

## A THREE-COMPONENT CONCEPTION OF INTUITION: IMMEDIACY, SENSING RELATIONSHIPS, AND REASON

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**Abstract**—Based on a comprehensive review of the published literature, a model of intuition is presented with the following three components: immediacy, the sensing of relationships, and reason. These interactive components contribute specific aspects of intuition: the components of immediacy and relationships contribute insight; the components of relationships and reason contribute metaphorical and analogical thinking; and, the components of immediacy and reason contribute an action-oriented type of reasoning that is antithetical to metacognition. Implications of the model for psychological and educational research are presented. © 1997 Elsevier Science Ltd. All rights reserved

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### INTRODUCTION

What constitutes intuition? Referring to Pasteur's intuitive discovery of germ theory, Koestler (1964) describes the intangible act of seeing/creating:

In most truly original acts of discovery the "seeing" is in fact imagining; it is done in the mind's and mostly the unconscious mind's eye. The analogy between the life of one kind of microbe inside a cow and another kind of microbe in a forgotten culture tube was not "hidden" anywhere; it was "created" by the imagination; and once an analogy has been created, it is of course there for all to see—just as a poetic metaphor, once created, soon fades into a cliché. (p. 200)

The act of intuition is generally considered to be a moment of truth, or the sudden emergence of a new insight (Koestler, 1964). A clinical psychologist initiates a new direction in therapy by deciding to confront her client at just the right time. A football player follows his instincts and chooses an unusual play that is successful. A neuropsychologist sees a connection between his research and a colleague's cognitive psychological model, leading him to implement a new set of methods and add a meaningful new dimension to his research. A news broadcaster delivers pertinent, insightful questions to a politician by spontaneously comparing her policies to those of another government official. There is an element of mystery surrounding the concept of intuition. How and from where does an intuition come? Bruner (1963) characterizes intuition as

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the intellectual technique of arriving at plausible but tentative formulations without going through the analytical steps by which such formulations would be found to be valid or invalid conclusions. Jung (1921) defines intuition as the psychological function that explores the unknown and senses possibilities and indications which may not be readily apparent; it is a kind of instinctive apprehension. Through intuition, Jung attests that knowledge presents itself as whole and complete, without one being able to explain or discover how this knowledge came into existence. Describing intuition as a creative process is problematic since creative processes may be unanalyzable (Hayes, 1989). Consequently, it is desirable to explain intuition in more concrete terms.

In considering intuitive thinking as a process different from logical thought, one salient characteristic is that it may be emotionally driven. Rousseau contrasts the spontaneous, thinking, feeling, and seeing aspects of intuitive thinking with the schooled, cultivated reasoning of the adult (as cited in Schon, 1982, p. 244). In cognitive-experiential self theory (CEST), Epstein (1994) contrasts two parallel and interacting forms of information processing: a rational system, and an emotionally driven experiential system, with the experiential system accounting for intuitive processes. Noddings and Shore (1984) describe the role of affect that accompanies an intuitive accomplishment: the surprise, clarity, and beauty of an intuitive perception which can leave a person inarticulate. While these affective aspects of intuition, and others such as empathy (Bastick, 1982), are interesting and important, this paper will focus on the cognitive aspects of intuition.

The question whether two fundamentally different cognitive processes exist has been considered by personality, developmental, and social psychologists, as well as philosophers and theologians. Generally, intuitive processes tend to be characterized as subjective or experiential in contrast to logical, analytical thought (e.g. Epstein, 1994; Labouvie-Vief, 1990). Or, with logical thought at one end of the continuum, intuitive understandings (i.e. knowledge of "hunches") lie at the other end. Together with philosophical and psychological speculation, there has been biological confirmation of cerebral asymmetries and right-left brain hemispheric distinctions. Clinical studies with split-brain patients and other brain-damaged groups confirm that people temporally order information via the left-analytic mode whereas part-to-whole match information via the right-holistic/intuitive mode (Iaccino, 1993).

While intuition has long been recognized as critical to the domains of psychotherapy (Bastick, 1982), and mathematics and science (e.g., Fischbein, 1975), research into its nature is lacking (Bastick, 1982). Since many famous inventions and concepts (e.g. from Benjamin Franklin, Newton, Pasteur, Freud) came about from what would be described as intuitive processes (Koestler, 1964), and intuition is recognized as an important consideration in curriculum for the gifted (Brown & Wolf, 1986), determining the nature and cultivation of this construct is of interest. My intent in this paper is to suggest a particular conception of intuition with the hope of encouraging further conceptualization and research.

### A MODEL OF INTUITION

Consider the following example. A renowned software designer who develops educational applications wakes up in the middle of the night with an intuition. She visualizes a way of conveying the complexity of DNA through a simple animation. The object of her intuition is the animation of DNA that she figuratively "sees."

To describe the software designer's intuition, consider the model of intuition comprised of

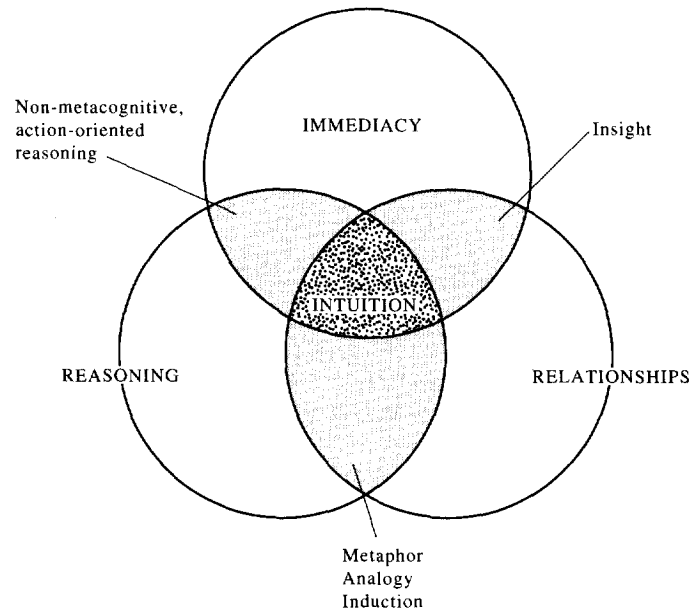


Fig. 1. The three components of intuition: immediacy, sensing relationships, and reasoning.

three components as shown in Fig. 1. First, intuition has an element of immediacy. The software designer has the realization when she is asleep, without her conscious intent. An important part of the intuitive process is the timing of when the relationship is realized. Second, intuition senses relationships. The software designer relates the complex DNA concepts as together forming a new entity through the animation. Intuitive processes draw links and highlight patterns, formulating connections between objects or ideas. Third, intuition is a type of reasoning. Through supporting thought processes, the software designer mentally formulates a new animation. Intuition results from a reasoning process that lacks metacognitive control. Reasoning in intuition proceeds automatically, immediately interpreting the present relationship. In summary, intuition acts in the immediate future, senses relationships, and functions through reasoning without conscious intent. Intuition is represented by the center area of Fig. 1, where the three components overlap. The component of sensed relationships reflects a person's knowledge structures. The complexity of those knowledge structures determine whether a person will have access to immature or mature intuition (Baylor, 1997). In the case of the software designer, her expertise and correspondingly advanced knowledge structures would lead her to realize mature intuition.

In describing this model of intuition, I will consider each of the three main components—immediacy, sensing relationships, and reasoning—and devote special attention to the regions formed by their overlap. While I will present the components in a linear way, that is not meant to express that the components are linearly related to each other. Rather, each component is very different from the others, but conceptually each contributes to intuition. Starting with immediacy in the top circle, I will move clockwise to briefly consider the components of sensing relationships and then reasoning. The overlapping regions will be described in more detail given there is more empirical research in these areas. Insight characterizes the overlapping region of immediacy/relationships. Metaphors and analogies characterize the

overlapping region of relationships/reason. The overlapping region of reasoning/immediacy represents a special kind of reason that is antithetical to metacognition. Finally, intuition will be shown to comprise the center region consisting of the overlap of the overlapping regions of insight, metaphors and analogies, and reasoning/immediacy.

### IMMEDIACY

The component of immediacy reflects the role of timing in intuition. An intuition occurs immediately with no planning. The component of immediacy is supported by the fact that a person cannot wilfully maintain herself in the act of intuiting. Furthermore, intuiters, perform most effectively when they are not conscious that they are in fact intuiting (Noddings & Shore, 1984). In an intuitive mode, a person eliminates or deactivates the cognitive mediators that she uses unconsciously. As Noddings and Shore (1984) describe, "The hallmark of the intuitive mode is seeing without glasses, hearing without filters, touching with ungloved hand. The immediate character of intuition does not imply accuracy, rightness, or moral goodness. It does imply commitment and clarity" (p. 57). As Schon (1982) describes, the immediacy of intuition is reflected by its getting at truth all at once, without the time-consuming effort of deliberation that is also a source of error (p. 233). Or, Mandler (1995, p. 17) proposes the term "mind popping" to explain thoughts and solutions that come to mind nondeliberately when one is engaged in some other, usually irrelevant, train of thought.

### SENSING RELATIONSHIPS

How is it that we see relationships and formulate connections between objects, concepts, ideas? A music composer formulates a series of notes of a certain pattern to make music. A designer selects a key piece of furniture to complement the decor. The component of sensing relationships reflects the formulation of connections, an intrinsic property of intuition. This formulation of connections is based upon a person's knowledge structures which reflect his/her level of expertise.

### THE INTERPLAY OF REASON WITH INTUITION

Intuition and traditional reasoning comprise a unique and paradoxical relationship. As a whole, intuition as a concept is in contrast with analytical reasoning, as described earlier. Furthermore, the development of intuition is in contrast to the metacognitive development that facilitates coordinating theory and evidence (Kuhn, 1989). Yet while intuitive thinking contrasts with analytical reasoning, intuition involves a particular type of reasoning.

Noddings and Shore (1984) claim that intuition acts in a complementary fashion with reason, and it is impossible to isolate the two meticulously and discretely. In analytical reasoning the person moves from a postulate toward what can be derived from it; in contrast, with intuitive thinking, the person may return to the postulate itself and evaluate acceptance of it and consider alternatives. Analytic thinking is directed by concepts they have attached to the object whereas intuitive thinking keeps returning to the object. Consider their following example (pp. 69–70) where subjects are presented an ordinary brick and asked to list as many uses for it as they can

think of in a limited time interval. A subject operating analytically might first associate a brick with building:

What can I build with it? He might ask. His list would be constructed from his consideration of the concept "build:" Use it to level a short table leg; use it to support a shelf; build a tower of it and other objects; prop a broken chair with it; prop a broken dresser with it.

A subject operating intuitively would reject the temptation to be diverted by a conceptual line:

She might look at it: It's red—hang it on the wall where I'd like a bit of red; it's rectangular and solid—use it to demonstrate a rectangular solid. She might touch it: It's hard—use it for a robot's pillow; it's grainy—use it as an abrasive. She might lift it: It's heavy—use it as a doorstop or paper weight; use it as a weapon. She might strike it: It crumbles—dissolve its grains and make a red liquid. She might think of expressions she could coin from contact with it: "brick red," "he's a brick," "hard as a brick." She might listen to it: It's quiet—makes a good companion for a pet rock.

In this manner, intuitive processes direct the analytical processes while figuratively developing a life of their own. Success in an analytic mode is realized in an answer—a proof, a numerical result, a finished poem. In contrast, success in an intuitive mode is realized in seeing, creating a picture in mind, and understanding. Since the analytical mode implements a step-wise process, a person can progress and then resume at a later point in time. A person cannot easily "continue where he left off" in intuitive processing. Overall, the intuitive process could be described as a mode of reasoning that ironically incorporates analytical processes while functioning in contrast to them.

Verbal protocol analysis highlights the differences between intuitive and analytic thinking. Schooler and Melcher (1995) found that success in solving analytic problems was related to instances of logical reasoning (referred to as "argument",  $r=0.57$ ,  $p<0.01$ ) whereas success in solving intuitive problems was not at all related to logical reasoning ( $r=0.08$ ). In another related study Schooler examined individual differences in cognitive capabilities between intuitive and analytic tasks and found that perceptual restructuring and the ability to overcome context-induced set were highly correlated with intuitive performance but insignificantly correlated with analytic performance. In contrast, analytic problem solving was particularly correlated with step-by-step tasks such as anagrams and mathematical ability.

#### IMMEDIACY/RELATIONSHIPS: INSIGHT

Both insight and intuition have a component of immediacy, occurring in a narrow span of time without conscious control. Both insight and intuition sense and formulate relationships. However, in this model intuition is differentiated from insight because intuition is mediated by reason as discussed earlier. Insight could thus be considered to be a component of intuition, as shown in Fig. 1.

Consider for example, an entrepreneur who suddenly has a brilliant idea: she sees a potential business opportunity between her pizza delivery service and delivering groceries to busy young urban professionals. The act of relating two services that initially seem unrelated occurs through insight. Insight also involves one's willingness to restructure one's mental

representation. The entrepreneur is willing to modify her expectations of what constitutes her business to relate the two services. Solving JUMBLE puzzles provides another example of insight. A person may reframe the JUMBLE word by methodically (not analytically) manipulating the order of the letters to facilitate insight (i.e. to “see” the word).

Insight, as well as intuition, can be characterized as an all-or-nothing response; in other words, where one sees the relationship or not. A person may become aware of the whole configuration, of the “gestalt.” Metcalfe and Wiebe (1987) note the difficulty of determining the criteria for an insight problem. They suggest that subjects provide estimates every few seconds of how close they are to the solution of the problem. These estimates, called feeling-of-warmth indicators, can diagnostically characterize an insight problem as one with sharp distinctions of feeling-of-warmth between the problem-solving process and its solution. Incubation, or taking time away from the content of interest, is thought to facilitate insight (Yaniv & Meyer, 1987). One explanation is that by not restricting possible solutions, incubation permits extensive activations that may lead to a solution (Mandler, 1995, p. 17).

Smith and Blankenship (1989) gave subjects insight problems with either helpful or misleading hints. There was a benefit of incubation only for subjects who received the misleading hints, suggesting that the main benefit of the incubation period was to enable the decay of activation of the misleading hint.

In contrast, using both gestalt-closure items and series of partially-completed words, Bowers, Farvolden and Mermigis (1995) found that the cognitive processes in insight may be more continuous than the appearance of sudden insight implies. They found that associative “clues” presented to subjects incrementally improved subjects’ guesses at the correct answer, even when subjects did not report greater feeling-of-warmth toward the solution.

For the purpose of this discussion, whether or not insight is realized incrementally does not change the fact that the person’s perception of the insight is immediate. As presented here, intuition is characterized as insight plus (a particular kind of) reason.

#### RELATIONSHIPS/REASON: DRAWING ANALOGIES

In this section I will consider the overlapping region of relationships/reason in Fig. 1 by primarily looking at the process of drawing analogies. Consider this overlapping area of relationships/reason as it exists apart and separate from immediacy. The creation of metaphors and the development of analogies serve as a component of intuition. By definition, a metaphor consists of a figure of speech in which a term is transferred from the object it ordinarily designates to an object it may designate only by implicit comparison or analogy, as in the phrase “evening of life” (Houghton & Mifflin, 1987). There is a richness in using metaphors; they provide a compact way of connotating much information (e.g. in poetry). Similarly, an analogy is defined as consisting of a correspondence between things otherwise dissimilar or as a form of logical inference based on the assumption that if two things are known to be alike in some respects, then they must be alike in other respects (Houghton & Mifflin, 1987).

Some analogies realized by famous inventors include the following:

Newton saw that the moon behaved like an apple. Pasteur saw the analogy between a spoilt culture and a cow-pox vaccine; Fleming saw the analogy between the action of a mold and the action of a drip from his nose. Freud conceived the idea of the sublimation of instincts by looking at a funny cartoon: in the first picture a little girl was herding a flock of goslings with

a stick; in the second she had grown into a governess herding a flock of young ladies with a parasol. (Koestler, 1964, p. 200)

These scientific breakthroughs are based upon the achievement of seeing an analogy where no one saw one before. Koestler suggests that the creative act in its entirety is identified with the unearthing of hidden analogies. These “hidden analogies” are based upon a person’s knowledge structures which affect his/her sensing of relationships.

The ability to develop metaphors and draw analogies may lie in the process of analogical thinking development. Halford (1987) proposed that analogical reasoning may lie at the core of development, as children may represent the world around them by mental models that are structurally similar to the real world. According to Halford, development consists of assigning elements of one structure to elements of another to preserve relations (a structure-mapping theory of cognitive development). This early development of classical analogical reasoning is present in children by at least age four. Goswami (1991) remarks that young children can reason analogically in both classical and problem analogy tasks as long as they have knowledge of the relations used in the analogies. Analogical development consists of a greater metacognitive awareness of the analogy rather than the ability to reason about higher order relations (Goswami, 1991).

Interestingly, and in contrast, consider that dreams frequently contain vivid analogies and novel combinations of objects and/or concepts. While inappropriate analogies may be filtered out when one is conscious, they may exist in a dream. Consequently, the intuitive processes of formulating relationships may be facilitated by the sleeping state since there is no interfering metacognitive control.

One of the central mechanisms for drawing analogies and formulating relationships is inductive reasoning, which requires reasoning from part to whole or from particular to general. Inductive reasoning presents such behaviors as reasoning logically, identifying connections among ideas, seeing all aspects of a problem, and getting to the heart of a problem (Sternberg, 1985). Another mechanism for sensing relationships is the process of generalizing from disparate elements. People tend to represent the dispersion of properties around their central tendencies, and use these estimates to generalize about categories (Holland, Holyoak, Nisbett & Thagard, 1986).

#### IMMEDIACY/REASONING: A REASONING PROCESS ANTITHETICAL TO METACOGNITION

The deactivation of cognitive mediators that is part of immediacy, together with reasoning, forms the particular kind of reasoning that comprises intuition. This intuitive reasoning contrasts with metacognitive reasoning as it is active, immediate, and uninhibited. Interestingly, Schooler and Melcher (1995) found that while subjects solving intuitive problems generated almost three times as many metacognitive statements than subjects solving analytic problems, metacognitive statements were not a predictor of success at solving the problem ( $r=0.01$ ). Importantly, subjects solving the intuitive problems commented on the unreportability of the intuitive cognitive processes.

Fischbein (1975) describes intuition as intrinsic to reasoning. The essential quality of intuition is its intimate contact with action. With the first cognitive stage as “I know what I am looking for,” and the second cognitive stage as “I know what to do,” intuition is the moment of

transition from the first to the second stage. Intuition is intermediate to these two stages, performing the function of gearing knowledge into action. Fischbein further characterizes intuition as a form of immediate cognition in which the justifying elements, if any, are implicit. The immediate reasoning process of intuition functions in dialectical opposition to the process of metacognition. Whereas metacognition is thinking about action, intuition is the immediate part of thinking. As Noddings and Shore (1984) describe, when a person provides an intuitive presentation, she incorrectly wants the audience to not “just” listen and follow directions:

We want to be sure they are thinking as well. But this may be exactly the wrong thing to insist upon. It may be that the intuition can pursue its quest for understanding only if analytic thinking is suspended or placed in a subservient role. (p. 83)

Furthermore, other literature refers to the possibility that language and logic may impede insight (Schooler & Melcher, 1995). As Koestler (1964) attests “words are a blessing which can turn into a curse. They crystallize thought; they give articulation and precision to vague images and hazy intuitions. But a crystal is no longer fluid” (p. 173). Schon (1982), in describing intuition as direct and passive, characterizes intuition as apprehending what is without the mediation of inference, with the mind receiving truth without activity. Activity of the mind, or awareness, may restrict the use of unconscious material and thereby the production of novel concatenations through an interference mechanism (Mandler, 1995).

All three components and three subcomponents are necessary for intuition. There must be reasoning together with immediacy and the sensing of relationships. How many discoveries (i.e. insights) have there been that were not intuitively realized? Such discoveries would be left undiscovered because the person did not recognize the importance or see the relationship. Conversely, it does not matter if an intuition is realized unintentionally; what matters is that the intuition is recognized as more than just an anomalous occurrence, whatever the circumstances. Importantly, intuition implies that there is some pattern, structure, or organization that exists prior to its detection (Bowers *et al.*, 1995). Note that an erroneous reasoning process cannot be intuitive because an intuition by definition reflects accurate interpretation and meaningfulness. In this way, intuition is never an accident but is a complex interaction of thinking processes (e.g. reasoning antithetical to metacognition), time (e.g. immediacy) and knowledge structures (e.g. sensing relationships). Thus, all three concurrent mediators are necessary for intuition.

A classic example of intuition that fits this model is the two-string problem of Maier (1940). While this problem is frequently referred to as an example of insight, according to the model here, it would fall under the category of intuition because some reasoning is involved. In this problem, the person is asked to tie together the ends of two strings, each of which has one end fastened to the ceiling with the other end just reaching the floor. The strings are separated enough so that by taking hold of one string, a person will be unable to reach the other string; hence, the problem is to obtain a string that is out of reach. In the pendulum solution, the person uses the pliers in the room as a weight for one of the strings. By holding the other string and waiting for the swinging string to come close enough to be grasped, the problem is solved. Here, as Dominowski (1995) suggests, multiple meaning changes are the crux of the solution. For example, the person must see the pliers as a weight instead of as a tool; rather than the person going to the needed string, the string comes to the person. The change in meaning accompanying the production of a new combination constitutes the experience of what I term intuition. In terms of this model, the person must sense relationships between the objects in the room, use some form of reason to see the meaning changes, and these occur with immediacy.



## RESEARCH DIRECTIONS

Of the three proposed components of intuition, perhaps the most difficult aspect of intuition to operationalize is the component of immediacy. As Jung (1921) comments, it is difficult to explain or discover how intuition comes to exist. While it may be difficult to isolate an intuitional thought, dynamic assessment measures may facilitate studying the intuitive process in action. Also getting at the component of immediacy, research could evaluate how processes such as incubation (taking time away from the task of interest) contribute to an intuitive reorganization of ideas.

The role of metacognition in intuition experimentation is intriguing. Can intuition coexist with metacognitive reasoning? What procedures discourage metacognitive thinking so as to facilitate intuitive thinking? Conversely, can intuition be prevented by forced engagement in metacognitive thought processes? Does intuition suffer in overly structured, self-conscious settings (as suggested by Noddings & Shore, 1984)? Intuition as conceptualized here can be characterized as intrinsic to the problem solving processes of prediction and estimation. An interesting line of research would be to study intuitive, analytical, and metacognitive components of prediction and estimation.

How does intuitive thinking fit into an information processing model such as that proposed by Pressley and McCormick (1995)? For example, how do short term memory capacity and knowledge influence intuition? Automaticity is associated with greater levels of expertise and well-developed knowledge structures; consequently, is it valid to ask if intuition is proceduralized, or is just the analytical reasoning supporting it proceduralized?

Methodologies to test and measure intuition and intuitive development need to be developed. For example, a person could look for patterns among items of variability in order to test his/her intuitive capability. Along that line, specific criteria for intuition problems need to be defined. How do factors such as format and representation facilitate making intuitive connections in traditional tasks? How do graphs, for example, facilitate intuitive understanding of mathematical results? For instance, can a person more readily see patterns by viewing data visually as a graph as opposed to viewing the data as a table? Also, methods to differentiate between intuitive understanding and numerical or analytical understanding (e.g. Ahl, Moore & Dixon, 1992) would be useful. What differences in the task itself encourage intuitive as opposed to more analytical processing? Given that subjects suggest that intuitive processes are unreportable creates an inherent difficulty in using self-report data (Schooler & Melcher, 1995).

In summary, research could address the following three areas: (1) the component of immediacy; (2) the relationship of intuition with metacognition and information processing; and (3) methodologies to test and measure intuition. Overall, more conceptual development of the construct of intuition would help to more clearly delineate intuitive thinking processes and provide a basis for research.

## REFERENCES

- Ahl, V., Moore, C., & Dixon, J. (1992). Development of intuitive and numerical proportional reasoning. *Cognitive Development, 7*, 81–108.
- Bastick, T. (1982). *Intuition: How we think and act*. New York: John Wiley and Sons.
- Baylor, A. (1997). A non-linear model for the development of mature intuition in the expert. Manuscript in preparation.

- Bowers, K., Farvolden, P., & Mermigis, L. (1995). Case studies of creative thinking: Reproduction versus restructuring in the real world. In Smith, Ward & Finke (Eds.), *The creative cognition approach* (pp. 27–51). Cambridge, MA: MIT Press.
- Brown, G., & Wolf, J. (1986). Development of intuition in the gifted. *Journal for the Education of the Gifted*, 9, 157–164.
- Bruner, J. (1963). *The process of education*. Cambridge: Harvard University.
- Dominowski, R. (1995). Productive problem solving. In Smith, Ward & Finke (Eds.), *The creative cognition approach* (pp. 73–95). Cambridge, MA: MIT Press.
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, 49, 709–724.
- Fischbein, E. (1975). *The intuitive sources of probabilistic thinking in children*. Boston: D. Reidel Publishing.
- Goswami, U. (1991). Analogical reasoning: what develops? A review of research and theory. *Child Development*, 62, 1–22.
- Halford, G. (1987). *Children's understanding: The development of mental models*. Hillsdale, NJ: Erlbaum.
- Hayes, J.R. (1989). Cognitive processes in creativity. In Glover, Ronning and Reynolds (Eds.) *Handbook of creativity*. New York: Plenum Press.
- Holland J., Holyoak, K., Nisbett, R., & Thagard, P. (1986). *Induction: Processes of learning, inference, and discovery*. MIT Press: Cambridge, MA.
- Houghton & Mifflin (1987). *The American heritage dictionary* [CD-ROM]. Microsoft Booksshelf 1992.
- Iaccino, J. F. (1993). *Left brain-right brain differences: Inquiries, evidence, and new approaches*. Hillsdale: Lawrence Erlbaum.
- Jung, C. C. (1921). Psychological types. In H. Read, M. Fordham & G. Adler (Eds.), *Collected works of C.G. Jung* (Vol. 6). Princeton, NJ: Princeton University.
- Koestler, A. (1964). *The act of creation*. New York: Macmillan.
- Kuhn, D. (1989). Children and adults as intuitive scientists. *Psychological Review*, 96, 674–689.
- Labouvie-Vief (1990). Wisdom as integrated thought: Historical and developmental perspectives. In R.J. Sternberg (Ed.) *Wisdom: Its nature, origins and development* (pp. 52–83). New York: Cambridge University Press.
- Maier, N. (1940). The behavior mechanisms concerned with problem solving. *Psychological Review*, 47, 43–53.
- Mandler, G. (1995) Origins and consequences of novelty. In Smith, Ward, & Finke (Eds.), *The creative cognition approach* (pp. 9–25). Cambridge, MA: The MIT Press.
- Metcalf, J., & Wiebe, D. (1987). Intuition in insight and non insight problem solving. *Memory and Cognition*, 13, 238–246.
- Noddings, N., & Shore, P. (1984). *Awakening the inner eye: Intuition in education*. New York, NY: Teachers College Press.
- Pressley, M., & McCormick, C. (1995). *Advanced educational psychology for educators, researchers, and policymakers*. New York, NY: HarperCollins College Publishers.
- Schon, D. (1982). Intuitive thinking? A digression stimulated by U-shaped curves. In S. Strauss (Ed.), *U-shaped behavioral growth* (pp. 227–247). Academic Press: New York.
- Schooler, J., & Melcher, J. (1995). The ineffability of insight. In Smith, Ward & Finke (Eds.), *The creative cognition approach* (pp. 97–133). Cambridge, MA: MIT Press.
- Smith, S., & Blankenship, S. (1989). Incubation effects. *Bulletin of the Psychonomic Society*, 27(4), 311–314.
- Sternberg, R. (1985). *Beyond IQ: A triarchic theory of human intelligence*. Cambridge: Cambridge University Press.
- Yaniv, I., & Meyer, D. (1987). Activation and metacognition of inaccessible stored information: Potential bases for incubation effects in problem solving. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 13, 187–205.