METACOGNITION AMONG STUDENTS IDENTIFIED AS GIFTED OR NONGIFTED USING THE DISCOVER ASSESSMENT

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DEDICATION

To Mom and Dad,

to Matt, Nick, and Bess,

and to Jacquelin

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ABSTRACT

Metacognition is an umbrella term that encompasses many related constructs about the knowledge and regulation of one's own thinking processes. Metacognitive knowledge about memory and attention has been found to correlate with intelligence levels and has been viewed as one component of giftedness. In this paper, definitions of both metacognition and giftedness are explained and situated in context so that the relationship between the two may be explored further. I also describe traditional and non-traditional methods of identifying children as gifted. While previous studies of metacognitive differences between gifted and nongifted children have been based on students traditionally identified as gifted, my study employed a non-traditional identification method, the DISCOVER assessment. In the study, I examine metacognitive knowledge about three elements: memory, attention, and decision making, in gifted and nongifted second-graders through an interview. The two main purposes of the study were to explore metacognitive knowledge about decision making, which had not been studied previously, and to see if varying the method of identification for giftedness would affect the metacognitive advantage for gifted children found in prior studies. No significant differences were found among the types of metacognitive knowledge studied. Statistically significant differences were found between the scores of gifted and nongifted children, with gifted children demonstrating greater ability to articulate their metacognitive knowledge. A qualitative discussion of students' responses illustrates areas in which the two groups of children differed in their understanding of their own thinking.

CHAPTER I

INTRODUCTION

While many ways of determining giftedness exist, few methods yield explanations of how gifted and nongifted students are different. Beyond the fact that some students have been called "gifted" and others have not, what are the important differences among these students? Metacognition, which may be thought of, in a simple way, as higher-order thinking abilities, is one promising area of study in which answers to this question may begin to be found.

In this study, I examined metacognition using an investigator-designed metacognitive instrument based on existing questionnaires (Borkowski & Peck, 1986; Kern, 1989; Kreutzer, Leonard, & Flavell, 1975; Miller & Weiss, 1982; Schwanenflugel, Stevens, & Carr, 1997). Groups of previously identified and non-identified second-grade students of various ethnic/cultural groups were assessed on three aspects of declarative metacognitive knowledge using an interview. The gifted students were identified as gifted by being rated highly in two or more areas of the DISCOVER assessment (Maker, 1992, 1996, 2001, 2004; Maker, Nielson, & Rogers, 1994).

In the section below, I discuss the significance of this study, addressing the gaps in current knowledge of metacognition and the difficulties with existing research on metacognition and giftedness. In addressing these difficulties, I also examine two paradigms for defining and identifying giftedness, the traditional and the nontraditional. At the end of this chapter, I present the research questions that guided this study.

Significance of the Study

Through a study of metacognition in young children, the current research furthers the description of possible differences in thinking between gifted and nongifted children. Whether identified gifted children differ from their non-identified peers qualitatively or quantitatively in their thinking processes has been the subject of discussion for some years (e.g., Rogers, 1986; Sternberg & Davidson, 1983; Shore, 1986, 2000). The exploratory study of metacognitive differences may provide more information about thinking differences than have other areas of study.

Studying Metacognition as a Means of Understanding Giftedness

Researchers and professionals in the fields of cognitive psychology and education of the gifted have stated that general intelligence tests are not fully adequate for addressing the host of cognitive questions of interest to them (cf. Maker, 1992; Renzulli, 1978; Shore & Kanevsky, 1993; Sternberg, 1982b, 1985a, 1988). Many in these fields have begun to investigate the use of measures of higher-order thought processes as more productive and useful than measures of general intellectual ability in understanding differences between gifted and nongifted students. Many giftedness identification procedures have proven useful in sorting students into gifted and nongifted groups. Typically, however, the identification process yields little to help researchers comprehend the ways in which these students differ in fundamental aspects. Perhaps the observable characteristics of behavior and performance documented in giftedness identification procedures reflect inner mental processes that can be examined through the study of metacognition.

Metacognitive ability may be a key component of giftedness (Cheng, 1993). In the Triarchic Theory of Intelligence, Sternberg (1985a, 1986, 1988) relates metacognition to both intellectual and creative functioning through the processes collectively known as "insight." Studies show that insight processes are used more often, or more effectively, by gifted students than by their nongifted peers (Davidson, 1986).

Extending Knowledge About Metacognition

Metacognition in a General Intelligence Theory Approach

One of two general approaches to research on exceptional performance is the traditional intelligence theory approach, in which measures of general intellectual ability taken in childhood are presumed to predict future academic or occupational performance. Such a belief guided Terman's (1925, 1959) longitudinal studies of children with high IQ scores. This approach has been followed in most research on metacognition, which will be examined in Chapter II.

Metacognition and Expertise

The second approach to studying exceptional performance is to examine those who are actually performing at very high levels. Such studies of expertise are based on the assumption that general abilities contribute little to expert performance. Rather, the extensive knowledge, specific skills, and sustained activity within a domain required for expertise must be acquired over time (Chi, Glaser, & Rees, 1982; Schneider, 1998). Recent studies of adult expertise show that general intellectual ability plays only a minor role in adult exceptional performance in a specific area (e.g., Chi et al., 1982; Chiesi, Spilich, & Voss, 1979; Posner, 1988). Some studies of the factors leading to exceptional adult performance have been focused on specific domain knowledge and, therefore, have not been generalizable to metacognition, which transcends specific knowledge.

However, exceptional performance by adults within a domain has been linked also to metacognition (Körkel & Schneider, 1992; Schneider, 1998), leading some researchers to believe that pursuing accurate measurements of metacognition would be more fruitful in helping to predict students' future success in a field than would measuring general intellectual ability. In reviews of research on metacognition (Alexander, Carr, & Schwanenflugel, 1995; Carr, Alexander, & Schwanenflugel, 1996), the reviewers have indicated that knowing a student's level of metacognition may be more useful than knowing his or her IQ, as metacognition may predict both school performance and adult performance better than does IQ (cf. Körkel & Schneider, 1992).

Areas of Metacognition Studied

Most studies of metacognition have been focused on measuring declarative metacognitive knowledge, cognitive monitoring, and strategy use. Researchers agree that the first two areas are components of metacognition, while the third area, strategy use, is less widely accepted as integral to the concept. Differences between gifted and nongifted groups have been identified relative to declarative metacognitive knowledge and strategy use, especially among older elementary age students. In their major review of the metacognition literature, Alexander and her colleagues (1995) have suggested that further research is needed in measuring declarative metacognitive knowledge in young children to establish what differences, if any, exist at young ages. More complex areas of metacognition than have been measured previously need further research, according to the review authors. Such studies should be focused on differences between gifted and nongifted groups, differences that may not be found when simple knowledge and skills are measured (Carr et al., 1996).

Extending the Areas of Metacognition That Have Been Studied

Generally, significant effects in favor of samples of gifted participants (giftedness effects) have been found for declarative metacognitive knowledge (Alexander et al., 1995), mostly in the metacognitive elements of memory and attention. Declarative metacognitive knowledge is comprised of many additional elements, however. My intent was to extend the study of declarative metacognitive knowledge beyond the elements of memory and attention to see more clearly the areas in which giftedness effects may be greatest. Knowledge of memory has been researched extensively (e.g., Alexander & Schwanenflugel, 1994; Borkowski & Peck, 1986; Borkowski, Ryan, Kurtz, & Reid, 1983; Flavell & Wellman, 1977; Kurtz & Weinert, 1989; Schneider, 1985). Knowledge of attention also has been examined (Kern, 1989; Miller & Weiss, 1982; Schwanenflugel et al., 1997), but no other elements of declarative metacognitive knowledge have been studied at all. In individual studies, significant effects in favor of gifted participants have been inconsistent (Alexander et al., 1995), at times indicating advantages for the gifted in metacognitive knowledge about memory and attention and at other times failing to show such advantages. Gifted and nongifted groups may have greater differences in other aspects of declarative metacognitive knowledge than they do in metamemory and meta-attention.

Extending the Range of Gifted Students Studied

Most research conducted on gifted students has included IQ or achievement scores as the basis for identification (Davis & Rimm, 2003; Richert, Alvino, & McDonnel, 1982). Historically, the use of standardized, norm-referenced tests as a means for identifying students for inclusion in special programs for the gifted has resulted in the identification and placement of students from the dominant ethnic, linguistic, socioeconomic, and culture group in numbers disproportionately large in relation to their representation in the general population (Frasier, García, & Passow, 1995; Maker, 1996; Richert, 1991; U.S. Department of Education, 1979). The continued use of traditional identification measures has resulted in a body of research conducted mostly on a homogeneous, dominant-culture population (Frasier, 1989). Through this study, I have broadened the range of students whose metacognitive abilities have been researched, by using a nontraditional means of identification to determine the gifted and nongifted groups.

Problems of a Limited Research Base

This research was designed to replicate and extend research in education of the gifted using nontraditional identification procedures. As stated above, the current body of research on gifted students has been based on limited groups. In the studies of gifted students and metacognition, researchers have failed to find significant giftedness effects in all areas of metacognition, effects that might have been found if other identification means had been used (Carr et al., 1996).

Broadening the Range of Participants in Studies

The giftedness identification method used in this study, the DISCOVER performance-based assessment (Maker, 1992, 1996, 2001, 2004; Maker et al., 1994), is a measure of problem-solving abilities in the multiple intelligences (Gardner, 1983, 1999, 2006). For this study, gifted students were defined as those students who had been rated as superior problem solvers on two or more portions of the five-part DISCOVER assessment. The DISCOVER method of identification is well-grounded in theory (Gardner, 1983, 1999, 2006) that links mental processes to observable behavior, making it a good fit for cognitive research (Shore, 1986). The DISCOVER assessment has been shown to identify as gifted equitable proportions of minority students (Perry, 1996; Sarouphim, 2001). Use of the DISCOVER assessment leads to identification of gifted minority students (with respect to ethnicity, language preference, and socioeconomic status) in the same number as their proportion of the larger population (Maker, 1997; Nielson, 1994). Through this study, I hoped to broaden the range of students whose metacognitive abilities have been researched by using a nontraditional means of identification to determine the gifted and nongifted groups for my study.

Looking at How Giftedness is Identified

Identifying Giftedness: The Traditional Paradigm

In recent years, the field of education of the gifted has resembled a maze of paths that converge at a single endpoint. The endpoint is the common goal of identifying and nurturing the talents of youths. The paths are the many ways of arriving at the goal. For example, many accepted definitions of giftedness have been developed (e.g., Marland, 1972; Renzulli, 1978; Gagné, 1985; Sternberg, 1986; Maker, 1993a). In addition, many methods of determining giftedness have been used to identify students for inclusion in programs for the gifted (see Table 1).

Traditionally, identification procedures that have been used widely include standardized tests of intelligence, achievement, or ability, and locally developed instruments (Callahan, Tomlinson, Hunsaker, Bland, & Moon, 1998). As stated previously, use of such traditional identification procedures has resulted in a largely homogeneous, dominant-culture population of identified gifted students. This situation has become less and less politically popular and defensible over time in the face of rising minority enrollment in American schools in recent years (Frasier et al., 1995; National Association for Bilingual Education, 1993).

The use of instruments thought to be more sensitive to individual students, such as locally developed teacher checklists, has not been a viable alternative to the use of standardized tests. Typically, locally developed instruments are created with little thought to alignment with theory, little or no pilot testing, and scant, if any, research into their validity and reliability (Callahan et al., 1998).

Major scholars in education of the gifted (Maker, 1993b; Renzulli & Reis, 1985; Sternberg & Clinkenbeard, 1995; VanTassel-Baska, 1998) have advocated an aligned approach to giftedness that includes a theory-based definition, identification procedures that result in the identification of children who fit the definition, educational programming that matches the needs of the students identified, and assessment procedures that provide useful feedback on the entire process. Without concern for

Table 1. *Traditional Methods of Identifying Giftedness*

Identification procedure	Example(s)
Individually-administered, standardized, national norm-referenced tests of general intelligence	Stanford-Binet Intelligence Scale, Fifth edition (Roid, 2007); Wechsler Intelligence Scale for Children, Fourth edition, or WISC-IV (Wechsler, 2003)
Group-administered, standardized, norm-referenced tests of intellectual ability	Cognitive Abilities Test (Lohman & Hagen, 2001); Naglieri Nonverbal Analogies Test (Naglieri, 1997); Otis-Lennon School Ability Test, Eighth edition (Otis & Lennon, 2005)
Standardized, national norm-referenced tests of achievement	Stanford Achievement Tests (Gardner, Rudman, Karlsen, & Merwin, 1982); Iowa Tests of Basic Skills (Hoover, Dunbar, & Frisbie, 2007); Iowa Tests of Educational Development (Forsyth, Ansley, Feldt, & Alnot, 2007); Terra Nova Multiple Assessments (CTB/McGraw-Hill, 2007)

Table continues.

Table 1. *Traditional Methods of Identifying Giftedness*

Identification procedure	Example(s)
Various criterion-referenced tests	State-mandated, standards-based competency tests
Identification through student interest and creation of a product	Revolving Door Identification Model (Renzulli, Reis, & Smith, 1981)
Tests of specific academic aptitude, such as mathematical ability	Scholastic Ability Test – Mathematics (SAT-M); Test of Mathematical Abilities for Gifted Students (TOMAGS) (Ryser & Johnsen, 2006)
Performance-based identification	Auditions; portfolios
Nomination	By teacher, parent, peer, or self
Grades	Report card

Table continues.

Table 1. *Traditional Methods of Identifying Giftedness*

Identification procedure	Example(s)
Teacher-developed rubrics	Project rubrics
Locally-developed checklists, interviews, and questionnaires	Various questions or characteristics compiled by an individual or team without reliability or validity studies
Checklists of behavioral characteristics	Scales for Rating the Behavioral Characteristics of Superior Students (SRBCSS) (Renzulli, Smith, White, Callahan, Hartman, & Westberg, 2002); Kingore Observation Inventory (KOI), Second Edition (Kingore, 2001)
Observations of problem solving	Harrison Observation Student Form (Harrison, 1996; Harrison, Coleman, & Shah-Coltrane, 2004); DISCOVER (Discovering Intellectual Strengths and Capabilities while providing Opportunities for Varied Ethnic Responses) process (Maker, 1992, 1996, 2001, 2004; Maker et al., 1994)

alignment, they argue, programming for the gifted becomes a piecemeal undertaking the cost and results of which may be difficult to defend.

Identifying Giftedness: A Newer Paradigm

Researchers and practitioners in the field of education of the gifted in recent years have intensified their efforts to create, validate, and implement new giftedness identification procedures. Several researchers including Joseph Renzulli, Robert Sternberg, and June Maker have stressed the importance of identification procedures that are grounded in theory, based upon consistent conceptual frameworks and definitions, supported by research, and aligned with educational methods for the effective implementation and evaluation of programs for the gifted. Sternberg has created a total model for definition, identification, programming, and evaluation (Sternberg & Clinkenbeard, 1995; Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Sternberg & Grigorenko, 2000). Both Renzulli, in the Schoolwide Enrichment Model (Renzulli & Reis, 1985) and in Total Talent Development (Renzulli, 1994), and Maker, in the DISCOVER process (Maker, 1992, 1996, 2001, 2004; Maker et al., 1994), have put their ideas of identification and alignment into practice on a continuing basis. Other theory-based, practice-aligned methods for identifying giftedness include observation-based performance assessments connected with Project STAR (VanTassel-Baska, 1996, 2002, 2005) and Projects U-STARS (Coleman, 1999) and U-STARS~PLUS (Coleman, 2001).

The field of education of the gifted has been far from reaching consensus regarding a single definition of giftedness or a single best identification procedure. Much more agreement among practitioners and scholars has existed about recommended instructional and curricular practices for use with gifted students, whether or not those practices are backed by solid empirical support (Shore, Cornell, Robinson, & Ward, 1991; Robinson, Shore, & Enersen, 2006).

The widespread use of untested identification procedures and of educational practices unsupported by empirical studies may have been partially attributable to the small body of existing research in the field. For the past couple of decades, an increase in research has been possible due to funding from the Jacob K. Javits Gifted and Talented Students Education Act (1988). Establishment of the National Research Center on the Gifted and Talented in 1990, with headquarters at the University of Connecticut and with additional research sites at universities across the country, has spurred a flood of needed empirical studies. In addition, other projects funded by Javits grants, such as DISCOVER III (Maker, Nielson, & Rogers, 1993), DISCOVER V (Maker, Nielson, Rogers, McArthur, & Nelson, 1997), Project STAR (VanTassel-Baska, 1996, 2002, 2005), Project U-STARS (Coleman, 1999), and Project U-STARS~PLUS (Coleman, 2001), have produced valuable additions to the research base in the field. New reviews of research on educational practices with gifted students have pointed to practices that are particularly effective (cf. Delcourt, Cornell, & Goldberg, 2007; Rogers, 2007; Swiatek, 2007; VanTassel-Baska & Brown, 2007).

Research has been conducted that affirms the validity and reliability of several recently-developed methods for assessing giftedness, such as the Revolving Door Identification Model (Renzulli et al., 1981; Renzulli, 1988; Starko, 1986), the DISCOVER assessment and curriculum (Griffiths, 1997; Maker, 1997, 2001, 2004;

Rogers, 1998; Sarouphim, 1999a, 1999b, 2000, 2001), and the Triarchic Model (Sternberg, 1981, 1986; Sternberg et al., 1996; Sternberg, Torff, & Grigorenko, 1998). As these and other methods of identification gain wider acceptance, replication of many studies of gifted individuals will be useful to see what effects varying identification procedures may have on other knowledge about giftedness. When research is conducted with more inclusive identification procedures based on broader definitions of giftedness and, therefore, with a wider range of participants, including participants from more diverse ethnic/cultural groups, heretofore undocumented differences between gifted and nongifted groups may be found.

Purposes of the Study

The two purposes of this study included further exploration of the qualitative differences between young gifted and nongifted students through extension of the study of declarative metacognitive knowledge beyond the previously studied elements, memory and attention, to include decision making. The second purpose was to replicate an existing metacognition study of gifted young children (Schwanenflugel et al., 1997) using nontraditional, rather than traditional, identification procedures and to compare the results of the current and previous studies.

Limitations of the Study

While many definitions of giftedness and many methods of identifying children as gifted exist, none has been agreed upon as the best. The definition of giftedness (Maker, 1993a; Maker et al., 1994; Maker et al., 1996) and the identification procedure (Maker, 1992, 1996, 2001; Maker et al., 1994) employed in this research were chosen for reasons that are articulated and explained later in this paper.

Agreement has not been reached among researchers concerning all the elements of metacognition, and I did not presume to complete the definition of metacognition. I only examined agreed-upon aspects of this multidimensional construct. I also did not attempt to fully define the relationship between metacognition and giftedness, although results from this research may further clarify that relationship.

Research Questions and Hypotheses

Three research questions guided this study:

1. In what ways do gifted and nongifted students differ in their metacognitive abilities, as measured by the metacognitive instrument?
2. To what extent will the results of the current metacognition research in which the participants have been identified as gifted using nontraditional identification procedures be similar to the results of a previous study in which participants were identified using traditional procedures?
3. When the study of declarative metacognitive knowledge is extended beyond the elements of memory and attention, in what ways will participants differ on measures of the additional element, decision making, as compared to measures of metamemory and meta-attention?

Hypotheses about each research question are listed below, stated as null hypotheses:

1. Students identified as gifted using the DISCOVER process as a means of identification do not differ in metacognitive ability, as measured by the investigator-designed metacognitive instrument, from their nongifted peers.
2. Identifying children as gifted or nongifted using non-traditional means results in gifted and nongifted participants demonstrating similar declarative metacognitive knowledge to the same degree that gifted and nongifted participants' metacognitive knowledge was found to be similar in previous studies where traditional intelligence testing was used as the identification method.
3. Gifted and nongifted students show similar scores on a measure of the decision making element of declarative metacognitive knowledge as compared to their scores on measures of other metacognitive elements.

This research was designed to investigate previously examined metacognitive advantages of gifted children over their nongifted peers in the areas of metamemory and meta-attention using an interview. Another facet in the design was created to address the issue of the low-level areas of metacognition that had heretofore been studied by adding the area of decision making to the metacognitive interview. Alternative identification measures, while not the primary focus of the study, are important to the study, because I believe that using such procedures will widen the range of gifted students whose thinking processes have been examined.

CHAPTER II

LITERATURE REVIEW

Metacognition has at its root conceptions of intelligence. As its name implies, it is a level of thought beyond thoughts, an ability to think about one's own thinking. Metacognition leads the learner to understand and manipulate his or her own learning (Baker & Brown, 1984; Brown, 1987; Jacobs & Paris, 1987; Schraw, 1994). As such, it is of interest to those who would study intelligence as a fluid construct. If metacognition allows one to comprehend and regulate one's own learning, then it should be studied by psychologists and educators as a possible framework within which to think about ways to help learners improve their own learning.

The purposes of this literature review are to explain to the reader the "fuzzy concept" (Baker & Brown, 1984) of metacognition, to assist the reader in understanding the history, scope, and methods of research about metacognition, and to lead the reader to recognize the importance of continuing to study the relationship between metacognition and giftedness. To accomplish these three purposes, this chapter is arranged into three sections: Defining Metacognition, Examining Research about Metacognition, and Probing the Relationship between Metacognition and Giftedness.

Defining Metacognition

Metacognition is an umbrella term that describes several sets of mental processes, all of which contribute to one's ability to think about one's own thinking. As such, according to Schraw and Moshman (1995), metacognitive theories are subsets of theories of mind. Wellman (1985) refers to metacognition as a theory of mind because it represents “acquisition of a large number of related propositions, facts, and implications through a complex and extended process” (p. 2). As theorists and researchers have attempted to define and study metacognition, they have identified and labeled various aspects of the construct. With the intent of clarifying a working definition of the term, I present the definitions of several key scholars here.

Definitions of the Term “Metacognition”

Metacognition is not a unitary construct (Alexander et al., 1995), but a combination of stored concepts that one possesses about one's own inner resources as a learner and current reactions to ongoing activity (Flavell & Wellman, 1977). Most researchers credit Flavell with coining the term metacognition and with being the first to use it consistently to refer to “the knowledge and control children have over their own thinking and learning activities” (Baker & Brown, 1984, p. 22).

Flavell (1987) stated that no metacognition exists without conscious awareness of it, making it a set of deliberate processes. Metacognition can be defined as the knowledge and deliberate regulation of cognitive processes while one is learning or performing a task (Brown, Bransford, Ferrara, & Campione, 1983; Miller, 1985). Brown and her colleagues stated that the two forms of metacognition, knowledge and regulation, are closely related and that attempts to separate them would result in oversimplification.

Two Agreed-upon Components of Metacognition

Most researchers agree that metacognition is of two types: knowledge and skills. Schraw and Dennison (1994) used factor analysis to examine the internal consistency of a two-component model of metacognition. They found that factors loaded in the same way across two different experiments, leading them to believe that metacognition consists of two parts, knowledge of cognition and regulation of cognition. The two factors, however, are not independent (Schraw, 1994; Swanson, 1990).

Metacognitive Knowledge

Metacognitive knowledge is knowledge about one's cognitive resources and the compatibility between oneself as a learner and the factors that influence one’s performance (Schraw & Moshman, 1995). For example, a learner who is aware of her own strengths in paying attention and in memory knows that she can learn effectively from a physics demonstration, because the learner knows she can pay careful attention to the demonstration and also can relate the demonstration to physics principles she has stored in memory. Metacognitive knowledge includes an appreciation of the variables that influence thinking, as well as the sensitivity to act accordingly (Cross & Paris, 1988). Our hypothetical physics student, then, will also be sensitive to how much attention she needs to allocate to the demonstration and to how important it is for her to activate the stored knowledge she possesses about physics.

Metacognitive knowledge is often described as static or declarative. Brown and others (Baker & Brown, 1984; Brown, 1987; Flavell, 1987; Schwanenflugel et al., 1997) have used the term “declarative metacognitive knowledge” to refer to long-term factual knowledge that children possess about mental activities. Brown described such knowledge as stable, referring to its long-term status, and as statable, meaning that children should be able to articulate it in some way.

Wellman (1985) described five overlapping sets of knowledge that comprise metacognitive knowledge: (1) the existence of thoughts and mental states, (2) awareness of and ability to distinguish among distinct mental processes, (3) knowledge about integration among mental processes, (4) knowledge about variables that influence cognition and about their specific effects, and (5) the ability to accurately assess the state of information within one's own cognitive system (cognitive monitoring). Flavell (Flavell & Wellman, 1977) categorized metacognitive knowledge in a different way, one that has come to be used more widely than Wellman's taxonomy.

Flavell (1987) described types of metacognitive knowledge children might acquire in terms of three variables: person, task, and strategy. Knowledge about person variables includes knowledge about one's own abilities, the strengths and weaknesses of others, and the universal knowledge typically possessed by individuals. Knowledge about task variables includes knowing "the different kinds of information that [might be] encountered and … the kind of processing that each kind of information requires or does not require" (Flavell, 1987, p. 23). Knowledge about task also might be called procedural knowledge, as it is knowledge about the execution of procedural skills (Schraw & Moshman, 1995). Knowledge about strategy variables includes understanding both cognitive strategies for making cognitive progress and metacognitive strategies for monitoring the cognitive progress. Flavell also emphasized that the three variables always interact and that knowledge about their interactions also is acquired by learners.

Others have subdivided metacognitive knowledge still further, recognizing "conditional knowledge," knowing when and why to apply various cognitive actions

(Schneider, 1998; Schraw & Moshman, 1995). Paris and his colleagues (Cross & Paris, 1988; Jacobs & Paris, 1987; Myers & Paris, 1978) stated that conditional knowledge is a subset of metacognitive knowledge that consists of children's ability to justify or explain their decisions concerning actions.

Metacognitive Skills

Metacognitive skills also may be called metacognitive activities (Baker & Brown, 1984), or strategies (Garner & Alexander, 1989), or executive processes (Borkowski & Kurtz, 1987). Metacognitive skills are context-free strategies that can be applied to cognitive tasks in many domains. These skills can be thought of as self-regulatory mechanisms used by an active learner (Schraw, 1994). Metacognitive skills include checking, controlling, coordinating, planning, predicting, guessing, monitoring, testing, revising, and evaluating strategies for learning or completing a task (Brown et al., 1983; Jacobs & Paris, 1987; Kluwe, 1987). Executive control or self-regulation is referred to as fluid or strategic rather than static, because it is used while the thinker is engaged in mental activity. Some researchers have stated that critical factors in turning metacognitive knowledge into metacognitive action, or strategy use, are causal and situational attributions (Alexander & Schwanenflugel, 1994; Fabricius & Hagen, 1984).

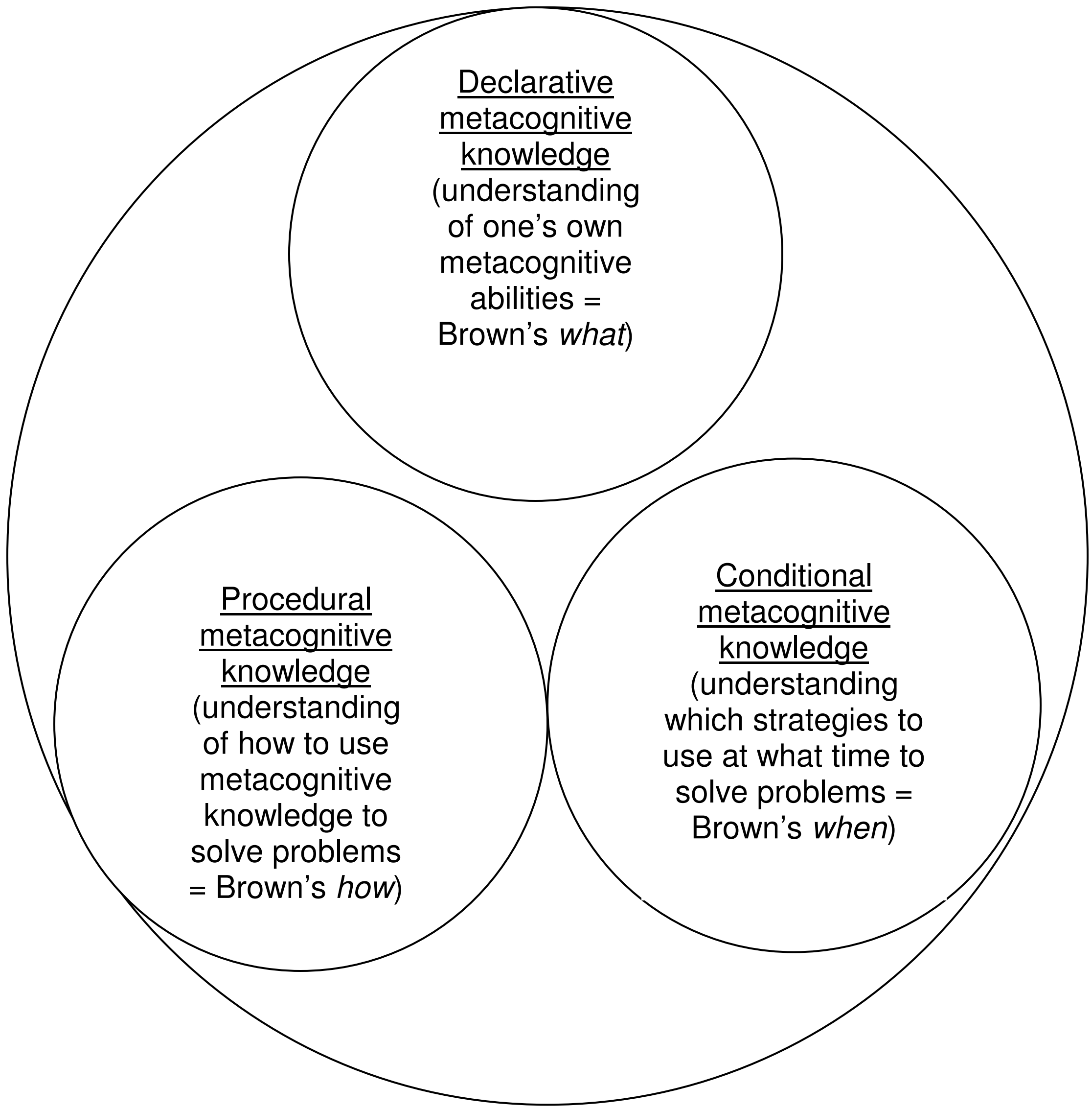
Regulatory processes, or metacognitive skills, may not be conscious or able to be articulated (Brown, 1987). Bouffard-Bouchard, Parent, and Larivée (1993) recommended that researchers control for the complexity of self-regulation, since it is a complex mechanism made up of mostly covert processes, by employing tasks in their studies that access multiple components, thereby allowing for the examination of these processes operating in concert.

Problems With the Definition of Metacognition

Ann Brown and her colleagues expressed concern about the proliferation of terms springing from early inquiries into the nature of metacognition and the misunderstandings that might occur (Brown et al., 1983). They recommended that researchers use the most precise terms available for any process they chose to investigate, such as planning or hypothesis testing, and leave the term “metacognition” in its original sense to refer to knowledge about cognition. The authors proposed that metacognition be studied in three aspects: knowledge about *what*, knowledge about *how*, and knowledge about *when*. That is, they proposed that researchers examine students’ understanding of their own cognitive abilities (the *what*), their understanding of how to go about using that knowledge to solve problems (the *how*), and their understanding of which strategies to use at what time (the *when*). (See Figure 1.)

Cross and Paris refined Brown’s terms and used them to describe three components of metacognition: metacognitive knowledge or **declarative knowledge** (Brown’s *what*), strategy use or **procedural knowledge** (*how*), and executive control or **conditional knowledge** (*when*) (boldface terms from Cross & Paris, 1988). Examination of the terms reveals a blurring of the distinction between knowledge and action. Over time, Brown’s idea of how children use their knowledge to go about solving problems, although renamed procedural knowledge, has become strategy use, an action. However, these three components, as named here and in Figure 1, have proven useful for

Figure 1. A graphic overview of metacognitive knowledge



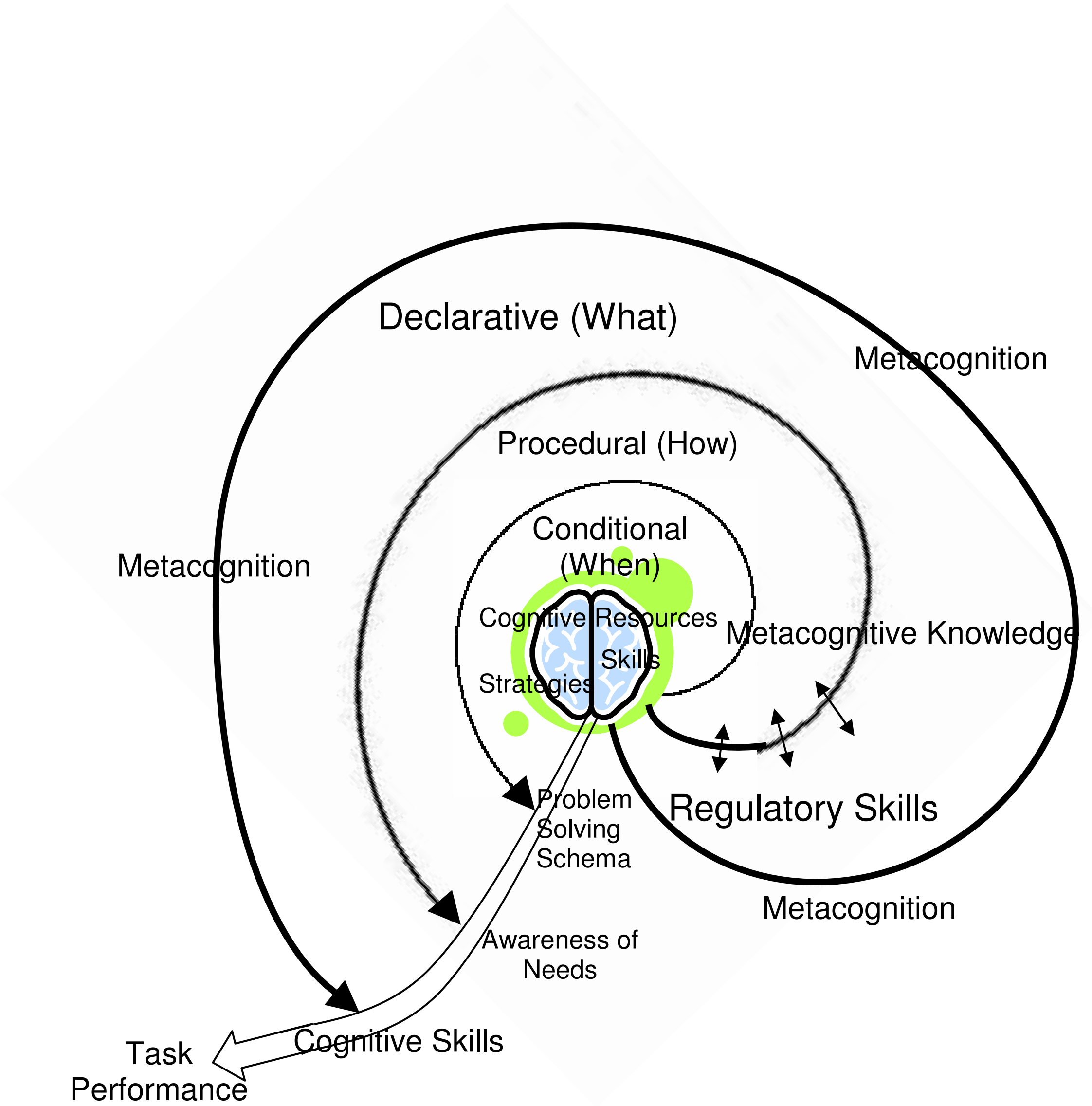
Underlined terms from Cross & Paris, 1988

Terms and explanations in parentheses from Brown, 1978: students' understanding of their own cognitive abilities (the *what*), their understanding of how to go about using that knowledge to solve problems (the *how*), and their understanding of which strategies to use at what time (the *when*) researchers. Each of these components has spawned its own body of literature, thereby contributing to the confusion about what constitutes metacognition. Strategy use seems to be the most pragmatic area to examine, because it points to specific training that can be used with students to improve certain skills such as reading. In fact, the majority of research on metacognition has been done on strategy use for improving reading, particularly for struggling students (e.g., Baker & Brown, 1984; Cross & Paris, 1988; Jacobs & Paris, 1987; Myers & Paris, 1978).

I briefly review the literature on strategy use below because it has shed light on the development and understanding of metacognition. However, the construct as I have explained it in this paper has two components: metacognitive knowledge and metacognitive, or regulatory, skills (see Figure 2). These two components interact to direct cognitive skills to the task at hand. Flavell's three variables are represented in the graphic by the brain (person variables), "Awareness of Needs" (task variables), and "Problem Solving Schema" (strategy variables). The brain illustrates the learner's cognitive resources, skills, and strategies, all of which are part of the learner's understanding of person variables. The learner must be aware of the demands of the task and must apply problem solving schema developed through experience. Understanding these three variables in a particular situation enables the learner to use his or her cognitive skills to cause a certain level and effectiveness of task performance.

Yussen (1985) argued that existing definitions of metacognition did not assist researchers in answering important key questions, such as how metacognitive knowledge develops in children across various quantitative or qualitative levels of understanding,

Figure 2. A graphic representation of metacognition



Original graphic design by W. Leader and P. Heller, 2007 during what period of time in childhood it develops, or whether it can be taught. He recommended that researchers use alternative frameworks for studying metacognition besides general problem solving. He suggested such approaches as information processing, psychometric, cognitive-structural, and cognitive-behavioral and listed ways in which each of these approaches might add to the knowledge base. He stated that research based on complex frameworks might uncover the nature of metacognitive knowledge that might be dependent upon the type of problem being pursued, for example. He also stated that different levels of analysis might be required to explain metacognition in different kinds of problem frameworks, such as automatic, and in rapid executive processes versus conscious, deliberate ones.

Examining Research About Metacognition

Early Research Into Metacognition

John Flavell's work as a psychologist led him to theorize about metacognition in the 1970s. The movement away from seeing intelligence as a fixed, one-faceted construct gave rise to ideas about what processes or components might make up intelligence. "The term metacognition was introduced by psychologists to refer to the knowledge and control children have over their own thinking and learning activities" (Baker & Brown, 1984, p. 22, citing Flavell, 1978 and Brown, 1978).

Identification of metacognition as a part of intellectual functioning began with research into the thinking of children with developmental disabilities by Brown and her colleagues (cf. Brown, Campione, & Murphy, 1977). One of Brown's main interests was examining the differences in metacognition between developmentally disabled children and children of regular intelligence levels, especially as it related to reading comprehension. Brown hypothesized that, just as differences in metacognition separate average from developmentally disabled intellectual performance in experiments (e.g., Brown et al., 1977), so those differences might be a distinguishing characteristic of gifted intellectual performers as compared to average performers (Campione, Brown, & Bryant, 1985; Sternberg, 1985b, 1988).

The Study of Metamemory

The most-studied aspect of metacognition is metamemory (e.g., Borkowski & Peck, 1986; Kreutzer et al., 1975; Kurtz & Weinert, 1989; Schneider, 1998), or how the learner understands and manages memory tasks. Since memory is recognized as a considerably important aspect of intelligence, these studies have value for researchers studying high intellectual ability. Certainly one of the most important aspects of problem solving is recalling what one already knows. Sternberg and Davidson's (1983) concept of selective encoding, or recall of only specific pieces of information or processes, is a crucial aspect of what they refer to as "insight," which is required for solving problems.

Metamemory has been studied extensively by psychologist John Borkowski (Borkowski & Kurtz, 1987; Borkowski & Peck, 1986; Borkowski, Ryan, Kurtz, & Reid, 1983) and by German scholars such as Weinert (Kurtz & Weinert, 1989), Schneider (1985, 1998), and Kluwe (Kluwe, 1987). Classical speed-of-processing tasks such as card-sorting or cloze tasks often were used to elicit measurement of metacognition. However, the spate of studies on metamemory in this decade and the next began to demonstrate researchers' desires to explore the existence of metacognition in authentic tasks such as reading comprehension (Hannah & Shore, 1995) and in other areas of psychological processing.

Memory was considered by researchers to be necessary to intelligence (Campione et al., 1985; Pressley, Borkowski, & O'Sullivan, 1985). Relating memory to expertise, Chi (1987) stated that it was a large number of chessboard patterns stored in memory that distinguished chess experts from novices, not powerful search heuristics.

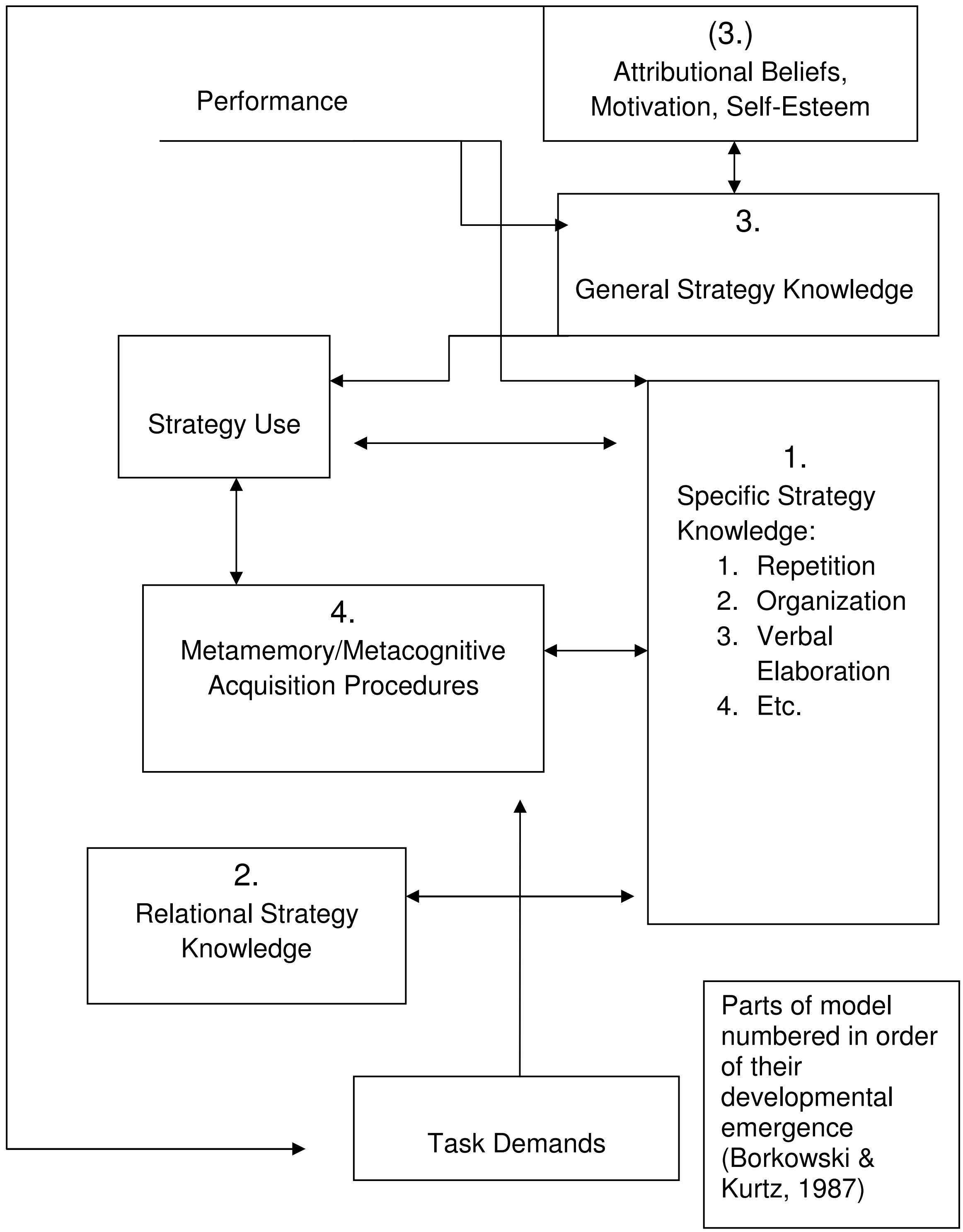
Researchers sought more details about memory and its connection to intelligence through the study of knowledge about memory, or metamemory. Results of some studies of metamemory were encouraging in making distinctions between groups of varying intellectual levels. For example, Borkowski and Peck (1986), Kurtz and Weinert (1989), and Swanson (1992) all found that gifted children showed greater knowledge of variables affecting memory than did nongifted children. Borkowski, Ryan, Kurtz, and Reid (1983) found significant correlations between a metamemory battery and intelligence as measured by psychometric tests. When a task-specific study of metamemory was undertaken by Alexander and Schwanenflugel (1994), they found that gifted children had better understanding of the use of higher-level strategies for recall than did their nongifted peers.

Kurtz and Borkowski (1987) studied the relationship of metacognition to cognitive style (reflectivity and impulsivity). They stated that impulsivity is associated with a metacognitive deficit and can be of two types, a deficiency in cognitive strategies or a deficiency in executive processes. In their longitudinal study, they predicted that metacognitive training in executive control would influence the cognitive style of students, causing those with more highly developed metacognition to become more reflective. This prediction was not supported. Instead, they found that their executive process training was beneficial to the performance of children with both impulsive and selective cognitive styles. They also found that early metamemory predicted acquisition of high-level reading skills three years later.

In another study, Borkowski and Kurtz (1987) measured the metacognitive knowledge of students of varying intellectual levels and compared them on their strategy use. They concluded that "…efficiency in strategy use defines gifted performance, especially on complex tasks." They used a conceptual model of metacognition (see Figure 3) that was first created by Pressley, Borkowski, and O'Sullivan (1984) as a framework for examining a wider range of cognitive activities than just memory. Echoing the views of Sternberg, Borkowski and Kurtz stated that the type of interactions among metacognitive components comprises a qualitative difference among students of various intellectual levels. Insight and the executive processes included in metamemory acquisition appeared to be standard for gifted children, whereas average students required help to coordinate higher- and lower-level processes. Borkowski and Kurtz became early proponents of the connection between metacognition and giftedness when they stated that more sophisticated and accessible executive processes are key signs of giftedness.

Schneider (1998) examined the relationship between metacognition and performance at a high level, or expert performance. His 1985 meta-analysis of studies about the metamemory-memory performance relationship found that links between children's general knowledge about memory and their memory performance were only

Figure 3. A conceptual model of metacognition



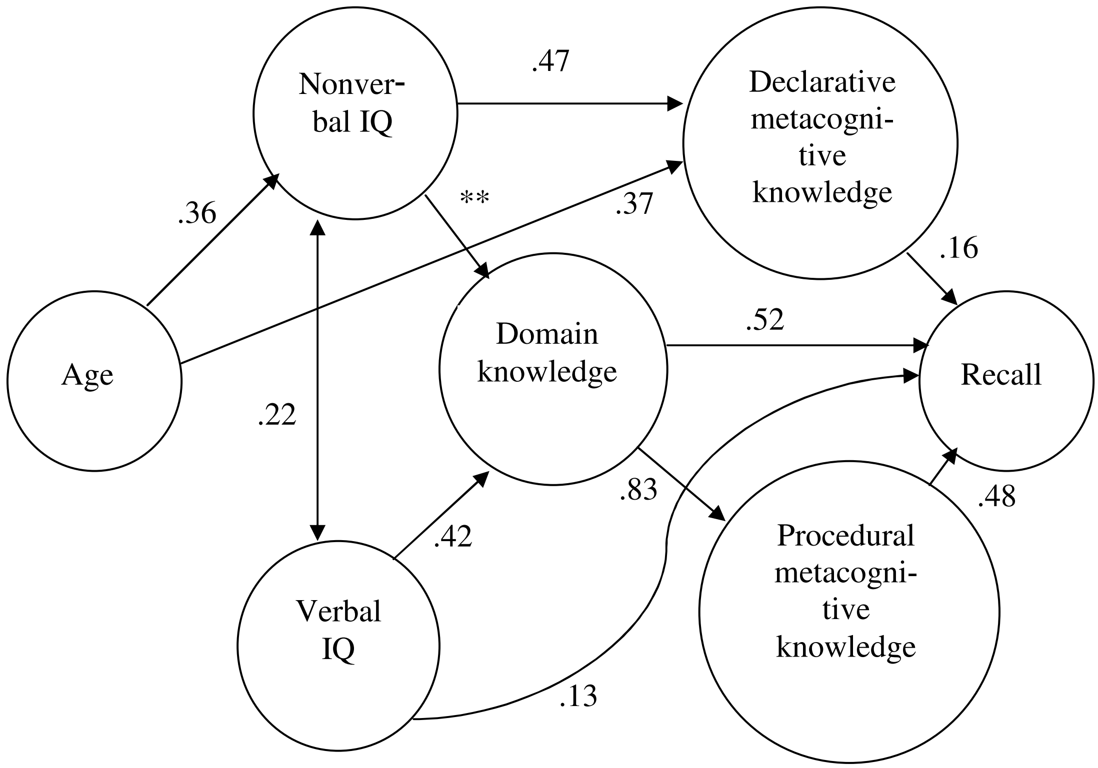
moderate (Pearson's *r* of .41). When he examined procedural knowledge about memory as it related to domain-specific recall, however (Körkel & Schneider, 1992), the link was found to be both direct and indirect. Körkel and Schneider used structural equation modeling to illustrate the effects of both procedural metamemory and domain-specific knowledge on performance (see Figure 4).

Chi (1987; Chi, Glaser, & Rees, 1982) viewed metacognitive knowledge as part of problem solving schema used by experts. Declarative knowledge in the schema generates potential problem configurations and conditions of applicability for procedures, while procedural knowledge generates potential solution methods.

The Study of Meta-Attention

Miller and her colleagues (Miller & Weiss, 1982; Miller, 1985) studied metacognition about attention in children in a range of ages, seeking understanding about the development of metacognitive knowledge. Attention is another aspect of cognition that has been noted to contribute to problem solving. If one does not allocate the proper amount of attention to the various parts of the task at hand, the task does not get completed accurately, in the best way, or in a sufficient amount of time. Miller (1985) stated that planning, or regulation, was allocating attention, and she therefore studied it as a vital part of metacognition. The efficient thinker cannot give attention to all things in memory and in the environment equally. Meta-attention has been studied briefly by researchers seeking to discover when children first become aware of how they allocate attention (Kern, 1989; Miller & Weiss, 1982; Schwanenflugel et al., 1997). Differences in meta-attention have been mostly developmental and not ability-related, indicating that

Figure 4. Structural equation model of metacognition-performance links



Structural equation model describing the impact of intelligence and various knowledge components on text recall (data from Körkel & Schneider, 1992; reported in Schneider, 1998, p. 17).

** path coefficient of Nonverbal IQ to Domain Knowledge not given in the original report children of different levels of intelligence grow in their knowledge about attention at similar rates (Alexander et al., 1995).

The decade 1990-2000 saw a flood of studies of metacognition by psychologists and educators. As educators sought deeper understanding of the richness of students' thought processes, they began to wonder about level of metacognition as an alternative, or as a correlate, to the psychometric measurement of intelligence levels. Sternberg (1985b) postulated that gifted children put together the various components of mental functioning more efficiently than do their nongifted peers because of their superior knowledge of and abilities to manipulate their own thinking.

Development of Metacognitive Knowledge

At what age do children begin to be aware of how they think? Research yields mixed results about the ages at which children demonstrate metacognition, although a certain amount of self-understanding is presumed to be shown by young children as they learn language (Moss, 1990, 1992; Wellman, 1985). Understanding about memory and attention at very simple levels begin as early as pre-school age (Miller, 1985; Wellman, 1985), but more sophisticated understanding may not appear until college age. Indeed, level of metacognitive awareness seems to vary widely in adults. A high level of domain-specific metacognitive awareness is one of the distinguishing characteristics of experts (Chi et al., 1982; Schneider, 1998).

Strategy Use

Strategy use is the action caused by declarative metacognitive knowledge. Strategies are described by Chi (1987) as the control processes used to manipulate information.

Brown (1978) made a bidirectional hypothesis about causal links between metamemory and appropriate use of a strategy, with metamemory directing strategy use and successful strategy employment producing changes in knowledge about memory. This hypothesis has had some confirmation, with some researchers finding that strategy use produces increased learning (Cross & Paris, 1988; Gaultney, 1998; Kurtz & Weinert, 1989) and some finding that prior successful strategy use increases metacognitive knowledge (Carr, Alexander, & Folds-Bennett, 1994). In the case of gifted learners, however, researchers often find that strategy training does not improve performance (Gaultney, 1998), or that instructor-chosen strategies interfere with gifted children's own strategy invention (Davidson, 1986; Kyllonen, Lohman, & Snow, 1984).

Although strategy and reading research are frequently hand-in-hand, strategy use has been the focus of many studies in a variety of areas of mental tasks besides reading (e.g., mathematics – Carr et al., 1994; Dover & Shore, 1991; Shore, Koller, & Dover, 1994; spatial tasks – Kyllonen et al., 1984; verbal concept formation – Bouffard-Bouchard et al., 1993). Researchers in the field of education of the gifted do not often study strategy instruction and transfer, although it is still studied and promoted in general education (e.g., Cross & Paris, 1988; Fabricius & Hagen, 1984; Kyllonen et al., 1984; Paris & Jacobs, 1984; Pressley, Harris, & Marks, 1992). When strategy use is studied in the context of giftedness, research generally is focused on strategic behavior and individual strategy generation as a qualitative difference between gifted and nongifted individuals (e.g., Hannah & Shore, 1995; Kurtz & Weinert, 1989; Scruggs & Cohn, 1983; Scruggs & Mastropieri, 1985, 1988). Indeed, Jackson and Butterfield (1986) stated that one of the most reliable differences between the cognitive behaviors of gifted and average children is their use of strategies on problem solving and memory tasks.

Despite researchers' and educators' practical interest in examining strategy use, however, Sternberg (1991) placed it as merely a skill within one component of intelligence. Others found that strategy use was so embedded and automatic in the thinking and problem solving of gifted students that they either did not appear to use strategies (Garner & Alexander, 1989) or were unable to make use of strategy instruction (Gaultney, 1998). In instances of high ability in specific areas, strategy instruction was actually counterproductive (Kyllonen et al., 1984).

Although this was not the case in every study of strategy use among gifted students (Carr et al., 1996), many researchers found that when gifted students did learn strategies, they often spontaneously transferred them to other learning situations (Borkowski & Peck, 1986; Kanevsky, 1990; Scruggs, Mastropieri, Monson, & Jorgensen, 1986). Some researchers have found that gifted children resemble their older nongifted counterparts in strategy use and transfer (e.g., Cho & Ahn, 2000; Scruggs & Cohn, 1983). Strategy use and transfer, say some researchers, appear so complex (Zimmerman, 1990) and idiosyncratic (Kyllonen et al., 1984) that it is difficult to study them as general processes.

In their study of the self-regulatory skills of gifted and average students, Bouffard-Bouchard and her colleagues used multiple measures of strategy use and motivation and concluded that their gifted participants did not use more strategies than average students, but that they used their existing strategies more consistently in solving a complex problem. Further, gifted students exhibited higher motivation than did their average counterparts in the study, leading the authors to state that metacognitive understanding of the value of strategy use may lead to greater investment of effort, which in this research was correlated to a higher performance level (Bouffard-Bouchard et al., 1993).

Affective and Social Facets of Metacognition

That metacognition is a complex construct has been stated repeatedly by researchers as far back as Flavell. He described metamemory as a form of social cognition, since it refers to cognition about a type of human activity (Flavell & Wellman, 1977). The social aspects of metacognition have been investigated extensively by Moss (1990, 1992), who described the effects of social interaction with their mothers on very young children's metacognitive expressions. Moss reported that the type of mother-child teaching she observed involved modeling and scaffolding to assist guided discovery, as described by Vygotsky (1978).

Miller (1985) described social attribution theory as a framework for studying meta-attention, because children's attributions have an effect on their emotions, self-concept, and subsequent behavior. She used the example of a child who attributes her inattention to lack of effort and is therefore more open to the suggestion to try and pay more attention than are children who attribute their inattention to lack of ability.

Garner and Alexander (1989) concluded that “without high self-esteem, internal locus of control, and the tendency to attribute success to effort, students are unlikely to invoke complex cognitive and metacognitive routines to improve learning” (p. 146). Bouffard-Bouchard and her colleagues (1993) found differences between gifted and nongifted students in their affective reactions to tasks and the number and valence of metacognitive statements they made while engaging in the tasks. Average students made more negative statements about their metacognitive experiences than did gifted students. The authors speculated that when problem solving was going well, as it did for the gifted students in the study, participants tended to comment less on the process.

Metacognition and Motivation

Borkowski and Kurtz (1987) also studied relationships between metacognition and motivation. They concluded that realizing the value of strategy use is motivational, particularly for exceptional children. Bouffard-Bouchard and her colleagues (1993) found that effort and efficient strategic processing were related to high performance levels by gifted students on a complex task. Students with a high “learning” orientation (i.e., those who see ability as malleable and incremental and who are interested in improving their competence as opposed to just demonstrating it) use more learning strategies than do students with other orientations (Schraw & Dennison, 1994). Carr, Alexander, and Folds-Bennett (1984) found similar results with a study relating internal strategy use and metacognition. They also found that metacognitive levels and effort attribution are related.

However, Weinert (1987) also examined connections between metacognition and motivation. Kurtz and Weinert studied metacognition and its relationships to attribution theory (1989). They used a causal modeling program to determine the relationships between metacognitive knowledge and performance based on their experiments with average and gifted children of different ages (see Figure 5). According to the authors, strategy use was a mediator between metacognitive knowledge and memory performance the majority of the time. It directly influenced performance in younger gifted children and in older average children as well as indirectly influencing it through strategy use. One of the interesting conclusions they reached was that effort attribution played a negative role in the performance of gifted children. The study was valuable in linking metacognition causally to performance, which became a building block for studies of metacognition and expertise.

Problems With Studying and Measuring Metacognition

One of the chief problems in the study of metacognition has been the difficulty in settling on a common definition and on agreed-upon components (Brown et al., 1983). It is a term that has been applied generally to many specific areas of concern to both developmental psychologists and cognitive psychologists.

A persistent problem for researchers studying metacognition has been that self-report and behavior often do not match, due to the distinction between statable declarative knowledge and procedural knowledge, which may be subconscious (Baker &

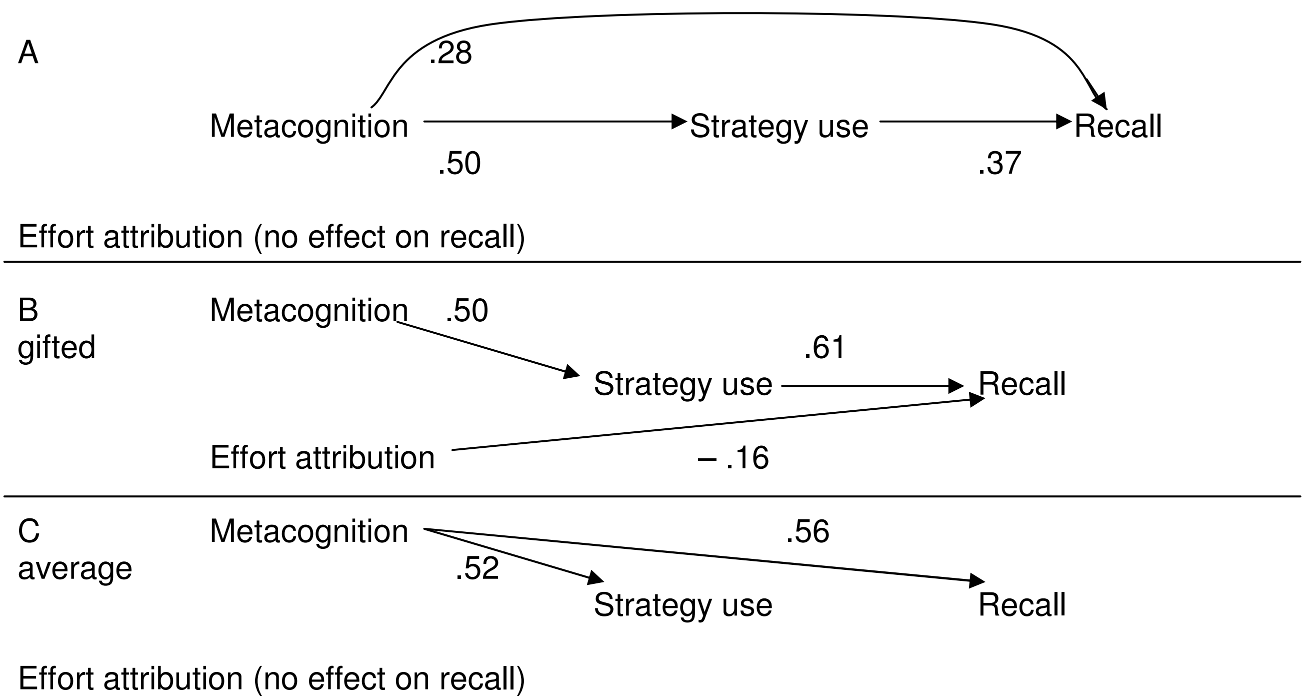
Figure 5. Causal modeling applied to memory performance

Use of a causal modeling program:

A – for average 7th-graders and gifted 5th-graders: metacognition directly and indirectly influences recall

B – for gifted students: metacognition directly influences recall; effort attributions negatively influence recall

C – for average students: effort attribution has no effect on recall; metacognition has no indirect influence on recall



(Kurtz & Weinert, 1989)

Brown, 1984). The many attempts of researchers to model the effects of various aspects of metacognition on actual performance, particularly in memory, demonstrate that the cognitive mechanisms that translate knowledge into action are not well understood.

A third concern with studies of metacognition is the difficulty of the tasks assigned to participants. Campione, Brown, and Bryant (1985) reported that by the 1960s, researchers had begun to recognize that the use of simple, low-level tasks would not elicit information from participants about their cognitive processes, but would only demonstrate their abilities to perform. Since that study, many researchers have found that the more difficult and complex the task, the greater the differences between the metacognition of gifted and nongifted students (Carr et al., 1994; Gaultney, 1998; Schofield & Ashman, 1987; Schraw & Dennison, 1994). Schwanenflugel, Fabricius, and Noyes (1996) stated that uncertainty produces deeper mental processing, which would account for the improved metacognition that accompanies complex tasks.

Methods for Studying Metacognition

Metacognition can be assessed directly through interview or indirectly through observing problem solving and inferring or deducing certain metacognitive capabilities from the problem solving processes employed (Shore, 1986). Domain-independent measures (i.e., not tied to either task or subject matter) of metacognition are usually self-report scales (O'Neil & Abedi, 1996). Self-report from children usually involves an interview, either structured or open-ended. "Verbal self-report is a crucial source of information on self-regulation…," declared Bouffard-Bouchard and her co-researchers (Bouffard-Bouchard et al., 1993). According to Miller (1985), the most demanding method of metacognitive research, from a child's viewpoint, is the open-ended interview, because he or she is asked to be introspective or to give reasons for his judgments.

Researchers must be careful to avoid asking children to report on that for which they have no vocabulary. They also need to be aware how unaware many children are of their own cognitive processes. Another issue is the possible influence that one may have on a child's cognitive processes or his view of cognitive processes simply by asking a question about them (Brown et al., 1983). These authors suggested that one way to strengthen the probability that verbal reports will be truthful is to use the "critical incident" technique (Brown et al., 1983). In this technique participants are asked only about specific incidents that are clear in their minds, not about general situations. In addition, the authors recommended that children asked to give verbal reports about nonverbal phenomena be given "goal-directed guidance," such as asking them to state a rule or to give instructions that someone else could use.

Miller (1985) reflected on the advantages of using the open-ended interview with children: the answers can be unconstrained by the questions and can be rich and complex. The disadvantages, however, are numerous: children's difficulties with comprehending verbal material, difficulties in putting thoughts into words, and inaccuracy of responses due to poor introspection ability. For these reasons, and because of the availability of previous successful interviews upon which to build, I selected a structured interviewing approach. Structured interviews have been used frequently for assessing metacognitive knowledge (e.g., Borkowski & Peck, 1986; Kreutzer et al., 1975; Miller & Weiss, 1982; Myers & Paris, 1978). My interview questions, while open-ended, included a structure by employing hypothetical situations similar to those in real life to elicit children's responses, thereby calling upon metacognition that is meaningful in the participant's mental life (Yussen, 1985).

Critique of the Methods Used in Major Studies Cited in This Paper

Major primary research on metacognition has been conducted over a period of several decades by a large number of scholars interested in a variety of questions. Because I have relied on results from this body of research in my own study, I thought it important to make certain that the authors cited used viable research designs and methods. I have summarized the major studies cited in this paper in Table 2, listing the critical components of each study as well as my own critique of the quality of each.

To facilitate examination of the studies, I divided them into categories based on the major focus of each study. The six categories are metamemory; metacognitive knowledge – nature and development; strategy use, development, and transfer; metacognitive knowledge and domain-specific knowledge base; problem solving; and other cognitive processes.

Probing the Relationship Between Metacognition and Giftedness

Cheng (1993) proposed that metacognition and giftedness were integrally related to the extent that measures of metacognition should predict levels of giftedness. Because metacognition is a component of intelligence, and intelligence is manifest in its highest levels in giftedness, Cheng gave voice to the possibility that metacognition and giftedness share a special relationship.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metamemory

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Borkowski, Ryan, Kurtz, & Reid, 1983. Metamemory and metalinguistic development: Correlates of children's intelligence and achievement. Purpose: to study internal consistency of metamemory	1st- and 3rd- graders given metamemory subtests; two active-engagement metamemory tasks; metalinguistic tasks (asked about understanding of sentences, sounds, words); various ability tests; question about purpose of reading; teachers rated student metamemory high or low.	Correlation matrices among *z* scores on all subtests and between subtests and sums of subtests for both age groups; intelligence partialled out for some results: seen as confounding factor for teacher ratings. Key finding: metacognition linked to achievement independent of IQ	Thorough examination of all correlations to explore possible reasons for various results; design is sound; sample 98% Caucasian; tasks used as proxies for metacognition (memory, language, reading, and attention) do not completely define construct; some dichotomous scoring limiting

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metamemory

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Brown, Campione, & Murphy, 1977. Maintenance and generalization of trained metamnemonic awareness by educable retarded children. Purpose: to examine a general skill in metamemory for its immediate and long-term effects	68 children (mean IQ = 70) in young (mean age = 9 years) and old (mean age = 11 years) groups trained in predicting own memory ability; some given general feedback, others specific feedback on how many items they predicted vs. how many recalled correctly	Age x feedback x trial block (or post-test) ANOVAs; means compared: differences between predicted, actual recall; only originally realistic predictors transferred; no strategy generalization for most; young need specific feedback; Key finding: metamemory predicts performance better than IQ	Research design fit research questions well; trials, tests, and data analysis thorough Limitation: tasks were context-free; no reason given to participants to use or transfer strategy

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metamemory

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Carr & Borkowski, 1987. Metamemory in gifted children. Purpose: to assess the interdependence of divergent thinking, convergent thinking, and metacognition	Sample: 5th- and 6th-graders in gifted program (mean IQ = 113); hypotheses: divergent thinking will predict academic achievement, relate to metamemory; IQ will correlate with achievement, metamemory, not divergent thinking, because IQ tests use convergent thinking questions	Correlations among scores for achievement, metamemory, IQ, and divergent thinking; Results: metamemory gives new information about achievement, independent of IQ; metamemory = 10% of variance in achievement, independent of convergent and divergent thinking.	Correlations examined exhaustively, with various factors partialled out to test significance; additional multivariate test and canonical correlation computed. Excellent literature review with solid reasoning explained. Identification basis: teacher report, grades, achievement.

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metamemory

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Fabricius & Hagen, 1984. Use of causal attributions about recall performance to assess metamemory and predict strategic memory behavior in young children. Purpose: to examine metamemory through statements about strategy usefulness	1st- and 2nd-graders: picture recall task using sorting strategy – two trials; gave reports just after task attributing success to various causes, including use of study behavior; used retrospective reports because prospective sometimes do not connect strategic knowledge, strategy use	Sorting strategy: 2x4 (grade x trial) repeated measures ANOVA; Recall: 2x3 (grade x trial) repeated measures ANOVA; multiple regression: study-period behavior consistent with pattern of recall across trials; Results: causal attribution about effect influences strategy use; strategic insight gained during task	Inherent verbal self-report problems in young children; low-level tasks, but probably adequate for this study; data analysis, research design appropriate

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metamemory

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Kreutzer, Leonard, & Flavell, 1975. An interview study of children's metacognitive knowledge about metamemory. Purpose: to explore metamemory in children and develop a self-report instrument	80 middle-class children in grades K, 1, 3, 5 (gender-balanced) randomly chosen; items generated from Flavell's theory of three metamemory variables: person, task, strategy and interactions among variables	Questions randomized; pictures, when used, randomly presented; chi-square tests within questions (all 2x2 contingency tables) for age (K & 1st vs. 3rd & 5th) by categories of responses; Key finding: questions are valid indicators of metamemory	Chi-square tests varied – if multiple categories on one question, one vs. all others combined or one group of categories vs. another; or one category vs. another Reliability of scoring categories well-presented: two judges used

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metamemory

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Kurtz & Weinert, 1989. Metamemory, memory performance, and causal attributions in gifted and average children. <u>Purpose</u>: to further the study of cognitive differences between gifted and average students regarding relationships among cognitive and motivational variables	113 German 5th- and 7th-grade high or average achievers tested for cognitive ability, metacognitive knowledge, attributional beliefs on success (effort or ability); sort recall task Belief: metacognitive theory may help explain individual differences in children's strategic behavior	Grade x ability x gender ANOVA; used correlations, ANCOVA to examine gender, age, metacognitive ability effects, and to test causal models created – separate model for gifted data needed Key finding: "accelerated development" theory of giftedness discounted	Description of metamemory battery confusing; reliability reports vague ("adequate"); some statistical terms not explained; ability groups well-separated; complex research design ensured full examination of data – well-suited to theory testing purpose

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Hannah & Shore, 1995. Metacognition and high intellectual ability: Insights from the study of learning-disabled gifted students. <u>Purpose</u>: to determine if metacognition is a component of giftedness even when the giftedness is compromised by learning disabilities	Sample: 48 school-identified gifted learning-disabled (GLD), gifted, learning-disabled (LD), and average-performing boys in grades 5-6 and grades 11-12; participants assessed on metacognitive knowledge, metacognitive skills on a think-aloud error-detection reading task, error detection, and comprehension	3-way MANCOVA: prior knowledge was covariant; correlations between pairs of dependent variables to ensure MANCOVA was appropriate; Result: gifted and GLD boys outperformed average-performing and LD in both grade levels; Key finding: GLD more like gifted than like LD	All variables chosen to enable results to be compared with those of prior research; complete explanations of choice of each variable, analysis method; So well-written, it almost could be replicated from the article

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Jacobs & Paris, 1987. Children's metacognition about reading: Issues in definition, measurement, and instruction. <u>Purpose</u>: to develop a measure of metacognition, and to report on a study testing the relation between metacognition and performance in reading	46 teachers in two districts: intact classrooms of 783 3^{rd}-graders and 801 5^{th}-graders; 25 teachers in same districts: control classrooms; gender-equal groups; 20% from minority populations; used "Informed Strategies for Learning" (ISL): strategy to test relationship between strategies and skills in reading	Students took "Index of Reading Awareness" (IRA), standardized comprehension test as pretests; treatment: ISL; pretest learning used as covariate in 3-way ANCOVA Key finding: classroom strategy training increased reading performance in experimental group	Reading awareness based on somewhat low-level criteria: finding names in story, simple recall, decoding, focus on test preparation Authors: objective multiple-choice test better for examining metacognition than interview; data limited to correct/incorrect responses

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Moss, 1990. Social interaction and metacognitive development in gifted preschoolers. <u>Purpose</u>: to answer the question, "Do parents of preschool gifted children model metacognitive strategies to a greater extent than do parents of normal-ability children?"	15 gifted 3-4 year olds and 15 nongifted and their mothers (Stanford-Binet – gifted >130; nongifted 100-120); semi-structured play: given blocks and asked to construct something together; all statements and questions coded according to Brown & Deloache's 4 basic tactics/ metacognitive activities	Series of *t*-tests: overall metacognitive verbalization and use of each tactic for mothers; chi-squares for sequential analyses of conversational exchanges; controlled for quantity of verbalizations; Key finding: differences between gifted and nongifted children's metacognitive skills may be rooted in social interaction	Impossible to tell if mothers shape gifted responses or if they respond to gifted children's needs and actions; verbal level made a bigger difference than did IQ; Author stated that essential research question remained unanswered by this study

Table continues.

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Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Myers & Paris, 1978. Children's metacognitive knowledge about reading. <u>Purpose</u>: to explore the kinds of metacognitive understanding young children have about reading	20 2nd-graders and 20 6th-graders, all readers of varying abilities; gender-balanced; 18-item interview based on Flavell's person, task, and strategy variables; categories of responses created, subcategories broken out (as in Kreutzer et al.)	Chi-square tests of responses from two age levels, followed by Fisher's exact test Results: older children more aware than younger children of strategy existence, when and how to use Key finding: metacognitive knowledge about reading was similar to reported metamemory in young children	Study was exploratory in nature, so not all items or responses included in analysis; study design permits descriptions of age-related changes in children's reports about reading, but does not allow explanations of "why"

Table continues.

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Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schraw, 1994. The effect of metacognitive knowledge on local and global monitoring. Purpose: to examine if high knowledge about cognition is necessary to successful regulation of cognition among adults, and whether some students profit more from information acquired during testing than others	115 college students – pretest scale estimating own monitoring ability; 50-item vocabulary test administered, followed by a reading comprehension test and two performance accuracy rating scales, local and global	ANOVAs: high, average, low monitors on test performance, confidence, and global/local monitoring; Newman-Keuls post-hoc; dependent sample *t*-tests: local vs. global monitoring for each group; correlational analysis of pairwise relationship between each of 4 dependent measures Key finding: high monitors more accurate, confident	Extremely detailed descriptions of procedures, instruments, group assignment, analysis processes, and results Clear, detailed discussion of results, recommendations for future research

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schraw & Dennison, 1994. Assessing metacognitive awareness. Purpose: to test a measure of adult metacognitive awareness, to examine relationship between knowledge and regulation of cognition, and to investigate convergent validity of the instrument	52-item self-report "Metacognitive Awareness Inventory" (MAI) developed; given to 197 college students; instrument examined to compare two-factor vs. eight-factor solutions; predictive validity examined	Unrestricted factor analyses: MAI did not correspond to 8-factor solution; use of restricted factor analyses demonstrated accuracy of 2-factor model: knowledge and regulation, with high internal consistency; factors confirmed in another study; Key finding: metacognitive knowledge related to accurate judgments and performance	Instrument development, item creation, pilot testing, item discarding reported in detail; factor analysis explained clearly; decisions to use various statistical tests explained, follow-up tests clarified results

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metacognitive Knowledge

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schwanenflugel, Stevens, & Carr, 1997. Metacognitive knowledge of gifted children and nonidentified children in early elementary school. Purpose: to compare metacognitive knowledge about memory and attention variables between groups of gifted and nongifted young children	40 gifted, 22 nongifted students from suburban school (55% African-American); gifted identification by IQ; interview based on items developed by Kreutzer et al., Borkowski & Peck, and Miller & Weiss	IQ of gifted children was known; KBIT given to nongifted children to ensure separation between groups; chi-square comparisons on each question segment; followed by 2 x 2 ANOVA on overall metacognitive awareness Key finding: gifted children's scores were superior in both elements of metacognition	Authors questioned method of identifying giftedness; additional questions created for interview – no reliability results reported on old or new parts of instrument; methods concerns: Why conduct chi-squares on each part of a question? Why conduct chi-squares before ANOVA? Scoring criteria poorly described

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Bouffard-Bouchard, Parent, & Larivée, 1993. Self-regulation on a concept-formation task among gifted and average students. Purpose: to examine relationships among types of strategies used on a novel, challenging task, frequency of strategy use, metacognitive experience, and motivation	8th-grade female parochial school students: 23 average, 22 gifted – giftedness determined from multiple criteria; verbal concept identification task (sentences including nonsense words in place of key words); verbal reports transcribed, segmented into units	Protocols categorized according to previously developed coding scheme based on components of self-regulation; MANOVA followed by Fisher's exact test; chi-squares on dichotomous variables; Key finding: all used strategies, gifted used them more consistently	Multiple, complex aspects of metacognition examined in concert; scoring clearly explained; statistical procedures controlled for verbal fluency levels; partialled out cognitive level to check correlation between self-regulation, performance; motivation importance emphasized for gifted

Table continues.

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Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Carr, Alexander, & Folds-Bennett, 1994. Metacognition and mathematics strategy use. <u>Purpose</u>: to explore, through a longitudinal study, how metacognitive knowledge about mathematical strategies and effort attributions affect young children's correct use of strategies	39 2nd-grade German students completed "Intellectual Achievement Responsibility" (IAR) scales in Sept. and Jan.; two interviews measured strategy use (Sept.) and metacognitive knowledge about strategies (Jan.); post-test: children engage in mathematical tasks then immediately rank strategies	IAR: 24-item forced-choice measure – children choose between internal and external attributions as causes of hypothetical performance situations; children observed using mathematical strategies; Key finding: knowledge of strategies affected by prior strategy use	Justification given for selection of participants at this age level; instrument and scoring described well; possible ceiling effect, as children were proficient in strategy use in September Many related questions raised in discussion: effort attribution, domain specificity, self-developed strategies

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Cho & Ahn, 2003. Strategy acquisition and maintenance of gifted and nongifted young children. <u>Purpose</u>: to examine strategy use by comparing recall, clustering, and study behaviors (kinds and frequency of strategies used)	11 gifted and 10 nongifted 5-year-old children; 11 nongifted 7-year-olds; gifted IQ = 142; nongifted IQ = 100-103; children observed for 5 consecutive days: days 1 and 2 – study-recall task (some strategy generation); day 3 – strategy training; days 4 and 5 – strategy learning and maintenance	Day x Group ANOVAs for recall, clustering, study behaviors; Adjusted Ratio of Clustering (ARC) calculated; Key finding: training benefited older nongifted children; had no effect on gifted children, whose strategy use increased each day independent of training	References to previous studies throughout – comparisons with previous findings help to illustrate results of this study

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Cross & Paris, 1988. Developmental and instructional analyses of children's metacognition and reading comprehension. <u>Purpose</u>: to clarify the relationships among awareness, strategic reading, and reading comprehension; follow-up to Paris's previous study using Informed Strategies for Learning (ISL)	ISL treatment with intact classes of 87 3rd- and 84 5th-graders (mixed ethnicities); students assessed for reading comprehension, strategic reading, reading awareness, strategy rating	Cluster analysis: subgroups identified, cluster profiles created, transitions analysis between clusters; *F* ratios and differences: large between-clusters, small within-clusters variability = good cluster separation; Key findings: instruction needed with poor readers, not with good ones; metacognition, performance more congruent with time	Cluster analysis and various methods extremely well-explained; discussion addressed aptitude-by-treatment interactions, tied results to previous research; all conclusions reasonable based on data; several clear implications for instruction given

Table continues.

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Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Kurtz & Borkowski, 1987. Development of strategic skills in impulsive and reflective children: A longitudinal study of metacognition. <u>Purpose</u>: to test the hypothesis that metacognitive knowledge about reading is causally related to earlier knowledge about learning and memory strategies	Children assessed for verbal IQ, metamemory, cognitive tempo; 3 years later, same children, plus others, assessed for same things, and for summarization skills; two treatments: summarization instruction (s.i.), or s.i. with metacognitive training	3 (grade) x 3 (condition) x 2 (tempo) ANCOVA on post-training summarization scores, with pre-training scores as covariate; other ANOVAs compared groups on variables; correlations between summarization and metamemory; metacognitive development causal model created; Key: metacognition predicts strategy acquisition	Emphasis on reflective/ impulsive dichotomy seems dated; data reduction and analyses well-explained; causal modeling explained and illustrated complex relationships of variables, including both direct and indirect influences of metacognitive knowledge on strategy acquisition

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Kyllonen, Lohman, & Snow, 1984. Effects of aptitudes, strategy training, and task facets on spatial task performance. <u>Purpose</u>: to train specific problem-solving strategies and to assess the effects of the training on performance on a complex spatial visualization task and on related transfer tasks	56 high school students chosen for high/low scores in either fluid-analytic (spatial) visualization ability or verbal-crystallized ability; members of each group assigned to strategy training: visualization or analytic, or no training with performance feedback; solved paper-folding tasks in simultaneous or successive presentation	Design: 2x2x2x3 between-subjects, 2^5 within-subjects factorial; Result: participants with high levels of either spatial or verbal ability performed best when given no strategy training or training in own strength area; Key finding: models must take into account individual differences in strengths, strategy shifting	Results presented in graph form made understanding them easy, despite many variables and complex combinations of variables in groups; study has implications for information processing models that treat individuals similarly or that view only one type of strategy use

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Scruggs & Cohn, 1983. Learning characteristics of verbally gifted students. <u>Purpose</u>: to determine whether verbally gifted students differ from average students in quality of learning strategies employed or effectiveness of strategies	29 students in writing class in summer program for gifted youth - ≥ 370 on SAT-V; participants diverse ethnically and economically; engaged in paired-associate learning task, then asked to describe strategies used; strategies ranked by sophistication, student scores weighted by level of strategy used; group compared to college group	Spearman's rank correlation coefficient compared total strategy score with level of performance; strategy score accounted for 46% of variance in task; correlation compared to that of college-age group with Fisher *Z* transformations; Result: gifted students not qualitatively different, use same strategies earlier	Authors: "[o]bviously, all learning cannot be reduced easily to paired-associate paradigms." Task was so simplistic, failure to find "dramatic difference" in types of strategies used not surprising – how many ways exist to recall nonsense word pairs? In literature, this type of study contributes to inconsistent gifted advantage.

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Scruggs & Mastropieri, 1985. Spontaneous verbal elaboration in gifted and nongifted youths. Purpose: to examine learning, use of spontaneously produced strategies, and effectiveness of strategies, comparing gifted to nongifted students	22 gifted middle school students in summer program for gifted youth; SAT-V $\geq$ 370; 23 average-ability age peers; #1: paired word task (actual words); #2: half nonsense words, half real words; 5 minutes of free study time allowed; self-reported strategies used for recall placed in 3 categories: rote, structural, semantic	Inter-scorer agreement on strategy categories .96; #1: *t*-tests: recall between groups; in gifted group only, semantic strategy users outperformed others; #2: 2 group x 2 meaningfulness ANOVA: group main effect; chi-square: use of semantic strategies in groups; Key finding: self-developed strategies effective	Lead author attempted to see if rapid presentation, low meaningfulness of tasks in previous studies inhibited strategy formation; low strategy use by nongifted group did not allow analysis of their data – more meaningful tasks needed

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Scruggs & Mastropieri, 1988. Acquisition and transfer of learning strategies by gifted and nongifted students. Purpose: to further examine gifted students' use and transfer of both trained and spontaneous strategies, confusion from additional data to be memorized, stability of learning after interference of more data	48 each gifted, nongifted elementary students randomly assigned to conditions; 4 conditions per group: free study, 3 mnemonic conditions (high to low-structure: amount of mnemonic information given); only elaborative strategies reported received a point	Nonparametric (Mann-Whitney U and Kruskal-Wallace ANOVA) tests employed; *r* between strategy use and performance; Key findings: gifted students made use of strategy instruction in recall, transfer, and recall retention; performance did not vary significantly between groups, perhaps due to age	Floor and ceiling effects constrained variance estimates, eliminated ability to use *F*- or *t*-tests; nonparametric tests did not permit complex analyses of multiple nonindependent comparisons; studies of factual recall less valuable than those of thinking, reasoning, and problem solving

Table continues.

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Studies of Strategy Use, Development, and Transfer

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Scruggs, Mastropieri, Jorgensen, & Monson, 1986. Effective mnemonic strategies for gifted learners. Purpose: to examine strategy use under two mnemonic strategy instruction conditions vs. free study, for gifted vs. nongifted groups, and transfer of strategy	96 gifted and nongifted 4th- and 5th-graders randomly assigned to one of three conditions: free study (test 1 control), mnemonic transfer (picture and keyword given) followed by #1: instruction to use trained strategy or #2: no specific instructions; all reported strategies used; test on new information; scored for recall and strategy use	Interrater agreement (on strategy type) 100%; #1: 2 condition x 2 group ANOVA: main effects for both factors; #2 (transfer task): 2 group x 3 condition ANOVA: main effect for group; for gifted group, transfer 1 highest, transfer 2, control (Duncan's post-hoc procedures); Key finding: gifted students freely transferred strategy	Task: recall of factual information; information was meaningful, however Good research design for questions under study Raised further questions on benefits of mnemonic strategies to learning in complex situations, extent to which gifted students apply strategies without cueing

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Metacognitive Knowledge and Domain-Specific Knowledge Base

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Alexander & Schwanenflugel, 1994. Strategy regulation: The role of intelligence, metacognitive attributions, and knowledge base. Purpose: to examine the combined effects of knowledge base, intelligence, and metacognitive attributions on recall and strategy use	78 rural 1^{st}- and 2^{nd}-graders grouped by intelligence (verbal and nonverbal) in both trials, and assigned to knowledge base groups (items familiar or not) in session 2; all students learned a sorting strategy on recall tasks using stimuli able to be categorized or not, then made metacognitive attributions (if and why strategy helped)	One-way repeated measures ANOVA by stimuli set trials on recall, then on strategy sophistication; correlation matrix among all variables; clustering items for recall measured by ARC; tested models using recursive path analysis with standardized beta weights; Key finding: more difficult tasks elicit more strategic behavior	Narrow range around average intelligence; extremely thorough tests of all variations of model; Supports expertise research: domain-specific knowledge base predicts strategy use and recall better than does intelligence; key finding about task difficulty important to future metacognitive research

Table continues.

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Studies of Metacognitive Knowledge and Domain-Specific Knowledge Base

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Chiesi, Spilich, & Voss, 1979. Acquisition of domain-related information in relation to high and low domain knowledge. <u>Purpose</u>: to examine how knowledge of a particular domain (baseball) influences acquisition of new domain-related information	5 experiments: college students given baseball knowledge and understanding test; 24 high (HK) and 24 low (LK) knowledge students identified; given complete game descriptions with details changed or passages with incorrect facts inserted, event sequences scrambled, possible actions left out	ANOVA used for comparison between groups in each experiment Key finding: HKs acquire information more readily than do LKs: authors theorize that input information is mapped onto existing (superior) knowledge structure; differences in encoding information exist (Sternberg's selective encoding)	Participants not categorized as experts, but people with high levels of knowledge – study is broader than expertise studies, results applicable to more people; participants chosen from college classes – convenience sample; similar intelligence levels between groups not examined

Table continues.

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Studies of Metacognitive Knowledge and Domain-Specific Knowledge Base

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schneider, Körkel & Weinert, 1989. Domain-specific knowledge and memory performance: A comparison of high- and low-aptitude children. (Part 1) Purpose: to examine domain-specific recall and interactions among high- and low aptitude, high and low domain-specific knowledge participants	Experiment I: 576 middle-class German children (106 3rd-gr., 236 5th-gr., 234 7th-gr.) gender-balanced; aptitude: verbal intelligence (comprehension, reasoning) on German cognitive abilities test; expertise: soccer; task: read about soccer, recall; dependent variables: text detail memory, inferences, detect contradictions	2x3x2 ANOVA (aptitude x grade x expertise); Student-Newman-Keuls post-hoc analyses; for all 3 dependent variables: significant effects for grade and expertise Key finding: performance dependent on knowledge base – low-aptitude experts significantly better performers than high-aptitude novices	Little separation in verbal intelligence of groups (above median = high; below median = low); few items on recall instrument

Table continues.

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Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schneider, Körkel & Weinert, 1989. Domain-specific knowledge and memory performance: A comparison of high- and low-aptitude children. (Part 2) Purpose: to examine domain-specific recall and interactions among high- and low aptitude, high and low domain-specific knowledge participants	Exp. II: 185 middle-class German children – (64 3rd-gr., 67 5th-gr., & 54 7th-gr.) gender-balanced; measures of strategic operations, feeling of knowing; metacognitive knowledge and processes: importance ratings, prediction; dependent variables: free and supported recall; recognition: original and distracter sentences	Free recall analyzed by semantic units; supported recall demonstrated with cloze task; Aptitude x Grade x Expertise ANOVA; in both recall conditions, significant effects for expertise; main effect for grade in free recall condition only Key finding: expertise is most important variable in domain-specific recall	No qualitative analysis of participant responses in free recall condition Emphasis on recall results

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Problem Solving

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Dover & Shore, 1991. Giftedness and flexibility on a mathematical set-breaking task. <u>Purpose</u>: to compare children's performances on a mathematical set-breaking task with those of adults regarding flexibility, accuracy, and speed	25 gifted, 25 average 11-yr.-olds, gender-balanced; gifted identified with multiple criteria (2 out of 4: $\geq 90^{\text{th}}$ percentile on any of 5 CTBS subtests; $\geq$ 130 IQ; parent or peer nomination); all at or above grade level in math; sample reduced: some failed to establish set; remaining sample: 19 gifted, 11 average	Depending on comparisons made, Chi-square tests, *t*-tests, and ANOVA used; Einstellung-test problems, then Metacognitive Knowledge Interview (MKI); on E-test, children measured for flexibility (ability to overcome set), accuracy, speed; Key finding: speed and accuracy compatible for gifted children	Clear, precise descriptions of task, sample reduction, procedures; detailed analyses gave clear pictures of solution awareness and monitoring behaviors; later reanalysis of data showed that limiting sample to those who formed the set limited knowledge gained

Table continues.

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Studies of Problem Solving

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Kanevsky, 1990. Pursuing qualitative differences in the flexible use of problem-solving strategy by young children. Purpose: to explore a number of qualitative and quantitative dimensions of young children's learning with transferring a problem solving strategy	89 4- to -8-year-olds in 4 IQ-based groups: young average (YA), young high (YH), older average (OA), old high (OH); learned a problem solving strategy on one version of Tower of Hanoi; different version of task (same strategy used to solve); quantitative data: number moves, hints; qualitative: use of hints, rules understanding, see similarity	3-way repeated measures ANOVA (IQ x age x task); frequencies of qualitative categories reported; Results: high generalized strategy more, performance dropped less; IQ-related differences in hint denial, understanding of rules, recognition of task similarity; Key finding: high IQ task knowledge goes from simple to complex with age	Extensive discussion of results, variety of responses, trends, differences and similarities due to wealth of qualitative data; implications for metacognitive theory and classroom practice also made possible by amount and richness of data

Table continues.

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Studies of Problem Solving

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schofield & Ashman, 1987. The cognitive processing of gifted, high average, and low average ability students. Purpose: to clarify cognitive characteristics of gifted children using Luria's simultaneous-successive model of cognitive processing. focusing on planning	323 elementary students from diverse SES groups, in 3 categories: low average (LA) = IQ < 105; high average (HA) IQ 105-124, gifted (G) IQ > 124; outstanding achievers also included in G; 8 information processing measures as markers of simultaneous and successive processing and planning	Factor analysis: inter-correlations among all variables, 3 predicted factors resulted, used in ANOVA for analysis of relationships with problem solving; results inconsistent for HA and G; Key finding: gifted students excel on high-level planning/metacognitive and simultaneous processing functions	Excellent description, explanation, and critique of Sternberg's conceptions of giftedness; construct behind each task fully explained; "planning" as a factor not fully represented by tasks given; ceiling effect on low-level tasks; inconsistent results of gifted superiority may be due to inadequate separation between HA, G

Table continues.

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Studies of Problem Solving

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Shore, Koller, & Dover, 1994. More from the water jars: A reanalysis of problem-solving performance among gifted and nongifted children. Purpose: to further explore the nature of flexibility and metacognition in relation to high ability, using data from a study of mathematical set-breaking	25 gifted, 25 average 11-year-olds from Dover & Shore's study; students who originally did not form set not excluded from this data reevaluation; newly-changed criterion for set formation changed categorization of sample to noncriterion (no set), flexible (used alternative when possible), persisters (continued to use E-method)	Graphs: undetected failures, mean speed by 3 new categories (ANOVAs, chi-squares); examination of item on which set must be broken: flexible group solved quickly; Results: high metacognitive knowledge gifted students solved problems more quickly than any other group; gifted students who did not form set performed worst	Reevaluation of data due to concerns about previous assumptions showed courage; results were more confusing, led to more questions than did initial results; intriguing questions raised about why some gifted students fail to work quickly, accurately, use metacognition; interesting questions about depth of math instruction raised

Table continues.

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Studies of Problem Solving

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Swanson, 1992. The relationship between metacognition and problem solving in gifted children. Purpose: to determine whether gifted children have higher metacognitive skills than children of lower IQ, and to examine intercorrelational patterns among metacognition, problem solving, and IQ	96 4th- and 5th-graders: gifted, high average, low average; 97% white; verbal IQ measured with CogAT or verbal WISC-R; reading, math achievement measured; TTCT measured creativity; metacognitive questionnaire coded: knowledge, person, strategy, and task; combinatorial problem measured for time, # moves	ANOVA followed by Duncan: gifted required fewest steps to solution; MANOVA (metacognition) significant for ability; ANOVA significant for person, strategy factors; correlations among all; Key finding: weak correlations among problem solution, metacognition, creativity, intelligence for gifted	Conclusion that gifted children's mental processes display independence through low correlational patterns is unique in these studies; author concludes that central processing system is less taxed because various systems operate independently – novel view of giftedness; procedures clearly explained

Table continues.

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Studies of Problem Solving

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Swanson, O'Connor, & Cooney, 1990. An information processing analysis of expert and novice teachers' problem solving. <u>Purpose</u>: to examine possible qualitative differences between expert and novice teachers in their think aloud protocols related to solving classroom discipline problems	24 pre-service teachers (novices), 24 mentor teachers (experts) given vignettes to study under 2 conditions: nondirective or directive (steps to follow), asked to think aloud while solving; protocols coded according to 24 mental components, categorized into heuristic (global) and strategy (specific) subroutines	Subroutines: expertise x instructions x 3 heuristic types or 6 strategy types ANOVAs with repeated measures on last factor: main effects for subroutine type, instruction, expertise; multiple interactions present; Results: directive instructions inhibit experts' problem solving; experts define, represent problems well	Coding scheme, research behind it, well-explained; preliminary analyses ruled out effects due to differential occurrence of mental components in vignettes, gender, or length of responses; follow-up statistical tests probed deeper into results, produced interesting discussion on problem solving factors

Table continues.

Table 2. *Critique of the Methods Used in Major Studies Cited in This Paper*

Studies of Other Aspects of Cognition

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Schwanenflugel, Fabricius, & Noyes, 1996. Developing organization of mental verbs: Evidence for the development of a constructivist theory of mind in middle childhood. Purpose: to examine changes in organization of mental verbs of knowing, toward developing a theory of mind in middle childhood	2 experiments: 8-11-year-olds and adults rated similarity of mental verb pairs in terms of the way they felt they used their minds in each one; #1: MDS dimensions from previous study used to test for commonality of structure; #2: relate developing organization to specific metacognitive behavior	Multidimensional scaling (MDS) exp. 1: 2-dimensional solution: information processing and certainty; Result: increasing emphasis on certainty aspect with age; exp. 2: comprehension monitors placed greater emphasis on certainty aspect; Key finding: with uncertainty, people process more deeply, with emotion	Complex MDS procedures well-explained; topic very esoteric and occasionally difficult to follow

Table continues.

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Studies of Other Aspects of Cognition

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Sternberg & Davidson, 1983. Insight in the gifted. Purpose: to define and examine insight processes as a way to distinguish gifted from nongifted persons qualitatively	Insight composed of three processes: selective encoding, selective combination, and selective comparison; 30 adults given unlimited time to solve 12 insight problems chosen to require little background knowledge; insight does not rely on prior knowledge, speed, or low-level tasks; theory drives task selection, not vice-versa	Performance on complete set of problems correlated (.66) to intelligence, .63 with inductive reasoning, .34 with deductive reasoning; point-biserial correlations between item scores and IQ: highest for problems measuring selective encoding, selective combination, or both (no items created for selective comparison)	Authors clearly lay out proposed theory of giftedness, address conflicting views, explain terms, ideas with easy-to-understand examples; utility of theory for identifying individuals from “nonstandard” backgrounds emphasized, as insight need not rely on common knowledge base

Table continues.

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Studies of Other Aspects of Cognition

Author, Title, Year, Purpose	Summary of Study	Methods and Results	Quality, Limitations
Swanson, Kontos, & Frazer, 1987. Intellectually gifted and nongifted children's inference from partial knowledge. <u>Purpose</u>: to explore the idea that children of different intellectual abilities vary in their metajudgment when they have partial knowledge	34 children ages 10-15 in a summer program given Otis-Lennon test and designated gifted (>134) or average (100-115); children rated likelihood that a protagonist (expert or novice) in a scenario who had or lacked knowledge about a category of items would remember an item with high or low salience	5-way ANOVA: 2 ability group x 2 knowledge condition x 2 expertise level x 2 salience level x 2 items previously recalled (large or small number) with repeated measures on last 4 factors; main effects for group, item salience, number of items; Key finding: gifted children less influenced by expertise, expertise, salience factor.	Conclusions surprisingly deep for simple experiment: knowledge of memory arises as interaction between task variables and existing metamemory; authors relate results to Sternberg & Davidson's insight, hypothesize that gifted children have novel ways of selectively encoding, combining, and comparing

In part as a response to Cheng's article, Alexander and her co-authors (1995) reviewed previous studies to see if Cheng's assertions were warranted. They concluded that although promising connections exist between metacognition and giftedness, results have been inconsistent enough to cast doubt on the assumption of a defined relationship. As previously mentioned, Alexander and her colleagues stated that there were several limitations in the body of research that might explain the inconsistency of results. Since the method of identifying giftedness in most metacognitive studies was one of the difficulties pointed out by Alexander and her co-authors, I explored the various ways in which intelligence has been defined and measured, seeking a method of identifying giftedness that would allow me to overcome this problem in my study.

Defining and Measuring Intelligence the Traditional Way

In the nineteenth century, it became fashionable and intriguing for educated men to attempt to fathom all the world's natural phenomena. This was the age of an explosion of knowledge and exploration in the sciences. One of the last areas of science to be considered worth studying was the science of psychology, or how humans thought. At the end of that century, Francis Galton (1869) looked at what he termed "genius," that is, men who made great discoveries or created great works. Galton's method of examining high levels of intelligence by looking at its products is still practiced today by those who study expertise in various areas (cf. Chi & Glaser, 1985; Glaser & Chi, 1988; Posner, 1988). Whereas Galton drew his own conclusions about what went on in the minds of geniuses, today's researchers in expertise use the words and actions of experts to demonstrate what and how they think.

Attempts were made, again at the end of the nineteenth century, to quantify intelligence. If measurement could be done in a simple way, it could, for instance, keep officials from allowing unsuitable men to enter the army or keep educators from enrolling in school children who were unlikely to learn. In France, such research was undertaken, and psychologist Alfred Binet created a test that could be given quickly to sort people into categories of mental acuity.

In the early part of the twentieth century in the United States Charles Spearman, a noted psychologist, first labeled the concept of "g," a general intelligence factor that he believed was derived from individual differences in mental energy (Sternberg, 1988). Psychologists devoted considerable effort to methods of quantifying and assessing their own conceptions of intelligence.

Binet's test was further refined in the United States by Stanford University psychologist Louis Terman into the Stanford-Binet IQ (or intelligence quotient) test. The famous number, with 100 as its mean, median, and mode, is calculated by dividing the subject's measured mental age by his or her chronological age and multiplying by 100.

Long-term studies of high-IQ people, however, (see Terman, 1925; Terman & Oden, 1947, 1954) failed to predict "geniuses" from IQ scores alone. Later studies have shown that IQ tests can yield scores that predict school success, but that they are not good tests of abstract intelligence (cf. Chi et al., 1982, p. 71). Posner (1988) stated that the psychometric approach to intelligence testing was not related to any theory of intelligence. Campione and his colleagues (Campione et al., 1985) stated that IQ tests ere successful in predicting who would do well in school but they did not tell *why*.

According to Wigdor and Garner (1982), IQ predicts only 4% of the variance in measures of occupational success. Questions about the predictive value of test scores on future success of many kinds have been posed for decades (Wallach, 1976; Sternberg, 1982b; Taylor, Albo, Holland, & Brandt, 1985). Further, knowing the IQ score itself gives educators very little information that may be used for individualizing or differentiating instruction for various types of learners. Our most popular methods of identifying "gifted" children, intelligence tests and achievement tests, may not be valuable at all in helping us predict which children need differentiated instruction to help them become experts or notable adults (cf., Sternberg, 1982b). Psychologists have theorized that other ways of examining the richness of human thought than psychometric testing will yield more complete information and will supply educators with more detailed methods of helping learners than have the results of such tests (Carr & Borkowski, 1987).

New Ways to Think About Intelligence

In 1983, Harvard researcher Howard Gardner published *Frames of Mind*, in which he proposed a new way to look at intelligence or, as he says, the intelligences. Using medical research conducted on people with brain trauma due to stroke or accidents, he found people who could still demonstrate intelligence in certain areas but no longer in others after their traumas. Some people gained new skills at a high degree in areas in which they had never possessed skill before. Surely, Gardner reasoned, different parts of the brain must control different ways of being intelligent.

A great many ways have been developed to try to use Gardner's theory to identify children's levels of the multiple intelligences, as they have come to be known (Boggeman, Hoerr, & Wallach, 1996; Campbell, 1992; New City School Faculty, 1994). As with IQ tests, the goal for educators is to attempt to identify children with potential abilities or potential struggles so that educational interventions may be used to assist them in learning. Such assessments have proven difficult to devise and validate (Plucker, Callahan, & Tomchin, 1996). No clear evidence yet exists to show a correlation between high measured levels of any of the multiple intelligences and adult success (VanTassel-Baska & Brown, 2007).

What Does "Being Intelligent" Mean?

Gardner also used anthropological studies to examine the construct of intelligence in different cultures. Skill at piloting small watercraft and at catching fish would be highly valued in certain cultures whose livelihood depends upon the sea. But in modern-day New York City, for example, that skill may be interesting, but it is not considered as valuable as the ability to predict trends in stock prices. So in the seaside culture, the kinesthetic skills of piloting and catching fish would be considered evidence of a high level of intelligence, whereas in the financial district of New York City, the logical-mathematical skill of trend prediction would be considered highly intelligent behavior. Thus Gardner's definition of intelligence is

> solving problems valued within the cultural context in the most creative ways ... must entail a set of skills of problem solving -- enabling the individual *to resolve genuine problems or difficulties* that he or she encounters and, when appropriate, to create an effective product – and must also entail the potential for *finding or creating problems* – thereby laying the groundwork for the acquisition of new knowledge (Gardner, 1983, pp. 60-61, emphasis in the original).

Another Theory of Intelligence

Robert Sternberg’s work has been important to both psychology and education. Sternberg's Triarchic Theory of Intelligence (1985a, 1986, 1988) is a three-component view of intelligence. The three parts are the Componential Subtheory, the Experiential Subtheory, and the Contextual Subtheory. The Componential Subtheory, which Sternberg has further subdivided into three sections, deals with an individual's mental mechanisms that lead to intelligent behavior. The Experiential Subtheory specifies the relationship between an individual's quality of performance on a task and that individual's amount of experience with that task. The Contextual Subtheory addresses the question of what behaviors are intelligent for whom, and where they may be valued as intelligent. In proposing this theory, Sternberg sought to account for and, to some extent, subsume other theories of intelligence that he regarded as incomplete (Sternberg, 1988).

The Componential Subtheory interests researchers in metacognition most among the subtheories. The three parts of this subtheory are metacomponents, performance components, and knowledge-acquisition components. Metacomponents (or executive components) are higher-order processes used in planning, monitoring, and decision making. Performance components are processes used while performing tasks. Knowledge-acquisition components come into play while learning new information. These three sets of processes correspond roughly with the three aspects of metacognition that have been most studied: declarative metacognitive knowledge, cognitive monitoring, and strategy use.

Metacognition and Insight

Sternberg (1986) linked metacognition to higher level intellectual functioning, which he hypothesized would enable gifted children to solve problems and to cope with novelty across a range of tasks. In the 1986 book *Conceptions of Giftedness*, which he co-edited with Janet Davidson, Sternberg and Davidson made a case for higher order internal mental processes, termed “insight,” that might distinguish gifted from nongifted individuals. As the authors defined the term insight, it has similarities to metacognition.

Insight, argued Davidson and Sternberg, occurred when the thinker put together selective encoding, selective combination, and selective comparison. Selective encoding involves sifting out relevant from irrelevant information. Selective combination involves combining diverse and seemingly-unrelated bits of information into a unified whole, which may or may not resemble its parts. Selective comparison, the third part of insight, involves relating newly acquired information to information already acquired. Sternberg and Davidson argued that insight sets the gifted apart from the nongifted qualitatively in that insight may never appear in the nongifted. While there are quantitative differences between gifted and nongifted groups, such as in IQ or in speed of information processing, "the study of insight seems to form the basis for an understanding of giftedness as a phenomenon in its own right rather than merely as an extension of normal intellectual functioning" (Sternberg & Davidson, 1983, p. 52).

The insight approach differs from typical psychometric and information processing approaches to studying giftedness in several ways (Sternberg & Davidson, 1983). Sternberg described his highly theoretical insight approach as particularly well-suited to the study of giftedness. Measurement of insight skills may be accomplished without extreme emphasis on speed of processing or prior knowledge. Both of these emphases may put certain highly intelligent individuals at a disadvantage. Another key point of departure from the norm emphasized by Sternberg and Davidson was that insight assessments do not use the same types of low-level information processing tasks that are used in most psychological intelligence testing. They asserted, "Skills such as rapidity of lexical access to items in memory may be one basis for differentiating levels of intelligence, but they seem not to be the basis for distinguishing, say, the Einsteins from the average" (Sternberg & Davidson, 1983, p.56).

In studying metacognition, researchers hope to define, measure, and distinguish the most complex mental processes and, in so doing, extend our knowledge of what constitutes giftedness. For this to occur, studies should be based on complex tasks and skills (Shore, 1986; Carr et al., 1996). Memory and attention are the simplest of the skills that comprise metacognition. Insight consists of higher-level skills related to problem solving.

Metacognition, Insight, and Problem Solving

Yussen (1985) argued that metacognition is really the same thing as problem solving, consisting of the elements of attention, perception, memory and retrieval, and inference. His view certainly includes processes that have been studied or that have been proposed for study in connection with metacognition, but it seems to be focused only on learners engaged with existing situations or problems. As such, it does not address the nature of thinkers who discover new problems, something that researchers such as Sternberg (1986) and Shore (2000) insist are essential to understanding metacognition.

Discovering new problems has been labeled "problem finding" by researchers (e.g., Getzels & Csikszentmihalyi, 1967). Both Sternberg and Shore have discussed problem finding and problem manipulation a great deal over the years, seeing gifted students and successful adults shape their environments to fit their preferred modes of thinking. Sternberg and his colleagues have related problem finding to metacognition, stating, "Metacognition helps the problem solver recognize that there is a problem to be solved, figure out exactly what the problem is, and understand how to reach a solution" (Davidson, Deuser, & Sternberg, 1994, p.208).

The close relationship between problem solving and metacognition made decision making a good direction in which to extend the study of metacognitive knowledge. Indeed, Bouffard-Bouchard and her colleagues recommended measuring decision making as a way to understand more clearly results of their study of self-regulation among gifted and average students. Although the researchers observed that their gifted participants made more accurate estimations of the outcomes of their problem solving behavior than did the average participants, they did not know why. They speculated, "A measure such as decision making about the overall sequence of execution of problems might have provided a more sensitive tool for distinguishing between gifted and average students" (Bouffard-Bouchard et al., 1993).

Decision making also fits well with Sternberg and Davidson's insight processes. In solving problems, the thinker must engage in selective comparison and selective combination, both of which require the thinker to make decisions about which items in memory or in the environment to combine and to compare. How effective problem solvers make these decisions may be defined through metacognitive research.

Problem Solving and Creativity

The emphasis placed on problem solving by both Gardner and Sternberg fit in well with the literature on creativity. Begun in earnest during World War II, as the army was attempting to recruit officers for its most elite OSS units (cf. MacKinnon, 1978), creativity studies examined what led certain people to think of multiple and/or novel solutions to problems. For a long time, it was assumed that intelligence and creativity were separate constructs (Getzels & Jackson, 1962; Wallach & Kogan, 1965). Problems in measuring both constructs did not clarify matters. Graphs showing the two tended to rise together up to a threshold, above which they disintegrated into a scatter plot. But if the concept of creativity is defined as solving problems effectively, as Gardner did, then creativity merges with intelligence, particularly as the latter term is defined in modern research literature.

Sternberg stated that there are two ways to look at creativity: as an aspect of intelligence or as a type of giftedness (Sternberg & Lubart, 1993). Problem solving is at the heart of creative behavior. “Metacognition, or knowledge of one’s own cognitive processes, guides the problem-solving process and improves the efficiency of [this] … goal-oriented behavior” (Davidson et al., 1994, p. 207). Davidson and her co-authors define four metacognitive steps in problem solving: identifying and defining the problem, mentally representing the problem, planning how to proceed, and evaluating what you know about your performance. Insight processes are important in problem solving, especially to the forming and reforming of mental representations. The three components of insight help the solver to add to or delete from the mental representation (selective encoding), to change the mental representation by combining the problem’s elements in new ways (selective combination), or to use similarities between old and new information (selective comparison) to change mental representations through analogies, metaphors, and models (Davidson et al., 1994).

Problem Solving and Expertise

The literature on expertise examines persons who solve particular types of problems, such as chess board configurations or physics problems, efficiently, effectively, and rapidly (Glaser & Chi, 1988). “…[W]ithout actually solving the problem, and in less than 45 seconds, experts can encode the problem into a deep level of representation, which enables them to grossly determine the solution method applicable to the problem” (Chi et al., 1982, p. 51). They may also represent problems, such as physics problems, physically. These representations help them generate equations, check errors, provide concise and global descriptions of the problem, and permit inferences about features and relationships (Chi et al., 1982). Experts develop efficient systems by categorizing problems quickly and by possessing a large set of fundamental subroutines (Swanson, O'Connor, & Cooney, 1990). If subroutines do not already exist, they have a rich internal representation of the problem, so the problem can be simplified and reduced. For example, chess experts do not use very wide or deep searches for their next moves – they use selective search (Chi et al., 1982).

The use of the word "selective" in describing experts brings to mind insight processes that are necessary to solving problems (Metcalfe, 1998; Swanson, Kontos, & Frazer, 1987). The three insight processes have a commonality, the importance of selection and relevance. Products of selective encoding, combination, or comparison are called "insights" when an individual suddenly realizes which relevant information to select for encoding, combining, or comparing (Davidson et al., 1994). Experts demonstrate insight in abstracting relevant tacit knowledge from problem situations quickly and accurately. They see and represent a problem in their domain at a deeper level than do novices, who tend to represent problems at superficial levels (Glaser & Chi, 1988).

Finding who may become an expert has not been accomplished, although further studies of domain-related knowledge acquisition, motivation, and metacognition may prove fruitful in that endeavor. We may know greatness when we see it, or when we look back on it, but we do not necessarily recognize it in its early stages. Retrospective studies of experts and creative producers have yielded a great body of literature (Cox, 1926;

Goertzel & Goertzel, 1962), but they involve the collection of a great deal of personal information which is beyond the scope of schools to obtain. Moreover, many such studies indicate that adult producers of excellent work do poorly in school (cf., Polette, 2004). Although metacognitive abilities show potential for predicting success (Carr et al., 1996; Schneider, 1998), the difficulties with identifying high levels of potential in children have not been solved.

Researchers have proposed that metacognition and motivation appear to be related (Bouffard-Bouchard et al., 1993; Carr et al., 1994; Cross & Paris, 1988; Garner & Alexander, 1989; Schraw & Dennison, 1994), and motivation is linked inextricably to success in adults and in children, providing a further hint to the predictive value of metacognition.

> The problem of producing an expert may be not so much in selecting someone who has special capability, but to create and maintain the motivation needed for long-continued training. … it is important to assess motivation as well as capability of learning within any domain, to see possibilities for expertise (Posner, 1988, p. xxxv).

Ways of Studying Thinking and Problem Solving

Various breakdowns of the processes that make up thinking have been provided by examinations of this complex mental activity. Most applicable to the current study is what makes up the meta- level of thinking. An observer watching adults or children solve problems obtains feedback about their thinking in two ways: observing their actions or listening to what they say as they work (think-aloud). Adult experts tend to provide better oral feedback about what they are thinking than do children, because of their greater verbal facility and their presumed greater self-understanding (Baker & Brown, 1984; Miller, 1985).

Review of the Research on the DISCOVER Assessment Process

The DISCOVER assessment provides educators and researchers with a way to examine the thinking, creativity, and problem solving behaviors of students through a structured, researched process. The trained observers who administer the assessment receive feedback in three ways: observers watch and record the actions of the students as they solve problems, observers make records of the products that result from student problem-solving, and observers record what students say as they are solving the problems. DISCOVER has been the subject of many research studies since its inception. Maker's monograph (2005) for the National Research Center on the Gifted and Talented is a thorough presentation of the development and history of DISCOVER, a review of research about the assessment and curriculum processes, and practical applications. Much of the assessment research is summarized in Table 3 and is referred to again in Chapter III.

Qualitative Differences Between Gifted and Nongifted Children

Studying metacognition may be a way of examining qualitative differences between gifted and nongifted individuals (Rogers, 1986; Sternberg & Davidson, 1983). In the past, researchers have noted such quantitative differences between gifted and nongifted persons as IQ score, speed of information processing, and rate of progress through developmental stages (e.g., Cross & Paris, 1988; Garner & Alexander, 1989;

Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Maker, 1992. First DISCOVER activities described	Descriptive report	Description of problem solving activities initially designed for grades K-2; some observed behaviors of effective problem solvers described
Maker, 1993. Theory underlying DISCOVER	Relationships among creativity, intelligence, problem solving, and MI	Research design of studies testing theory described and summary of important results
Maker, 1994. Nature of authentic assessment	Descriptive report	Authentic assessment and problem solving in secondary schools described; DISCOVER assessment described and validation methods proposed

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/ Key Information
Maker, Nielson, & Rogers, 1994. Explanation of DISCOVER assessment and curriculum	Descriptive report	Philosophy and implementation of all phases of DISCOVER project discussed
Nielson, 1994. Gender and ethnicity fairness of the assessment	Questionnaires about family size, parent occupation, and other demographic characteristics mailed to families of students identified as gifted in one of two ways: traditional or DISCOVER; data compared using chi-square tests	Traditionally-identified gifted students differed from DISCOVER-identified peers with respect to preferred language; race/ethnicity; ancestral origin; parental birthplace (foreign or U. S.); family income; and parental occupation and education. Traditionally-identified group did not match local population demographics

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Al-Megta, 1994. Concurrent validity and internal consistency of the DISCOVER math assessment	Relationships examined among standardized math testing (ITBS and CTBS), accuracy and strategy subscores on DISCOVER math assessment, gender, and giftedness as determined by overall DISCOVER ratings; Pearson's Correlation Coefficients calculated to determine nature of relationships	All students: significant correlations: standardized math - DISCOVER math, standardized math - DISCOVER accuracy subscore; nonsignificant relationship: standardized math -DISCOVER strategy subscore; Internal consistency: high internal correlations (math-accuracy = .977, math-strategy = .895, accuracy-strategy = .780); .05 significance level; Boys: stronger relationships (than girls') between standardized math and math subscores Gifted students: significant correlations: standardized math - DISCOVER math overall

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Maker, 1995. Descriptions of individual children	Cultural, linguistic, and economic backgrounds of four children described, along with their strengths	Descriptive report, with personal reflections
Griffiths, 1995. Inter-observer reliability	Videotaped portion of assessment observed by 2 other researcher/ observers independently, ratings given. Cohen's Kappa correlation coefficients calculated among ratings of all observers	All Kappa coefficients significant at the .05 level. Percent of agreement on ratings given by the three observers reported as 75% - 100%

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Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Griffiths, 1996. Inter-observer reliability	Researcher observed assessment simultaneously with 6 other observers of differing experience levels; ratings on individual activities and overall ratings of giftedness compared using Cohen's Kappa, and percent of agreement on ratings.	Kappa coefficients were moderately high to high, with higher correlations obtained between the researcher and expert observers. Agreement on ratings was positive, with more agreement (95%) at the highest rating level.
Maker, 1996. Problem of underrepresentation of diverse students in gifted education programs	Changing conceptions of giftedness examined; new assessment (DISCOVER) described	Suggestions made for validating and refining the assessment in ways consistent with the new paradigm under which assessment was created

Table continues.

Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Perry, 1996. Use of DISCOVER to identify diverse students	Nearly 500 second-graders in schools of diverse populations, low socio-economic status assessed using DISCOVER. None previously identified for placement in gifted programs	After assessment, 6.2% of the students identified and placed in gifted programs
Griffiths & Rogers, 1996. Concurrent validity	Researcher observed and recorded behaviors of 2 case study students at different time periods. Behaviors later coded using codes on DISCOVER behavior checklists. Triangulation obtained by interviewing teacher about students' problem solving in classroom	Students' problem solving behaviors on the DISCOVER assessment similar to problem solving behaviors they displayed in their classrooms and to descriptions of behaviors by the students' teacher

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Maker, 1997. Update on DISCOVER research	Assessment described; review of research on development, reliability, and validity	Strengths of diverse students identified; assessment is equitable across gender, language, economic, and cultural groups
Schonebaum, 1997. Use of DISCOVER with deaf/hard of hearing students; concurrent validity	Researcher adapted DISCOVER assessment for use with deaf students; research assistant (regular interpreter for deaf students) trained in assessment; instructions given in American Sign Language (ASL) and in Simultaneous Communication (SimCom, signing and talking at the same time); ratings from assessment compared to determinations from IQ	Only minor adaptations needed to use assessment with deaf students; 100% inter-observer reliability; DISCOVER an effective way to identify giftedness – no students identified by IQ scores; linguistic component able to be assessed with DISCOVER – not possible with other cognitive tests

Table continues.

Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Griffiths, 1997. Comparative validity	Profiles of 33 Mexican-American kindergartners assessed using DISCOVER, WISC-III or WPPSI, and Ravens Progressive Matrices (RPM) analyzed	Each assessment fit the theory on which it was based; each measured different abilities; DISCOVER was most useful in identifying Mexican-American students as gifted
Rogers, 1998. Analysis of how DISCOVER parts are connected to each other and to underlying framework	Analysis of assessment and underlying theories; specific examples of students' responses to various parts of the assessment	DISCOVER provides a multi-faceted view of children's abilities and is well-grounded in its theory bases

Table continues.

Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Lori, 1998. Internal structure of linguistic DISCOVER assessment	Bahraini children assessed with DISCOVER; checklists for linguistic characteristics, interpersonal traits, and intrapersonal traits examined and totaled; means and standard deviations calculated; *t*-tests compared 3rd-grade means to 4th-grade means; Pearson Correlation Coefficients calculated for 3rd-graders, 4th-graders, and for all children in all 3 characteristics areas	3rd-graders moderately better storytellers than 4th-graders (p <.10) Correlation coefficients of storytelling (linguistic characteristics) with interpersonal traits (.26) and with intrapersonal traits (.29) significant at the .05 level. Storytelling abilities compared with interpersonal and intrapersonal traits: nonsignificant for interpersonal traits but significant for intrapersonal traits (.33, p <.01 for 3rd-graders and .24, p <.10 for 4th-graders), indicating that intrapersonal traits are related to storytelling ability

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Sarouphim, 1999a. Review of preliminary studies of reliability and validity	Description of the assessment and review of reliability and validity studies	DISCOVER is a promising alternative to addressing the problem of under-identification of minority students as gifted; caution to schools: make certain that gifted programs match what the assessment measures
Sarouphim, 1999b. Concurrent validity	Content analysis of researcher's field notes as she observed students rated at various levels in the DISCOVER assessment, and of teacher and aide comments about student strengths	Researcher's ratings and those of teacher and teacher aide matched ratings from DISCOVER assessment in intelligence areas measured; specific tasks should be designed to assess bodily-kinesthetic, interpersonal, and intrapersonal intelligences to improve effectiveness and credibility

Table continues.

Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Sarouphim, 2000. Internal structure; relationship of assessment to its underlying theory	Non-parametric correlations (Spearman's Rho) used to examine relationships among ratings given to 257 Navajo and Mexican-American students in assessment activities	Low and nonsignificant internal correlations among high ratings in each of the tasks, demonstrating that children can be rated as high in one of the Multiple Intelligences without being rated high in any other. This shows that DISCOVER fits well its underlying theory
Maker, 2001. Review of research about and revisions to DISCOVER assessment and curriculum models	Published and unpublished studies reviewed; revisions described	Description of current assessment and curriculum features; examples of teaching activities and photos of children involved

Table continues.

Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Sarouphim, 2001. Concurrent validity; gender and age effects	Results of DISCOVER compared to results from the RPM by correlational analyses at each grade level, with R-squared values figured to gauge effect sizes. MANOVA to determine gender or grade level effects. Chi-square tests for gender by gifted ratings to determine differences in identification	Mostly high correlations between DISCOVER ratings and Raven's scores revealed high concurrent validity. No main or interaction effects for the MANOVA, indicating an absence of significant grade level or gender effects. Chi-square analyses showed no significant differences in numbers of boys and girls identified as gifted at each grade level
Sarouphim, 2002. Analysis of high school assessment checklist and DISCOVER rating process, relationship to theory	Correlations conducted between/among ratings on activities in different/same intelligences, different cultural groups' ratings, gender ratings	Nonsignificant correlations: ratings on activities measuring different intelligences; moderate correlations: activities in same intelligences. Equitable representation found.

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Sak & Maker, 2003. Long-term predictive validity	School records of kindergartners assessed with DISCOVER examined several years later – state standards-based assessment scores, standardized achievement tests, and grades reviewed	Significant differences between students identified and not identified in their achievement measures and in grades. Achievement reflected areas in which students were identified as gifted. Kindergarten results predict achievement up to six years later.
Wallace, Maker, Cave, & Chandler, 2004. Thinking skills and problem solving in schools – early childhood emphasis	DISCOVER and the "Prism of Learning Model" combined with "Thinking Actively in a Social Context" for action research	Action research results reported; teaching examples, checklists for observation, and assessment activities described

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Joffe, Crawford, McLennan, & Spencer, 2004. Identifying students from underserved populations	Over 2,000 children from ethnically and linguistically diverse, high-poverty schools assessed using DISCOVER as part of a Javits grant-funded project. Before project initiated, traditional identification measures (Naglieri Nonverbal Intelligence Test and/or Cognitive Abilities Test) used at the schools. Percentages of identified children from each ethnic and linguistic group and from free/reduced lunch classification compared before and after grant implementation	Use of DISCOVER resulted in identification of numbers of ethnically, linguistically, and economically diverse students in similar proportion to their presence in the larger population. Seven or more percent of population in each school was identified, compared to 0%-2% before project implementation. Use of traditional identification measures had resulted in disproportionate numbers of unidentified students in these schools prior to the grant

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Sarouphim, 2004. Internal structure; gender and ethnicity effects	Correlations among the various DISCOVER tasks calculated to demonstrate the fit between the middle school assessment and its underlying theory. MANOVA used to examine gender and ethnicity effects. Chi-square tests conducted to look for significant differences between males and females identified and among individuals identified from various ethnic groups	Correlations mostly low and nonsignificant, showing that the middle school DISCOVER assessment fits well with Multiple Intelligences theory. No significant interaction effects or a main effect for ethnicity in the MANOVA analyses. Main effect found for gender: males scored significantly higher on Math portion of assessment; univariate post-hoc analysis showed effect size of .69. Chi-square showed no overall gender or ethnic differences in identification

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Maker, 2004. DISCOVER research and the relationship between intelligence and creativity	Previous research applied to questions about the value of intelligence and creativity in society, if and how they are related, how these traits may be nurtured and assessed	Creativity and intelligence are not different, but may result differentially from the prompts given to students on tests, in activities and situations, or as a result of attitudes toward student responses; methods of fostering talents, adaptability, problem solving presented
Sak & Maker, 2004. 15-year research review, curriculum model success	Underlying theories discussed; research on reliability and content, criterion, and construct validity reviewed; evidence for curriculum model success presented	Reliability and validity well-established; curriculum model successful; use of DISCOVER models in gifted programs discussed

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Table 3. *Information from Major Studies of and Publications on the DISCOVER Project*

Author(s), Year, Purpose	Method/Contents of Publication	Results/Key Information
Maker, 2005. Monograph presenting DISCOVER within the context of its research and theory backgrounds	Research from multiple fields presented; author's personal research and thinking processes discussed; practical applications of DISCOVER and case studies presented; description of new framework being developed cooperatively in Europe and Asia	Wide research used to support changes in gifted programming to develop talent of students from culturally, linguistically, economically, and geographically diverse backgrounds; synthesis of ideas presented, along with policy implications and recommendations for implementation
Sak & Maker, 2005. Relationships between divergent and convergent thinking; emphasis on creativity within mathematical domain	857 students took DISCOVER math assessment; correlations between divergent and convergent thinking and components; correlations studied between open and closed mathematical problems in the assessment	Significant correlations: divergent - convergent thinking, convergent thinking - divergent thinking components; correlations between problem types varied with similar/ difference of item types; construct validity of Schiever & Maker's problem types continuum

Keating, 1975; Scruggs & Cohn, 1983). Educators in possession of such information, however, have noticed its limited contributions to a rich understanding of the complex inner workings of the mind of the gifted individual.

Researchers studying experts have found that quantitative findings such as errors, speed, and nature of “chunking” information (grouping closely-knit units of knowledge structure) do not answer qualitative questions about the differences between novices and experts. Such qualitative differences do exist and have been the focus of nearly all expertise research. Glaser and Chi (1988), for instance, found that those who possess high levels of procedural knowledge use qualitatively different strategies to solve problems.

Other researchers found qualitative differences between the cognitive processes of gifted and nongifted children. Swanson (1992) examined the intercorrelational patterns among a variety of cognitive factors among gifted, high average, and low average children. For gifted children, the patterns reflected independence among mental processing as measured by verbal IQ, achievement, and creativity, metacognition, and problem solution. Swanson stated that this low correlational pattern suggested a more efficient thinking and processing system for gifted children. This assertion calls to mind the statement by Borkowski and Kurtz (1989) that the interaction among metacognitive components was the distinguishing factor between gifted and nongifted children.

In a study of reading comprehension in deliberately “bugged” text, Hannah and Shore (1995) studied the metacognition of gifted, nongifted, nongifted learning disabled, and twice exceptional students who were gifted and had a learning disability. They found that the learning disabled gifted children were more like gifted children in their thought processes than they were like average or learning disabled nongifted children. Differences in metacognitive knowledge or skill, error detection (strategy use), or comprehension were related to age and giftedness, not to the presence of a learning disability.

As Bruce Shore began to look at metacognition differently, seeing if it might hold a clue to qualitative differences in the thinking processes of gifted individuals, he and his colleagues examined heretofore unexplored aspects of metacognition (cf. Dover & Shore, 1991; Hannah & Shore, 1995; Shore et al., 1994). Shore (1986, 2000) argued that the low-level aspects of metacognition that had been studied so far were not useful in pinpointing meaningful differences in the ways that individuals think. He asserted that the use of high-level tasks would be needed to elicit different levels of metacognition from subjects, a view also promoted by earlier researchers (e.g., Campione et al., 1985).

The literature review of metacognition by Alexander, Carr, and Schwanenflugel (1995) concurred with Shore that low-level aspects of metacognition were unlikely to show meaningful differences in the ways that individuals think. The literature, up to that point, illustrated inconsistent differences between gifted and nongifted groups in various aspects of metacognition. The authors, therefore, proposed that metacognition not be considered a single construct, but rather a connected collection of constructs. They suggested that several extensions of metacognition research might illustrate conclusive differences between gifted and nongifted groups in various areas.

Metacognitive Knowledge in Gifted Children

Results also are mixed about how the gifted differ from their nongifted peers in metacognitive knowledge, just as results in strategy use and executive control are mixed (Alexander et al., 1995). In some metacognitive areas, a developmental ceiling effect appears to exist, with the gifted outpacing their age peers until a certain threshold is reached, as though the development of the gifted was merely accelerated, not qualitatively different. Scruggs and Cohn (1983) found such quantitative differences in strategy use: the same strategy was used earlier by the gifted versus the nongifted. In areas other than strategy use, the gifted start out ahead and remain that way, suggesting qualitative differences in their thinking.

Alexander, Carr, and Schwanenflugel (1995) have postulated that one reason consistent differences have not been found is that most studies have separated the two samples, gifted and nongifted, based on IQ scores. In general, IQ tests rely on closed-ended, right-or-wrong questions that do little to illuminate the depth of thinking of the participants. Since IQ scores give researchers little information to assist them in understanding differentiated mental processes, the authors proposed that other methods of identifying potential giftedness may yield more consistent results in metacognitive studies. An identification method that uses problem solving as its basis, such as the DISCOVER assessment, may differentiate groups more effectively for cognitive studies than do IQ tests. The questions that are used in the DISCOVER assessment range from convergent to divergent, as I explain in a later section of this paper.

Metacognition research seems to have slowed to a crawl in the past decade. Little has been written about it since the psychological studies of the 1980s and the theoretical writings of Shore and others in the 1990s. This may be because metacognition is a hard construct to define precisely ("…the concept of metacognition is somewhat fuzzy" – Baker & Brown, 1984, p. 353) or because it is difficult to do metacognitive research with children. Their verbal skills and reflective speech may be poorly developed, and regulatory processes may not be conscious or statable in many learning situations (Brown, 1987).

The slowdown in research may be due, however, to a feeling that metacognition's value has been established enough to proceed with training students in its use. In many modern curriculum programs, metacognition is being used as part of the overall approach to reading and to mathematics (e.g., Schoenfeld, 1987). But its differential value in students of differing intellectual levels has not yet been established. Davidson, Deuser, and Sternberg (1994) found that gifted children spontaneously use insight processes and neither need cueing nor benefit from training. Attribution theory also plays a role in increasing students' cognitive behavior based on their understanding of their own thinking. Those who think their poor performance is due to lack of effort may respond better to requests to try harder than those who attribute their poor performance to lack of ability (Miller, 1985). Different types of strategy training (visualization versus verbal versus analytic) have been found to work differently with different styles of learners (spatial versus verbal) and even with different genders (Kyllonen et al., 1984). So to promote the common use of "metacognitive training" with all students in the same manner is not intelligent use of educational research. The central research question in all metacognitive studies is, what is the relationship of metacognition and actual cognitive behavior (Miller, 1985)? For this reason the following study was conducted.

CHAPTER III

METHODS

The purposes of this study were to explore further the qualitative differences between young gifted and nongifted students through extension of the study of declarative metacognitive knowledge, and to replicate an existing metacognition study of gifted and nongifted young children (Schwanenflugel et al., 1997) using different identification procedures. The three research questions addressed differences between the gifted and nongifted groups, differences between the results of the current study and previous studies when the method of identification for giftedness was changed, and differences among the three metacognitive elements examined.

Discussion of the methods of this study begins with the reasons for the selection of the method used to identify students as gifted or nongifted for the study. The DISCOVER process was introduced in Chapter I, and a detailed explanation of the process is presented here. Following an explanation of the DISCOVER assessment process, I address participants; procedures; and data collection, scoring, and analysis in three additional sections. At the conclusion of the chapter, I illustrate how the analyzed data are used to address the three research questions.

Selection of an Identification Process for Use in this Study

Given the variety of definitions and identification procedures available to researchers for use in their studies of giftedness, a researcher must consider carefully which identification process will be used to distinguish gifted from nongifted participants. As Callahan, et al. pointed out in their 1998 monograph on gifted identification measures, many practitioners select identification procedures with little thought to their alignment with a theoretical construct of giftedness and without thinking about how the results of identification may fit the programming available.

An aligned approach to giftedness has been advocated by many leading scholars in the field (Maker, 1993b; Renzulli & Reis, 1985; Sternberg & Clinkenbeard, 1995; VanTassel-Baska, 1998). I decided to adopt the consistent approach to giftedness represented by the DISCOVER process (Maker, 1992, 1996, 2001, 2004; Maker et al., 1994) and to use its identification assessment in my study. The DISCOVER assessment for identification embodies four theory and research aspects: (a) identification procedures grounded in and aligned with a theory that suits the purposes of the researcher's study, (b) an identification procedure that was developed using methods that are appropriate to the current study, (c) an identification process that is supported by research that demonstrates its effectiveness, and (d) a method of identification that results in the distinction between gifted and nongifted children. Below, I examine each of these four aspects in detail.

Selecting a Theory-grounded and Aligned Approach

The DISCOVER process is grounded in theory (i.e., Maker, 1993, 2005; Rogers, 1998; Sarouphim, 2000, 2004, 2005) and aligned with related concepts and definitions, as mentioned above. The theory underlying the development of the DISCOVER process was the Theory of Multiple Intelligences (Gardner, 1983, 1999, 2006). In his original theoretical research, Gardner identified seven separate and relatively autonomous domains of intelligence: linguistic, logical/mathematical, spatial, bodily/kinesthetic, musical, interpersonal, and intrapersonal. He later added an eighth, naturalist (Gardner, 1993), and has explored others (Gardner, 1999). Use of the DISCOVER process has resulted in the identification of students' strengths in several of the multiple intelligences in a manner consistent with Gardner's definition of intelligence. According to Gardner (1983, 1999, 2006), intelligence, or human intellectual competence,

> ...must entail a set of skills of problem solving -- enabling the individual *to resolve genuine problems or difficulties* that he or she encounters and, when appropriate, to create an effective product – and must also entail the potential for *finding or creating problems* – thereby laying the groundwork for the acquisition of new knowledge (Gardner, 1983, pp. 60-61, emphasis in the original).

Maker's definition, which is the one used in this study, is based on Gardner's conceptual framework, and states that giftedness can be defined as "*the ability to solve the most complex problems in the most efficient, effective, or economical ways.* In addition, gifted or highly competent individuals are *capable of solving simple problems in the most efficient, effective, or economical ways"* (Maker, 1993a, p. 71, emphasis in the original). In the DISCOVER assessment, children have been involved in solving problems that range from structured to open-ended. In this way, they have been given a chance to solve defined problems as well as to interpret open-ended problems, thus exhibiting "problem finding" behavior. This is a definite departure from the closed-ended questions (Carr & Borkowski, 1987) that have been employed in traditional IQ tests. A procedure based upon Maker's definition was presumed to be ideal for a study of metacognition, as problem solving is believed to be one of the ways in which students demonstrate metacognitive processes (Carr et al., 1996) and one of the ways in which researchers often examine metacognition (Shore, 1986).

Selecting an Approach Developed Using a Method Suited to the Study

The DISCOVER process seemed a logical means for identifying students for a metacognition study because of the way in which the DISCOVER assessment was developed. Metacognitive interviews formed a part of the initial observations of superior problem solvers on which the final version of the assessment was based (Maker, 1992, 1994, 1996, 2001). In addition, in the DISCOVER method, children's problem solving abilities with open-ended questions and prompts, which often are viewed as evidence of metacognitive abilities (Carr et al., 1996), are observed and documented carefully .

Selecting a Research-Supported Approach

The third aspect of selecting an approach to giftedness for use in a study was to look for an approach with research to support its effectiveness, validity, and reliability. (See Table 3 for details of the methods and findings of the following reported research studies.) Research on the DISCOVER process is in its second decade. Various researchers have examined the internal structure of the DISCOVER assessment instrument (Sarouphim, 2000, 2002, 2004) and its parts (Al-Megta, 1994; Lori, 1998; Sak & Maker, 2005). Many types of validity of the assessment have been established: concurrent validity (Al-Megta, 1994; Griffiths & Rogers, 1996; Sarouphim, 1999b, 2001; Schonebaum, 1997), comparative validity (Griffiths, 1997), and content, criterion, and construct validity (Sak & Maker, 2004). The reliability of the process also has been affirmed (Griffiths, 1995, 1996; Sak & Maker, 2004; Sarouphim, 1999b). The effectiveness of the assessment in identifying students from diverse populations has been examined. Gifted deaf students were able to be identified using DISCOVER (Schonebaum, 1997), and the level of representation of minority gifted students in special programs for the gifted changed through use of the assessment (Joffe, Crawford, McLennan, & Spencer, 2004; Nielson, 1994; Perry, 1996; Sarouphim, 2001, 2002, 2004). The degree to which superior problem solvers are identified who continue to demonstrate similar gifted behaviors in their regular classrooms was studied by Griffiths & Rogers (1996) and by Lori (1997), as well as in a study of long-term predictive validity by Sak & Maker (2003). Several researchers have reported on the gender fairness of the assessment (Maker, 1997, 2005; Nielson, 1994; Sarouphim, 2001, 2002, 2004). In addition, Rogers (1993) tested the relationship between Gardner's theory and the behaviors and processes of students identified through the spatial portion of the DISCOVER assessment. She found that identified students described using problem solving processes similar to those described by Gardner as “core capabilities” of spatial intelligence (Gardner, 1983). Sarouphim (2000, 2004) also reported that the assessment fit its underlying theory, the theory of multiple intelligences, well. (For a comprehensive guide to DISCOVER and its research, see Maker, 2004, 2005.)

Selecting a Non-traditional Approach that Discriminates Between Gifted and Nongifted

Further, the purposes of my study dictated that I use an identification process that accomplished two goals: (a) distinguishing between gifted and nongifted young students, and (b) being a nontraditional identification procedure, for comparison purposes with a previous study that used traditional identification procedures. The use of the DISCOVER process, a non-traditional approach to identifying giftedness, allowed me to identify gifted and nongifted groups of young children for my study. The assessment is fully described in the next section. One of my purposes was to examine metacognition in a group of children who had been identified as gifted using a nontraditional identification procedure and then to compare the results of the current study with the results of a previous metacognition study that was done using traditional identification procedures.

The DISCOVER Process

The DISCOVER process, while not the metacognitive instrument used in this study, is the identification procedure that was employed to determine giftedness in the participants in this research. A description of the assessment process and of the theory and definitions of intelligence and giftedness that underlie the process are critical to understanding research in which the DISCOVER assessment is used as a means of identification.

The assessment consists of engaging activities in each of the three intelligences (Gardner, 1983, 1999, 2006) most commonly addressed in schools: spatial, logical/mathematical, and linguistic. The problems that are posed in each activity are arranged along the problem solving continuum described by Schiever and Maker (1991), based on the work of Getzels and Csikszentmihalyi (Getzels & Csikszentmihalyi, 1967, 1976; Csikszentmihalyi & Getzels, 1971). Problems progress from convergent and very structured to open-ended and very loosely-structured. The tasks are grouped developmentally, with different tasks for grades K-2, 3-5, 6-8, and 9-12.

The DISCOVER assessment has been designed carefully in alignment with its underlying theories, in particular, the theory of multiple intelligences described by Howard Gardner (1983, 1999, 2006). Although problem solving is a key element in most ideas about intelligence and creativity, the creators of traditional intelligence tests define problem solving narrowly, accepting only one "right" or "best" answer or solution. Gardner states that human intelligence is manifest in solving real problems that are encountered in one's everyday existence and, furthermore, intelligent behavior also consists of finding or creating new problems, an activity that leads to the acquisition of new knowledge. When DISCOVER is used, students are assessed in their classroom settings, a comfortable context for them. They also are assessed in their first language, so that communication does not become a barrier to problem solving. Since the problems posed within the tasks range from closed to open, students are given the opportunity to solve both defined problems and undefined problems, thus exhibiting "problem finding."

The definition of giftedness employed in the DISCOVER process, based on the conceptual framework of Gardner's theory, is that giftedness is "the ability to solve complex problems in effective, efficient, elegant, and economical ways" (Maker, 1993a; Maker & Nielson, 1996; Maker, Rogers, Nielson, & Bauerle, 1996). The key term in understanding this definition is the word "complex." A problem solver may employ known information, use known methods, and arrive at the "right" answer. However, demonstration of intelligent behavior, in accordance with the theory, depends upon the ability of the solver, when necessary, to depart from known information, concepts, and methods, to redefine the problem, and to reach entirely new solutions. Thus, the problems solved by the gifted individual must be complex, in order to provide the opportunity for such richness of problem solving behavior.

In keeping with the contextual framework of the theory, the DISCOVER assessment setting needs to be within the realm of students' understanding, as do the problems themselves. The tasks, which employ a number of materials appropriate to each intelligence, simulate activities that would be used in classrooms for gifted learners. Authenticity is stressed further by the use of small groups for the assessment, each group facilitated by a trained observer. Instructions for each task are read by the students' own teacher. The assessment closely resembles a fun classroom learning experience and is conducted in an encouraging atmosphere.

Finally, the activities are as "intelligence-fair" (Gardner, 1992) as possible, meaning, for example, that linguistic ability is not required to solve the logical/mathematical or spatial problems, and the linguistic problems do not require the solver to be mathematically or spatially adept. Three of the activities are done orally, and the other two activities, a mathematics worksheet and a writing assignment, require the so-called "second order" skills of using notational symbol systems (Gardner, 1992). For this reason, students who have had limited exposure to the use of symbol systems taught in school are not at a disadvantage because, in the majority of the assessment, "first order" knowledge is used.

The DISCOVER tasks were developed from their underlying theories (see Maker, 2004 for a thorough discussion) in a qualitative manner. From the observation of more than five thousand children, checklists were derived to describe the behaviors of superior problem solvers. Currently, when assessments are administered, observers "debrief" immediately following the assessment, using the checklists to assist them in decisions about their ratings of the students. Discussion among the observers is focused on careful notes, sketches, and actual products made during the assessment.

Preliminary research on the DISCOVER assessment indicates that it equitably identifies gifted students from ethnic minority groups in which it has been used (Joffe et al., 2004; Nielson, 1994; Perry, 1996; Sarouphim, 2004). Further study is needed before a conclusion can be reached regarding the subsequent performance of DISCOVER-identified students in special programs matched to their abilities, although one such study of predictive validity (Sak & Maker, 2003) was encouraging.

The result of administering the DISCOVER assessment is a set of student strength profiles in problem solving abilities. Students are classified as being either "Definitely," "Probably," or "Maybe" superior problem solvers in a given activity, or their ability in that activity is said to be "Unknown." In most cases, as is the case in this study, students with a rating of "Definitely" in two or more areas are considered gifted.

Participants

Because of the relatively small population for this study and the small sample size, descriptions of both population and sample are blended in this section. In Chapter IV, the focus is only on the sample.

Criteria for Inclusion: Gifted Group

Children were included in the gifted group for this study if they received two or more ratings of “Definitely” (“D”) or “Wow” (“W”) on the DISCOVER assessment, including a “D” or “W” on the Spatial-Analytical portion of the assessment. Although two or more ratings of “D” or “W” generally serve to identify a student as gifted in normal circumstances, I decided to add the additional qualification of a “D” or “W” rating on the Spatial-Analytical task because of the nature of another question asked after the interview, the results of which are not included in this study.

Criteria for Inclusion: Non-identified Group

Children were considered nongifted for the purposes of this study if they received no ratings of “D” or “W” on the DISCOVER assessment. Students with one “D” or “W” rating were not included as participants, to avoid confounding the giftedness variable and to give a greater separation between the two groups. Also, students who were absent for one or more parts of the assessment were not included in the pool of possible participants in the non-identified group, because of the possibility that they might have been rated “D” or “W” in the missed part(s) of the assessment, had they actually participated.

Sampling the Population

The 21 participants were drawn from a population of second-graders in a very large suburban public school district in the West who had been assessed using the DISCOVER process. Reducing the numbers of assessed students to a workable sample is explained below and is summarized in Table 4. A total of 301 first-graders was assessed the year prior to the current research. Those who received two or more ratings of “D” or “W” were considered gifted. Of those gifted children, 17 received a “D” or “W” in the Spatial-Analytical task and were therefore eligible to be included in the gifted group for this study. Because so few students met the criteria to be included in this group, all 17

Table 4. Sampling Procedures for the Study.

Step 1. Students are assessed using the DISCOVER process.

- 301 first-graders (assessed year before research)
- 143 second-graders (assessed year of research)

All assessed students described above are considered for the study.

Step 2. Students qualified for the study are selected.

- 17 gifted students qualify (all 17 placed in pool)
- 173 nongifted students qualify (25 placed in pool)

Step 3. Students are asked to participate in the study.

- 12 gifted students remain in pool after five move (all 12 participate)
- 25 nongifted students in pool (only 9 participate)

Step 4. Study commences with 21 participants.

were included in the pool from which the gifted sample was to be drawn. At another two schools, 143 second-graders were assessed in the year of the research, and none received a “D” or “W” in the Spatial-Analytical task, so no students from these two schools were included in the gifted pool. The total number of students in the gifted pool therefore remained 17.

A total of 121 first-graders completing the full assessment received no “D” or “W” ratings, and they were therefore included in the pool of possible participants in the non-identified group. Among the second-graders who were assessed, 52 students who completed the full assessment received no “D” or “W” ratings and were added to the pool of possible non-identified participants. Thus, the total of eligible students in the non-identified pool was 173. Initially, 25 students were randomly selected from the non-identified pool as possible participants. Random selection was accomplished by the assignment of non-sequential three-digit numbers to all students in the non-identified pool. A random number table was then used to select possible non-identified participants in a number equal to the number of available gifted participants.

Availability and Mobility of Participants

Of the 17 gifted students in the pool, five were no longer enrolled in district schools at the time interviewing began and could not be located to be interviewed. That left 12 as the number of gifted students who possibly could be interviewed and could participate in the study. All 12 were contacted and were included in this study.

Although approximately 25 non-identified students were originally placed in the pool and contacted about participation, a combination of factors reduced actual non-identified participants to nine. Some parents failed to respond to requests to interview their child. Others changed their minds after initially agreeing to participate. However, in two instances, the interviewer inadvertently obtained parent signatures on a copy of the consent form without the official University of Arizona Internal Review Board stamp. After I realized the error, the two families had moved and could not be located to sign the correct form. The interviews with the children of those two families were not transcribed or analyzed for this study. (See Appendixes A and B for the consent form for parents/guardians and the oral consent form for participants. The Russian translation of the parental consent form used in the study is available from the researcher.)

Due to these factors, the small number of eligible gifted students and the many difficulties described above with non-identified students, the total sample consisted of 21 students. Some of these students were assessed using the DISCOVER process when they were first-graders and some were assessed as second-graders. All participants were second-graders at the time of the research interview.

The mobility of the students in the population presented another hurdle to the completion of research. The 301 assessed first-graders were enrolled in five elementary schools at the time of assessment, and the 143 second-graders who were assessed were enrolled in two different elementary schools. By the time of the interviews, five gifted and non-identified participants had moved to different schools in the district. Due to this mobility, the second-grade participants attended 11 elementary schools in the district at the time of the interviews.

DISCOVER Assessment of the Participants

Most participants were administered the DISCOVER assessment for giftedness identification purposes at the beginning of their first-grade year. Some received the assessment at the beginning of their second-grade year. The DISCOVER assessment was administered by an experienced cadre of trained observers, assessment leaders, and scorers. University of Arizona DISCOVER personnel observed and certified most of the observers during the assessment of the first-graders. As a certified DISCOVER trainer, I trained the other observers. I also observed and provided the annual certification for all observers according to DISCOVER Project guidelines.

Procedure

Following the completion of the Research Application approval process in the school district, I contacted the principals of each school where prospective participants attended to explain the study and to obtain administrative approval. (School district research approval materials are available from the researcher.) Then I contacted participants' teachers to explain the study. Permission forms granting informed consent were given to teachers to be sent home with each participant, in both Russian and English for parents of the ELL student. I followed up by telephone with parents until all permission forms were signed and returned.

Participants were interviewed in their home schools during the school day or in the participants' homes, if the parents preferred the home environment. A quiet room was found at each school site and reserved as necessary for interviews. Parents were allowed to choose the interview site in their own home. Four families chose alternative interview sites, such as a local park or a parent's workplace. The interview schedule was created for the convenience of parents.

At the time of each interview, participants were greeted and the interviewer introduced herself and gave a brief explanation of what would happen in the interview. The children were told that the researchers wanted to learn about how second-graders thought about things. All interview sessions were tape-recorded. Interviewers familiarized the participants with the tape recorder prior to the interviews. Oral consent forms were read to the participants and signed by them, or oral consent was obtained. After consent was obtained, the interviews commenced.

All children were individually interviewed using the metacognitive questionnaire in three sections. After sections I and II had been administered, the interviewer allowed the participant to get a drink of water and take a restroom break, if necessary. The student was then invited by the interviewer to move and stretch the large muscles, to allow the student to take a break from cognitive activity. The total break was about five minutes for those who chose it. Each interview session, consisting of all three questionnaire sections and the break, lasted about 45 minutes.

As a result of researcher oversight, some participants were not administered all of the interview items. Omissions were few and were considered to be random; consequently, sample size varied slightly for one or two questions.

Instrument

Use of the instrument in the study, a verbal self-report in an interview format, is a method of assessing children's understanding of their own thinking processes. The instrument was an open-ended metacognitive questionnaire with 25 items in three sections (see Appendix C). In the first section, items 1-10, children were asked about their knowledge of variables affecting memory. These questions were derived by Schwanenflugel and her co-authors (1997) from previous metacognitive interviews in studies by Kreutzer and her colleagues (1975) and by Borkowski and Peck (1986). To increase clarity and to decrease the opportunities for participants to give yes/no answers, minor changes in the wording of the questions were made. Otherwise, the memory items were used as written for the Schwanenflugel, Stevens, and Carr study (1997). Items 4 and 5 required the participants to refer to several colored pictures that accompanied the questions. Copies of the pictures can be obtained by contacting the researcher.

In the second section, items 11-17, children were asked about their knowledge of variables affecting attention. Schwanenflugel and her colleagues (1997) based their meta-attention questions on previous studies by Kern (1989) and by Miller and Weiss (1982), adding additional items to the instrument. I used these items with some modifications in wording for clarity and to encourage expanded responses.

No reliability information was reported in any of the previous studies that included the questions on memory variables or on attention variables. (See Table 5 for results of an internal consistency study I conducted on the entire instrument.) Results among the studies using these instruments have been very similar, however. For instance, the categories of responses to the items in the memory index of the interview in my study were nearly identical to those listed by Schwanenflugel and her colleagues (1997). In addition, Schwanenflugel's categories closely matched those listed in the original

Table 5. *Internal Consistency of the Metacognitive Instrument*

Reliability Estimate Summary Table

Source	*SS*	*df*	*MS*	Variance component
		Memory Index, $r = 0.39542$		
Participants (P)	5.914286	20	0.295714	0.011693
Items (I)	10.11905	9	1.124339	0.045026
Residual (PxI, e)	32.18095	180	0.178783	0.178783
Total	48.21429	209		
		Attention Index, $r = 0.275109$		
Participants (P)	3.115646	20	0.155782	0.006122
Items (I)	4.734694	6	0.789116	0.0322
Residual (PxI, e)	13.55102	120	0.112925	0.112925
Total	21.40136	146		
		Decision Making Index, $r = 0.665315$		
Participants (P)	5.034014	20	0.251701	0.023923
Items (I)	5.605442	6	0.93424	0.040476
Residual (PxI, e)	10.10884	120	0.08424	0.08424
Total	20.7483	146		

memory study conducted by Kreutzer, Leonard, and Flavell (1975). In the 1975 study, two raters assigned student responses on all except yes/no questions to categories. Kreutzer and her colleagues calculated the percentage of agreement between the raters on questions with the possibility of multiple categories of responses. Most of the reported inter-rater reliability was 90-100%, with no agreement percentages below 85 reported.

The third section, items 18-25, contained questions about children's knowledge of variables affecting decision making. Decision making is a key component of Sternberg's and Davidson's concept of insight (1983), in that problem solvers select, or make decisions about, information and stimuli to encode, compare, and combine. I constructed the items in this section to be similar in style to the questions in the other two sections. To create the categories for items 18-25, I separated the construct of decision making into various components based on the circumstances in which the decision was to be made. I based these circumstances and occasions for decision making on my understanding of the experiences these particular young children have had with decisions, not on any theoretical or empirical study of the nature of decisions. I used this situational approach because I thought it would be well understood by the participants, based on my knowledge of their lives and experiences. I devised scenario-based questions similar to those used in the memory and attention sections of the interview. I wrote scenarios that would be understandable to the student population and to the targeted age level of the responders. The wording of the questions was piloted with two second-grade students known to me, both of whom understood and were able to respond to the questions as written. I also discussed the questions with other educators.

Internal Consistency of the Instrument

To estimate the reliability of the instrument, I studied its internal consistency. Internal consistency is a reliability estimate for individual items on a test, in this case, the interview questions, to see how dependably individual items all measure the same construct. Since each section of the interview was designed to measure a different metacognitive element, I examined each section separately.

To determine internal consistency, all sources of variability in the scores on test items (interview questions) were examined through the collection of data in a random-effect model with a participants-by-items design (Shavelson, 1996). I calculated variance components for both variables (test items and participants) and for residual error. The residual contains inconsistencies that may be due to interaction between the two variables or to error. The same procedures are used for computing the variances as are used in conducting a repeated-measures Analysis of Variance. The ANOVA procedures are used only as a means of obtaining the variance measures; the actual reliability statistic is a correlation. The reliability coefficient, *r*, is the ratio of true-score (*x*) to observed-score (*x'*) variance.

I set up a reliability estimate summary table for each of the three sections (see Table 5). In the table I list the three sources of variability: the sums of squares, degrees of freedom, and mean squares for each source, and the variance components. The variance components were then used in the following reliability formula:

$$r_{XX'} = \frac{\sigma^2_P}{\dfrac{\sigma^2_{res.}}{\sigma^2_P + k}}$$

where *P* stands for the participants, *res* stands for the residual term (interaction between participants and items plus error), and *k* stands for the number of items (Ruiz-Primo, Mitchell, & Shavelson, 1996, p. 402).

The reliability coefficients for the Memory and Attention indexes are 0.395 and 0.275, respectively. Such low coefficients are expected because of the nature of the questions within each index. Since both metamemory and meta-attention have been studied extensively, distinct components within each construct have been identified and used as the basis for the questions. Thus each question within an index differs from the others in relation to its research-based salience. For the Decision Making index, however, no such solid research base exists to help the researcher delineate separate and distinct components of the construct. Therefore, since my questions simply concern decision making in various contexts such as number and knowability of options, I expected that the internal consistency of this index would be high, because the items are all testing the same construct. I did not separate decision making into distinct components, and so the internal consistency correlation is high (0.665).

Interviewers

Interviews were conducted by trained personnel experienced in working with young children. In addition, the interviewers had extensive experience with the DISCOVER assessment. I was the main interviewer. The assistant interviewer was a trained DISCOVER observer who had worked with children for three years in the DISCOVER assessment process. (See Appendix F for University of Arizona Human Subjects Review documents, including Verification of Training for both interviewers.) Each interviewer worked alone with each participant. The assistant interviewer was trained in the purpose of the current research and in the interview protocol as discussed in the following sub-section. The assistant interviewer was blind to the giftedness status of the participants, although that was not possible for me.

Interviewer Training

I met with the assistant interviewer twice for training. In the first training session, we informally discussed the purpose of the study and the procedures for the interviews. I addressed how the participants were selected, as well as the fact that the assistant interviewer would not know the giftedness status of the interviewees. The assistant interviewer was given a copy of the questionnaire and supporting materials to study before the next training session. The assistant interviewer and I spoke by telephone to clarify the questions and the task.

At the second training session, the assistant interviewer was given the opportunity to ask me questions about the questionnaire. I made clarifications and answered questions, particularly about follow-up questions and what the interviewer could and could not ask children during the interviews. Then she observed while I conducted an interview. The assistant met with me once again to clarify any remaining questions before she began doing interviews on her own.

Data Collection, Scoring, and Analysis

Data Collection

Tapes of the interviews with all participants were kept and labeled with the participants' name. I transcribed all the tapes. The auditory transcripts were word-for-word transcriptions of the questions and what the participants said in response.

Two Types of Scoring and Data Analysis

The first type of analysis conducted on the data was an Analysis of Variance (ANOVA). For this analysis, I needed overall scores for the gifted and nongifted groups in each of the three metacognitive areas. To obtain these scores, I followed the procedures from the Schwanenflugel, Stevens, and Carr (1997) study. In this type of scoring each numbered question was considered as a whole, and I examined whether the combined responses on all the parts of a particular question reflected that participant's understanding of the overall metacognitive construct as represented by that question.

The parts of each question were designed for clarification of the overall construct. For example, Question 18 is about the child's general understanding of his or her decision making ability. Parts A to G are prompts to help the respondent be more specific and clarify his or her answers. In the original study of metamemory, Kreutzer et al. (1975) conducted chi-square tests for each part of a question to find the differences between age groups and to confirm the separation of categories of responses. Schwanenflugel et al. conducted chi-square comparisons on each part of each question to examine fine-grained differences between the gifted and nongifted groups.

Scoring the parts of questions separately allowed me to make more fine-tuned comparisons between individuals and to look at patterns of responses qualitatively. I also wanted to compare the gifted and nongifted groups' responses part-by-part, since some question parts were designed to elicit responses about *why* a child had responded in the way he had. For this part-by-part comparison, I originally planned chi-square tests to compare the groups, as Schwanenflugel and her colleagues (1997) did, but I did not follow through on that plan, for reasons I explain in later sections of this chapter.

The processes of scoring the responses in the overall manner described and of scoring them part-by-part were more recursive than they were sequential and separate. As I read and reread participant responses, I made marginal notations on each transcript that summarized students' thinking using their own words or words that were semantically equivalent to the original reports, for data reduction. In this way, I was able to derive the units of meaning that would be used both in the assignment of responses to categories and in the concept development process described in a later subsection about part-by-part scoring. The concept development process, which involves looking at pieces of information and grouping them into categories, was the basis of the part-by-part scoring that was necessary for the second type of data analysis, the chi-square comparisons.

I was the only one involved in the scoring, on which I spent several months. During that time I read many resources about analyzing student writing (although the responses were oral) and about qualitative analysis. I also reread the original studies upon which this study is based to compare the responses of my participants with those of previous participants. I examined how my participants' responses fell into categories similar to those listed by Schwanenflugel, Stevens, and Carr in their 1997 article, to check for criterion validity. In the two indices that were mutual to both the 1997 study and mine, Memory and Attention, I only had different categories on one question, Question 11.

Scoring the Responses for Overall Metacognitive Understanding

As stated previously, the purpose of overall scoring was to obtain scores for each cell of a planned ANOVA. In the Schwanenflugel et al. (1997) study, criteria for judging overall responses to each question were not listed. In an effort to make evident my thinking about the constructs represented by the questions, I examined the questions and their wording carefully to seek units of meaning and key words that pointed me toward the purpose of the question. I further clarified these key words and phrases into the criteria listed in Table 6. Once I defined these overall scoring criteria, I did not change them at any time in the data analysis process.

If there was exact matching between the words in my criteria and the words a student used in his or her response, that child received a point in the overall scoring of that question. That was not common, however. Most often, my understanding of the meanings of the children's responses to the whole question indicated that they did or did not meet the criteria. If a child demonstrated understanding of the metacognitive purpose of the question, that child received a point for that question in the overall scoring. Each child's scores were totaled for each metacognitive element. Then the scores for gifted students and for nongifted students were totaled within each metacognitive element, thus providing the six scores required to fill the cells of the ANOVA design (see Table 9).

Table 6. *Overall Metacognitive Scoring Criteria*

Memory Index

Aspect of memory that question probes	Criteria used to judge whether participant understood aspect of memory represented by this question
1. Memory ability	Understands own ability to remember; what types of items are easiest/hardest to remember
2. Relearning	Knows relearning is easier than new learning, effect of savings from previous learning
3. Short-term memory	Knows how short the short-term memory is, value of acting immediately and of off-loading items in short-term memory
4. Story context	Sees value in putting items in story context to aid memory
5. Sorting strategy	Sees value in sorting items to aid memory
6. Prospective memory	Has advance strategies for memory before needed
7. Retrieval cues	Has strategies for retrieval of items in memory
8. Learning intentionally	Knows when intentional study is needed, has strategies for studying
9. Rote vs. gist	Knows rote learning is harder than gist learning
10. Memory cues	Knows value of some cues for remembering

Table continues.

Table 6. *Overall Metacognitive Scoring Criteria*

Attention Index

Aspect of attention that question probes	Criteria used to judge whether participant understood aspect of attention represented by this question
11. Attention ability	Knows what paying attention is, when it is easier/harder to pay attention and why
12. Influence of distractions	Knows that external factors (noise) and internal factors (interest and focus) influence attention
13. Avoiding distractions	Knows certain cognitive and sensory distracters, how/when to avoid
14. Preoccupation	Knows that preoccupation influences attention, discriminates preoccupation from sensory distraction
15. Role of interest	Understands role of interest in paying attention
16. Divided vs. focused	Knows that focused attention is more powerful than divided attention
17. Limited capacity	Knows people have limited capacity for paying attention to multiple stimuli

Table continues.

Table 6. *Overall Metacognitive Scoring Criteria*

Decision Making Index

Aspect of decision making that question probes	Criteria used to judge whether participant understood aspect of decision making represented by this question
18. Decision making ability	Understands own ability to make decisions, when it is hard/easy for self and others to make decisions
19. Multiple good choices	Has strategies to choose between multiple good options
20. Difficult choice	Has strategies to make difficult choices
21. Known vs. unknown	Has strategies to choose between known and unknown options
22. Two unknowns	Has strategies to choose between two unknowns
23. Joint decision making	Understands how decisions are made with friends, why having fewer people in a group makes joint decisions easier to make
24. Goal-driven decisions	Can set criteria for making a decision when invested in a goal
25. Self-set problems	Can decide on an answer to an open-ended question, knows why choice was made

Scoring Question Parts

The second type of analysis I conducted consisted of chi-square comparisons of the gifted group and the nongifted group on each individual question. To facilitate this, I scored responses for each question segment separately for each participant. Each question consisted of at least two parts. To determine whether responses should be scored with one or zero points, I first examined the questions and how their parts related to the whole construct of each question. Part-by-part scoring is summarized in Appendix D.

The relationship of the parts of a question to its whole became clearer the more I worked with the data. My intention was not to set a certain percentage of points on a question's parts as a threshold beyond which the student would get a point for the whole question. Rather, I looked at each question segment as contributing to the construct of that question.

The question parts were of two types. The first type included questions with responses that fell into a dichotomy (such as Yes or No) or into categories that indicated distinctly correct or incorrect answers. Of the second type were those that allowed for a number of permissible responses based upon the child's idiosyncratic preferences or understandings of the general metacognitive nature of the overall question. As an example of the first type of question, Question 2A concerns whether a person learning material for the first time will remember the material equally as well as a person relearning the material. The overall purpose of Question 2 is to see whether the respondent understands that relearning is easier than initial learning. Thus, a participant answering that the relearner will find it easier to remember the material gave a correct response to that question part in the context of the overall question and earned a point. Participants answering that the new learner would find remembering easier or that the two would find their learning experiences to be the same, or giving an irrelevant response or no response, were considered to have misunderstood the overall purpose of the question and did not earn a point. Question parts of this type were coded "+/-" to indicate that responses were clearly correct or incorrect (see Appendix D).

However, Question 11A concerns the definition of paying attention. Many acceptable responses were given to this question part. Some children replied that paying attention meant listening, while others said that it meant concentrating on what was being presented, or both. Still others gave different but no less relevant responses, such as that paying attention meant sitting still or looking at the speaker. Any relevant response was considered to demonstrate that the child understood the overall purpose of Question 11, understanding the ability to pay attention. The only way a participant could fail to be considered as having responded correctly to such a question was if he or she failed to respond or gave an irrelevant answer (e.g., telling a story about a time when he or she was not paying attention, or commenting on something in the surroundings of the interview). This type of question, on which it was difficult for a participant to fail to earn a point, was coded as "O" for open (see Appendix D).

The wording of the possible response categories was taken from the text of the transcripts and from the previous studies by Kreutzer et al. (1975) and Schwanenflugel et al. (1997). Responses that were very similar were grouped into categories. Categories were examined for consistency, and some were subsumed into other categories until the categories were distinct and represented all the responses given by the participants. This is the way that categories were created by Kreutzer and her colleagues in the 1975 metamemory study, a study containing considerable detail about scoring procedures. Categories were given labels that reflected the children's meanings. I differed from Kreutzer et al. in my scoring, because the 1975 researchers labeled all responses that failed to address the metacognitive issue as "No." In my scoring system, all responses that failed to deal directly with the question, even after prompting, were considered "Irrelevant responses." If a participant did not answer or responded by saying, "I don't know," that was coded as "No response." The code "Missing" refers to those times when, through researcher oversight, a question was not asked. Missing responses on an entire question occurred just once and were not included in data analyses.

For an example of the use of the same categories in all three studies (Kreutzer et al., 1975; Schwanenflugel et al., 1997; and the current study), I refer again to Question 1. In Parts D and E, students are required to tell what types of things are hardest and easiest to remember. Schwanenflugel and her co-authors listed the labels "Categories" and "Instances" to describe specific responses given by students. Those labels fit my students' responses as well, because some students responded at a more inclusive (categorical) level, such as "things I like are easy to remember," and others responded at the specific event (instance) level, such as "One time I forgot to turn in my homework." The same categories were described by Kreutzer and her co-authors in the 1975 metamemory study.

> [A participant] was classified under Categories if his answer included anything categorical or recurrent ('Assignments,' 'To do things,' My lunch,' etc.) He was scored as Instances if his answer made reference only (i.e., no Categories present) to one or more specific, concrete, non-recurring experiences in the past ('One time I forgot to do *X*,' 'I can remember when we were at *Y* and *Z* happened,' etc.) (Kreutzer et al., 1975, pp. 6-7)

The possible responses were then examined to see whether they fit within the overall purpose of the question (see Table 6). This examination functioned as a cross-check that was not intended as a different way of awarding points. On those questions that had clear correct or incorrect responses, if a response matched the overall question's purpose, it was designated as a correct response and thus its responder could earn a point, as described above. If the response was outside the question's purpose or was irrelevant, it was designated as an incorrect response and was scored as a zero. Thus, one point was given for each response that indicated recognition of the metacognitive issue by falling into one or more of the categories of possible correct responses (see Appendix D). In cases in which a participant gave more than one appropriate response to a question, all were recorded and scored. Fractional value was given to each appropriate response such that the participant's total score for that question was equivalent to one point per respondent.

Relationship of Part-by-Part Scoring to Overall Scoring

After I had completed both types of scoring, I went back to see if the two scoring processes resulted in a similar outcome. If they did not, I looked at everyone's responses again to detect any inconsistencies in my scoring. I examined the ways in which the various parts of questions contributed to an expression of the overall purpose (see Table 6) of the question. Since overall scoring was done first, this type of cross-check represented a way for me to be certain that my scoring process made sense.

The following is representative of my reasoning on this cross-check. I examined Question 1 in this manner. The question had five parts, labeled A – E. In Part A, I asked children if they ever forgot things. Only two answers were possible, Yes and No, making this a correct/incorrect (+/-) type of question. A response of Yes earned a point, while a No response earned no points. (See Appendix D.)

Part B concerned the child's view of him/herself as either good at remembering or not good at it. A viewpoint question such as this represents the open (O) type of question. (See Appendix D.) Thus, a response of "Good" or "Not good" earned a point. The only way to fail to earn a point was to fail to answer or to give an irrelevant answer.

Likewise, Part C dealt with the child's perception of herself as being a better or worse rememberer than her friends. Responses of either type, or a response of "the same," were awarded one point.

In Parts D and E, students were asked if they understood that some types of things are easier and harder to remember than others. In Part D, the question was worded so that the participant could give a Yes or No answer without specifying what types of things were easier to remember. In Part E, the question was more narrowly worded so that a simple yes/no response was not possible. In both parts, those responses specifying the types of things that are easiest/hardest to remember were divided into two categories, Instances and Categories. A participant who replied that he found it easy to remember the day he had received a black eye had his response coded as "Instances." A response specifying "the names of friends and relatives" as easy to remember was coded as "Categories."

In relating the parts of the question to its overall meaning, my reasoning is explained below, again using Question 1 as an example. The key points of the construct as represented by the question are "Understands own ability to remember" and "Understands what is easiest/hardest to remember" (see Table 6). These key points are reflected in the wording of the five parts of the question. Since understanding one's own ability to remember is defined by the question as comparing one's memory ability to that of others, a person can be said to understand his or her own ability to remember whether she says she is a poor rememberer or a good one and whether she responds that she remembers better than her friends or worse than them. This means that Parts B and C are not likely discriminators between those who understand their memory ability and those who do not. Students do need to respond, however, to these parts. Parts A, D, and E are of the correct/incorrect type. Since the response to Part A is explored further in the other parts of the question, and since it is an introduction to the entire interview and the entire topic of memory, a positive response ("Yes, I sometimes forget things") was not essential for a child to be considered to possess understanding of the overall purpose of the question. In comparing responses to the question parts with responses to the overall questions, I decided that a child whose responses earned all five points or all points except the one given for Part A demonstrated an understanding of the overall question about memory ability.

For most questions, I reasoned that all parts of the question needed to be answered to demonstrate understanding of the construct of that question. The exceptions are explained here. For Question 3, I followed the reasoning of Kreutzer et al., who stated that it was not necessary for a child told a telephone number to respond that she would make a telephone call before getting a drink of water (Part A), as long as the child indicated in Part B that she was aware that having a phone number in short-term memory meant that the information would not be available for long, and that the phone call would need to be made quickly or the number would be forgotten. In Part C, children listed ways they used to remember telephone numbers. Thus, for a child to demonstrate that he understood the overall concept of short-term memory as represented by this question, only appropriate responses to Parts B and C were necessary.

Question 5 was about using a sorting strategy to aid memory of pictures. One or two children indicated that they would not use the strategy (Part A) but that a younger child would (Part B). Awareness of the overall purpose of the question, that using the sorting strategy would be of benefit to someone, was indicated by a positive response to either part.

In the Attention Index, the first question, Question 11, contained one part that I considered optional. In Part B, children were asked if they ever had trouble paying attention. Most answered that they did, but one or two students maintained that they always paid attention. As a teacher, this fit my own observations over the years; there are a few students who are always paying attention.

Question 13 was a long question, with children asked to explain cognitive and sensory distracters and how to avoid them. The final part, Part G, was about rating the relative importance of the distracters that were mentioned in the question. I did not see how this rating indicated whether a child understood the concept of distractions and thus considered it optional. Another interesting aspect of scoring this question was that I had several students respond to Parts C and D, about listening to the radio while doing homework, by saying that they did listen to music while working because it helped them concentrate. This may not have been considered a viable response when Miller and Weiss (1982) asked this question, but it is widely accepted now. In fact, several students mentioned that their teachers sometimes played music in class while they worked. So I accepted as correct those responses that indicated the child would leave the radio on, only if the child later responded that music helped her think.

In the section of the interview that I designed, the Decision Making Index, I only found one part that I considered optional to demonstration of understanding. Part C of Question 23 was about what types of things children thought about when they decided with friends what to play. The responses were so varied that it was impossible to codify them or to see how they might demonstrate understanding of the overall idea of joint decision making.

Data Analysis

Two types of analysis were conducted on the participant responses. For the ANOVA, the overall type of scoring was employed. Each individual response on items 1-25 was analyzed to see whether it addressed the fundamental issue of metacognition. Criteria for each acceptable response are listed in Table 6. Responses that did not indicate understanding of the metacognitive issue of that particular question or that were irrelevant were scored negatively with no point recorded for that response. I tallied each participant's responses in a point/no point format and totaled each child's points within sections I-III of the interview. Thus, each child received three overall scores, one for each metacognitive element (memory, attention, and decision making). Means and standard deviations for each group, gifted and nongifted, were calculated from these total scores. These figures and the range of scores are listed in Table 8 (see Chapter IV).

The overall analysis was done using a two-group (gifted versus nongifted) by three-element (memory versus attention versus decision making) ANOVA, with group as a between-participants variable and metacognitive element as a within-participants variable. For the ANOVA, a .05 level of significance was used (see Table 9 in Chapter IV).

For the second type of analysis, proportions of points earned on each individual question by both groups were compared using chi-square analyses (see Table 10). To conduct the chi-square tests, I collapsed the categories of responses to make four-fold contingency tables for each question. I grouped all categories of responses into two larger categories, one that contained "correct" responses or those that earned a point, and one containing responses that did not earn a point. For example, on Question 1 in the Memory Index, 11 gifted participants earned a point for understanding the metacognitive nature of the question and one earned no point. Within the nongifted group, seven students earned a point and two did not. Thus, 91.66% of the gifted group earned a point, and 77.78% of the nongifted group earned a point. In this manner, proportions of responses from the gifted and nongifted groups were compared using chi-square analyses to see if they differed from each other in a statistically significant way ($\alpha = .05$).

In the Schwanenflugel, Stevens, and Carr (1997) study on which the current research is based, the authors conducted a chi-square test for every part of a question. However, I could not discern a reason for doing so in the literature. In their study, Schwanenflugel and her colleagues found only six out of 48 contrasts were significantly different at the .05 level. Such fine-grained comparisons did not contribute to the purpose of the study. It did not make sense to me to break up the constructs as they are represented in each question by conducting multiple tests on each one. All results of data analyses are presented in Chapter IV.

How Data Analysis Procedures Answer the Research Questions

The first research question is, "In what ways do gifted and nongifted students differ in their metacognitive abilities, as measured by the metacognitive instrument?" A main effect of one factor of the ANOVA, giftedness status, gives us information to respond to this question. One or more chi-square analyses of statistical significance also answers this question, although not as thoroughly as does a main effect in the ANOVA.

The second question, “To what extent will the results of the current metacognition research in which the participants have been identified as gifted using nontraditional identification procedures be similar to the results of a previous study in which participants were identified using traditional procedures?” may be answered by seeing how gifted and nongifted groups perform on the memory and attention sections of the metacognitive questionnaire. ANOVA results showing a main effect for giftedness status, and comparison of means demonstrating that the nature of that effect is such that gifted students outperform their nongifted peers in those two areas, will be useful in answering this question. Those results can be compared to the results of previous studies and especially to those of the Schwanenflugel et al. (1997) study on which the current research was based, since the authors of the1997 study concluded that gifted students demonstrate higher levels of metacognitive knowledge with respect to memory and attention variables.

“When the study of declarative metacognitive knowledge is extended beyond the elements of memory and attention, in what ways will participants differ on measures of the additional element, decision making, as compared to measures of metamemory and meta-attention?” is the third research question. One factor of the ANOVA is “metacognitive element.” A main effect for this factor will provide preliminary information about question three. Post-hoc analysis of such an effect gives information to determine if the nature of the effect is such that results on the measure of decision making can be viewed as significantly different from those of memory and/or attention.

Possible Contributions to Knowledge

For each hypothesis, possible outcomes are examined for their potential contributions to knowledge in the field of research on giftedness:

Hypothesis # 1 -- Rejection of the null hypothesis: Students identified as gifted using the DISCOVER process as a means of identification have greater metacognitive ability, as measured by the investigator-designed metacognitive instrument, than do their nongifted peers. The results of the ANOVA on the giftedness factor and/or of the chi-square analyses confirm or refute this hypothesis.

Failure to reject the null hypothesis: No differences are apparent between the metacognitive abilities, as measured by the investigator-designed metacognitive instrument, of students identified using the DISCOVER process as gifted and those of their nongifted peers.

Hypothesis #2 -- Rejection of the null hypothesis: Means of identification of giftedness do not affect the results of studies of declarative metacognitive knowledge in gifted and nongifted children. This hypothesis can only be confirmed or disputed with regard to metamemory and meta-attention, because previous studies have been conducted to examine those two elements only. The second research question implies that results of this study will be compared to previous results with traditional means of identification used.

Failure to reject the null hypothesis: Similar results may not be obtained from studies of declarative metacognitive knowledge about memory and attention in gifted and nongifted children, depending upon whether traditional or nontraditional means of identification are used.

Hypothesis #3 -- Rejection of the null hypothesis: Gifted and nongifted students appear to excel on a measure of the decision making element of declarative metacognitive knowledge as compared to measures of the memory and attention elements. This hypothesis may be confirmed or refuted by a significant effect in the metacognitive factor of the ANOVA, as followed up by post hoc analyses to determine the nature of the relationship among the elements.

Failure to reject the null hypothesis: The decision making element of declarative metacognitive knowledge does not appear to be more evident in students than are the elements of memory and attention.

CHAPTER IV

RESULTS

The purposes of this study were to examine metacognitive knowledge in young gifted and nongifted children and to seek differences between the two groups and among the three elements of metacognitive knowledge studied. To facilitate examination of the data, this chapter is organized into three sections: Demographics of Participants, Overall Analysis of Variance, and Question-by-Question Comparisons Between Groups.

Demographics of the Participants

A total of twenty-one students participated in the study. Twelve students comprised the gifted group (mean age 8 years 4 months) and 9 students the nongifted group (mean age 8 years 0 months). Of the total participants, 0% were Native American, 5% were Asian/Pacific Islander, 5% were Black not Hispanic, 27% were Hispanic, and 64% were White not Hispanic. One student (5% of the total) was labeled an English Language Learner (ELL) at school at the time of the study. The ELL student in the study spoke Russian and English. A summary of participant demographic characteristics is presented in Table 7.

Due to federal privacy rules, the number of students in the study receiving free or reduced lunch could not be ascertained. However, at the schools the students attended when they were assessed, the mean percentage of students receiving free or reduced lunch was approximately 65%.

Table 7. *Participant Information*

Name code	ID status	Gender	Ethnicity code	Age when assessed (in years-months)
PA	Nongifted	M	4	8-7
NA	Nongifted	M	5	8-2
JB	Gifted	F	4	8-2
JD	Nongifted	F	5	7-10
JG	Gifted	M	4	8-9
KG	Gifted	F	4	7-10
BG	Nongifted	F	3	8-1
BH	Gifted	F	5	8-8
AH	Nongifted	F	5	8-10
JK	Nongifted	F	5	7-9
MK	Gifted	M	5	8-5
NM	Gifted	M	5	8-6
LM (ELL*)	Gifted	F	5	8-7
TP	Gifted	F	4	8-7
AP	Nongifted	F	5	7-9
TR	Nongifted	M	5	8-0

*ELL = English language learner; Ethnicity codes: 5 = White, not Hispanic; 4 = Hispanic; 3 = Black, not Hispanic; 2 = Asian/Pacific Islander; 1 = Native American

Table continues.

Table 7. *Participant Information*

Name code	ID status	Gender	Ethnicity code	Age when assessed (in years-months)
LS	Gifted	F	2	7-10
JS	Gifted	M	5	8-4
KT	Gifted	F	5	7-11
AV	Gifted	F	4	8-9
LW	Nongifted	M	5	8-5

Summary of Participant Information

Category	Number	Category	Code	Number
Gifted females	8	Ethnicity	5	13
Gifted males	4		4	6
Nongifted females	5		3	1
Nongifted males	4		2	1
Mean age gifted	8-4		1	0
Mean age nongifted	8-0			
ELL*	1			

*ELL = English language learner; Ethnicity codes: 5 = White, not Hispanic; 4 = Hispanic; 3 = Black, not Hispanic; 2 = Asian/Pacific Islander; 1 = Native American

Overall Analysis of Variance

The study was designed for a two-group (gifted versus nongifted) by three-element (memory versus attention versus decision making) Analysis of Variance, with giftedness status as a between-groups variable and metacognitive element as a within-participants variable. Scoring was described in Chapter III (see Table 6 for overall scoring criteria used for the ANOVA). Means, standard deviations, and range were calculated for the scores of the gifted and nongifted groups (see Table 8).

Although the six cells contained unequal numbers of observations, the ANOVA was still an acceptable way to examine the data (Glass & Hopkins, 1996; Jaccard & Becker, 1997), because the fundamental assumptions of the test were not violated. The assumptions for ANOVA are that the population variances are normally distributed around the means and that the observations are independent (Glass & Hopkins, 1996). According to Jaccard and Becker (1997, p. 501), meeting the assumption of independent and random selection is more important than meeting the normality and homogeneity of variance assumptions. Sampling procedures for this study, described in Chapter III, ensured that the selection assumption was met.

In the case of unequal sample sizes in two-factor ANOVA, a relationship may be perceived between the two factors due to unequal probabilities. In this study, for instance, a certain score for metamemory may be more likely to be observed in the gifted group than in the nongifted group simply because there are more scores in the larger group. However, "unequal sample sizes do *not* introduce a relationship between the two independent variables when the sample sizes for the groups that make up one factor are

Table 8. *Means, Standard Deviations, and Range of Scores – Overall Metacognitive Scoring*

Overall Means *M* (*SD*)	Gifted Group	Nongifted Group	Metacognitive Element
Memory index	6.65 (1.71)	6.11 (1.76)	6.42
Attention index	6 (0.95)	5.44 (1.13)	5.76
Decision making index	6.25 (0.75)	5.22 (1.72)	5.81
Totals	18.9 (2.69)	16.78 (3.05)	

Range of Scores	
Memory index	7 (3-10)
Attention index	3 (4-7)
Decision making index	6 (1-7)

proportional across levels of the other factor" (Jaccard & Becker, 1997, p. 514, emphasis in the original). In the current study, the proportion of gifted to nongifted participants is the same across all metacognitive elements. Thus, unequal sample sizes do not affect the power of the ANOVA test.

A two-factor ANOVA was conducted on the overall scores of the metacognitive interview (see Table 9). The first factor listed in the table was the metacognitive element: memory, attention, or decision making. The second factor was the giftedness status of the participants: gifted or nongifted.

The ANOVA indicated one main effect. For giftedness status, the result was significant, $F(1, 57) = 4.2706$, $p = .04317$. The strength of the relationship between giftedness status and overall metacognitive score was estimated using eta^2. Eta-squared for the group factor is .068, indicating that giftedness status accounts for approximately 6.8% of the variability in metacognitive knowledge score. The implications of the eta^2 test result are discussed in Chapter V.

The nature of the relationship between giftedness factor and overall score was discerned by comparing the total means of the two groups. The mean for the gifted group was 18.9, and the mean for the nongifted group was 16.78. Scores of the gifted group on this measure of metacognitive knowledge are higher than scores of the nongifted group.

No main effect was found for metacognitive element, $F(1, 57) = 1.5818$, $p = .21421$. The result for the interaction of the two factors was not statistically significant, $F(2,57) = 0.2119$, $p = 0.80971$.

Table 9. *Analysis of Variance Table*

Source	*df*	Sum of Squares *SS*	Mean Square *MS*	F Value	Pr (>F)
Metacognitive element (Meta)	2	5.810	2.905	1.5818	0.21421
Group	1	7.843	7.843	4.2706	0.04317 *
Meta x Group	2	0.796	0.398	0.2119	0.80971
Within	57	107.036	1.878		
Total	62	121.485			

* $p < .05$

Question-by-Question Comparisons Between Groups

One of the purposes of the study was to examine metacognitive knowledge in young children. To accomplish this meaningfully, I designed the study to be analyzed with chi-square tests of each individual question so that I could see how gifted and nongifted children responded to requests to reflect on different aspects of their thinking.

Chi-square comparisons for each overall question are reported in Table 10. The questionnaire was divided into three sections, one for each metacognitive element examined. To facilitate presentation of the data, Table 10 is divided into three corresponding sections. In Appendix E, I include tables containing summaries of the numbers and proportions of each group of students who responded in various ways to the questions in each section. I present a synthesis of the responses for each metacognitive element in Chapter V.

Chi-square Results

As described in Chapter III, four-fold contingency tables were created for each question to facilitate comparison of responses. Each chi-square statistic represents the proportion of gifted students who answered with a response that earned a point compared to the proportion of nongifted students who did the same (see Table 10). Significance of the chi-square tests is discussed in Chapter V.

Table 10. *Chi-Square Comparisons Between Gifted and Nongifted Group Responses*

Section 1. Memory Index

Question	Percentage of Correct Responses		Chi-square (*df*)	*p* level
	Gifted	Nongifted		
1	91.66	77.78	χ^2 (1) = 0.81	$p < .50$
2	58.33	33.33	χ^2 (1) = 1.39	$p < .25$
3	50	22.22	χ^2 (1) = 1.99	$p < .20$
4	58.33	77.78	χ^2 (1) = 0.87	$p < .50$
5	41.66	44.44	χ^2 (1) = 0.02	$p < .90$
6	100	100	χ^2 (1) = 0	
7	100	100	χ^2 (1) = 0	
8	45.45	66.67	χ^2 (1) = 0.9	$p < .50$
9	58.33	55.56	χ^2 (1) = 0.02	$p < .90$
10	58.33	33.33	χ^2 (1) = 1.29	$p < .30$

Table continues.

Table 10. *Chi-Square Comparisons Between Gifted and Nongifted Group Responses*

Section 2. Attention Index

Question	Percentage of Correct Responses		Chi-square (*df*)	*p* level
	Gifted	Nongifted		
11	100	77.78	χ^2 (1) = 2.95	$p < .10$
12	91.66	100	χ^2 (1) = 0.79	$p < .50$
13	100	88.89	χ^2 (1) = 1.4	$p < .25$
14	50	44.44	χ^2 (1) = 0.06	$p < .90$
15	91.66	88.89	χ^2 (1) = 0.05	$p < .90$
16	100	88.89	χ^2 (1) = 1.4	$p < .25$
17	66.67	55.56	χ^2 (1) = 0.27	$p < .70$

Table continues.

Table 10. *Chi-Square Comparisons Between Gifted and Nongifted Group Responses*

Section 3. Decision Making Index

Question	Percentage of Correct Responses		Chi-square (*df*)	*p* level
	Gifted	Nongifted		
18	75	22.22	χ^2 (1) = 5.74	$p < .02$*
19	100	88.89	χ^2 (1) = 1.4	$p < .25$
20	100	88.89	χ^2 (1) = 1.4	$p < .25$
21	—	—	—	—
22	100	88.89	χ^2 (1) = 1.4	$p < .25$
23	58.33	44.44	χ^2 (1) = 0.41	$p < .70$
24	91.66	88.89	χ^2 (1) = 0.05	$p < .90$
25	100	100	χ^2 (1) = 0	

*$p < .05$

Note. Data from Question 21 were not analyzed.

CHAPTER V

DISCUSSION AND CONCLUSION

The purposes of this study included further exploration of the qualitative differences between young gifted and nongifted students through extension of the study of declarative metacognitive knowledge beyond the previously studied elements, memory and attention, to include decision making. In addition, the study was designed to replicate an existing metacognition research study of gifted young children (Schwanenflugel et al., 1997) using nontraditional, rather than traditional, identification procedures and to compare the results of the current and previous studies. The ways in which these purposes have been fulfilled are discussed in this chapter. It is divided into six sections: Summary of Answers to Each Research Question, Interpretations of Findings, Qualitative Discussion of Participant Responses, Critique of the Study, Implications of the Study, and Recommendations for Further Research.

Summary of Answers to Each Research Question

The first research question, "In what ways do gifted and nongifted students differ in their metacognitive abilities, as measured by the metacognitive instrument?" was answered by the presence of a main effect for the giftedness factor of the ANOVA. Results of the ANOVA, $F(1,58) = 4.2706$, $p = .04317$, indicate that significant differences exist between the metacognitive knowledge scores of gifted and nongifted children. In this study, gifted students showed a metacognitive advantage ($\overline{X}_G = 18.9$) over their nongifted counterparts ($\overline{X}_{NG} = 16.78$). This result aligns with the results of previous studies comparing gifted and nongifted groups on measures of metacognitive knowledge (e.g., Schwanenflugel et al., 1997). In most previous studies of metacognition, researchers have reported results in favor of gifted students (Alexander et al., 1995; Carr et al., 1996).

Question-by-question analyses by chi-square tests added a small amount of information to this answer (see Appendix E for all chi-square results). On Question 18, the gifted group outperformed the nongifted group to a significant degree [$\chi 2$ (1) = 5.74, $p < .02$]. From these results, I conclude that the gifted students were able to articulate their understanding of their own decision making abilities better than were the nongifted students in this study.

The ANOVA results also provide the answer to the second research question, "To what extent will the results of the current metacognition research in which the participants have been identified as gifted using nontraditional identification procedures be similar to the results of a previous study in which participants were identified using traditional procedures?" In the previous study by Schwanenflugel, Stephens, and Carr (1997), the gifted group demonstrated a statistically significant metacognitive advantage as shown by ANOVA results, $F(1,60) = 14.67$, $p < .001$. In the current study, a significant main effect for giftedness also was found. In the previous study participants were identified as gifted or nongifted based on standardized intelligence test scores, while in this study the DISCOVER process was used to distinguish between groups. The different, nontraditional method of identification used in this study did not affect the gifted group's advantage in metacognitive knowledge scores in the areas of memory and attention.

The third research question is, “When the study of declarative metacognitive knowledge is extended beyond the elements of memory and attention, in what ways will participants differ on measures of the additional element, decision making, as compared to measures of metamemory and meta-attention?” The absence of a main effect for metacognitive element in the ANOVA answered this question, $F(2, 57) = 1.5818$, $p = .21421$. Students were able to explain no more about their decision making abilities than about other abilities.

Interpretation of Findings

Meaning of the Statistics

No main effect was found for metacognitive element. In this study, students were no more likely to be able to articulate their understanding of their thinking about one metacognitive element than they were about another. In addition, no interaction effect indicating a relationship between the two independent variables was found. Neither conclusions about comparisons among measures of knowledge about different metacognitive elements nor those about interactions between giftedness status and metacognitive element are supported by the data.

Eta-squared for the main effect of group was .068. With very small sample sizes, such as those in this study, examination of the eta^2 statistic is advisable even for non-significant effects (Jaccard & Becker, 1997). If no significant effect exists for a factor (metacognitive element) but the eta^2 for that factor is large, a loss of statistical power might be indicated. Eta-squared for the effect of metacognitive element was .051. Since the eta^2 statistic for neither factor is large, I feel confident in the power of the ANOVA in this study.

The eta^2 statistic for giftedness status (.068) represents a weak-to-moderate effect (Jaccard & Becker, 1997, p. 276). The presence of a main effect for giftedness status, however, is important despite its small eta^2 value. Since statistical power decreases as sample size decreases, it is difficult to obtain a result that allows the researcher to reject the null hypothesis in a study with a small sample (Jaccard & Becker, 1997).

Only a small difference between the amounts of variability among scores can be accounted for by giftedness status (6.8%) and by metacognitive element (5.1%). However, in the context of a study of complex behavior (metacognitive self-report) that is likely influenced by a number of variables, the presence of any main effect is important. The large Sum of $Squares_{WITHIN}$ indicates that much of what influences metacognitive self-report is not accounted for by the giftedness status of the participant or by the metacognitive element being studied.

The lack of a main effect for metacognitive element is consistent with the results of the 1997 study by Schwanenflugel and her colleagues. However, a new metacognitive element was added to this study. The means of the three metacognitive elements (see Table 8) were all within one point of each other: Memory – 6.42, Attention – 5.76, and Decision Making – 5.81. In the absence of a main effect for metacognitive element, it is unlikely that the difference between group means for any one element contributed more to the ANOVA result than the difference between the means for any other element.

Significance of the Answers to the Research Questions

Several important statements relative to the study's purposes can be made from these findings. Two of the main purposes, stated above, were to examine qualitative differences between gifted and nongifted students through the expanded study of metacognition and to compare metacognitive differences between groups when the method of identifying giftedness is nontraditional.

The presence of high levels of metacognition among gifted students from the expansion of the Schwanenflugel et al. study (1997) to include the study of decision making supports the claim of Shore (1986) and others (Campione et al., 1985; Gaultney, 1998; Schofield & Ashman, 1987; Schraw & Dennison, 1994) that the results of studies in which participants used difficult thinking tasks would show greater differences between gifted and nongifted groups than did the results of those employing simple tasks. Decision making was chosen as the additional element for this study because it is a complex task requiring high-level thinking (Swartz & Parks, 1994). Several researchers have stated that use of low-level processing skills may lead to only quantitatively different results between groups but that high-level skill use may result in studies whose results demonstrate qualitative differences (Alexander et al., 1995; Borkowski & Kurtz, 1987). Rogers, in her 1986 review of studies of qualitative differences between gifted and nongifted students, concluded that most of the differences found in the studies were quantitative in nature. However, she stated that "quantitative differences tend to produce qualitative differences over time" (p. 31). That some significant difference, as shown by the chi-square test for question 18, in the decision making understanding of gifted and nongifted second-graders exists points to either an established or a beginning qualitative difference in thinking between the two groups.

In this study, metacognitive differences between gifted and nongifted children were found when the method of identifying giftedness was different than it was in previous studies. In all the studies of differences between gifted and nongifted students that Rogers reviewed (1986), IQ tests were used as the identification method. This was the case in the studies reviewed by Alexander, Carr, and Schwanenflugel (1995) as well. The latter authors posited that more distinct metacognitive differences might be found between groups if the method of identification was closely aligned in theory to thinking and problem solving rather than psychometric in nature. Based on this conjecture, I designed this study to examine metacognitive differences between groups identified using the DISCOVER assessment.

As discussed in Chapters I, II, and III, the DISCOVER assessment is firmly rooted in problem solving. Use of this identification method did not result in markedly different metacognitive results from those found in previous studies. This finding is a validation of the DISCOVER process as a means of identifying young children who are similar in their thinking processes to those identified by standardized intelligence tests. As such, it adds to previous confirmations of the concurrent validity of the process (Griffiths & Rogers, 1996; Sarouphim, 1999b, 2001).

Another important implication is that DISCOVER is capable of identifying gifted students from diverse backgrounds (see Table 3) who are as metacognitively aware as are gifted children identified through more traditional measures. According to many researchers and scholars (Frasier, García, & Passow, 1995; Richert, 1991), traditionally-identified gifted children tend to be more non-Hispanic Caucasian, English-speaking, and middle class than is the total population of the United States. Alternative measures of identification provide researchers with broader samples of gifted children with whom to replicate previous research, thus giving the field of education of the gifted a more solid foundation upon which to base assertions about the characteristics of gifted learners.

Qualitative Discussion of Participant Responses

Memory Variables

In the Memory Variables section of the metacognitive interview, no chi-square comparisons yielded significant differences between the groups. The nature of the children's responses, however, bears examination.

The first question was about children's understanding of their own memory ability. The proportion of percentages of gifted group to nongifted group correct responses was 91.66: 77.78. Asked to compare her ability to remember with that of her friends, KT (gifted group) answered that if her friends remembered six items out of ten before they were taken away, she would probably remember the same number. "I think the same. I don't really know how they remember, but I do know how I remember."

On Question 2, the proportion of correct responses, by percentages, by the gifted and nongifted groups was 58.33: 33.33. Responding to the question, which was about two boys who were learning bird names that one boy had already learned but had forgotten, MK's reasoning was that the one relearning would find the learning easier this time. He not only realized that there would be some savings in the boy's memory, but he acknowledged also the value of understanding how to use resources. “Since he knows where to find the books and see what the names are, he could say, ‘Oh, now I remember!’” MK elaborated on the “correct” answer as it was described by Kreutzer, et al. (1975) by extending the perceived value of relearning beyond that of memory savings to include knowledge about external memory cues. Question 2B was a question asking participants to explain why they thought a particular way. For this “why” question, eight of twelve gifted students gave appropriate responses, while only three of nine nongifted students did so.

Few students understood the question about short-term memory. The proportion of percentages of correct responses was 50: 22.22 (gifted group: nongifted group). Question 3 was asked in the form of a choice between phoning a friend right away as soon as you heard the phone number or getting a drink of water first. JG (gifted group) answered that you should phone first; his reason, however, was, “Well, if you got a drink of water first, and you’re still drinking it, you probably won’t be able to talk.” He had misunderstood the point of the distraction introduced into the question, getting a drink. Only two participants, NM and TP, both from the gifted group, understood that the point of the distraction was to encourage respondents to express an awareness of how short a time items remain in one’s short-term memory. However, according to the scoring as described by Kreutzer, et al. (1975), children responding with any awareness of short-term memory were awarded a point for understanding the metacognitive nature of the question. Thus, this question was an indirectly worded “why” question. Half of the gifted children were able to articulate an awareness of short-term memory while only two out of nine nongifted children were able to do so.

Question 4 was about the value of putting a list of words to be remembered into a story context. On question 4A, the groups of children were roughly equal in their responses about whether the story would make remembering the words easier or harder for a hypothetical child, but when asked to give justification for why the story would make remembering easier or harder (4B), the nongifted group outperformed the gifted group (58.33: 77.78, gifted: nongifted for the whole question), because all were able to give a reason for what they thought. LW from the nongifted group explained his reasoning for saying the story made remembering the words easier for the child, “Because she learned about what the story was and stuff, and all the detail. ‘Cause she could think about what you were talking about.” JG (gifted group) explained his thoughts this way, “Because you know the story and you saw the pictures a lot of times, and the story kind of records stuff in your head.” However, MK from the gifted group felt that hearing the story and seeing the pictures would confuse the hypothetical girl in the question.

The sorting strategy question, Question 5, was not understood well either. The proportion of percentages of appropriate responses, gifted to nongifted, was 41.66: 44.44. Few children figured out that sorting the pictures into fairly obvious categories would help them in their recall. In fact, some students who suggested that younger children would use a sorting strategy had not suggested its use for themselves.

For Questions 6 and 7, all children in both groups received points for their answers. In these questions, students were asked to list strategies for remembering. In Question 6, the mean number of prospective memory strategies listed was 3.25 for the gifted group and 2.44 for the nongifted group. On Question 7, five children from each group were able to list more than one strategy for memory retrieval when asked.

KT (gifted group) also understood, on Question 10, that she could remember a story she had read a week ago if her teacher gave her the main idea. “It would tell me what the story’s all about, and I would right away remember the story.” NM’s (gifted group) response to the main idea question was very unusual. He didn’t think having the main idea would help him remember a story because “the stories I read don’t have any common sense in them.”

Although, over the years, researchers have refined the original questions from Kreutzer and her colleagues, there were some questions for which the wording allowed participants to give yes or no answers. In every instance where a response of “Yes, not specified” is listed, such a question had been asked, as in 1D, 10A, and 10B.

The gifted group was no more likely and no less likely to give no response or an irrelevant one than was the nongifted group. There were 22 instances of “No Response” from each group of participants.

Attention Variables

There were only seven questions in this section of the interview, but in most of them at least one question part addressed why students thought as they did. Since the Schwanenflugel et al. study (1997) concluded that gifted children responded more frequently and in more detail to "why" questions than did the other children, I wanted to see if the same held true in my study.

Questions 11C and 11D were worded to ask students if and when they ever had difficulty paying attention and under what conditions it was easy to pay attention, and why they thought that was so. On both question parts, gifted children were able to give responses 100% of the time, while nongifted children did so only 78% of the time. Question 13 was a multi-part question about various distracters to concentration and why the children thought those particular things were distracting. Both groups of children were able to say why they felt each thing would interfere with their ability to pay attention.

In Question 14, the children were asked if it would be easiest to hear their mother calling them if they were reading a book, listening to the radio, or doing nothing, and why. Children in the gifted group were more likely (11:1) than those in the nongifted group (5:4) to be able to give a reason. I conducted a chi-square test on these proportions, and the result approached statistical significance, $\chi 2$ (1) = 3.075, $p < .10$. LM, the only English language learner in the group, responded in a reasonable way, but with a word finding difficulty that made me wonder about her ability to answer the questions to her full potential. She said, "Maybe if she turns on the radio and it's too loud, or when you're playing a game or listening with the stuff that's on your ear *(I clarified "headphones")* for music."

Question 17 was about a person's limited capacity to pay attention to simultaneous stimuli. All children said that the person in the scenario could not pay attention to three people talking to him at the same time, but the gifted respondents were more able to explain why (8:4) than were the nongifted respondents (5:4).

A few items in this section of the questionnaire elicited a 100% rate of response of a certain type: 12A, 15A-B-D, and 16A. For example, Question 12A was, “Would it be easier to pay attention to something when it’s quiet or when it’s noisy?” No children responded that listening was easier when it was noisy.

There were some idiosyncratic responses to items in this section that bear comment. One participant from the gifted group, NM, responded to part B of the first attention question, Question 11, “Do you sometimes have trouble paying attention?” by saying, “Yes, when I don’t take my pills, because I do got ADHD.” Many of his responses were the opposite of the expected response. In two parts of Question 12, B and C, NM responded completely differently than all the other children in both groups. When asked in 12B, “Would it be easier to pay attention to something when you’re interested or not interested?,” he responded “not interested.” I asked a follow-up question, “When you’re not interested in it, you pay attention better?” NM replied, “So I get the point of it.” In a similar manner, he responded to Question 12C by answering that he paid attention better when he was thinking about other things than when not thinking about other things.

Because he had seemed to understand every question in the Memory section clearly, it was hard to imagine that he did not know what I was talking about. A similar question, 15C, was about a teacher explaining a new style of painting, “Who could listen more carefully to the teacher, one who is interested in painting or one who is not interested?" Again, NM replied, "Not interested." I asked, "So if they're not interested in painting they could listen better?" His response was, "I can at least." My curiosity piqued, I asked him to explain to me why he could listen better when he wasn't interested. He replied, "Because it's new to me." All I could assume was that he had his own definition of what being "interested" in something meant. LW (nongifted group) seemed to have a similar idea. His response to the painting interest question was, "Not interested … Yeah, because then he would probably get interested in painting."

On one question I accepted responses that were quite different than those accepted as correct in previous studies. Question 13, a multi-part question, dealt with avoiding distractions. The children were asked to think about doing homework that was important to them and whether they would avoid certain cognitive or sensory distracters such as television or watching their friends play outside a window with an open curtain. One part of the question was about if they would leave a radio on or off. Four students replied that they would leave the radio on because music helped them concentrate. LW (nongifted group) explained, "Because when I have something going on, I can focus on something else better, because there are two things going on." PA (nongifted group), however, responded that he did not want the TV or the radio on or the curtain left open. When asked which of the three would bother his work the most, he replied, "I'd say every of them."

One of the students who preferred to have the radio on was NM. He elaborated on his answers to these questions: "If the TV was off and the radio was off I couldn't hear a thing in my mind. I wouldn't be able to think." He appeared to have a good understanding of his own abilities to pay attention and when they worked best.

Responding to Question 16, about a child working a puzzle while the teacher was talking to the class, NM agreed that a child not working a puzzle could listen better. In Part B he was asked why, and NM responded, "Because it distracts the mind." All children in both groups responded that it would be easier to pay attention while not engaging in another task at the same time. Several other children had insights about distraction. Responding to 16B, JG (gifted group) replied, "Because your attention doesn't draw to something else." KG (gifted group) responded to that question with "Because nothing's taking away their mind except the book."

Decision Making Variables

In this part of the questionnaire, there was one significant chi-square comparison. For Question 18 the chi-square value was 5.74. The difference between the proportion of the gifted group's correct to incorrect responses and that of the nongifted group's answers was significant at the .02 level, with the gifted group showing the advantage.

Question 18 was an introductory question about children's knowledge about their own decision making. It was similar in nature to the introductory questions from the first two sections of the questionnaire in that it was exploratory in nature. However, I made it specific enough to give the children something to refer to in their own experience (Yussen, 1985). Several children were able to go into detail about what was easy or difficult about deciding on a book to check out at the library. LW (nongifted group) had a ready response when asked if some people had a hard time choosing a book. "Yes, actually my best friend," he replied. When asked why that was, he said, "Because he likes Greeks a lot; he likes ancient Greece a lot, and so do I, but I don't read about it that much. We don't have many books in our library about that, in our school library." When I asked him the converse of that question, whether some people had an easy time choosing, he quickly said, "Yes, my friend Alex." He explained, "Because he reads very easy books, and we have a giant selection of easy chapter books."

Most children had reasons for why selecting a book was easy or hard. If they said it was easy, they usually said that was because they knew how to find books they wanted. NM (gifted group) said, "I log in what I want to look for and it pulls all the books up that's about that thing."

KG (gifted group) was often able to see merit to answers on both sides of a question. The last part of Question 18 was about whether the children felt that decision making was easier or harder for them than for their peers. "I think it's a little easier, and it's a little harder for me," she said. I asked her why and she responded, "Well, it's easy, because I can check out a book because I know how to do it, but sometimes it's hard, because I don't know what book to choose." NA (nongifted group) said that decision making was harder for him, "Because my mind thinks different."

Half the parts of Question 18 were "why" questions, so it is interesting that this question in particular had a significant chi-square value. In the previous two sections of the interview, gifted children responded to this type of question with reasonable responses more often than did the nongifted children. In the decision making section, Question 18 had the most parts requiring a "why" response.

Questions 19 and 20 explored how children made particularly difficult decisions, such as choosing among several good options or between two simultaneously occurring good choices. Most children gave some type of strategy for choosing, with the gifted group slightly more likely to name a strategy than the nongifted group (see Appendix E). Some of the strategies given were quite original, such as MK's (gifted group) response to Question 20, which was about choosing a party to attend. "It would be more easy if I was at Hogwart's and Professor McGonagall gave me a time traveling device. It's be easy because you like, turn you could be at one birthday party, then you could click that time traveling device, and you can travel back ten, maybe twenty minutes, like, two hours and then go to the other one." NA (nongifted group) had an equally original idea for attending both parties, "You could have two clones."

Question 21 turned out to be an unsatisfactory question for exploring children's decision making when there was a choice between a known and an unknown. The scenario I chose was to force a choice between a familiar food and an unfamiliar one. My experience with elementary-aged children, as well as the experience with the two children in the pilot study, told me that children would choose the familiar food. My follow-up questions were predicated upon that choice. However, most participants said that they would choose the unfamiliar food. TP (gifted group) stated, "Because every time you see food, and you taste new kinds of food, you always get more goods in your stomach 'cause that could have been good for the mind." TP was not identified as an English language learner by her school, but she was identified as being Hispanic, and several of her awkwardly phrased responses led me to believe that perhaps she may not have been a native English speaker. I did not analyze the results of this question in the ANOVA, although the results were analyzed with a chi-square test.

Question 22 was similar to Questions 19 and 20 because children were asked to choose between two unknowns. Again, the gifted group was slightly more likely to give selection strategies than was the other group (see Appendix E). Fewer than half of the nongifted children gave selection strategies.

Joint decision making was the topic of Question 23, and the specific situation was figuring out what to play with friends. There was a wide variety of methods given by the participants for deciding what to play, although JG (gifted group) replied, “We mostly argue most of the time.” As the children expanded on how they make group decisions, some were very specific in what they think about when they decide, such as JB (gifted group), who said, “We might think about the games that, if you have a baby brother, or a big sister, or something like that. We might think about the games that we used to play with, like me and my brother play, and we might do that game.”

When asked whether it was easier to decide what to play if there were many children or just a few playing, responses tended mostly toward fewer friends playing together. Some children, however, were able to give reasonable justification for why many friends would make for easier decisions, or for why it the size of the group did not matter. LW (nongifted group) stated, “A lot of friends playing, because we have – well, actually, it kind of depends if it’s an even or an odd number. Because if it’s an odd number, it would be easier because we could vote, but if it’s an even number, we could all vote and it could be a tie.” KG (gifted group) said, “It doesn’t really matter, because you're like doing one thing with two persons, and the other two people can do it, and then the other two. Or just something like that." LM (gifted group) said that if there were few children, then certain games would be appropriate, and if there was a large group, then other games would be possible that were not an option with only a small group. Children from both groups were equally likely to give a reason for the choice they made.

The participants showed well-reasoned opinions when asked how they would select someone to work with in their class on a project that was important to them and why (Question 24). Three children in the gifted group gave more than one way to decide who to pick as a partner. JG responded, "I usually observe them and what their actions are, and what they do when they usually pick partners and how they do it. So I would pick someone who was really cooperative with people."

One of the gifted girls, KG, was very insistent that I understand her reasoning for not wanting to choose someone who did the best work. My clarifying questions are in parentheses. She explained, "I wouldn't choose someone who's like doing the best, because maybe other people think that they can do their best, and they think that they can do their best work and that they can do everything that they want to do their way, and everything is just gonna *be* the best by everybody. ("So sometimes the person that could do the work the best would just want to do it their way?") Yeah. ("And maybe you wouldn't have a chance? Is that what you mean?") No. What I mean is, there's like this person who is mostly the best, but if you think about it, everybody *is* the best, because everybody does their own work, and all the answers are not wrong." I believe that KG was expressing her desire to find the good qualities in the work of others and to validate their efforts.

LW (nongifted group) gave an interesting justification for who he would choose to work with and why. “I pick one I’m not very fond with, otherwise we’d probably talk a lot, and we wouldn’t get it done. So I pick someone like Alyssa [pseudonym]. Well, we don’t hate each other, but yeah, we’re not very fond of each other.”

The final question in this section of the interview was about self-set problems. I was interested in exploring children’s problem finding abilities. I asked them what they would create if they would draw or paint anything they chose and their reason for that choice. I grouped their responses into categories. Four children from each group said that they would draw animals. Unusual topics for drawings all came from the gifted group and included the choice of JS, “If I had a big piece of paper I would make a huge Roman city.”

BG (nongifted group) had an unusual reason for wanting to draw her family. She explained, “Um, if one of my sisters go to Washington, D.C., like for a project or something, then I can always remember what they look like.” LM (gifted group) had both an unusual topic and an unusual reason for what she would draw. “A picture of our school and all the kids playing on the swings and stuff. … to show how the kids play and what they do and how the playground looks like, and maybe how the school is made.” TP (gifted group) was thoughtful about her choice. “That’s always a hard decision. I would make a picture of me and someone outside when it’s a nice day and stuff,” she decided, “because it’s always fun to draw what you really do see.”

Across all three sections of the interview, gifted children appeared to understand why and when they had certain metacognitive responses more often than did their nongifted counterparts. On questions in which they were asked to list strategies (Questions 6 and 8B), gifted children were able to list more strategies than were nongifted children, $\overline{X}_G = 2.65$; $\overline{X}_N = 1.72$. This finding is consistent with a result of the Schwanenflugel, Stevens, and Carr (1997) study, in which gifted children demonstrated a greater tendency to provide causal attributions for their answers.

Critique of the Study

Limitations and Key Assumptions

I did not attempt to label any one definition of giftedness or identification process as superior. The definition of giftedness (Maker, 1993a; Maker et al., 1994; Maker et al., 1996) and the identification procedure (Maker, 1992, 1996, 2001, 2004; Maker et al., 1994) employed in this research were chosen for reasons that were identified and explained previously.

This research was based on two assumptions about giftedness. One was that giftedness can be identified in children using a means other than standardized intelligence or achievement testing. Another was that children who were rated "Definitely" in two or more areas of the DISCOVER assessment were considered gifted for the purposes of this study.

Agreement has not been reached among researchers concerning all the elements of metacognition, and I did not presume to complete the definition of metacognition. I only examined agreed-upon aspects of this multidimensional construct. I also did not attempt to fully define the relationship between metacognition and giftedness, although results from this research may further clarify that relationship. Further research on metacognition will be needed in the future to address these and other issues.

Because of the limited age group studied in the current research, the results may not be generalizable to gifted children of all ages. However, one of the purposes of the study was to confirm findings of metacognition studies at the lower age limit of participants previously studied.

Concerns About Methods

Although I designed this study as a partial replication of the study by Schwanenflugel, Stephens, and Carr (1997) and therefore used the same metacognitive questionnaire as an instrument, I have concerns about this particular set of interview questions. As I stated in Chapter III, there is no information available about previous attempts to establish the reliability of the instrument, although it has been used repeatedly since its creation in 1975 (Kreutzer et al.). Kreutzer and her colleagues stated that they chose items randomly to be judged by two different raters, to test the reliability of their scoring categories. In all instances, interrater reliability was over 90%. Since the scoring categories as well as the results have remained relatively consistent over the decades, it is reasonable to assume that there is a certain amount of test-retest reliability to this instrument, although that assumption has never been tested.

In addition, items were generated in a haphazard way, with little in the way of explanation of underlying theory that could be used for validation. Kreutzer and her colleagues Leonard and Flavell generated items by thinking about what types of situations would check the understanding of children's knowledge about person, task, and strategy variables, as Flavell had categorized aspects of metamemory knowledge (Flavell & Wellman, 1977). The items in the attention section were generated in the same way by Schwanenflugel and her colleagues (1997) based on the work of Kern (1989) and Miller and Weiss (1982). Kern and Miller and Weiss had examined only the effects of interest and noise on attention, so Schwanenflugel and her co-researchers expanded the number and type of variables they postulated would affect attention in young children. Nothing in their research report explained why they created the items they did.

I generated items for my own section of the questionnaire in much the same way, thinking about the aspects of decision making that would be comprehensible to second-graders and about the types of situations in which they would be called upon to make decisions. I checked my questions with other educators and with the two children in my pilot study. I did not have a resource against which to check the completeness of my coverage of the construct of decision making. Given the high internal consistency correlation of the items within the decision making section (0.665), I can infer that my questions addressed one construct, but I cannot assume that I completely exhausted the concept of decision making.

In their 1975 study of variables affecting memory, Kreutzer and her colleagues stated that they simply invented the interview questions, because there was so little known about metamemory at the time that there were no other data collection tools to build upon. That is no longer the case with metacognition. Shore and his colleagues (1996, 2000; Dover & Shore, 1991; Hannah & Shore, 1995; Shore & Carey, 1984; Shore

& Kanevsky, 1993) have collected data based on self-report, but also based upon observations and upon the think-aloud technique. Given the several difficulties of using children's self-reports (Baker & Brown, 1984; Miller, 1985; Yussen, 1985) as data, and given the assertions of some researchers (e.g., Bouffard-Bouchard et al., 1993) that it is important to study aspects of metacognition in concert, it may be that more complex techniques for collecting data would give researchers more interesting material to examine than has the interview technique.

Concerns About Participants and Sampling

I intended to have 24 participants in this study, but circumstances that I detailed in Chapter III narrowed my number down to 21. The unequal size of the groups was of concern to me throughout the study, although Schwanenflugel and her colleagues (1997) did not have equal group sizes, either. Nine is a small number upon which to base conclusions about the thinking of nongifted children.

I was unable to compare my group demographics with those of other studies, because in most published research reports, space is at a premium and only the simplest characteristics of participants are described. In the Schwanenflugel, Stevens, and Carr study (1997), 55% of the sample was African-American and the other 45% was White. The sample was from suburban schools. My sample was more urban and more Hispanic in ethnicity than was the 1997 sample. My sample was also extremely mobile, as described in Chapter III, which led to problems keeping the entire sample in the study from beginning to end. No information on the socio-economic status of the Schwanenflugel sample was given, although the word "suburban" often carries with it a connotation of middle-class status. My sample was drawn from schools with high poverty rates. The effects of these demographic differences between the two study samples, if any, are unknown.

Implications of the Study

The most important implication of this study is that the DISCOVER assessment shows concurrent validity with traditional intelligence testing when used as an identification method for the participants in cognitive research. The children identified as gifted in the sample for this study were more diverse than have been samples of gifted children used in most previous studies of metacognition (Alexander et al., 1995; Rogers, 1986). A major recommendation by many leaders in the field of education of the gifted (e.g., Davis & Rimm, 2003) has been that seminal studies in the field be replicated using alternative means of identifying participants, to establish a non-biased body of knowledge about gifted children, their characteristics, and their appropriate education. Researchers conducting studies similar to this one, following the guidelines of prior research but varying the method of identification, could make enormous contributions to the field.

Implications for Theory

Brown (Baker & Brown, 1984) recommended that researchers use the most precise terms available for cognitive processes they chose to investigate, such as planning or hypothesis testing, and leave the term "metacognition" in its original sense to refer to knowledge about cognition. These recommendations make even more sense now than they did when they first were made. Publications about various aspects of metacognition run the gamut from theoretical arguments about components that should be included in definitions to empirical studies about the use of mnemonic strategies to assist students in reading comprehension. Articles about training students in metacognitive strategies abound. What, then, is meant by metacognition? The meaning of the term is no clearer after decades of examination by scholars from a variety of fields than it was when Flavell first coined it (1977).

If the formation of theory is to be served by studying metacognition, the limits of what the term includes must be defined. Although I stated my own operational definition for purposes of this study, I would have difficulty contributing to theoretical knowledge based on my findings. I found that as I learned about metacognition, I needed to create my own mental representation of the construct (see Figure 2). If each researcher does this, there is no systematic way to combine the results of studies into a cohesive theory. Because I believe in the importance of establishing foundations before building structures, I believe that psychologists need to put concerted effort into creating a unified but flexible theory of metacognition.

Implications for Practice

Research into strategy use is both plentiful and practical. Most modern curricula contain some elements of strategy use and training. Research on the brain has affected our understanding of how children learn most effectively, and strategy research has blended in well with neurological findings. Strategy use seems to have become its own field of study, less likely to be meshed with metacognition than in previous decades.

Metacognition as a vague and general construct appears to have been subsumed into systems of instruction in reading, mathematics, thinking skills, and questioning strategies. Instructional strategies are usually recommended based on research results showing increases in student achievement. Metacognition generally is agreed to be a multifaceted concept, comprised of knowledge and skills. The only major areas of metacognitive knowledge that have been studied extensively are the relatively simple elements of memory and attention. Metacognitive skills are online processes used while engaging in a cognitive task. Since current research suggests that the two major components of metacognition are differentially effective in diverse situations and with various populations, it seems premature to recommend that "metacognition" be encouraged in the same way in all students with the intent of increasing achievement.

Although research in metacognition has slowed recently, with few articles on the topic published in scholarly journals since the mid-1990s, the current study shows that surprising and interesting knowledge still may be discovered. If metacognitive knowledge about decision making is significantly different between gifted and nongifted children, in what other areas might marked discrepancies in understanding among groups of children be seen?

However, educators should realize that, as this study has shown, children of diverse populations and particularly from backgrounds of poverty are no less knowledgeable about metacognition than are children from more privileged backgrounds. The diverse sample of gifted children in this study was superior to the nongifted sample in metacognitive knowledge. Educators working with children from impoverished backgrounds should not refrain from engaging all students with high potential in challenging cognitive activities.

Recommendations for Further Research

The study of metacognition and its differential attributes in persons of various intellectual levels, developmental stages, and ages is far from complete. Future researchers interested in the deep cognitive processes of gifted and nongifted children should consider examining other elements of metacognitive knowledge at various ages. Planning, predicting, and evaluating are all high-level areas of metacognition that have never been studied. A map of metacognitive knowledge as it exists in different segments of the population would provide useful information to those who would guide students' thinking effectively.

I have stated that I believe in the value of underlying theory to guide research and to ensure that practical recommendations are useful. I also believe, however, that theory-building and specific knowledge-acquisition are part of a recursive process. It would be helpful in this process if future researchers moved further in their study designs toward the integration of metacognitive knowledge and skills, because the two components of metacognition are rarely seen in isolation. Knowledge gained from empirical studies using such complex designs could be valuable in theory-building as well as in practical applications.

Finally, future researchers should attempt to replace the old biased knowledge base in education of the gifted with knowledge gained from new studies conducted with diverse participants. Recently-developed methods of identifying giftedness that have been the most effective in identifying gifted learners from diverse populations are those that are based on observations of performance (Joffe et al., 2004; Reid, Romanoff, Algozzine,

& Udall, 2000; Sarouphim, 2001, 2004; VanTassel-Baska, Feng, & Evans, 2007). Such authentic assessments, including the DISCOVER process, are aligned with current, inclusive theories of intelligence such as the Triarchic Theory of Intelligence (Sternberg, 1981, 1985a, 1988, 1991). Such views of intelligence are connected to the real-world processes of thinking and problem solving in ways that old ideas about intelligence, such as those proposed in the nineteenth century, have never been. When intellectual theories and theories of giftedness are in alignment, and when identification procedures that acknowledge the complexity and diversity of gifted learners are in widespread use, parents and educators can expect to see the strengths of children being recognized and nurtured in effective ways. Researchers can help to make this ideal situation a reality by expanding the knowledge base about gifted children and about cognition.

APPENDIX A

SUBJECT'S CONSENT FORM

Subject's Consent Form

Title of research project: Metacognition Among Students Identified as Gifted or Nongifted Using the DISCOVER Assessment

I AM BEING ASKED TO READ THE FOLLOWING MATERIAL TO ENSURE THAT I AM INFORMED OF THE NATURE OF THIS RESEARCH STUDY AND OF HOW MY CHILD WILL PARTICIPATE IN IT, IF I CONSENT TO HIS/HER PARTICIPATION. SIGNING THIS FORM WILL INDICATE THAT I HAVE BEEN SO INFORMED AND THAT I GIVE MY CONSENT. FEDERAL REGULATIONS REQUIRE WRITTEN INFORMED CONSENT (BY PARENTS) PRIOR TO PARTICIPATION (BY MINOR CHILDREN) IN THIS RESEARCH STUDY SO THAT I CAN KNOW THE NATURE AND RISKS OF MY CHILD'S PARTICIPATION AND CAN DECIDE FOR HIM/HER TO PARTICIPATE OR NOT PARTICIPATE IN A FREE AND INFORMED MANNER.

[**Information about the researcher: Wendy Leader** works for Jefferson County Public Schools in the Office of Gifted and Talented. She is also a student at the University of Arizona in Tucson, AZ. She is working on a doctorate in the field of education. In order to complete her degree, she has to do a research project. She would like to have children in the second grade, like your child, participate in her study, which is explained below.]

PURPOSE
My child is being invited to participate voluntarily in the above-titled research project. The purpose of this project is to examine how students are able to think about their thinking and talk about their thinking. This research is important because it will help researchers and teachers to understand the different ways young children think. Educators need to understand children better if they are to become better teachers. Examining children's thinking processes should promote better understanding of children and lead to better methods for helping them learn to be clear and creative thinkers.

SELECTION CRITERIA
My child is being invited to participate because he/she is a second-grader who has participated in the DISCOVER assessment at school, either during first grade or during second grade. In the DISCOVER assessment, observers looked at how children solved problems. All children invited to participate in this study attend one of several Jefferson County elementary schools. Children who performed at different levels on the assessment were listed, and then some were chosen randomly, like the flip of a coin, to be asked to participate in the study. Approximately 24 children will be enrolled in this study.

STANDARD TREATMENT
Children who do not wish to participate in the study will continue with their normal school day.

Subject Consent Form

PROCEDURE
If I agree for my child to participate, I will be asked to consent to the following:
The researcher or her associate will conduct an individual interview with my child to see how he or she thinks and talks about his or her own thinking. The interviewers are experienced teachers who love working with young children and who will help make my child feel comfortable while he/she is being asked questions during the interview. The interviewer will explain the interview to my child before beginning, so that my child will fully understand and feel good about participating.

The interview will take place at my child's school during the regular school day at a time the teacher feels is appropriate. My child will not miss any important instruction as a result of participating in the interview. I do not need to make any special arrangements for my child for the interview. A letter from my child's principal is attached to this form, indicating that he or she knows about these interviews and approves of them. [If the interviews are conducted during the summer, my child will be interviewed either at my child's home, if I agree, or at the nearest public library.]

The interviews will be tape-recorded so that the researcher can listen to each child's answers several times. A small part of the interview will also be videotaped. In addition, an interpreter will work with children who are not fluent in English. The interpreter will work side-by-side with the interviewer, so that the child can talk freely in his/her own language. Each interview will last approximately 60 minutes. If my child becomes uncomfortable at any time, he or she may ask to stop and the interviewer(s) will stop asking questions immediately and take him/her back to class. No one will be upset with the child if he/she wants to stop the interview.

RISKS
There are no risks to allowing my child to participate in this research project.

BENEFITS
There are no direct benefits to my child to participate in this research project. However, the benefit of allowing my child to participate in this research is that educational knowledge will be gained that may help teachers understand children better.

CONFIDENTIALITY
All information provided to the researcher by the children will be confidential. The questions and answers that are recorded during each interview will be put into writing (transcribed) so that the researcher can study and analyze the words more closely. The researcher will assign each child a pretend name (pseudonym) or a number for use in the study. The children's real names will not be used in the research report at any time. The audiotape will not be used for any other purpose except the transcription and the analysis as stated above.

Subject Consent Form

If the audiotapes or videotapes are of a child who does not speak English, the interpreter will translate them so that the transcripts will be in English.

The videotape of each child will not be used for any other purpose except analysis for the research purposes that have already been described. The only person(s) who will watch the videotapes will be the researcher and the interpreter, if necessary. The researcher will keep the audiotapes and videotapes until the research is completed. After that, they will be kept at the University of Arizona for three years, so that the researcher may use them again if she needs to. At the end of three years, they will be taped over so that no tape of my child will be left.

PARTICIPATION COSTS AND SUBJECT COMPENSATION
There are no costs to my child to participate in the project except for his/her time out of the school day (or time from their regular day, if interviewed in the summer). Each child who participates in the research project and completes the entire interview will receive a gift certificate to a local fast food restaurant. If my child or I decide not to participate, there will be no hurt feelings, and my child will continue with normal classroom activities.

CONTACTS
I can obtain further information from the principal investigator, Wendy Leader, M.A., at (303) 982-8474. If I have questions regarding my child's rights as a research subject, I may call the University of Arizona Human Subjects Committee office at (520) 626-6721.

AUTHORIZATION
BEFORE GIVING MY CONSENT BY SIGNING THIS FORM, THE METHODS, INCONVENIENCES, RISKS, AND BENEFITS HAVE BEEN EXPLAINED TO ME AND MY QUESTIONS HAVE BEEN ANSWERED. I MAY ASK QUESTIONS AT ANY TIME AND I AM FREE TO WITHDRAW FROM THE PROJECT AT ANY TIME WITHOUT CAUSING BAD FEELINGS. MY PARTICIPATION IN THIS PROJECT MAY BE ENDED BY THE INVESTIGATOR FOR REASONS THAT WOULD BE EXPLAINED. NEW INFORMATION DEVELOPED DURING THE COURSE OF THIS STUDY WHICH MAY AFFECT MY WILLINGNESS TO CONTINUE IN THIS RESEARCH PROJECT WILL BE GIVEN TO ME AS IT BECOMES AVAILABLE. THIS CONSENT FORM WILL BE FILED IN AN AREA DESIGNATED BY THE HUMAN SUBJECTS COMMITTEE WITH ACCESS RESTRICTED TO THE PRINCIPAL INVESTIGATOR, WENDY LEADER, OR AUTHORIZED REPRESENTATIVE OF THE EDUCATION DEPARTMENT. I DO NOT GIVE UP ANY OF MY LEGAL RIGHTS BY SIGNING THIS FORM. A COPY OF THIS SIGNED CONSENT FORM WILL BE GIVEN TO ME.

Subject Consent Form

If you would like your child to participate in this research project, please sign and return this form to school with your child as soon as possible.

___________________________________ ________________________
Subject's signature/name Date

___________________________________ ________________________
Signature of parent/legal guardian Date

___________________________________ ________________________
Witness (if necessary) Date

INVESTIGATOR'S AFFIDAVIT
I have carefully explained to the subject the nature of the above project. I hereby certify that to the best of my knowledge the person who is signing this consent form understands clearly the nature, demands, benefits, and risks involved in the participation of his/her child and his/her signature is legally valid. A medical problem or language or educational barrier has not precluded this understanding.

__________________________________ _______________________
Signature of Presenter Date

___________________________________ _________________
Signature of Investigator Date

APPENDIX B

MINOR ASSENT FORM

Minor Assent Form to Participate in Interview Research

Minor Assent Form
Title of research project: Metacognition Among Students Identified as Gifted or Nongifted Using the DISCOVER Assessment

[Note to interviewer/interpreter: Read the script to the child and get a spoken affirmative response before proceeding with the interview.]

Your parents have told me it's O.K. for me to ask you some questions about how you think. [Your teacher says it's O.K. for us to use this time to talk about your thinking.] I will be asking you some questions, and I will be tape recording your answers so I can remember what you've said. Near the end of the interview, I will turn on the video camera to tape you doing an activity, so I can remember how you did the activity. The interview will last about an hour. [If you want to go back to your classroom, tell me and we'll stop, and I will take you back to class. If you do not want to do this, no one will be upset with you or have hurt feelings, and you will just continue in class with your normal work.] or [If you want to stop the interview, tell me and we'll stop. If you do not want to do this, no one will be upset with you or have hurt feelings.] Can we go ahead now?

[Have the student sign the following:]

I will answer the questions about my thinking. The lady will tape record my answers. She will videotape me when I do an activity. If I want to stop, I can tell her. [She will take me back to my classroom.]

____
(Child's name)

________________________________ ____________________
(Child's signature) (Date)

________________________________ ____________________
(Presenter's signature) (Date)

________________________________ ____________________
(Investigator's signature) (Date)

APPENDIX C

METACOGNITIVE INTERVIEW QUESTIONS

METACOGNITIVE INTERVIEW

Memory Variables

1. **Memory Ability:** Sometimes I forget things. (A) Do you forget? (B) Do you remember things well – are you a good rememberer? (C) Can you remember better than your friends, or do they remember more than you? For example, if I gave you ten things to look at quickly and remember and you remembered six of them, how many do you think your friends would remember? (D) Sometimes although a person is a good rememberer, (s)he can still remember some kinds of things better than others. Do you remember some kinds of things better than others? (E) What kinds of things are really hard to remember?

2. **Relearning:** Jim and Bill are in second grade (child's own grade). The teacher wanted them to learn the names of all the kinds of birds they might find in their city. Jim had learned them last year and then forgot them. Bill had never learned them before. (A) Do you think one of these boys would find it easier to learn the names of all the birds? Which one? (B) Why?

3. **Understanding Short Term Memory:** (A) If you wanted to phone your friend and someone told you the phone number, would it make any difference if you called right away after you heard the number or if you got a drink of water first? (B) Why? (C) What do you do when you want to remember a phone number?

4. **Story Context:** (The materials used in administering this item were seven pictures of the underlined objects mentioned in the story described below.) The other day I showed these pictures to other boys and girls your age. I asked one girl to learn them so that she could tell me what they were later when she couldn't see them anymore. And I showed the same pictures to another girl, but also told her a story about the pictures. (The examiner lays down each picture in front of the child as it is mentioned in the story.) "A man gets up out of <u>bed</u>, and gets dressed, putting on his best <u>tie</u> and <u>shoes</u>. Then he sits down at the <u>table</u> for breakfast. After breakfast, he takes his <u>dog</u> for a walk. Then he puts on his <u>hat</u> and gets into his <u>car</u> and drives to work." I told the girl who heard this story that she was supposed to learn the pictures so she could tell me what they were later when she couldn't see the pictures. She didn't have to tell me the story, just the pictures. (A) Do you think the story made it easier or harder for the girl to remember the pictures? Which girl do you think learned the most, the one who only saw the pictures, or the one who saw the pictures and heard the story? (B) Why?

5. **Sorting Strategy:** (The stimuli are nine colored pictures randomly arranged in a 3x3 matrix. The pictures were able to be categorized into three categories: (1) body parts – hand, foot, ear; (2) food – lemon, hot dog, red apple; (3) clothing – jacket, pants, shoes.) Now suppose I wanted you to learn these pictures. You could do anything you wanted with the pictures. You might want to move them around, for example. You would have three minutes to look and study, but then I would take the pictures away

and ask you what pictures you learned. (A) What would you do to learn these pictures? (B) How do you think a younger child would do it?

6. **Prospective Memory:** Suppose you were going skating with your friend after school tomorrow and you wanted to be sure to bring your skates. (A) How could you be really certain that you didn't forget to bring your skates along to school in the morning? (B) What else can you think of? How many ways for remembering can you think of?

7. **Retrieval Cues:** Suppose your friend has a dog and you ask him how old his dog is. He tells you he got his dog as a puppy one Christmas but can't remember what Christmas. What things could he do to help him remember which Christmas he got the dog? What else could he do?

8. **Learning Intentionally:** Suppose you need to remember the rules of a game for school tomorrow. Your mom read you the rules to the game a couple of days ago and you understood them. (A) Will this be enough for you to remember the rules tomorrow? (B) What else could you do to remember the rules of the game?

9. **Rote versus Gist Learning:** The teacher is reading a story to you at your school. Your task is to write down the story at home. Which is harder for you to do? (A) It is harder for me to write down the story in my own words. (B) It is harder for me to

write down the story word for word the way the teacher read it. (C) Both are equally difficult.

10. **Memory Cues:** Imagine that a week ago it was your homework to read a story carefully and remember it. Today the teacher asks you at school to remember the story as exactly as possible and to tell it. (A) Would it be helpful for you to remember and tell the story if you could look at some pictures from the story? (You didn't have pictures while reading the story.) Why would it be helpful? (B) Would it be helpful if the teacher, after asking you to tell the story, gave you the main idea of the story? Why would it be helpful?

Attention Variables

11. **Ability to Pay Attention:** (A) What do you think I mean by "paying attention"? (B) Do you ever have trouble paying attention to something? (C) When? Why do you have trouble paying attention then? (D) When is it easier to pay attention to something? Why?

12. **Influence of Distractions:** (A) Would it be easier to pay attention to something when it is quiet or when it is noisy? (B) Would it be easier to pay attention to something when you are interested or not? (C) Would it be easier to pay attention to something when you're thinking of other things or not?

13. **Avoiding Distractions:** Pretend you are doing some hard number problems. You are in a room that has a TV, a radio, and a big window through which you can see your friends playing in the park. You want to do a good job on the number problems. (A) Would you have the TV on or off? (B) Why? (C) Would you have the radio on or off? (D) Why? (E) Would you close the curtain so you couldn't see out the window or would you leave the curtain open so you could see out the window? (F) Why? (G) Which would bother your work the most, having the radio on, having the TV on, or having the curtain open? Which would bother your work more, _______ or _______ (the two not chosen)? Would _______ bother your work (last option not chosen)?

14. **Understanding Preoccupation:** Suppose you are in your room. Your mother comes to the door of your room and calls your name. Her voice is loud enough to reach your ears. (A) Do you think you would always hear her or would there be some times when you don't hear her? (B) Why? (C) When are you most likely to hear her, when you're reading an interesting book, doing nothing, or listening to the radio? (D) Why?

15. **The Role of Interest in Attention:** Suppose your teacher is telling you how to do a new kind of painting with special paints. She is telling you a lot that you have to remember, so you have to listen carefully. (A) Who could listen more carefully to the teacher, a child who is looking at the teacher or a child who is looking at other children? (B) Who could listen more carefully to the teacher, a child who is talking to other children or not? (C) Who could listen more carefully to the teacher, the one who

is interested or the one who is not? (D) Who could listen more carefully to the teacher, a child who is fooling around or not?

16. **Divided versus Focused Attention:** Suppose that two children are in the same grade. One of the them is working on a puzzle and, at the same time, listening to the teacher tell a story. The other child is only listening to the story. (A) Which child do you think will understand the story better? (B) Why?

17. **Limited Capacity:** Sandra, Jim, and Joe are all talking to Johnny at the same time. (A) Will Johnny be able to understand what each person is trying to tell him? (B) Why or why not?

Decision Making Variables

18. **Decision making Ability:** (A) When you go to the school library to check out a book, is it easy or hard for you to decide which book to check out? (B)What is easy, or hard, about deciding which book to check out? (C) Do some people have a hard time deciding on a book to check out? (D) Why do you think that is? (E) Do some people have an easy time deciding on a book to check out? (F) Why do you think that is? (G) Do you think decision making is easier or harder for you than for most people your age? (H) Why?

19. **Multiple Good Choices:** Suppose your family goes out to dinner at a restaurant. You are pretty hungry. There are four things at that restaurant that you really like to eat. How do you decide which thing to order?

20. **Difficult Choice:** Suppose that two equally good friends in your class are having their birthday parties at the same time. You have been invited to both parties, but you will only be able to go to one of them. How will you decide which party to go to?

21. **Choice Between Known and Unknown:** Suppose there is a celebration at school. There are two kinds of food being served. You get to choose only one. One is something you have tasted before. The other is something you have never tasted before. (A) Which food do you think you would choose? (B) Why? (C) Would your answer be any different if the food you had tasted before was just O.K.? (That means you didn't really like it and you didn't really dislike it?) (D) Why would/wouldn't your answer be different?

22. **Two Unknowns:** Susan is a second-grader like you. Christopher is in her class. Christopher was holding two things behind his back so Susan couldn't see them. He had one thing in each hand, like this. [*Examiner demonstrates, using empty hands.*] Christopher said to Susan, "I have a surprise in each hand. Pick one." Susan didn't know what Christopher had in his hands. She didn't know if Christopher meant the

things were a good surprise or a bad surprise. How could Susan decide which hand to pick?

23. **Joint Decision Making:** (A) How do you and your friends decide what you are going to do when you play? (B) Do you always use that way to decide? (C) What other things do you and your friends think about when you decide what to play? (D)Does it make it easier to decide if there are a lot of friends playing, or just a couple? (D) Why?
24. **Goal-Driven Decisions:** Suppose your teacher lets you choose a partner in your class to work on a special project with. You want to do your best work on the special project. You can choose any partner you want to help you with the work. (A) What things do you think about when choosing a partner to work with? (B) Pretend that none of the other children in the class are your close friends and none of them are enemies. Does this make any difference in how you decide who to choose as a partner? (C) If so, what difference does it make?

25. **Decisions about Self-Set Problems:** (A) If you got to draw or paint a picture of anything you wanted to, what would you make? (B) Why did you decide to make that?

APPENDIX D

PART-BY-PART SCORING RESPONSES AND VALUES

Appendix D. *Part-by-Part Scoring Responses and Values*

Memory Index

Question number /type of question	Score value of response	Categories of all responses given by participants
1A/ +/-	1	Yes, I forget
	0	No, I don't forget
1B/ O	1	Yes, good rememberer
	1	No, not a good rememberer
1C/ O	1	Better than friends
	1	Not as well as friends
	1	Same as friends
1D/+/-	1	Yes, categories easier
	1	Yes, instances easier
	1	Yes, but not specified
	0	No response/ irrelevant response
1E/ +/-	1	Categories harder
	1	Instances harder
	0	No response/ irrelevant response
2A/ +/-	1	Relearner
	0	New learner
	0	No response/ irrelevant response

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Memory Index

Question number /type of question	Score value of response	Categories of all responses given by participants
2B/+/-	1	Memory savings
	1	Other relevant reason
	0	Repeats that one boy relearned
	0	No response/ irrelevant response
3A/+/-	1	Phone right away
	0	Same
	0	Get drink first
3B/O	1	Phone first, aware why
	1	Aware of memory limits
	0	No response/ irrelevant response
3C/ O	1	Write it down
	1	Rehearsal
	1	Other strategy
4A/+/-	1	Story made it easier
	0	Story made it harder
4B/+/-	1	Justification
	0	No reason/ irrelevant reason

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Memory Index

Question number /type of question	Score value of response	Categories of all responses given by participants
5A/ +/-	1	Sorting strategy
	0	No sorting used
5B/ +/-	1	Sorting strategy
	0	No sorting used
6/ +/-	1/#	Has a strategy, # of strategies
	0	No strategies
7/ O	1	Other people
	1	Written down
	1	Self remember
	1	Photo
8A/ +/-	1	Not enough
	0	Yes, it’s enough
8B/ +/-	1/#	Intent to study, # of strategies
	0	No strategies
9/ +/-	1	Rote harder
	0	Own words harder
	0	Same or no answer

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Memory Index

Question number /type of question	Score value of response	Categories of all responses given by participants
10A/ +/-	1	Yes, w/ justification
	0	Yes, reason not specified
	0	No
	0	No response/irrelevant response
10B/ +/-	1	Yes, w/ justification
	0	Yes, reason not specified
	0	No response/irrelevant response

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Attention Index

Question number /type of question	Score value of response	Categories of all responses given by participants
11A/ O	1	Listening
	1	Concentrating
	1	Other relevant response
11B/ +/-	1	Yes
	0	No
11C/ O	1	Internal distraction
	1	External distraction
	0	No reason/don't know
11D/ O	1	Internal distraction
	1	External distraction
	1	Other reason
	0	No reason/don't know
12A/ +/-	1	Quiet
	0	Noisy
12B/ +/-	1	Interested
	0	Not interested

+/- correct/incorrect   O open   Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Attention Index

Question number /type of question	Score value of response	Categories of all responses given by participants
12C/ +/-	1	Not talking
	0	Talking
13A/ +/-	1	TV off
	0 or 1	TV on (1 pt. if O on 13B)
13B/ O	1	Cognitive distraction
	1	Sensory distraction
	1	"O" – Other relevant reason
	0	No response/irrelevant response
13C/ +/-	1	Radio off
	0 or 1	Radio on (1 pt. if H on 13D)
13D/ O	1	Cognitive distraction
	1	Sensory distraction
	1	"H" – Music helps me concentrate
	0	No response/irrelevant response
13E/ +/-	1	Curtain closed
	0 or 1	Curtain open (1 pt. if O on 13F)

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Attention Index

Question number /type of question	Score value of response	Categories of all responses given by participants
13F/ O	1	Cognitive distraction
	1	Sensory distraction
	1	"O" – Other relevant reason
	0	No response/irrelevant response
13G/ O	1	TV worst
	1	Curtain worst
	1	Radio worst
	1	Other relevant response/all same
	0	No response/irrelevant response
14A/ +/-	1	Yes, sometimes not hear
	0	No, always hear her
	0	No response/irrelevant response
14B/ O	1	Noise
	1	Preoccupation
	0	No response/irrelevant response

+/- correct/incorrect O open Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Attention Index

Question number /type of question	Score value of response	Categories of all responses given by participants
14C/ +/-	1	Doing nothing
	0 or 1	Reading a book (if J on 14D)
	0 or 1	Listening to radio (if J on 14D)
	0	No response/irrelevant response
14D/ O	1	"J" – Justification
	0	No reason/irrelevant reason
15A/ +/-	1	Looking at teacher
	0	Not looking at teacher
15B/ +/-	1	Not talking
	0	Talking
15C/ +/-	1	Interested
	0	Not interested
15D/ +/-	1	Not fooling around
	0	Fooling around
16A/ +/-	1	One task
	0	Both tasks

+/- correct/incorrect O open Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Attention Index

Question number /type of question	Score value of response	Categories of all responses given by participants
16B/ O	1	Attention/focus affected
	1	Effect on listening
	1	Other relevant (noise level)
	0	No response/irrelevant response
17A/ +/-	1	No
	0	Yes
17B/ +/-	1	Can’t hear
	1	Can’t understand
	0	All were talking/not further explained
	0	No response/irrelevant response

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Decision Making Index

Question number /type of question	Score value of response	Categories of all responses given by participants
18A/ O	1	Hard
	1	Easy
18B/ O	1	Too many choices
	1	Check-out limits
	1	Other relevant
	0	No response/irrelevant response
18C-D/ O	1	Yes, w/ justification
	0	Yes. but not specified
	0	No response/irrelevant response
18E-F/ O	1	Yes, w/ justification
	0	Yes. but not specified
	0	No response/irrelevant response
18G/ O	1	Easier
	1	Harder
18H/ O	1	Justification
	0	No reason/irrelevant reason

+/- correct/incorrect O open Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Decision Making Index

Question number /type of question	Score value of response	Categories of all responses given by participants
19/ O	1	Strategy to choose
	1	Avoid choosing
	0	No response/irrelevant response
20/ O	1	Strategy to decide
	1	Avoid deciding
	0	No response/irrelevant response
21A-B	(1)	New food
(Not scored)	(1)	Familiar food
21C	(1)	Yes
(Not scored)	(1)	No
21D	(1)	Justification
(Not scored)	(0)	No reason/irrelevant reason
22/ O	1	Selection strategy
	1	Other person helps
	1	Avoid choice
	0	No response/irrelevant response

+/- correct/incorrect O open

Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Decision Making Index

Question number /type of question	Score value of response	Categories of all responses given by participants
23A/ O	1	Vote
	1	Consensus
	1	Take turns
	1	Play a deciding game
	1	Other reasonable way
23B/ O	1	Yes
	1	Sometimes another way
23C/O	1	What's fun
	1	Taking turns
	1	Other relevant response
	0	No response/irrelevant response
23D/ O	0 or 1	Just a couple (if J on 23E)
	0 or 1	Lots of friends (if J on 23E)
	0 or 1	Both/either (if J on 23E)
	0	No response/irrelevant response

+/- correct/incorrect O open Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Decision Making Index

Question number /type of question	Score value of response	Categories of all responses given by participants
23E/ O	1	"J" – Justification
	0	No reason given
	0	No response/irrelevant response
24A/ O	1	Works well with me
	1	Good/smart worker
	1	Hard worker
	1	Quiet/won't talk to me
	1	Friend
	0	No response/irrelevant response
24B-C/O	1	No, wouldn't change
	1	Yes, make new friends
	1	Yes, other reason
	0	No response/irrelevant response

+/- correct/incorrect O open Table continues.

Appendix D. *Part-by-Part Scoring Responses and Values*

Decision Making Index

Question number /type of question	Score value of response	Categories of all responses given by participants
25A/ O	1	Animal(s)
	1	Friends/Family
	1	Flowers
	1	Self
	1	TV/movie characters
	1	Other
25B/ O	1	Like the subject – simple
	1	Favorite/cute/nice
	1	Like the subject – elaborated
	1	To remember the subject
	1	I can draw it well
	1	Unusual reason

APPENDIX E

PROPORTIONS OF RESPONSES TO SECTIONS OF THE QUESTIONNAIRE

Appendix E. *Proportions of Responses to Memory Section of the Questionnaire*

Question[1]	Responses	G#	G%	NG#	NG%
1 – Memory ability					
1A	Yes, I forget	11	91.7	7	77.8
	No, I don't forget	1	8.3	2	2.2
1B	Good rememberer	8	66.7	8	88.9
	Not a good rememberer	4	33.3	1	11.1
1C	Better than friends	4	33.3	5	55.6
	Not better than friends	7	58.3	4	44.4
	Same as friends	1	8.3	0	0

[1]In the first column of this table is the number of each question in each section of the questionnaire along with the letter of each sub-question. Possible responses are listed in the second column (see Appendix D for Part-by-Part Scoring Codes listing categories of responses and their score values). The response "None" or "No Answer" includes the answers of those participants who gave responses that were irrelevant or that did not refer to the question at all as well as of those who did not answer or who said, "I don't know." In the third column is the number of participants in the gifted group who gave a particular response, followed by the percent of the gifted group responding that way in the fourth column. The same information for the nongifted group is listed in columns five and six.

Table continues.

Appendix E. *Proportions of Responses to Memory Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
1 – Memory ability					
1D	Yes, categories easier	1	8.3	0	0
	Yes, instances easier	2	16.7	4	44.4
	Yes, not specified	8	66.7	5	55.6
	No response	1	8.3	0	0
1E	Categories	8.5*	70.8	3	33.3
*1 gave >1 response	Instances	3.5*	29.2	4	44.4
	No response	0	0	2	22.2
2 – Relearning					
2A	Relearner	11	91.7	5	55.6
	New learner	1	8.3	3	33.3
	No response	0	0	1	11.1
2B	Memory savings	7	58.3	2	22.2
	Other reason	1	8.3	1	11.1
	Repeats that one learned before	1	8.3	1	11.1
	No response	3	25	5	55.6

Table continues.

Appendix E. *Proportions of Responses to Memory Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
3 – Short-term memory					
3A	Phone right away	4	33.3	1	11.1
	Same	7	58.3	5	55.6
	Get drink first	1	8.3	3	33.3
3B	Phone/aware why	2	16.7	0	0
	Awareness of memory role	4	33.3	2	22.2
	No response	6	50	7	77.8
3C	Write down	10	83.3	7^	77.8
^2 gave >1 response	Rehearse	2	16.7	1.5^	16.7
	Other	0	0	0.5^	5.6
4 – Story context					
4A	Easier	8	66.7	7	77.8
	Harder	4	33.3	2	22.2
4B	Justification	7	58.3	9	100
	None	5	41.7	0	0

Table continues.

Appendix E. *Proportions of Responses to Memory Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
5 – Sorting strategy					
5A	Sorting	4	33.3	3	33.3
	No sorting	8	66.7	6	66.7
5B	Sorting	3	25	1	11.1
	No sorting	9	75	8	88.9
6 – Prospective memory					
	# strategies				
	5	2	16.7	1	11.1
	4	3	25	1	11.1
	3	4	33.3	1	11.1
	2	2	16.7	4	44.4
	1	1	8.3	2	22.2
Mean # strategies		3.25		2.44	
7 – Retrieval cues					
*5 gave >1 response	Other people	4.5*	37.5	4.3^	47.8
	Written down	3.5*	29.2	1.8^	20
^5 gave >1 response	Self remember	3.5*	29.2	2^	22.2
	Photo	0.5*	4.2	0.8^	8.9

Table continues.

Appendix E. *Proportions of Responses to Memory Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
8 – Learning intentionally					
8A	Not enough	4	40	5	55.6
	Yes, enough	6	60	4	44.4
	Missing	2		0	
8B	3 strategies	3	27.2	0	0
	2 strategies	5	45.4	1	11.1
	1 strategy	3	27.2	7	77.8
	None	0	0	1	11.1
	Missing	1		0	
Mean # strategies		2		1	
9 – Rote vs. gist					
	Rote harder	7	58.3	5	55.6
	Own words harder	0	0	1	11.1
	Same or no response	5	41.7	3	33.3

Table continues.

Appendix E. *Proportions of Responses to Memory Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
10 – Memory cues					
10A	Yes, justification	8	66.7	7	77.8
	Yes, not specified	2	16.7	2	22.2
	No	1	8.3	0	0
	No response	1	8.3	0	0
10B	Yes, justification	10	83.3	5	55.6
	Yes, not specified	1	8.3	1	11.1
	No response	1	8.3	3	3.3

Table continues.

Appendix E. *Proportions of Responses to Attention Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
11 – Attention ability					
11A	Listening	6.2*	51.7	7^	77.8
*9 gave >1 response	Concentrating	2.2*	18.3	0	0
^2 gave >1 response	Other relevant	3.7*	30.8	2^	22.2
11B	Yes	11	91.7	8	88.9
	No	1	8.3	1	11.1
11C	Internal distraction	5	41.7	4.5^	50
^1 gave >1 response	External distraction	7	58.3	2.5^	27.8
	No reason/don't know	0	0	2	22.2
11D	Internal distraction	8	66.7	3	33.3
	External distraction	4	33.3	3	33.3
	Other reason	0	0	1	11.1
	Never/don't know	0	0	2	22.2
12 – Influence of distractions					
12A	Quiet	12	100	9	100
	Noisy	0	0	0	0

Table continues.

Appendix E. *Proportions of Responses to Attention Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
12 – Influence of distractions					
12B	Interested	11	91.7	9	100
	Not interested	1	8.3	0	0
12C	Not thinking of other things	11	91.7	9	100
	Thinking of other things	1	8.3	0	0
13 – Avoiding distractions					
13A	TV off	10	83.3	8	88.9
	TV on	2	16.7	1	11.1
13B	Cognitive distraction	6	50	5	55.6
	Sensory distraction	4	33.3	3	33.3
	Other	2	16.7	1	11.1
13C	Radio off	10	88.3	6	66.7
	Radio on	2	16.7	3	33.3

Table continues.

Appendix E. *Proportions of Responses to Attention Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
13 – Avoiding distractions					
13D	Cognitive distraction	4	33.3	0	0
	Sensory distraction	6	50	5	55.6
	Music helps	1	8.3	3	33.3
	Other	1	8.3	0	0
	No response	0	0	1	11.1
13E	Curtain closed	10	83.3	7	77.8
	Curtain open	2	16.7	2	22.2
13F	Cognitive distraction	5.5*	45.8	4	44.4
*1 gave >1 response	Sensory distr.	4.5*	37.5	3	33.3
	Other	1	8.3	1	11.1
	No response	1	8.3	1	11.1
13G	TV worst	8	66.7	5	55.6
	Curtain worst	3	25	1	11.1
	Radio worst	0	0	1	11.1
	Other/all same	1	8.3	1	11.1
	No response	0	0	1	11.1

Table continues.

Appendix E. *Proportions of Responses to Attention Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
14 – Preoccupation					
14A	Sometimes not hear	8	66.7	5	55.6
	No, always hear	3	25	3	33.3
	No response	1	8.3	1	11.1
14B	Noise	3	33.3	3.5^	58.3
"Sometimes not hear" only	Preoccupation	2	22.2	0.5^	8.3
^1 gave >1 response	Other	2	22.2	1	16.7
	No response	2	22.2	1	16.7
	Not asked	3		3	
14C	Doing nothing	8	66.7	4	44.4
	Reading a book	3	25	3	33.3
	Listening to radio	1	8.3	1	11.1
	No response	0	0	1	11.1
14D	Justification	11	91.7	5	55.6
	None	1	8.3	4	44.4

Table continues.

Appendix E. *Proportions of Responses to Attention Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
15 – Role of interest					
15A	Looking at teacher	12	100	9	100
	Not looking	0	0	0	0
15B	Not talking	12	100	9	100
	Talking	0	0	0	0
15C	Interested	11	91.7	8	88.9
	Not interested	1	8.3	1	11.1
15D	Not fooling around	12	100	9	100
	Fooling around	0	0	0	0
16 – Divided vs. focused attention					
16A	1 task	12	100	9	100
	2 tasks	0	0	0	0
16B	Attention/focus	7	58.3	3.5^	38.9
*2 gave >1 response	Effect on listening	4*	33.3	3.5^	38.9
^1 gave >1 response	Other relevant	1*	8.3	1	11.1
	No response	0	0	1	11.1

Table continues.

Appendix E. *Proportions of Responses to Attention Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
17 – Limited capacity					
17A	No	12	100	8	88.9
	Yes	0	0	1	11.1
17B	Can't hear	5	41.7	4	44.4
	Can’t understand	3	25	1	11.1
	Too many talking/not further explained	3	25	3	33.3
	No response	1	8.3	1	11.1

Table continues.

Appendix E. *Proportions of Responses to Decision Making Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
18 - Decision making ability					
18A	Hard	10	83.3	8	88.9
	Easy	2	16.7	1	11.1
18B	Too many choices	8*	66.7	4.5^	50
*2 gave >1 response	Check-out limits	2*	16.7	1.5^	16.7
^1 gave >1 response	Other	2	16.7	2	22.2
	No response	0	0	1	11.1
18C/D	Yes, justification	11	91.7	8	88.9
	Yes, not specified	1	8.3	0	0
	No response	0	0	1	11.1
18E/F	Yes, justification	11	91.7	4	44.4
	Yes, not specified	0	0	1	11.1
	No	0	0	1	11.1
	No response	1	8.3	3	33.3
18G	Easier	7	58.3	5	55.6
	Harder	5	41.7	4	44.4

Table continues.

Appendix E. *Proportions of Responses to Decision Making Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
18 – Decision making ability					
18H	Reason	8	72.7	6	66.7
	No reason	3	27.2	3	33.3
	Missing	1		0	
19 – Multiple good choices					
	Strategy to choose	10	83.3	6	66.7
	Avoid choosing	2	16.7	2	22.2
	No response	0	0	1	11.1
20 – Difficult choice					
	Strategy to decide	12	100	8	88.9
	Avoid deciding	0	0	0	0
	No response	0	0	1	11.1
21 – Known vs. unknown					
21A/B	New food	7	58.3	7	77.8
	Familiar food	5	41.7	2	22.2
21C	Yes	1	20	1	50
for 'Familiar' only	No	4	80	1	50

Table continues.

Appendix E. *Proportions of Responses to Decision Making Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
21 – Known vs. unknown					
21D	Justification	1	100	1	100
for 'Yes' on 21C only	No justification	0	0	0	0
22 – Two unknowns					
*1 gave >1 response	Selection strategy	8.5*	70.8	4	44.4
	Other person helps	1	7.6	3	33.3
	Avoid choice	2.5*	20.8	1	11.1
	No response	0	0	1	11.1
23 – Joint decision making					
23A	Vote	3	25	3	33.3
	Consensus	2	16.7	1	11.1
	Take turns	3	25	1	11.1
	Game	2	16.7	2	22.2
	Other way	2	16.7	2	22.2

Table continues.

Appendix E. *Proportions of Responses to Decision Making Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
23 – Joint decision making					
23B	Yes	9	75	7	100
	No, sometimes another way	3	25	0	0
	Missing	0	0	2	0
23C	What's fun	4	33.3	0	0
	Taking turns	0	0	2	25
	Other things	6	50	2	25
	No response	2	16.7	4	50
	Missing	0		1	
23D	Just a couple	7	58.3	7	77.8
	Lots of friends	3	25	1	11.1
	Both/either	2	16.7	0	0
	No response	0	0	1	11.1

Table continues.

Appendix E. *Proportions of Responses to Decision Making Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
23 – Joint decision making					
23E	Couple with justification	5	41.7	4	50
	Couple - no reason	2	16.7	3	37.5
	Lots with justification	1	8.3	0	0
	Lots - no reason	2	16.7	1	12.5
	Both with justification	1	8.3	0	0
	Both - no reason	1	8.3	0	0
	Missing	0		1	
24 – Goal-driven decisions					
24A	Work well with me	3.83*	31.9	2	22.2
*3 gave >1 response	Smart/does good work	1.67*	13.9	1	11.1
	Hard worker	1.33*	11.1	0	0
	Quiet/won't talk	0.33*	2.8	2	22.2
	Friend	3.83*	31.9	3	33.3
	No response	1	8.3	1	11.1

Table continues.

Appendix E. *Proportions of Responses to Decision Making Section of the Questionnaire*

Question	Responses	G#	G%	NG#	NG%
24B/C	No, wouldn't change	7	58.3	5	55.6
	Yes, make new friends	1	8.3	3	33.3
	Yes, other reason	3	25	0	0
	No response	1	8.3	1	11.1
25A	Animal(s)	4	33.3	4	44.4
	Friends/Family	0	0	3	33.3
	Flowers	1	8.3	1	11.1
	Self	2	16.7	1	11.1
	TV/movie character(s)	2	16.7	0	0
	Other	3	25	0	0
25 – Self-set problems					
25B	Like subject - simple	2	16.7	3	33.3
	Favorite/cute/ nice	3	25	2	22.2
	Like subject - elaborated	3	25	1	11.1
	To remember subject	0	0	2	22.2
	Can draw it well	2	16.7	1	11.1
	Unusual reason	2	16.7	0	0

APPENDIX F

HUMAN SUBJECTS AND VERIFICATION OF TRAINING FORMS

Human Subjects Protection Program
http://www.irb.arizona.edu

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23 July 2004

Wendy Joffe, Ph.D. candidate
Department of Special Education, Rehabilitation and School Psychology
College of Education
PO Box 210069

RE: **BSC B04.110 METACOGNITION AMONG STUDENTS IDENTIFIED AS GIFTED OR NONGIFTED USING THE DISCOVER ASSESSMENT**

Dear Ms Joffe:

We received your 15 July 2004 letter and accompanying revised Verification of Human Subjects Training Form (VOTF) for the above-cited study. Permission is requested to amend the VOTF to add Katy Ferrero (Research Assistant/Interviewer) to the study. This change does not impact subject safety nor the consenting documents. Approval of this change is granted effective 23 July 2004.

The Human Subjects Committee (Institutional Review Board) of the University of Arizona has a current ***Federalwide Assurance*** of compliance, ***FWA00004218***, which is on file with the Department of Health and Human Services and covers this activity.

Approval is granted with the understanding that no further changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research related physical or psychological harm to any subject must also be reported to each committee.

Sincerely yours,

Theodore J. Glattke

Theodore J. Glattke, Ph.D.
Chair
Social and Behavioral Sciences Human Subjects Committee

TJG:mm

cc: Departmental/College Review Committee

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Human Subjects Protection Program
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MEMORANDUM

TO: Katy Ferraro
1101 Bellaire St., # 304
Denver, CO 80220

FROM: Rebecca Dahl, Ph.D.
Director, Human Subjects Protection Program

DATE: 1 July, 2004

SUBJECT: Human Subjects Training Program

On 28 June, 2004, you successfully completed the Social & Behavioral Sciences Test, "Protection of Humans Who Participate in Nonmedical Research." Therefore, you have met the criterion required by the University of Arizona to be certified in human subjects protection.

This is the only notification you will receive. Please give a copy of this memo to your department head and keep this memo in your files.

THE UNIVERSITY OF
ARIZONA.
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257

UA Student Name: **Wendy S. Joffe**

UA Student ID: **443584281**

Answer Sheet Number: **11624**

Module Name: **Rochester Manual Test**

Test Date: **29-DEC-03**

When you logged in to the Online Test system, you indicated that you are a student.

Provisions of the Family Educational Rights and Privacy Act of 1974 (FERPA) require that we get your written permission to release the results of this test because it identifies you personally as the individual who passed the test. Please sign below to indicate that we may release the fact that you have passed this test on the above date.

You may disclose the fact that I have passed this test.

Signature Wendy S. Joffe Date 12/29/03

Note: You must also sign on the following page where indicated.

THE UNIVERSITY OF
ARIZONA.
TUCSON ARIZONA

Training Results: Passing Score

Report run on: December 29, 2003 12:47 PM

258

UA Student ID: **443584281**

UA Student Name: **Wendy S. Joffe**

Mailing A**425 S Rosemary St Denver**

Phone:

Answer Sheet Number: **11624**

Module Name: **Rochester Manual Test**

Test Date: **29-DEC-03**

signing and dating I certify that I completed
test without assistance from another individual:

Wendy S Joffe 12/29/03
Signature Date

r signing the
), mail it to: **Human Subjects Protection Program, 1350 N Vine Ave, Tucson, AZ 85724** or **Human Subjects Protection Program, PO Box 245137, CAMPUS**

Answer Sheet

Question Number	Your Answer				
1	B	23	B	45	B
2	A	24	D	46	A
3	A	25	D	47	B
4	B	26	D	48	D
5	B	27	A	49	A
6	A	28	C	50	A
7	A	29	D		
8	B	30	B		
9	A	31	A		
10	A	32	A		
11	A	33	A		
12	A	34	B		
13	A	35	A		
14	B	36	A		
15	A	37	A		
16	A	38	B		
17	B	39	A		
18	D	40	A		
19	A	41	D		
20	B	42	A		
21	E	43	A		
22	C	44	A		

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