of the order in which objects are counted.

Another example is in research by Carey (1985), who studied children's understanding of principles and concepts of the domain of biology between the ages of 6 and 10 years. During that time, children's understanding of species of animals and biological functions becomes more systematic. Carey presented a convincing interpretation that between the ages of 6 and 10 years, children modify their implicit theory of living things from a naive psychology to a naive biology. More recently, Hatano and Inagaki (1987) obtained evidence that 6 year olds have implicit understanding of some biological concepts that did not appear in Carey's data until later, supporting the idea that the conceptual competence of 6 year olds includes both psychological and biological principles, and they have yet to sort out the appropriate conditions for applying the two sets of ideas. In any case, the important conclusion for this discussion is that children during their years in elementary school accomplish significant reorganization of the concepts and principles that they use to understand living things.

In addition to principles of mathematics and biology, young children's implicit understanding has been shown for principles of physical causality (Bullock, Gelman & Baillergeon, 1982); for psychological concepts such as thought, belief, and intention (Wellman & Estes, 1986); for distinctions between natural kinds and physically similar individuals (Gelman & Markman, 1986) and between natural kinds and artifacts (Keil, in press); and for predicability of attributes and ontological categories (Keil, 1979). Taken together, these results provide a compelling body of evidence that children should not be considered as mere vessels for receiving knowledge when they learn. Instead, when they arrive at a learning situation, they have rich, albeit largely tacit, structures of conceptual competence. And they learn over significant periods of time in ways that involve significant reorganization of conceptual structures.

Thinking in an Alternative Perspective

Framing assumptions are important in influencing the terms in which we formulate hypotheses and interpret findings of research. In this section, I discuss implications of the alternative framing assumptions that I have proposed for four topics in the psychology of thinking.

Productive Thinking

Wertheimer's (1945/1959) discussion developed the concept of productive thinking. That concept captures much of the perspective that I have tried to develop in this article, although his discussion preceded almost all of the empirical research that I have cited in support of the framing assumptions that I have explored.

The central concept in Wertheimer's discussion was structural understanding. For example, he contrasted students' understanding of the area of a parallelogram using the equivalence of a parallelogram and a rectangle with knowledge of area based on the formula $A = B \times H$. With structural understanding, children grasp essential properties and relations of the ideas in a problem, rather than having mechanical knowledge that enables them to operate with symbols. He also discussed an example involving solution by young children of a problem of constructing a bridge with blocks, in which none of the blocks was long enough to reach between two blocks that were designated as the ends of the bridge.

In his interpretive discussion, Wertheimer used the terms "gap" and "tension" to refer to aspects of the cognitive situation that lead to restructuring. Although these can be thought of as aspects of a person's representation of a problem situation, they can also be considered as aspects of the situation that includes the person along with problem materials and other persons. Then a "gap" is a discrepancy between the person's thinking about the situation and the way the situation really is, and "tension" arises when the person's expectations or desires do not correspond to things that happen or to the way things are. For example, when a child tries to make a bridge by placing a block on each end so they meet in the middle, the blocks fall down. If the child focuses on the need for balance, the blocks can be placed on the ends so they balance, a third block can be used to span the gap between the other blocks, and two more blocks can be used as counterweights to keep the third block from making the structure collapse. The change from the unsuccessful approach to the successful approach involves a shift in the child's cognitive connection with the objects in the situation. From being focused primarily on the distance between the ends, the child also becomes focused on conditions for achieving an arrangement that is balanced. This provides a coherent cognitive system, in which the child is focused on a feature of the situation that enables the goal of a stable bridge to be achieved.

Higher Order Thinking Abilities

The main concerns in discussions of higher order thinking are abilities that do not depend on knowledge in specific domains. There are two important aspects. One involves abilities to solve novel problems. The other involves abilities to learn in new domains.

Important information-processing analyses of these abilities have been provided. Newell and Simon (1972) gave examples of problem solving in unfamiliar domains based on general methods of means–ends analysis and constraint-based heuristic search, and Anderson (1982) showed how procedures can be learned from example problems in a new domain by adding "if. . . then" rules to one's knowledge based on the steps of example solutions.

The assumption of situated cognition puts the question of higher order thinking in a different focus. Rather than applying a general problem-solving method based on search, an individual or group can approach a novel problem in an effort to become deeply embedded in the situation of the problem, an effort toward structural understanding in Wertheimer's (1945/1959) sense that Levine (1987) called striving for intimate engagement with the problem. Rather than characterizing higher order thinking as application of a general skill, it would involve the ability to discern important structural features of a problem situation and become engaged with the situation in terms of those features.

A similar refocusing occurs in considering general learning abilities. Most discussions characterize strategies or skills of learning that can be acquired and then applied to assimilate new information, concepts, and cognitive procedures in any domain. But rather than assimilation of information, concepts, and procedures, we can consider learning in a domain as becoming able to think with and about the information, concepts, and procedures of the domain. This includes coming to know the generative principles of the domain, that is, learning what makes the information and procedures of the domain work, rather than simply learning what they are. According to this view, abilities for learning are characteristics that enable persons and groups to become intellectually situated in a domain of conceptual structures and operations, including manipulating conceptual objects to produce new combinations of ideas and learning from the activity of conceptual exploration.

The assumption of personal and social epistemologies plays a crucial role in considering higher order thinking and learning. Willingness to engage in novel problems that present a challenge is one of the striking characteristics found by Dweck (1983) to distinguish children who believe that intelligence is a malleable trait rather than a fixed entity. The women interviewed by Belenky et al. (1986) who understand knowledge as the product of individual and social intellectual construction are much more likely to strive to become engaged in a problem setting or a domain of concepts and operations than those for whom knowledge is something to be received or something whose validity depends only on an unanalyzed affective response.

The epistemology that is built into a social environment of learning can play a determining role in the abilities of children to think about novel problems and learn in new domains. Thus, to promote significant learning abilities for children, we must construct social environments for learning that reflect the kind of epistemology that we want to characterize students' knowledge. Classroom teaching in which the main activity is collaborative work aimed at making sense of the material (Fawcett, 1938; Lampert, 1986; Schoenfeld, 1987) embodies an epistemology of knowing as socially constructed understanding, as do many programs that are designed to enhance higher order thinking and learning skills (Lipman, 1985).

Proposals to consider learning as the achievement of structural understanding have often been met with the skeptical objection that most children lack the intellectual capability to achieve genuine understanding. The assumption of conceptual competence runs counter to that skepticism. The message of much of the recent research in cognitive development is that young children bring significant conceptual competence to the activities of learning in new domains. We need to understand the abilities and the situations for learning in which new information and procedures are related meaningfully to children's intuitions about the phenomena of the domain.

Critical Thinking

The main idea in discussions of critical thinking has to do with whether individuals think reflectively, rather than simply accepting statements and carrying out procedures without significant understanding and evaluation. One aspect of the issue involves the metacognitive process of monitoring one's own understanding of information and success in cognitive tasks. Palincsar and Brown's (1984) method of reciprocal teaching provides students with methods for evaluating their understanding of texts as they read.

According to the assumption of situated cognition, most cognitive activity occurs in direct interaction with a situation, rather than being mediated by cognitive representations. Cognitive representations play a role when something goes wrong. They are resources that humans have for dealing with situations when their more direct connection with objects and persons are not working well. According to this view, reflective thinking, in the sense of monitoring and evaluating one's own performance or things that other people are saying or doing, is not something that should be expected to occur at all times. The capabilities that we characterize as critical thinking, then, need to include recognition of circumstances when reflection and evaluation might be helpful in overcoming some difficulty that has emerged in the normal course of activity or conversation.

The assumption of personal epistemologies is that differences in individuals' beliefs about knowing influence their performance in cognitive tasks, including learning. It would be reasonable to expect that individuals who understand knowing as the product of their own construction would be more likely to reflect on their performance and thus realize that different conceptual resources are needed and to learn from the experience of their cognitive efforts. And if knowing is understood as a product of social as well as individual construction, it is natural for groups of individuals to engage in collaborative critical thinking, understanding that the result will be to increase their shared knowledge and understanding.

An important possibility is that critical and reflective thinking is more a social phenomenon than it is a characteristic of individuals. For example, in Fawcett's (1938) and Lampert's (1986) classes, students were engaged in reflection on the meanings of terms and mathematical methods and were encouraged to comment on each others' explanations and interpretations. These examples suggest that an effective way to engender critical thinking is to design social environments in which reflection and evaluation of ideas are encouraged, rewarded, and expected as part of the normal interactive activity of the group.

The assumption of conceptual competence is that individuals—especially children—have significant implicit understanding in domains in which they do not yet have explicit representations of concepts and principles. This raises a fascinating question about the role of intuition in reflective thinking. The concepts that children understand implicitly are not themselves available as objects of reflective thinking, by definition. But they may be available as resources for reflection about situations that children are in, and through such reflection the child's knowledge of the concept may become more explicit. Indeed, in groups in which intellectual interaction occurs by design, students naturally apply their intuitions in constructing explanations and interpretations, and they and the other members of the group reflect on them and thereby make them more articulate.

Creativity

The main issue in discussions of creativity involves flexibility of thinking and restructuring of understanding in innovative ways. In most discussions, a creative achievement is characterized as an occurrence in an isolated mind, almost by definition.

The assumption of situated cognition says that all of our cognitive activity is connected with situations. Creativity, in this view, involves reorganizing the connection the person has with a situation, rather than a reorganization that occurs within the person's mind. The situation with which one's connections are reorganized can be physical, social, or conceptual.

This view of creativity is consistent with an important set of results obtained by Getzels and Csikszentmihaly (1976). They gave tests and observed the activities of students at the School of the Art Institute of Chicago and correlated the results with the judged quality of the students' work, as well as with the success they had achieved in their careers seven years later. The most striking findings involved observations of the students' concern for problem formulation, including the extent to which they explored alternative arrangements of materials before they started a drawing, changes in structure during work on the drawing, and concern for discovery during formulation of the problem. These activities were strongly correlated with the judgments of originality of those drawings by expert judges and with the individuals' career success as assessed seven years after the observations were made. (The median correlation with judged originality was .58; the median correlation with early career success was .38!)

The view that creativity involves a restructuring of one's relation to a situation is consistent with Getzels and Csikszentmihaly's finding, if we make the reasonable interpretation that individuals who spent more time and effort on exploring alternative arrangements of materials were examining alternatives that differed in their structural properties. The view also is consistent with the intuition that creativity requires a break with previous understanding. Indeed, this view may make it easier to appreciate the difficulty of creative accomplishments, for it implies that one is disrupting not just the contents and organization of one's own mind, but a system of relations involving the world, other persons, or a set of concepts.

The assumption of personal and social epistemologies implies that creativity depends on beliefs and understandings that individuals have about knowledge, thinking, and learning. It may be that the extraordinary motivation for intellectual work that characterizes many exceptionally creative individuals is a version of the constructive epistemological position of individuals who believe that knowing and understanding are products of their intellectual processes. These attitudes and beliefs should be exceptionally strong for some individuals, for whom understanding and learning play a particularly central role in their understanding of themselves and their social roles. Social support for creative activity undoubtedly plays a crucial role in its occurrence, including recognition that restructuring of ideas, social relationships, and methods of interacting with the physical environment are possible, let alone valued positively.

The assumption of conceptual competence implies that resources for creative restructuring are available in intuitions that an individual is unable to articulate. Conceptual competence, as concepts and principles that function implicitly in an individual's thinking but cannot be expressed explicitly, can enable a person to begin to construct new sets of connections to situations. How such preliminary intuitive connections can grow into full-fledged new systems of interaction with physical, social, or conceptual settings is a major question for future research. The suggestion of implicitly understood principles has the virtue of hinting at a set of resources that could at least get the process started.

Concluding Comment

In this article, I have outlined a reformulation of the terms in which we conduct research about thinking. If we think about thinking in these terms, we will probably ask different questions about thinking and look for different kinds of phenomena. A theory of thinking, in these terms, would view it as activity in physical and social contexts and would consider the individual's intuitive conceptual understanding and beliefs about knowledge, learning, and intelligence as important background factors for thinking activity. Shifts such as these may seem to make the problem of understanding thinking more complex. However, we have not been making rapid progress in the study of critical thinking, higher order thinking abilities, creativity, and productive thinking using our present approach. Perhaps the phenomena will actually seem simpler when we take some of their contextual factors into account.

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