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PREVIEW

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**Information age cognition: A confirmatory factor analysis of  
critical thinking and metacognition with LISREL 7**

Munson, Dorie Elizabeth, Ph.D.

The University of Nebraska - Lincoln, 1992

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PREVIEW

**INFORMATION AGE COGNITION:  
A CONFIRMATORY FACTOR ANALYSIS OF CRITICAL THINKING AND  
METACOGNITION WITH LISREL 7**

by  
**Dorie E. Munson**

**A DISSERTATION  
Presented to the Faculty of  
The Graduate College at the University of Nebraska  
In Partial Fulfillment of the Requirements  
For the Degree of Doctor of Philosophy**

**Major: Interdepartmental Area of Psychological and Cultural Studies  
Under the Supervision of Professor Roger H. Bruning  
Lincoln, Nebraska  
August 1992**

DISSERTATION TITLE

INFORMATION AGE COGNITION: A CONFIRMATORY FACTOR ANALYSIS OF CRITICAL

THINKING AND METACOGNITION WITH LISREL 7

BY

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GRADUATE COLLEGE  
UNIVERSITY OF NEBRASKA

INFORMATION AGE COGNITION:  
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Dorie E. Munson, Ph.D.

University of Nebraska, 1992

Advisor: Roger H. Bruning

The purpose of this study was to attempt to gain insight into the constructs; metacognition and critical thinking, both individually and relative to one another. Both these types of thinking are necessary and appropriate for learning and managing in today's world. In order to approach the examination of these constructs individually and relative to one another, measurements of behaviors believed to be representative of both metacognition and critical thinking were taken. These measures then served as parts of a model. This model contained parameters that were specified a priori based on theory. The measured variables were specified as loading on one or the other factor in the model. A meaningful correlation between the two factors was anticipated. This proposed/specified model was then submitted to a confirmatory factor analysis to determine how well it fit the data.

The results of the study indicated a very good fit of the model to the data. One variable did not exhibit a meaningful relationship to either factor. The rest of the variables loaded well on the factors as specified a priori. The results also indicated a correlation between the factors much lower than hypothesized. The findings are discussed in light of the theory and future research in this area is recommended.

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PREVIEW



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## **Chapter One**

### **Introduction**

It has become increasingly apparent over the last few decades that we live in a world overflowing with information. We are constantly barraged with information on every topic imaginable in our work, our schooling, as consumers and in our private lives. Because of this tremendous amount of information, being a successful thinker today requires a greater complexity of thought. Thinking today needs to be higher-order and more integrative; focused on making sense of information and not simply trying to remember it. There is just too much to know.

In addition to the sheer volume of information being problematic, there is also the reality that information current today is often obsolete tomorrow. Technologies advance at amazing speeds, nations emerge and dissolve, and medical advances occur daily. Just this year we have seen the emergence of virtual reality technology in computer simulations, the dissolution of the Soviet Union, and a possible cure for cystic fibrosis on the horizon. These are just three of the dramatic ways our world changes almost daily.

As consumers of information and builders of knowledge we must focus on the critical analysis and monitoring of information. We must constantly ask ourselves; "Does this sound right? Is this conclusion supported by other information? Is this something I should remember? How can I fit this in with other things I know? What do I know? Is what I know consistent with information I'm receiving? How much do I know about this? Do I need to know more? Am I understanding this? Does this make sense?". And when

there is conflicting information, as there often is in a world in flux, we must ask; "Should I accept this new information, or is my current understanding OK? Which do I go with, my understanding, or the new and conflicting information?"

In tandem with this exponential increase in information, educators and researchers have become increasingly aware of and interested in complex cognitive processes. It is important to understand that there has been a dramatic shift in the study and framing of human thought and behavior. From the early part of this century until the early 1960's, psychology and society were dominated by the paradigm of behaviorism, which focused exclusively on human behavior and rejected the mind as worthy of investigation. There has occurred a revolution in both psychology and society that now sees the mind as a valuable and necessary focus of investigation if we are to come to a fuller understanding of the human experience. This shift in paradigms has been coined the cognitive revolution and is seen in both psychology and society. Baars (1986) has written extensively on this subject, making the point that in the last few decades both psychology and society have come to see the necessity and value of addressing the workings of the human mind -

- cognitive processes.

Cognitive processes can be understood to be "mental activities...including recognition, remembering, self awareness, thinking, reading, problem solving, and creativity" (Glover & Bruning, 1990, p. 20). Because cognitive processes are mental rather than physical activities, their existence must be inferred from behaviors. The study of cognition has been likened to the study of black holes in astronomy. Scientists who study black holes believe in their existence and seek to know more of them. Knowledge of black holes cannot be gained directly, but instead must be attained through inferences made about them based on the forces they exert on other entities in space. So it is with the study of the mind. We must develop new understandings of the mind not through direct

observation, but through inferences made about the mind based on observable behavior. This process is complex and elusive. The study of the human mind can take place only in small chunks, each attempting to address one small portion of the overall nature of the mind.

In pursuit of an increased understanding of cognition and especially cognition appropriate to the information age, study of complex cognitive processes must be undertaken. Two complex cognitive constructs of particular relevance to learning are critical thinking and metacognition. Critical thinking is generally understood to be thought that involves complex higher-order processing. This includes making inferences and deductions, testing assumptions, evaluating arguments, and examining the logic of a particular position (Watson & Glaser, 1980). It seems that the focus of critical thought is information external to an individual; (i.e., things we read, see, and hear).

Metacognition, on the other hand, is usually conceptualized as cognition about cognition or thinking about thinking. Metacognition involves "awareness and control of one's own cognition" (Brown, 1987). The focus of metacognitive activity is one internal to the individual; the inner knowledge and workings of one's mind.

Given that there is too much information to process at a level of rote memory and retrieval, we must devise and recognize ways to handle this overabundance of information. If an individual is able to assess not only the quality of information coming into their mind (critical thinking), but also the quality and status of the internal knowledge base and processing (metacognition), it seems reasonable to expect that cognitive resources may be allocated in a more efficient fashion, thus allowing an individual to function more effectively in this information explosion. Effective allocation of cognitive resources will allow for more functional responses to the demands placed on many learners in and out of formal educational settings. The importance of effective and efficient allocation of

cognitive resources cannot be overstated. Learners can be envisioned as managers of information. Those who most effectively manage their inventory and resources will prove most successful.

Although there seems to be a general consensus about what constitutes critical thinking and metacognition as well as agreement that they are both important for learning today, difficulties arise whenever one attempts to concretize definitions of these constructs. Both critical thinking and metacognition are complex cognitive processes that have defied close scrutiny, measurement, analysis, and clear definition. Many different terms have been used to attempt to communicate theoretical notions about them.

Although much has been written on the topics of critical thinking and metacognition separate from each other, little to nothing exists in the literature wherein the relationship between the two has been researched. This is intriguing because there seems to be a commonality between the two. While the foci of critical thinking and metacognition are different (external vs. internal), the nature of the thinking is similar in some aspects and there are recurring themes of reflection, analysis and other complex processing in the literature of both constructs. This is not to imply that, upon close examination of the research in these areas, critical thinking and metacognition are identical. They are not. However, they do seem to overlap in significant ways.

The overlap seems most prevalent in the nature of metacognition and critical thinking. Both exhibit characteristics of a reflective nature and both involve analytical thought. There also seems to be a common emphasis on the monitoring and evaluation of cognition in both. This overlap between critical thinking and metacognition can be visualized as two circles intersecting in a significant, yet not total way. The shared elements seem to be the reflection, analysis, monitoring, and evaluative thought evident in both critical thinking and metacognition. The areas that remain separate from each other



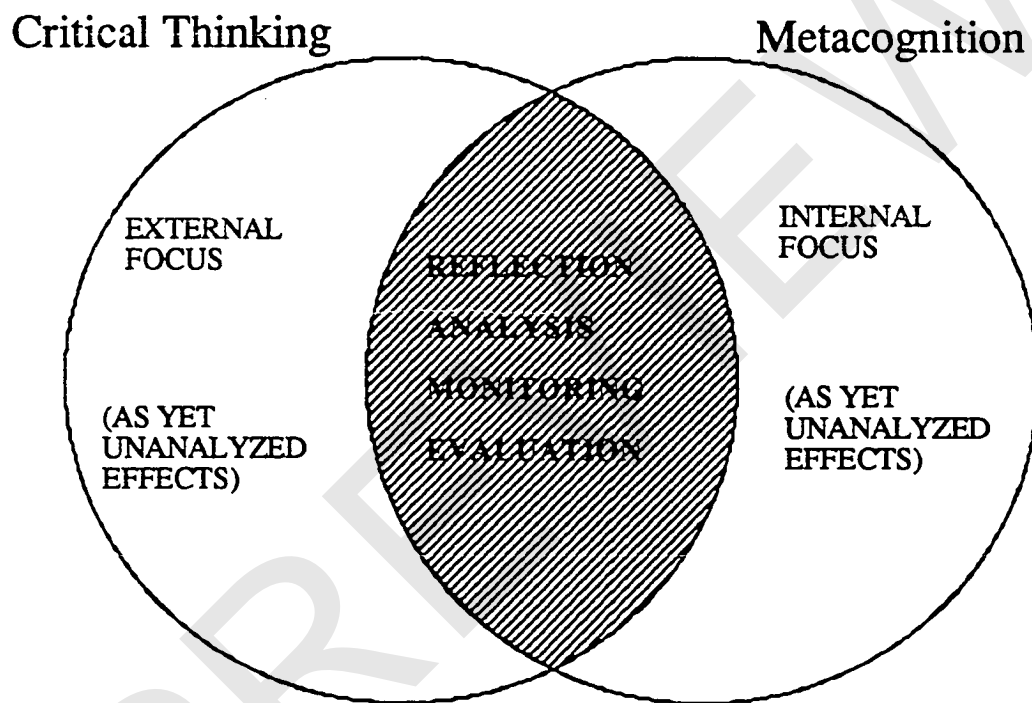
may result from the differing foci of each. It is also realistic to recognize that there are some elements in each contributing to the uniqueness that have yet to be analyzed or understood. These ideas are presented in Figure 1.

### **Purpose of this Study**

The purpose of this investigation was twofold. First, there was an attempt to gain insight into critical thinking and metacognition individually. This was addressed through measuring behaviors that were believed to be reflective of each and examining how well these variables grouped together as indicators of either critical thinking or metacognition. It was hoped that, as these constructs were subjected to systematic inquiry, a clearer and more easily communicated sense of these constructs would emerge. The second goal of this study was to better understand the relationship between critical thinking and metacognition. The focus of the second goal was the intersection (the shaded area) proposed in Figure 1. It was also hoped that the degree of overlap that appears in the literature would be supported by the emergence of a strong relationship between critical thinking and metacognition in this study.

Specifically this study sought to generate, through theory testing, a more highly evolved theoretical base in the area of critical thinking and metacognition. An important phase of theory development is the testing of a proposed theory and this study attempts to do exactly that – to seek empirical support for the theoretical bases of critical thinking and metacognition that are present in the literature as well as empirical support for the link between the two constructs proposed in this study.

There are different methods that allow for the testing of theory. For this study, the chosen method was confirmatory factor analysis. This method allows the researcher to specify a model based on theory, preliminary data, or both. Then through a number of

**FIGURE 1****The Intersection of Critical Thinking and Metacognition**

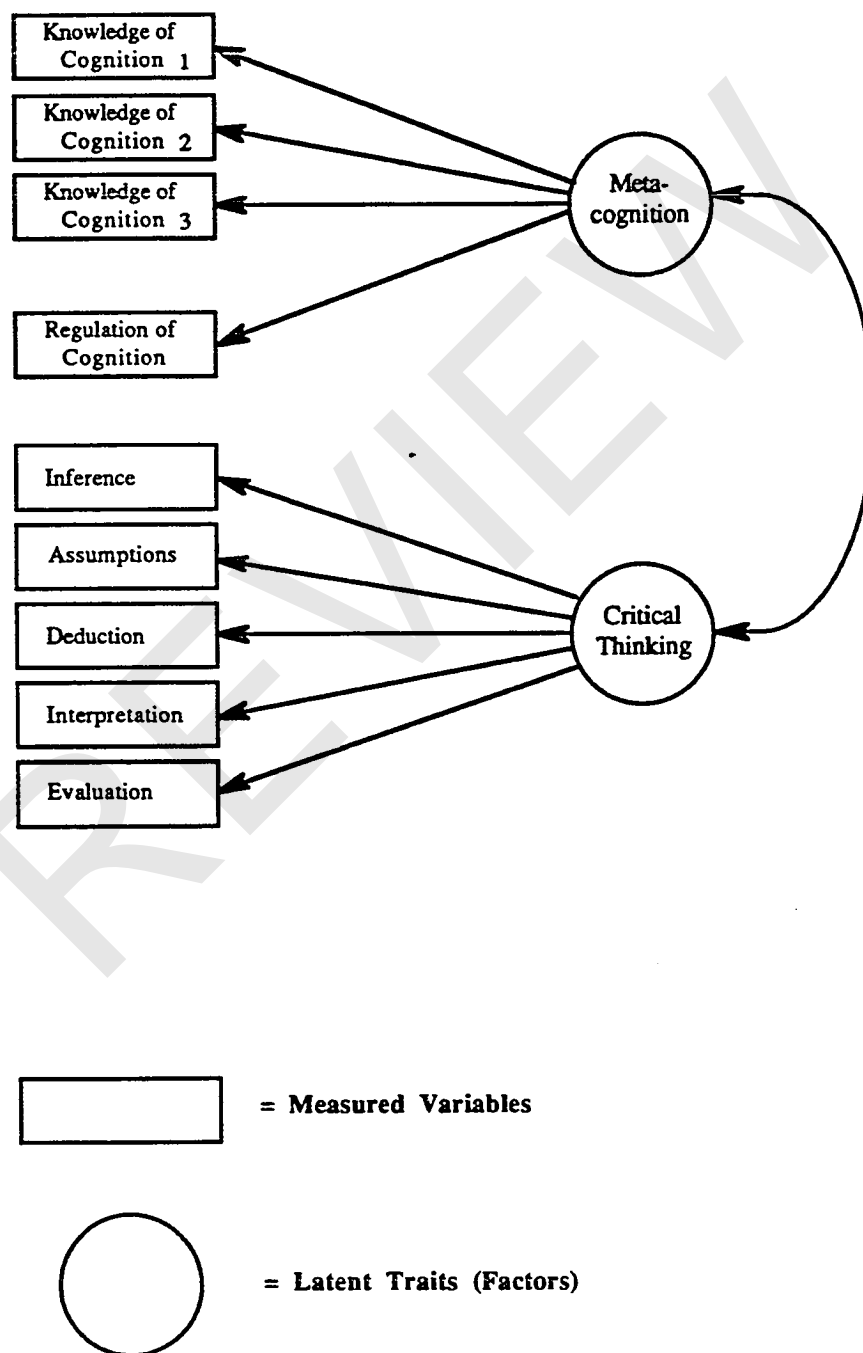
steps this model is tested for its appropriateness in explaining the data collected for the study. The model can be accepted as tenable if the fit between the specified model and the data is good enough. If the fit is lacking, however, the model can be respecified or even rejected. It has been suggested that researchers not conceptualize this process as looking for a goodness of fit, but rather, the question that needs to be addressed "...deals with how well a model *approximates* the observed data rather than whether or not the model *fits* the data" (p. 392) (Hoelter, 1983, in Marsh, Balla, & McDonald, 1988). No matter how one chooses to frame the process, model proposing and testing are valuable tools in moving forward both theory and practice.

### Discussion of the Proposed Model

The model being proposed for this study is shown in Figure 2. The rectangles in the model represent the measured or observed variables. These variables were generated from instruments that yielded data believed to be representative of the underlying construct. The circles represent the underlying constructs or factors in the model. The arrows in the model represent relationships between components of the model.

The first factor, metacognition, is believed to be manifest in performance on variables that tap an individual's knowledge of their own knowledge and their ability to regulate their cognition. These observed variables were obtained through the use of two different metacognition research instruments. One instrument examined an individual's knowledge of their own knowledge base. It involved judging the level of accuracy one attained in answering various questions at different points in a task. This instrument accounted for the observed variables Knowledge of Cognition 1, 2, & 3. The other observed metacognitive variable, Regulation of Cognition, was generated from an

**FIGURE 2**  
**Proposed Model of Metacognition and Critical Thinking**



instrument comprised of questions that focused on behaviors presumed to monitor and regulate cognition in learning.

The second factor, critical thinking, is believed to be manifest in performance on the remaining observed variables: Inference, Assumptions, Deduction, Interpretation, and Evaluation. Each of these observed variables was generated from a subscale of the *Watson - Glaser Critical Thinking Appraisal* (Watson & Glaser, 1980), which contains questions that require making inferences, recognizing assumptions, making deductions, interpreting logic, and evaluating arguments. Finally, the model portrays a relationship between the two underlying factors; metacognition and critical thinking. This relationship was specified based on the apparent link between critical thinking and metacognition implied by the literature.

The model proposed for this study knowingly addressed only portions of critical thinking and metacognition and was not intended to be wholly representative of either construct. This approach was deemed prudent by this researcher because of the difficulties inherent in the measurement of these constructs and the newness of model proposing and testing in this area of theory. It made sense to move from a simpler model to a more complex one later in the process of theory development. That is, the goal was to examine select aspects of each construct with the intention of expanding the model to include additional variables in later studies.

### **Significance of the Study**

Educators and researchers alike have come to recognize the importance and relevance of both critical thinking and metacognition in learning. Understanding these cognitive processes becomes important as the information continues to increase and learning by rote becomes increasingly inadequate and inappropriate. Few persons today

will leave their educational experience specifically trained for exactly what they will do once finished with school. For most, the educational experience can best serve long term needs by promoting and developing individuals' abilities to think.

As stated earlier, thinking required today seems to differ qualitatively from thought necessitated by earlier times as the amount and availability of information in the world has outstripped any individual's ability to know it all. For learners to attempt to do so not only is futile, but wasteful of cognitive resources. Instead, the emphasis in learning must be oriented toward the development and understanding of cognitive processes that allow individuals to manage and make sense of the sea of information encountered by all.

The overwhelming amount of information existing today has resulted in a considerable degree of change and perplexity for learners. According to Saylor, Alexander, and Lewis (1981), "One certainty in an otherwise uncertain future is that mankind will continue to be faced with social, economic, and technological changes, probably of an unprecedented nature." In light of this uncertainty, Bondy (1984) advocates reassessment of what it is children need to learn in school in order to succeed in the face of constant change and suggests that the enhancement of metacognitive abilities are essential. Bransford (1979), while rendering his opinion of current day education, points out that the products of learning are currently more heavily valued than the process. He suggests that it might be better for learners to focus on the processes involved in learning and evaluating their knowledge bases.

There appears to be no going back to a simpler time. Rather than struggling to keep pace while using outmoded ways of thinking, we must reframe and refocus our efforts to think in ways that empower us. This study is just one effort in the move toward better understanding and communication about thinking that will empower us and free us to face the world today better equipped cognitively.

### **Assumptions of the Study**

Because of the complex nature of both critical thought and metacognition it is important to explicitly identify and define which components of these constructs are being addressed in any particular investigation. Operational definitions are essential to increasing the understanding of and communication about these constructs. The provision of operationalized definitions in no way implies, however, that the variables in this study are wholly representative of critical thought or metacognitive activity. The specifics of both the componential and definitional aspects of critical thinking and metacognition will be provided later in this study after discussion of each construct. Nonetheless, it is important at this point to state the major assumptions of this study:

1. The constructs of metacognition and critical thinking are assumed to be too complex to be prudently addressed in their entirety in a single study. Hence, the measured variables in this study are acknowledged to represent some but not all dimensions of the underlying constructs of both critical thinking and metacognition.
2. Although the components of the critical thinking and metacognition constructs measured in this study and the definitions provided are acknowledged as partial, they are assumed to be valuable parts of the whole .

## **Research Questions**

The following research questions have been addressed in this study:

1. How well does the proposed model (Figure 1) represent the data collected in this study?
2. To what degree are the latent constructs, metacognition and critical thinking, related?

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