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Metacognition Gets Personality:
A Developmental Study of the Personality
Correlates of Metacognitive Functioning

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Abstract

Metacognition is a construct that is currently receiving a lot of attention in the cognitive and educational literature. The term has been used to label several levels of mental activity and confusion over the precise nomenclature continues to result in a lack of cohesiveness in the empirical findings. However, broadly defined, metacognition refers to the activity of monitoring our cognitive processes when solving a problem in order to effectively use our knowledge and skills and to circumvent our areas of weakness.

"Metacognition Gets Personality" is a study that was planned in three parts. At the time this study was conceptualized, there was an absence in the literature of a consistent means of assessing metacognitive functioning. Therefore, the first task was to design assessment measures. Accordingly, two instruments were constructed, pre-tested on a pilot sample and submitted to necessary changes. The two measures, a questionnaire to assess general knowledge about metacognitive activities (the Metacognitive Knowledge Assessment Questionnaire - MKAQ) and an interview schedule to facilitate a child's description of her metacognitive activities during a (cognitive) problem-solving task (the Metacognitive Interview - MI) were both submitted to assessments of their re-test and intrarater reliability and concurrent and external validity. Internal consistency coefficients were also obtained.

Results indicated that for the MKAQ, intrarater reliability and internal consistency coefficients were both high. Re-test reliability coefficients for individual subscales were low but for composite scores was high. Hypotheses for this pattern are offered. The pattern of validities results yielded interesting information that is integrated into a broader understanding of metacognition. Suggestions for future development of the MKAQ are made.

With regard to the MI, intrarater reliability was poor, re-test reliability was adequate. Internal consistency was adequate but suggested possible concern about one subscale. External validity was poor. Concurrent validity again suggested patterns that were used to illuminate our understanding of metacognitive issues. It was concluded the MI was sufficiently reliable and valid for use in this explorative study but that further use was limited.

The second and central part of the study focused on the examination of an hypothesized link between metacognition and personality characteristics. Although authors (eg., Torgeson, 1977) have alluded to the connection for a long time, this is the first attempt to empirically establish a link and to attempt to define the nature of the association. A multivariate correlational design was used to test the strength of the correlation between the metacognitive measures and personality constructs such as state-trait anxiety, a people-pleasing coping style and impulsivity-reflectivity.

The constructs were selected to be integrated within the construct of ego functioning. A measure of ego development was also included. Results suggested a weak link with ego development but a stronger link with aspects of ego functioning. From the pattern that emerged, it was concluded that metacognition is probably related to state rather than trait characteristics. As in a previous study (see Nandi, 1991), intelligence and maturation captured the largest part of the variance.

Finally, the third part of this study attempted to develop a model or guide for the understanding and future study of metacognition. This field includes many examples of creative investigations yet after 20 years it seems we are only fractionally closer to understanding what metacognition is, how it develops in the individual, how to predict when and how it will be used, or what interferes with its use. A heuristic is offered to integrate the results of past research and to point the direction for possible future studies.

Table of Contents

Chapter 1	Introduction.....	1
1.2	Overview of Thinking about Metacognition.....	8
1.2.1	History.....	9
1.2.2	Three Theories of Metacognition.....	11
1.2.2.1	John Flavell.....	11
1.2.2.2	Ann Brown.....	13
1.2.2.3	Robert J. Sternberg.....	17
1.2.2.4	An Integration of the three Models....	21
1.2.3	Metacognition and Development.....	25
1.3	Critique.....	37
1.4	Research Design.....	45
1.5	Metacognition and Personality.....	49
1.5.1	Metacognitive Functioning and the Ego.....	59
1.5.1.1	Ego Development.....	62
1.5.1.2	Ego Functions.....	65
1.6	Summary.....	68
Chapter 2	Method.....	72
2	General Description of Design and Procedure.....	72
2.1	Subjects.....	74
2.2	Instrumentation.....	76
2.2.1	Metacognitive Assessment.....	76
2.2.1.1	Self Report Measures.....	76
2.2.1.1.1	The Metacognitive Knowledge Assessment Questionnaire (MKAQ)..<	79
2.2.1.1.2	The Metacognitive Interview (MI).....	83

2.2.2	Validation Measures.....	90
2.2.2.1	Concurrent Validity.....	90
2.2.2.1.1	Japanese Folk Tales (Brown and Smiley, 1977, 1978).....	91
2.2.2.1.2.	Preparation Object (Kreutzer et al., 1975).....	92
2.2.2.1.3	Magic Trick (Markman, 1977).....	94
2.2.2.1.4	The Porteus Maze Test (Porteus, 1950).....	96
2.2.2.1.5	Numbers Backwards (Wechsler, 1974).....	97
2.2.2.2	External Validity.....	97
2.2.2.2.1	Kemler Hypothesis Formation Task (Kemler, 1978).....	99
2.2.2.2.2	Pattern Matching Task (Neimark & Lewis, 1967).....	103
2.2.3	Personality Measures.....	108
2.2.3.1	Matching Familiar Figures (MFF) (Kagan, 1966).....	108
2.2.3.2	The Spielberger State-Trait Anxiety Inventory for Children (STAIC) (Spielberger, 1970).....	114
2.2.3.3	The Children's Social Desirability Scale (Crandall, Crandall & Katkovsky, 1965).....	117

2.2.3.4	The Washington University Sentence Completion Test (WUSC) (Loevinger, 1970).....	119
2.2.3.5	Rorschach.....	122
2.3	Procedure.....	125
Chapter 3	Results.....	135
3	Review.....	135
3.1	Statistical Procedures.....	135
3.1.1	Reliabilities.....	135
3.1.2	Validities.....	135
3.1.3	Personality Correlates.....	136
3.2	Analyses Planned a Priori.....	139
3.2.1	Preliminary Considerations.....	139
3.2.2	Reliabilities.....	139
3.2.3	Validities.....	139
3.2.4	Personality Correlates.....	140
3.3	Results.....	140
3.3.1	Measures of Metacognition: The Metacognitive Knowledge Assessment Questionnaire (MKAQ)....	140
3.3.1.1	Data Screening.....	140
3.3.1.2	Reliabilities.....	141
3.3.1.3	Validities.....	146
3.3.2	Measures of Metacognition: The Metacognitive Interview (MI).....	152
3.3.2.1	Data Screening.....	152
3.3.2.2	Reliabilities.....	153

3.3.2.3	Validities.....	161
3.4	Personality Measures.....	168
3.4.1	MFF, CSD, STAIC, WUSC.....	168
3.4.1.1	Data Screening.....	168
3.4.1.2	Reliability.....	168
3.4.1.3	Canonical Correlations.....	168
3.4.2	Rorschach.....	183
3.4.2.1	Data Screening.....	183
3.4.2.2	Reliability.....	185
3.4.2.3	Canonical Correlation.....	185
3.5	Summary.....	187
Chapter 4	Discussion.....	189
4	Measures.....	190
4.1	The Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	190
4.1.1	The Metacognitive Knowledge Assessment Questionnaire (MKAQ) - Reliabilities.....	190
4.1.2	The Metacognitive Knowledge Assessment Questionnaire (MKAQ) - Validities.....	193
4.1.3	The Metacognitive Knowledge Assessment Questionnaire (MKAQ) - Summary.....	195
4.2	The Metacognitive Interview (MI).....	196
4.2.1	The Metacognitive Interview (MI) - Reliabilities.....	199
4.2.2	The Metacognitive Interview (MI) - Validities.....	203

4.2.3	The Metacognitive Interview (MI) - Summary...	211
4.3	Metacognition Gets Personality.....	211
4.4	Measurement: An "Ill-structured Problem".....	222
4.5	Recommendations.....	224
Chapter 5	Future Directions.....	231
5.1	Metacognition Then and Now.....	231
5.1.1	Déjà Vu All Over Again.....	231
5.1.2	Applications of Metacognition.....	239
5.1.3	Measurement Instruments.....	240
5.2	A Proposed Model of Metacognitive Development....	247
5.3	Personality and Metacognition.....	255
5.3.1	The Personality Link - An Ongoing Problem....	256
5.3.1.1.	Measurement of the Nonconscious Aspects of Metacognition - A Place for Introspection.....	258
5.3.1.2	Alternative Models of Information Processing.....	262
5.3.1.3	Metacognition and Nonconscious Functioning.....	268
5.4	Conclusion.....	271

List of Figures

Figure 1	Schematic Representation of the Study.....	73
Figure 1a	Schematic Representation of the Study (Including sample sizes).....	138
Figure 2	A Proposed Model of Metacognition.....	252
Figure 3	A Proposed Model of Metacognition: Developmental Diagram.....	253

List of Tables

Table 1	Characteristics of the Sample: Sex, School, Order, Program, Grade.....	127
Table 2	Characteristics of the Sample: Grade by Program, Grade by Sex, Program by Sex.....	128
Table 3	Characteristics of the Re-Test Sample - Metacognitive Knowledge Assessment Questionnaire (MKAQ): Grade by Program, Grade by Sex, Program by Sex.....	131
Table 4	Characteristics of the Re-test Sample - Metacognitive Interview (MI): Grade by Program, Grade by Sex, Program by Sex.....	132
Table 5	Intrarater Reliabilities - Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	143
Table 6	Re-test Reliabilities - Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	144
Table 7	Cronbach's Alpha - Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	147
Table 8	Concurrent Validity - Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	149
Table 9	External Validity - Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	151
Table 10	Intrarater Reliabilities - Metacognitive Interview (MI).....	154
Table 11	Re-test Reliability - Metacognitive Interview Kemler (MI-K).....	156

Table 12	Correlations of Administrations of the Metacognitive Interview - Pattern Matching (MIPM) with the Metacognitive Interview - Kemler (MIK).....	159
Table 13	Cronbach's Alpha - Metacognitive Interview - Kemler.....	160
Table 14	Concurrent Validity - Metacognitive Interview - Kemler (MIK-1 and MIK-2).....	162
Table 15	External Validity - Metacognitive Interview (MIK) with the Kemler Task.....	164
Table 16	Correlation between the Metacognitive Knowledge Assessment Questionnaire (MKAQ) and the Metacognitive Interview (MIK).....	167
Table 17a	Standardized Canonical Coefficients and Canonical Correlations between the Three Canonical Variables and Program, Grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, and WUSC - <u>Root 1</u>	171
Table 17b	Standardized Canonical Coefficients and Canonical Correlations between the Three Canonical Variables and Program, Grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, and WUSC - <u>Root 2</u>	172
Table 17c	Standardized Canonical Coefficients and Canonical Correlations between the Three Canonical Variables and Program, Grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, and WUSC - <u>Root 3</u>	173
Table 18	Regression Analyses for Within Cells Canonical	

	Correlation - Metacognitive Components with Grade, Program, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, WUSC.....	174
Table 19	Redundancies - Metacognitive Components with Grade, Program, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, WUSC.....	175
Table 20a	Standardized Canonical Coefficients and Canonical Correlations between the Three Metacognitive Variables and Program, Grade, STAIC 1, CSD and WUSC - <u>Root 1</u>	178
Table 20b	Standardized Canonical Coefficients and Canonical Correlations between the Three Metacognitive Variables and Program, Grade, STAIC 1, CSD and WUSC - <u>Root 2</u>	179
Table 20c	Standardized Canonical Coefficients and Canonical Correlations between the Three Metacognitive Variables and Program, Grade, STAIC 1, CSD and WUSC - <u>Root 3</u>	180
Table 21	Regression Analysis for Within Cells Canonical Correlations - Metacognitive Components with Program, Grade, STAIC 1, CSD and WUSC.....	181
Table 22	Redundancies - Canonical Correlation - Metacognitive Components with Program, Grade, STAIC 1, CSD, and WUSC.....	182
Table 23	Rorschach - Interrater Reliability.....	186

List of Appendices

A	Flavell's Model.....	318
B	Brown's Model.....	326
C	Sternberg's Model.....	334
D	Description of (6) Metacognitive Processes.....	339
E	Ego Development.....	343
F	Metacognitive Knowledge Assessment Questionnaire (MKAQ).....	356
G	Introductory Remarks - Examiner 1 and Examiner 2 and Testing Schedule.....	368
H	Metacognitive Knowledge Assessment Questionnaire (MKAQ): Six additional processes used in scoring system.....	373
I	Metacognitive Knowledge Assessment Questionnaire (MKAQ): Scoring system and sample score sheet.....	376
J	Metacognitive Interview (MI): Sample protocol.....	402
K	Metacognitive Interview (MI): Scoring System and Sample Score Sheet.....	406
L	Dragon's Tears (Brown and Smiley, 1977, 1978): Sample of stimulus and scoring system.....	411
M	Preparation Object (Kreutzer et al., 1975): Sample of stimulus and scoring system.....	421
N	Magic Trick (Markman, 1977): Sample of stimulus and probes.....	424
O	Proteus Maze Test (Porteus, 1952): Sample of Stimulus.....	428

P	Numbers Backwards (Wechsler, 1974): Sample of Stimulus and scoring system.....	420
Q	Kemler Hypotheses Formation Task: Instructions, sample of stimulus, and scoring sheet.....	433
R	Pattern Matching Task: Instructions, sample of stimulus and scoring sheet.....	442
S	Matching Familiar Figures (Kagan, 1966): Instructions, Sample of stimulus, score sheet.....	452
T	Spielberger State - Trait Anxiety Scale for Children (Spielberger, 1973): Test protocol.....	457
U	Children's Social Desirability Scale (Crandall et al., 1965): Test protocol.....	460
V	Washington University Sentence Completion Test (Loevinger, 1970): Test protocol girls, boys, sample of scoring criteria.....	464
W	Rorschach: Structural Summary Blank (Exner, 1989), description of the scoring criteria and interpretations of the indices used in the principal component analysis.....	471
X	Letters of Consent.....	488
Y	Testing sessions.....	494

Chapter One

Literature Review

1 Introduction

Life is not a matter of holding good cards,
but of playing a poor hand well.

- Mother Tried to Tell Me and I Just Wouldn't Listen, 1982, Orillia, Canada, Periwinkle Inc.

This thesis will attempt to explain why it is that some people can play a poor hand well, and some cannot play even a good hand well. It will further attempt to provide a model for investigating these differences.

People tend to solve problems differently. This is such an obvious statement that most people, lay and professional alike, would have no trouble agreeing with it. Broadly speaking, older people solve problems differently than do younger people. The approach of people with high intelligence is usually different from that of people with lower I.Q.s. However, even within these two groups, it is not at all difficult to pick out individual differences, differences which exist in efficiency, in sophistication, or in style. The factors contributing to these latter differences are perhaps somewhat less obvious.

Intelligence is one factor that almost anyone would select as an important contributing factor to differences in problem-solving. Experience -- with problems in general, and with the relevant class or type of problem -- is another factor. But a third factor is "metacognition" (Brown, 1975, 1977, 1978a;

Flavell, 1979; Flavell & Wellman, 1977; Sternberg, 1981, 1983, 1984, 1985). Metacognition is one of several terms currently being used to describe an essential part of learning and problem-solving processes, and is presently a by-word in the analysis of cognitive performance and cognitive difficulties. Broadly speaking, metacognition refers to our ability to monitor and consequently effectively use our cognitive processes.

Metacognition is often described as the executive process governing our cognitive efforts (Sternberg, 1981, 1983, 1984, 1985) and, as such, overlaps with the intelligence and experience factors mentioned at the beginning of this section. This perspective on the definition is an important one. Because the investigation of metacognition grew out of studies of the strategies used to improve memory functioning, confusion exists between the actual use of these cognitive strategies (cognitive level) and decisions concerning which strategy is required, and when (metacognitive level). Consider the situation in which you have a professional qualifying exam. The notes you take, the memorizing you do, the self-quizzing you engage in are all cognitive strategies. The decision to allow extra time for study since you have been out of touch with the material, the cataloguing of your existing knowledge, an awareness of the areas of weakness, and the decision to use a certain strategy because it fits the task and works well for you, these are metacognitive processes. The distinction is not a facile one. The two sets of processes seem to emerge at different times in

development with metacognitive processes emerging later. Furthermore, cognitive strategies can be taught, even to Educationally Retarded (ER) children (Campione & Brown, 1977). The results of teaching metacognitive strategies appears to be much more complex (Brown & Smiley, 1978) and for some groups, such as the ER children, teaching metacognitive strategies may be more difficult, very time consuming, and with fewer successes than is the case with cognitive strategies (Brown, 1977; Campione & Brown, 1977). Finally, it may be that the contribution of personality factors to metacognitive efficiency is a more central issue than in cognitive processes, although the research to support such an hypothesis has yet to be done.

Since metacognition clearly overlaps with aspects of intelligence and experience, it would be tempting to explain metacognition in terms of these two factors. However, it would be misleading to consider these as fully describing the metacognitive phenomenon. Although the most frequently used definition of metacognition refers to our ability to monitor, a willingness to be so involved in the learning process is implicit in this definition. Conceptualizing metacognition as a combination of ability and motivation factors widens the discussion to include personality as well as cognitive factors. It is the aim of this study to demonstrate that personality characteristics play a role in metacognitive functioning. Indeed it may be that metacognition is a relatively new way of looking at and operationalizing a part of a concept that is half

a century old.

If the concept of metacognition sheds new light on an old concept then likely it has incorporated many psychological concepts of the past 50 years. Indeed, metacognition overlaps with many other areas of psychology. Of course, there is a strong relationship and interdependence with cognitive psychology. Interest in metacognition grew out of the field of cognitive psychology. However, it is possible to picture an individual whose cognitive efficiency is fairly high but whose metacognitive functioning is not as efficient. It is possible, but not quite as easy, to picture the converse situation. Slife (1985), for example, found that, in patients suffering from mild to moderate (induced) depression, metacognitive skills in problem-solving were affected. However cognitive skills were not. In fact, cognitive and metacognitive skills were uncorrelated until severe levels of (induced) depression.

Another area of overlap would clearly be with developmental psychology. Theorists point to, and research clearly supports (Brown, 1978a; Kreutzer et al., 1975, etc.; Markman, 1973), the hypothesis that metacognition is a developmental issue. It emerges early in cognitive development (see Brown, 1978a; Kreutzer et al., 1975), and first emerges in a rudimentary form, to be refined later (see Brown, 1978a; Flavell & Wellman, 1977; Kreutzer et al., 1975).

A further, less obvious choice of overlap is with the broad area of personality psychology. Researchers (e.g., Brown,

1978a; Flavell & Wellman, 1977; Hagen, 1971; Torgeson, 1977) have suggested repeatedly a major contribution from personality factors but until the mid-1980s, little research has been undertaken in this area. Exploration of the personality-metacognition link has documented the relationship between impulsivity/reflectivity, and efficient (metamemory) performance (Kurtz, 1984; Kurtz et al., 1982; Stober, 1984). However, other issues in personality functioning warrant observation, including issues such as activity/passivity, self-concept, and anxiety. Also, it is not clear whether it is more important to examine state or trait factors in the link between personality characteristics and efficient metacognitive functioning. The major thrust of this thesis is the investigation of trait issues in an attempt to define the relation between personality and metacognitive efficiency. Analyses will also examine the interaction between metacognitive development and personality development.

Investigation of this area is not merely of intellectual interest. The possible applied uses of its results are many and quite varied. Thinking first of the academic sphere, at the moment metacognitive training is being given to children selected for the gifted program in some boards of education. This is occurring without a full understanding of the parameters of metacognitive functioning and without reliable methods of screening for those children who require such training. In addition, the most obvious target group might not be the gifted

children, but the children who are having difficulty learning such as the slow learners or the "learning disabled" (LD) groups since these groups have already been identified as generally metacognitively inefficient (Wong, 1982a, 1982b). Even so-called average children could benefit from learning more efficient learning strategies.

If this study demonstrates that personality characteristics are an important contributing factor to metacognitive functioning, it may be of additional help to know that the inefficient metacognitive individual also evidences specific personality traits or that particular state characteristics impede metacognitive efficiency. Without postulating cause and effect, intervention could be at the personality level as well as the level of the more specific metacognitive strategies. In other words, since the fostering of skills in one area does not automatically lead to skills in another area, perhaps what is required is a more wholistic approach to metacognitive remediation, one based not only on cognitive functioning.

Perhaps cognitive remediation requires the same wholistic perspective. Slife (1985) suggested the separability of metacognitive from cognitive functioning. The statistical results of Slife's (1985) study suggested that cognitive deficits may be ruled out as the cause of metacognitive deficits. He went so far as to suggest that metacognitive deficits may precede and contribute to cognitive deficits. If this is the case, then merely remediating the visible and

measurable cognitive deficits will ultimately meet with failure - as had indeed often been the case in academic remediation. Intervention for both metacognitive and cognitive deficiencies would perhaps be more efficient. Presuming that personality differences contribute to metacognitive efficiency, then intervening at the personality level, as well as the metacognitive and various cognitive levels may prove to be the most successful.

However, the possible application of metacognition extends far beyond the academic sphere. Applications are already being seen and made in the social skills area (eg., McFall & Dodge, 1982). Again, these would perhaps be more effective if the concomitant personality issues could be addressed at the same time. It may be that the same personality traits are evidenced by efficient metacognitive users in all areas -- in academic, social, and everyday problem-solving. Or it may be that a different constellation of traits emerges in each area, or that some traits remain central while others change. For the moment, the present research will be looking at the personality factors associated with a generic problem-solving task most closely related to the academic sphere.

Yet another area of application is in psychotherapeutic interventions. Many therapeutic strategies have been designed for the non-reflective client, for example, neurolinguistic programming (Bandler & Grinder, 1975), behaviour modification (eg., Bandura, 1969; Lazarus, 1973), and rational emotive

therapy (Ellis, 1962). In fact, along with motivation, the ability to reflect on one's own cognitions and behaviour is considered to be of prime importance by the assessing psychotherapist. Perhaps reflectivity, as a metacognitive process, has personality components which can be a first issue in therapy, rendering the client more amenable to insight oriented psychotherapy. As Slife (1985) has pointed out, cognitive therapies aimed at the alleviation of depression may be less effective since metacognition is a separate skill. Metacognition may be necessary for successful therapy but be the first to be affected by depression. Improvement of metacognitive skills may need to be a first step in treatment.

Therefore, metacognitive functioning is considered an important facet of successful problem solving. Effective metacognitive functioning is dependent on intelligence and experience factors and has clear developmental effects. Personality characteristics may also play a major part in metacognitive functioning. But what is metacognition? What is its theoretical background and how does current thinking describe the phenomenon?

1.2 Overview of Thinking about Metacognition

This section will describe the history of thought about metacognition. It will outline the perspectives of the three founding theorists and will describe the place of metacognition in development.

1.2.1 History

Metacognition as a field of study is a relatively recent phenomenon. As an area of research interest it is about 20 years old, appearing first in the late 1960s. Metamemory was the first to be studied, and until recently, received the most empirical attention (Brown, 1975). Ornstein (1978) traces the increased interest in "metavariabls" to the upsurge of experimental activity in memory development, part of the growing cognitive orientation in experimental research.

The more general research interests of such human memory theorists as Atkinson and Shiffrin (1968), Craik and Lockhart (1972), Tulving (1962), stimulated parallel research into memory development in children during the 1960s and 1970s (Ornstein, 1978). The areas covered were those outlined by research into adult memory processes -- organization in free recall (eg., Laurence, 1966; Rossi, 1964; Rossi & Rossi, 1965), short term memory processes and the use of rehearsal and related acquisition strategies (eg., Atkinson et al., 1964; Belmont & Butterfield, 1969, 1971; Flavell et al., 1970; Hagen & Kingsley, 1968), sensory memory (eg., Haith et al., 1970), and models of memory (eg., Atkinson et al., 1964; Hagen & Kingsley, 1968).

A separate but concurrent influence came from the research into cognitive development. As Ornstein (1978) points out, the 1960s was a time of intense research into cognitive development. Within developmental psychology, work was undertaken on the theories of Jean Piaget and Jerome Bruner. Research was also

completed on children's discrimination learning and concept utilization (eg., Kendler & Kendler, 1962; Tighe & Tighe, 1968; Zeaman & House, 1963), language (eg., Braine, 1963; Brown & Bellugi, 1964) and perception (eg., Bower, 1966; Fantz, 1963; Gibson et al., 1962). Out of these interests came two major lines of research (Ornstein, 1978): 1. research in modes of memorial representation; 2. research in production deficiencies.

The research in modes of memorial representation developed from the work of Jerome Bruner and his colleagues (Bruner, 1964, 1966; Bruner et al., 1966). This group hypothesized that young children initially represent information in a motoric or enactive manner, following which there is a gradual shift to iconic -- ie. visual -- imagery, and finally a shift to symbolic modes of representation. Although the resulting research in visual imagery in children yielded inconclusive results, the visual aspects of children's memory gained a prominent place in empirical investigations. Eventually, this research crystallized into interest in the broader question of visual encoding in children (Ornstein, 1978).

Of more relevance to the focus of this paper, is the second major outcome -- interest in production versus mediational deficiencies. Ornstein (1978) places the origins of this interest in discrimination learning and other complex learning paradigms. Research results (eg., Kendler & Kendler, 1962; Reese, 1962) suggested developmental differences in the degree to which verbal symbols could be used and function effectively

as mediators (or in the terms most frequently used, as "mnemonic strategies"). Flavell and his colleagues (Flavell, 1970; Flavell et al., 1966; 1977) embarked on a series of experiments aimed at distinguishing between mediational difficulties (ie., failures of a generated mediator to work) and production deficiencies (ie., failure to produce a mediator). Of interest was the performance of a group of subjects who had been identified as having production deficiencies, when prompted to generate appropriate strategies. It was demonstrated that the likelihood of the mediator being used spontaneously increased with age, and was closely linked to improved recall performance. Flavell et al. (1966) reported that among first grade subjects, recall was higher for producers than for non-producers, and that non-producing subjects could be prompted to employ mediators with a resulting improvement in recall (Keeney et al., 1967).

1.2.2 Three Theories of Metacognition

1.2.2.1 John Flavell

John Flavell is the first of three model-builders in the area of metacognition. His research is perhaps the earliest and his papers remain among the most frequently quoted.

Over the years, Flavell's understanding of "meta" processes appears not to have changed appreciably but to have become more refined, and to have moved away from writing about metamemory to discussing the broader category of metacognition. Flavell succinctly defines metacognition as "knowledge and cognition about cognitive phenomena" (Flavell, 1979, p. 906), involving

the monitoring of one's own memory, comprehension, and other cognitive enterprises. Broadening his original perspective from the "person - strategy - goal interaction" (Flavell & Wellman, 1977), he became interested in two classes of phenomena and the interaction between them.

Flavell further defines metacognition as "...one's knowledge concerning one's own cognitive processes and products or anything related to them....Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in the service of some concrete goal or objective" (Flavell, 1976, p. 232). More recently, Flavell and Wellman (1977) and Flavell (1979) have elaborated on a model of metacognition which encompasses metacognitive knowledge - about people (ourselves and others), about goals and tasks, and about strategies, or about interactions or combinations of all three. Flavell (1979) suggests that metacognitive knowledge is not essentially different from other knowledge stored in long term memory. Therefore, some metacognitive knowledge may be used as a result of a deliberate, conscious memory search for example for an effective strategy. Perhaps more commonly, some of it may be unintentionally and automatically activated by retrieval cues in the task situation. It is important to note that Flavell believes that such knowledge may govern the course of some cognitive enterprise without entering consciousness, although it

may also give rise to conscious experience. If beyond consciousness it can be brought to awareness when careful planning is required, or when decisions or actions are new or particularly difficult.

The second subdivision Flavell calls metacognitive experiences. These are any conscious cognitive or affective experience that accompany and pertain to any intellectual enterprise and include the ability to monitor these experiences in the here-and-now (see Appendix A for a more detailed exposition of Flavell's position).

1.2.2.2 Ann Brown

A second researcher in this area is Ann Brown. Brown and her research team approached the area of metacognition from a different perspective and hence their presentation of the issue differs from that of Flavell. Although the necessary external or environmental variables are acknowledged in her presentation, the focus remains the processes going on within the individual. Therefore, the differences are a result of emphasis.

The perspective presented by Brown and her colleagues is a reflection of their origins (Brown, 1975, 1977, 1978a, 1978b, 1979; Brown & Barclay, 1976; Brown & Campione, 1977; Brown et al., 1973, 1977; Brown & Smiley, 1978). Brown is a developmental psychologist with a Piagetian orientation. Inferring from her publications, her interest in metacognition appears to have derived from an early curiosity about the learning process and impediments to it in educationally retarded

(ER) children. Because she makes no distinction between memory processes and learning processes, her earlier papers focused on the memory processes of these and normal subjects. This lack of distinction may, in part, derive from her adherence to a level of processing (LOP) model (Brown, 1975) of memory with its emphasis on the mnemonic processes used to retain data either in immediate consciousness or in long-term store. In the LOP model, only processing to the deeper levels via semantic - or associative operations, leads to improved memory performance over time. Therefore, learning word lists may involve only primary memory, while analysis and learning of words/concepts in a meaningful sentence or paragraph would stimulate processing to a deeper level. This further differentiates the work and research summaries offered by Brown and Flavell. Brown, adhering to the LOP theory, tends to use both categories of stimulus - that is, word list and paragraph. Flavell concentrates mainly on the traditional memory paradigm involving learning of word lists, only.

The LOP theory also suggests that whether or not the material gets processed to a deeper level appears to depend on two things -- the necessity or usefulness of such an expenditure of energy, and also the amenability of the information for deeper processing. Again, this speaks to the interpretation problems presented by the word list versus paragraph problem of many paradigms, word lists being unsuitable for processing to deeper levels. It is also interesting to note that the emphasis

in the LOP model, on the usefulness of deeper levels of processing, is closely related to the notion in Russian psychology of the meaningfulness of an activity. This introduces the issue of ecological validity (Brown, 1975) here considered of utmost importance.

Ecological validity is another important focus of Brown's work (see Brown, 1975), deriving from her interest in Russian developmental psychology with its stress on the meaningfulness of the task for the subject. Although Brown and Flavell both stress the importance of the interlocking nature of person, task, and strategy variables, and although Flavell describes metacognitive experiences, Brown (1975) goes one step further. She stresses the importance of the purpose of an activity. The term "activity" refers here to the current (social) pursuit in which the individual is engaged. Thus the results of an experiment may be totally different if the activity is meaningful to the child, such as remembering where a doll has been hidden, rather than seemingly senseless, such as memorizing a list of words. Furthermore, by extension, this implies that experiments which take place in natural settings or their well-simulated counterparts are likely to produce results different from those "human-being-as-rat" experiments characterized by early learning research (Brown, 1975).

Quoting Russian research literature, Brown (1975) concludes that metacognitive skills emerge early, perhaps as early as 5 years of age, but develop in complexity and specificity. She is

convinced that what develops with age tends to be increasing strategic control over these early emerging processes. Her interest lies in the state of these processes at their emergence and the process of their development. She also retains an interest in the nature of the ability or inability to produce these strategies, and therefore her subjects include those who cannot produce 'meta' processes, those who cannot retain them even if they produce them under instruction, in contrast to those subjects who spontaneously produce and appropriately employ metacognitive strategies.

Brown (1978a) characterizes metacognition as "knowing about knowing" or the subject's awareness of her own cognitive workings and how they work. She summarizes these metacognitive processes as involving:

1. Analyzing the problem at hand and deciding what its solution requires. This analysis involves prior knowledge of problems in general and this class of problems in particular.
2. Reflecting on what one knows or doesn't know that may be necessary for a solution. Such reflection involves prior knowledge of one's own capabilities and knowledge of these capacities in relation to the skills and capacities of others.
3. Devising a plan for attacking the problem. At this stage, metacognitive skills involve selection of a strategy or multiple strategies for successful solution. Important, here, is prior knowledge of available strategies and particularly the optimal strategies for the task at hand, and of the selection of

the strategies which are most available or comfortable.

4. Checking or monitoring progress. The monitoring process may require redesigning the plan of attack, if the original plan poses problems or proves not to lead to successful solution (summary from Meichenbaum et al., 1985).

Seen in this way, metacognitive processes would appear to form a natural "do-loop", to borrow from computer language. Each step is integrally bound up with the others and metacognitive processing requires processing and sometimes re-processing through each step.

The model extracted from the three papers (Brown, 1975, 1977, 1978) appears quite complex since it seems to trace the stages of activities involved in metacognitive processes. Brown focuses more on the intraindividual aspects of metacognition, although she includes strategy and task variables as these overlap with processes going on inside the individual (see Appendix B for a more detailed examination of Brown's model).

1.2.2.3 Robert J. Sternberg

A third model builder, more recent to the area of metacognition, is Robert J. Sternberg. Sternberg appears to have arrived at his interest from a completely different perspective. A detailed cognitive theory builder, Sternberg's approach to metacognition appears to have come from an interest in the structure of intelligence and particularly in the attributes of the gifted subject (Sternberg, 1981, 1983, 1984, 1985). His model of intelligence is based on an information-

processing approach.

Sternberg defines intelligent behaviour as that which allows the individual to adapt to the demands of his/her environment (Sternberg, 1981). This behaviour is based on the individual's pool of knowledge, that is, experience, but it is the use of this knowledge that discriminates intelligent from unintelligent behaviour (Sternberg, 1981).

Sternberg (1981, 1983) described a three-tiered hierarchical model which is based on a generality-specificity continuum. The model classifies components according to the function they perform. Each process or component has three properties associated with it - duration, difficulty and probability of execution. Theoretically, the three properties are independent. Sternberg sees three distinct levels of functioning involved in intelligent behaviour: 1. acquisition, retention and transfer components; 2. performance components; 3. metacomponents.

The first level of componential analysis involves processes involved in learning new information and storing it - memory - whether in academic or everyday life situations. Acquisition components are involved in learning new information, retention components are skills involved in retrieving this acquired information; transfer components are skills involved in generalization of retained information from one situation to another. Research is still attempting to identify the components which affect acquisition, retention and transfer of

information when presented in real-world contexts. Sternberg (1983) lists three components he thinks play a major part in intelligent functioning at this level. These three components are: (a) selective encoding, which enables relevant information to be separated from irrelevant information in order that only necessary, relevant information is learned; (b) selective combination, which enables selectively encoded information to be combined in a particular way in order to maximize its internal coherence or connectedness; and (c) selective comparison in which selectively encoded and combined information is related to stored information in a manner which emphasizes the connectedness between new and old information.

The second level of componential analysis Sternberg calls performance components and these he describes as processes used in the execution of various strategies for the solution of a problem (Sternberg, 1983). The number of these performance components is large, but Sternberg (1981, 1983) describes seven notable for their generality across virtually the full range of inductive reasoning and problem-solving tasks. These include encoding, inference, mapping, application, comparison, justification, and response (see Appendix C for definitions of these performance components).

The third and highest order components are the metacomponents, used in executive planning and decision-making during problem-solving. Metacomponents appear to be roughly analogous to the metacognitive processes described by Flavell

and Brown. These metacomponents include recognition that a problem exists, definition of the problem, selection of the lower order component to be used for solving the problem, selection of a strategy for task performance into which to combine the lower-order components, allocation of time, selection of a way of mentally representing information, allocation of personal attentional resources, and solution monitoring (including flexibility if strategy requires changing), or keeping track of where one is in the process - what has been done and what needs to be done, understanding of comprehension of internal and external feedback concerning the quality of the performance, knowing how to act on this feedback, actually acting on this feedback.

Sternberg (1981, 1983) stresses that these three levels form a highly interactive (and, although he does not say it, interdependent) system. The metacomponents form the highest level and all direction to and from the system passes through the metacomponents. Thus, the metacomponents are the initial source and final repository of all directions and information in the information-processing system. The metacomponents are the mediating link in information which passes to and from the other component levels in the system. In addition, the metacomponents are unique among the three kinds of components in that they can directly activate and receive information from each other. In this way, the metacomponents are the central elements in the system. And through the feedback within the system, new

information gained from interaction with the environment is fed into, sorted, and stored in the metacomponents. However, the metacomponents are able to process only a limited amount of information at a given time (Sternberg, 1981, 1983). This limitation on the information-handling capacity of the system may be a limiting aspect of the system both in terms of immediate information-processing and in terms of information storage. However, it is further theorized (Sternberg, 1983) that automatization of component execution can increase the system's capacity.

1.2.2.4 An integration of the three models

It can be argued that the model proposed by Sternberg (1981, 1983, 1984, 1985) is merely an eloquent, more elaborate and refined model but uses much the same information as Brown (1975, 1978) and Flavell (1979). Each researcher is talking about an executive part of cognitive functioning which oversees and, when operating efficiently, regulates all other levels of cognitive functioning. Whether it is called metacomponents or metacognition makes little difference for the purposes of this study. All three are talking about processes superordinate to the known cognitive processes and which, explicitly stated to varying degrees in all three models, must contain something in addition to the already documented cognitive function. What this "something else" is, requires a deeper understanding of metacognition.

It would seem possible to draw on the strengths of all

three models to develop this deeper understanding of metacognition. From Sternberg, one might use the precisely delineated executive aspect of metacomponents. From his model, more clearly than elsewhere, one obtains a picture of the metavariabls in the seat of power, governing, mediating, initiating, collating. If one adds to this implicitly conscious model, Flavell's notion that these processes become conscious only when careful planning is required, or where decisions or actions may be particularly difficult, as perhaps in a new or exceptionally difficult task, then it is possible to achieve a more complete understanding of metacognition.

Flavell underlines the importance of making the distinction between the metacognitive knowledge and metacognitive experience. From the manner in which Sternberg outlines the components of his model, he would seem to be describing skills rather than knowledge or experience. He acknowledges the importance of the knowledge base, but believes that the differentiating factor in intelligent performance is how the individual makes use of that knowledge base. He elaborates the processes involved in making use of this knowledge base but does not enlighten us as to why some people can use these processes and some people cannot. In describing metacognitive knowledge, Flavell lends some clarity to the necessary content of this knowledge base and by discussing the metacognitive self concept, he is perhaps giving us the key element in the difference between metacognitively efficient and inefficient users, and

individuals who are unable to use metacognitive skills at all.

It is important, too, to include Flavell's emphasis on the interaction between person, task and strategy. Sternberg's model also takes a contextualist approach. The explicit aim is therefore much the same as that of Flavell. Both are attempting to account for the effects of the external environment on the problem-solving behaviour of the individual. Both operate from an explicitly Piagetian approach. However, although Sternberg examines the theoretical implications of assimilation and accommodation in some detail in relation to intelligence and the components, with respect to the immediate problem-solving task, his discussion of the implications of the effect of the environment for the individual is in the context of the larger society or culture. Flavell's elucidation of the person-strategy-task interaction albeit at a theoretical level at the present time, provides a structural framework for looking at the process at a micro-level.

Where then does Brown's scheme fit into this package? It is possible that Brown's model is important on several levels when conceptualizing a theory. Primarily, like Sternberg, her model implies a sequential aspect to the processes. It does not pretend to be exhaustive but it does point out that the processes themselves are part of an ongoing process. As such, even though in the structure-process dichotomy Brown says she focuses on the process, in fact her model, like Sternberg's, helps to define the structure behind the processes.

Selection of the metacognitive processes for use in this study came from a personal integration of the processes described by Flavell (Flavell, 1979; Flavell & Wellman, 1977), Brown (1978a), and Sternberg (1981, 1985). In choosing from the many possible alternatives, an attempt has been made to select processes central and essential to effective metacognitive functioning. In this context other processes that have been discussed by Flavell, Brown and Sternberg would be considered useful but refinements. The six processes selected are: problem definition, planning, strategy selection, flexibility (of strategy use), evaluating, and checking and monitoring (see Appendix D for a detailed definition of each process).

Furthermore, Brown accentuates two almost self-evident ideas to which little attention has been paid: the notions of activity, and ecological validity. She underlines the importance of the need for active involvement in the learning process and in the meaningfulness of the activity. These emphases would seem to complement well Flavell's delineation of metacognitive experience. Moreover, these perspectives may facilitate an operational definition of aspects of that metacognitive experience. It would seem that this area of metacognitive experience is the least elaborated in the study of metacognition, perhaps because it has been the most difficult to operationally define. The difficulty in operational definition may derive from the necessity in cutting across traditional boundaries in order to understand metacognitive experience.

Brown, Flavell, and many of the other original researchers (eg., Borkowski & Wanschura, 1974; Markman, 1973, 1977; Wellman, 1977; Yussen & Levy, 1975) in the area of metacognition were cognitive psychologists - an area in which there is no language to discuss experience. Experience falls more in the realm of social or even personality psychology. Early researchers (Brown, 1978a; Flavell & Wellman, 1977; Hagen, 1971; Torgeson, 1977) pointed to the importance of personality factors in the efficient use of metacognitive skills. However, their comments were often confined to their closing paragraphs. Until recently, little attention has been given to defining the pertinent personality factors.

1.2.3 Metacognition and Development

One striking feature of metacognition is its developmental nature. Parallel to cognitive development, with similar but not identical milestones, research findings suggest that metacognitive skills emerge in a rudimentary form to be later refined and elaborated (Brown, 1975, 1978).

Metacognitive skills appear to emerge or to be observable around seven years of age. If we examine a broad range of ages - say 6 to 8 - to allow for individual differences, research supports the hypothesis of the appearance of metacognitive skills around this age (Brown, 1978a; Flavell & Wellman, 1977). Among the person variables, research suggests that under the age of 6 or 7, children are unable to predict their memory performance in advance (Flavell et al., 1970; Wellman, 1978),

and do not demonstrate a "feeling of knowing" experience (a feeling that the knowledge is available but not immediately retrievable) (Flavell et al., 1970; Wellman, 1978).

Flavell et al. (1970) instructed their nursery, kindergarten, 2nd and 4th grade subjects to study a set of items until they thought they would be able to recall all of them. The 4 to 6 and 7 to 10 year old children were given three successive trials in which they first studied the items, signalled their readiness to recall them, and then attempted to do so. The size of each child's item set was determined by his recall performance. The older age group obtained perfect recall over all 3 trials, indicating accurate prediction of their own readiness. This was not the case for the younger age group. The younger subjects frequently signalled they were ready when their recall scores indicated they had not been. Furthermore, they did not improve significantly over trials. The authors concluded, from this study, that a "feeling of knowing experience" had not been available to their younger subjects.

With regards to strategies, subjects below the age of 6 have demonstrated an inability to plan ahead (Kreutzer et al., 1975) to predict the benefits of additional study time (Kreutzer et al., 1975), or of an active as opposed to a passive strategy (Brown et al., 1978), or to alter their apportionment of study time according to task difficulty (Kreutzer et al., 1975). Children of this age also have a demonstrated inability to predict their own performance. Furthermore, these same

guidelines apply to the basic issue of knowing that the need for a strategy exists. Appel (Appel et al., 1972) examined the ability of children to differentiate situations which call for specific efforts to retrieve. They tested 4, 7, and 11 year old children and compared their study behaviour under two instruction conditions: to memorize items for future recall versus just to look carefully at the items. Results suggested that the 11 year olds were able to differentiate both conceptually and behaviourally between the two instructional sets, that is, under memorization instructions they engaged in special study activities and achieved better recall performance. The 7 year olds were able to distinguish conceptually between the two instructional sets but did not show different behaviours based on this understanding. Four year olds failed to distinguish both conceptually and behaviourally. Further research supports the hypothesis that 7 year olds will process items differently under study or memorization instruction -- if they can think of a way of doing this (Salatas & Flavell, 1976; Yussen et al., 1974).

Within the area of the interface between task and metacognition, the evidence appears even clearer that before the age of 6, children do not demonstrate the ability to recognize the difference in difficulty imposed by various task variables such as familiarity (Kreutzer et al., 1975), perceptual salience (Kreutzer et al., 1975), the size of the body of data to be encoded (Kreutzer et al., 1975), the degree of association

between the items in the data set (Moynahan, 1973; Salatas & Flavell, 1976), or the structure of that data to be remembered (Tenney, 1975). However, the ages noted are variable. Ages of accurate awareness in the studies referenced vary widely from 5 years to 12 years of age, or more, seemingly dependent on the type of stimulus or encoding factor under examination. Simple item characteristics such as familiarity, and data set organizational characteristics such as size, were easily recognized by children as young as age 6 or 7. Results with respect to organizational structure were more varied with nonverbal material; the facilitation provided by grouping and meaningful association was recognized by 7 year olds. When the task was verbal, that is simple word list recall, children as young as 5 recognized the facilitation provided by such associational properties as narrow versus broad categorization. However, when the recall required semantic processing such as pairs of opposites versus functional association, it was not until age 9 that subjects were able to recognize the easier encoding factor. Furthermore, when the stimulus was a sentence or a prose passage rather than a word list, the age of awareness increased to 10 and 12 respectively. This may have been due to the greater amount of material to be processed, or due to semantic processing.

A clear view of the developmental trends can be obtained in the often-cited Kreutzer et al. (1975) study. Using an example of retroactive interference, they asked their subjects if it

would be harder to remember a set of people's names if you had learned another, potentially confusable set of names immediately afterwards than if you had not. None of their 6 to 7 year olds recognized the difficulties posed here; a few of the 9 to 11 year olds were able to recognize the effects of the second list. In the same study only about 25% of the younger subjects but almost all of the older subjects recognized the relative facility offered by the demands of paraphrased recall in opposition to rote recall. Thus it would appear that below the age of approximately 7, several skills are not apparent. Furthermore, it is not as though the skills emerge suddenly. Even in this brief review it is evident in a cross-sectional design such as the ones that have been typically used, some children in the younger group can and do display the skill being tested. For example, the research into confidence testing shows that although 9 year olds are better at estimating their own recall ability, some 5 year olds display this skill (Flavell et al., 1970). With regard to the ability to differentiate when mnemonic activity is called for, children as young as 3 were able to demonstrate some rudimentary awareness although they could not adequately conceptualize until age 7 and could not demonstrate follow-through behaviour until much later, age 11. Is it just a question of age or is cognitive and/or personality maturation a factor?

Several factors seem to play a role. The first issue is the type of experimental task presented to the subject. If the

stimulus is complex, such as a prose passage instead of a word list, the results are less conclusive: even 12 year olds may have difficulty distinguishing the important elements. A second issue is the extent to which the experimental task is action-oriented. Closely related is the degree of abstraction in the task. The more abstract and less relevant tasks are unlikely to produce successful results in children under age 6. Perhaps, then, the ability to produce some "meta" skills may be available to the child at a younger age but only in a rudimentary or primitive form and not consistently accessible until cognitive maturation allows for their use or their verbalization.

A further issue seems to be important as well. For most children, the person-oriented aspects of metacognition seem to be reliably measured later, after at least age 5. These person-oriented factors are those aspects which relate to self-concept, self-awareness, and the awareness of the difference between the self and others (Flavell et al., 1970; Flavell & Wellman, 1977; Miller & Bigi, 1979). Although this trend is clearly related to cognitive development, it also hints at a strong personality influence in metacognition. Therefore, when conceptualizing the etiological factors involved in efficient metacognitive performances it seems increasingly clear that it is important to also examine the contribution of task variables, cognitive maturation, and personality factors.

Looking now at the issue of cognitive development, it is difficult to separate out the effects of age from those of

cognitive developmental level. Clearly, the consistent and efficient use of metacognitive skills requires some facility with cognitive abstraction. According to Piaget's formulations, metacognition would then not be consistently available to the pre-adolescent child. Research such as that of Brown and Smiley (1978) would tend to support such a statement. However, few studies have specifically examined the issue so the statement cannot be held unequivocally. Also, as Brown (1978) points out, it is not simply a question of age, per se, but rather the development, partly with age, of increasing strategic control over metacognitive processes that emerge early. Her studies, using ER subjects can be used to distinguish between the effects of age and the effects of cognitive development. As her results indicate, even older, educable retarded subjects do not display the patterns of conscious control shown by a normal sample matched for MA. Furthermore, ER children do not display the normal pattern of increasing complexity and refinement of metacognitive skills with advancing age (Brown, 1978). This suggests that there is an aspect of metacognitive development which is in addition to the issue of chronological age and involves complex aspects of cognitive development-maturation, environmental interaction, and perhaps aspects of personality development.

The results of research using ER subjects lend further support to the general hypotheses under consideration in this thesis -- that personality factors play a major factor in

differentiating efficient metacognitive strategy users from inefficient ones. As with the summary of the results of research demonstrating developmental effects presented above, the results of research using ER children as subjects is inconclusive, but shows some interesting trends. In ER children, the metacognitive skills which have been investigated cannot be reliably observed until MA 8 at which time these ER subjects perform like or worse than their normal kindergarten-age counterparts (Brown & Lawson, 1977; Kreutzer et al., 1975; Tenney, 1975).

However, contradictions can be noted. Primarily, these ER subjects can be trained to display many of the skills shown by their normal MA counterparts (Brown & Campione, 1977). This evidence has often been used to suggest the presence of a production rather than a mediational deficiency. It does suggest that the importance of cognitive maturation may not be clearcut. At least some of the skills may be available to the child but not spontaneously or easily used by the ER subjects. As yet, we do not know why this is so. Furthermore, although maintenance can be demonstrated with this group, transfer has remained poor. They can learn the skills but do not generalize them (Campione & Brown, 1977).

The performance of ER subjects was affected by several design factors. For example, the degree of abstractness seems to effect their performance. Brown (Brown & Lawson, 1977; Brown et al., 1977) found that an MA8 and MA10 year old sample of ER

children were able to assess accurately the number of correct responses after they had been made. Furthermore, in a recall task the subjects could correctly identify the items they had accurately recalled (Brown et al., 1977). However, they could not accurately predict their memory span before their recall attempts (Brown et al., 1977). From these results, it would seem that they can accurately assess once they have concretely experienced, but without this experience they cannot predict their performance. The more abstract task seems beyond their capability.

A second, related factor which the literature points to as contributing to the metacognitive performance of ER children is the degree of demand on the children to pull the information from within, rather than to recognize it from without. Tenny (1975) asked kindergarten, third and sixth graders to compose lists of words which would be easy for them to recall. She compared these lists with lists constructed under instructions to free associate. Younger children made up the same lists under both conditions, older children tended to provide category organization in the recall lists. Brown (see Brown, 1978a) duplicated this study using ER children as subjects. She reported that her subjects were MA6 and MA8 children matched with normal children for CA and MA, although it is probably more accurate to assume they were matched for MA. Within the normal sample, the incidence of random responding decreased with age as did responding with sound-alike organization. There was a

concomitant increase in categorization (taxonomic or thematic). The ER sample showed no such improvement with increasing MA. They also produced many random units. The point to be underlined here is that asking a subject to produce a set is a more difficult task than asking them to recognize or recall one.

Brown et al. (in Brown, 1978a) looked at the ability of normal and ER subjects to predict the outcome of strategic activity. The children were asked to view a videotape of a 12 year old who was performing four different study activities while attempting to learn a 12-item list of pictures. The four activities were categorizing, rehearsing, labelling, and just looking. The subjects were then asked to indicate which they thought would lead to better performances. The MA6 and MA8 ER subjects appropriately predicted that categorization and rehearsal would facilitate learning. The normal four year olds had no such appreciation but were relatively evenly divided across all 4 activities. However, by third grade, the majority of normal subjects predicted the active strategy as best. ER subjects demonstrated developmental trends but did not behave quite like normal kindergarten age children. However, when faced with the actual task only 28% of the ER group actually adopted the strategy they predicted was best. Among the normal subjects, the tendency was to adopt the strategy chosen by the subject, with strong developmental trends between age groups. For the most part, third graders tended to adopt the strategy they predicted would be superior although even among this age

group, the relationship between prediction and performance was not a perfect one. These findings suggest that decision-making may be a component of metacognition which points to the contribution of cognitive style and hence to personality factors.

Reviewing the results of the research into developmental trends and the studies using ER children as subjects, four points emerge which argue strongly in favour of the implication of personality factors in successful or unsuccessful metacognitive activity. Metacognition refers to the individual's ability to monitor her own cognitive activities. Implied in this process is an ability to take a step back from the immediate thought or activity and to reflect on its appropriateness, usefulness, etc. This implies, but does not specify, the involvement of a self-awareness. In this way, self-awareness would be a necessary, but not sufficient, component of this reflective activity. In this context, it is interesting to note that the age at which metacognitive processes begin to be reliably observed is about age 5 or 6, at about the same age that the areas of metacognition which touch on the self system begin to be reliably detected (Flavell et al., 1970; Flavell & Wellman, 1977; Miller & Bigi, 1979). These areas of overlap are the metacognitive self concept, awareness of the difference between the skills of the self and others. Thus, there is a lot of correlational information which suggests that at least the development of the self system is in parallel

with the development of metacognitive abilities. However is this merely a parallel development, or is there an interaction?

Also, as has been repeatedly noted, subjects who do not spontaneously use metacognitive strategies can be prompted or trained to do so. Yet they never quite achieve the skill at using the strategy, or the performance level, that is achieved by spontaneous strategy users (Brown & Smiley, 1978). Why is this? If metacognition is simply a cognitive facility, then intellectual capabilities, cognitive maturation, and experience with the technique should determine how well the skill is used. Yet this is not so. Two groups with the same MAs and approximately the same IQs may differ in their abilities to use metacognitive strategies. Eliminate, to some extent, the experience factor and the differences remain. One plausible explanation would be differences in cognitive style, i.e., personality factors.

Finally, it has been noted repeatedly by Brown (1978a) that the meaning of the task to the subject is an important consideration. Meaningfulness can be seen in perception or framework terms, when it becomes roughly synonymous with familiarity. Yet, to reduce meaningfulness to this level belies the ability to engage a child's interest in a new but intriguing area. Otherwise how is it possible to explain the sudden popularity of computer games, or in a developmental context, how is it possible to explain an infant's sudden interest in his toes? Novel stimuli can and do have an intrinsic interest which

then requires accommodation. In fact, that is the premise on which some developmental theories of cognition are based (e.g., Piaget & Inhelder, 1973). Yet some children are intent upon seeking out and accommodating to novel stimuli, while others are not, they are more passive. Even if intellectual and cognition factors are accounted for, an active passive difference can be noted. This is often called motivation and, seen in these terms, personality factors would be an important component.

Repeatedly, personality factors and personality development emerge as having a potentially strong relationship with metacognition. However, before elaborating this relationship, it may be useful to discuss the difficulties with the concept of metacognition which have been reported in the literature.

1.3 Critique

A review of the metacognition literature to 1985 (see Baxt, 1985) reveals one striking feature; the findings lack cohesion. It was very difficult even to begin to develop a yardstick, or a set of hypotheses about the emergence and gradual refinement of the various metacognitive skills. Unlike other developments in cognitive psychology, the area of metacognition lacked a distinctive paradigm. Some researchers (e.g., Flavell et al., 1970; Salatas & Flavell, 1976; Wellman, 1977) use a memory model, others (e.g., Kreutzer et al., 1975; Markman, 1977) use interview techniques, still others (Brown & Smiley, 1978) use a training model. One aim of this investigation is an attempt to establish a workable and meaningful model from which to look at

metacognition.

The fact that researchers have not yet agreed upon a definition is of less concern -- this is not unusual in psychology. However, the fact that the current definitions cannot be consistently applied is of concern. From the recent literature, it is often impossible to extrapolate to new situations and to differentiate cognitive from metacognitive and metacognitive from metamemory. Until late in 1985, metacognitive skills were either considered to be glorified cognitive skills (Slife et al., 1985) or were confused with cognitive skills (Flavell, 1979; Gerber, 1983). Researchers, writing of metacognitive strategies would list as examples, or observe empirically, cognitive strategies. More subtly, the passive knowledge of metacognition and the active use of metacognitive skills were specifically delineated by some (e.g., Brown, 1978a, Yussen & Levy, 1975) but were more frequently used interchangeably by others (e.g., Stober, 1984). Gerber (1983) points out that "...the term strategy (has) often been employed as a bridge between implicit and explicit events occurring during experimentally manipulated problem-solving" (Gerber, 1983, p. 255). The distinction had been blurred between overt, manipulated behaviours and those presumed tendencies to develop strategic responses that are within the individual, but observable. That is, no distinction is made between a basically internal, ruminative, cognitive process and an overt, behavioural tactic. He argues that the distinction needs to be

made between covert and overt strategies, but also between the activity of planning specific responses and the ability or knowledge of how to plan responses and the knowledge that planning is necessary. Gerber (1983) suggests that the term metacognitive has been coined to differentiate the latter from the former.

Flavell attempted to distinguish between cognitive and metacognitive. He wrote "...cognitive strategies are invoked to make cognitive progress, metacognitive strategies to monitor it" (Flavell, 1979, p. 909). He further elaborated that reading through a section again the night before an exam is a cognitive strategy aimed at a cognitive goal of improving knowledge. However, you might also ask yourself questions - and note how well you answer them - a cognitive strategy aimed at the metacognitive goal of assessing the state of your knowledge. Although these examples help to elaborate the copious descriptions, they do, in part, seem to differentiate based on the goal rather than the action. That is, the same action may conceivably be either cognitive or metacognitive depending on the intent behind it or the goal at which it is aimed. This confusion is seen often in the literature where such strategies as rehearsal are variably labelled cognitive or metacognitive depending on the research design and the goal of the experimental task. In fact, it may be that rehearsal is a cognitive strategy activated by the metacognitive experience associated with the realization that some mnemonic device is

necessary to meet the task demand characteristics with the metacognitive knowledge that rehearsal is an appropriate strategy for the task at hand and is within the individual's capabilities.

Flavell (1979) agrees that it is possible, in some cases, for the same strategy to subserve either purpose and to achieve either, regardless of why it was invoked. Thus, questioning yourself about the content of the chapter would have the aim of increasing knowledge or of monitoring it but no matter what the original aim, an improvement in knowledge as well as an assessment of its quality, could result.

Thus, anyone's store of metacognitive knowledge is likely to include metacognitive as well as cognitive strategies. The monitoring of cognitive enterprises proceeds through the actions of, and interactions among, metacognitive knowledge and metacognitive experiences, goals/tasks and actions/strategies. It is the monitoring or executive functions that distinguish metacognitive from cognitive and all other actions.

In this project, every effort has been made to ensure that the differentiation between cognitive and metacognitive is clear and is maintained. Here, "metacognitive" refers to the ability or knowledge of the need to plan and how to plan responses--both in the long term and the short term. It may also refer to the planning itself. Following Sternberg's clarification and classification, the term metacognition is reserved for the superordinate, executive style thinking and strategizing. It

will be considered to include both the decision-making (executive) level, and the superordinate "switching box" level. Cognitive processes will be traditional cognitive processes and strategies used in problem-solving -- such as memory, rehearsal, etc. To give an example, in the empirical task which in this project will be called the "Kemler Task" (Kemler, 1976) in which the child is asked to identify the item of clothing which distinguishes one identical twin from another in a series of paired cards, the child's memorization of the clothing which has previously been shown together would constitute a cognitive strategy. The development of a hypothesis when necessary would constitute a metacognitive strategy. The decision-making process behind this hypothesis is also a metacognitive strategy. However, although this decision-making process will be referred to, it will not be investigated in this study.

Furthermore, experimental tasks have been pre-tested to select only those that will permit the tracing of cognitive strategic behaviours. It is not the intention to confuse these cognitive with metacognitive strategies but to observe what the subjects do with these cognitive strategies to observe the application of metacognitive processes.

Also, the distinction between passive knowledge and active behaviour will not only be maintained but explored. To this end, two questionnaires have been developed; a questionnaire tapping general metacognitive knowledge, and one to explore processes immediately following the experimental tasks.

A further critique of the current body of literature is its almost exclusive emphasis on the separate investigation of the "meta" variables in relation to individual cognitive processes--most frequently memory (and therefore, metamemory). It is rare and relatively recent to find an investigation which is based on problem-solving skills in spite of the fact that looking at the relation between metacognition and problem-solving skills would provide a more global and more easily applied view of metacognition.

In addition, the measures used vary so considerably, without concurrent validation, that it is sometimes difficult to be sure that researchers are measuring the same thing. A few stimuli such as Brown and Smiley's (1977, 1978) Japanese Folk Tales, or Neimark and Lewis's (1967) Pattern-Matching task or Kreutzer's (1975) interview schedule have been used more than once but this is the exception rather than the rule. A major focus of this study is to use stimuli which either have been used before (e.g., the Pattern-Matching Task) or which appear to improve on those currently reported in the research literature.

Flavell, Brown and others (e.g., Wong, 1982a; Torgeson, 1977) began by noticing that successful problem-solvers, for example, memorizers, readers, and so on, use skills that are not employed, or are not employed in an organized way, by unsuccessful problem-solvers. The difference appears to be that the successful subjects reflect on what they are doing and on what they are required to do. The components of this reflection

appear to include such variables as awareness of one's own knowledge state and its limitation, of one's own skills and experience, awareness of task requirements, and of difficulties imposed by stimulus characteristics.

But how do these different variables get played out in different subjects at different levels of development, with different intellectual capabilities, with different experiential backgrounds, having different ways of coping both intellectually and emotionally? How do the various stimulus and task demand characteristics interact with the individual variables?

Acknowledgement of these gaps seem to provide a strong argument for testing the various hypothesized components of metacognition on one sample, using a multivariate correlational design. Until recently (Borkowski et al., 1983; Kurtz et al., 1982; Stober, 1984) studies have been aimed at establishing the existence of metacognition and at describing developmental trends and phenomenon such as the metacognitive characteristics of LD or gifted samples. Clearly, this is only a beginning. Still unknown is the nature of metacognition - is it a cognitive facility or is it something else - perhaps in addition to cognition. Given a small (particular) sample, what environmental or internal conditions affect a baseline behaviour? How does it differ with differences in IQ level? Is metacognition culturally determined? Are subjects who are metacognitively inefficient in one area, say academic performance, inefficient in all other areas or can problems with

metacognition be isolated in one sphere of functioning only? What about the individual subjects who have experienced brain injury? Do their metacognitive skills or skill patterns differ from those of normal subjects? Does their pattern correspond in any way to the site of the trauma? Are they immature? Are they cognitively immature in other areas, as well? What are the family constellations and parental child rearing practices of the families of children who differ metacognitively?

The small body of research in metamemory and metacognitive processes has been criticized on a variety of points pertaining to often minor, methodological issues (Baxt, 1985). However, it must be underlined that for the most part these criticisms exist in isolation. That is, one paper by one or a set of authors, is devoted to each; no major critical theme has been noted. This lends credence to the belief that the lack of definitive results are due to reparable issues. And these are issues that this research project attempts to address.

Metacognition as a field of enquiry seems to have proliferated early without having firmly established an understanding of metacognition, itself -- under what stimulus or person conditions it appears or doesn't appear, its development over the years from, say, five to fifteen, whether or not its development can be speeded up, its relation to issues such as MA or IQ or cognitive style. To be sure the investigations which constitute the current body of literature could be seen as a way of establishing the parameters of metacognition, however, the

studies do not seem to have been designed in a way to pull out some of the essential characteristics of metacognition.

1.4 Research Design

This study has been designed first to look more closely at metacognition itself and to develop a model for looking at it. As a first step in this process it was considered essential to develop a valid and reliable means of measuring metacognition. To this end, a prototype of a test battery has been developed including two empirical measures of metacognition, an interview schedule to assess a child's awareness of his processes during a task to be given immediately following each of the empirical tasks and a three-part questionnaire attempting to measure a child's awareness of metacognitive processes in general. This model is based in part on the work of Stober (1984). In addition, a unique and complex, two dimensional scoring system has been developed which involves scoring each question for six processes along six dimensions (simultaneously), to be used for both the questionnaire and, in a modified form, for the interview schedule. The addition to the scoring system of the six additional dimensions was necessary to provide greater differentiation of children's scores on the six metacognitive processes.

Two empirical measures have been chosen. The first is considered to be easy at all levels, in order to establish a baseline and to ensure that the processes and skills required to successfully negotiate that type of task are within easy reach

of the child. The second is designed to provide a more difficult task, a task which stretches the resources of the children at all levels since it is considered that it is under novel or extremely difficult situations that we become aware of metacognitive processes (Flavell, 1979).

A major focus of this research is an examination of the question raised by Gerber (1983) relating to the differential development of active versus passive knowledge. As with many learning situations it is hypothesized that passive knowledge precedes active application of that knowledge. For example, think of a language learning situation -- how much easier it is to understand than to articulate in that new language.

From a different perspective, Brown (1978a) refers to the tendency in the literature to study metacognitive skills in isolated situations by asking children to predict how well they would perform, what strategy they would use, or what would be the outcome of the introduction of a particular strategy (e.g., Kreutzer et al., 1975). However, young children are less aware of the workings of their own mind (Nisbett & Wilson, 1977), less able to introspect to be able to describe their mental states, and therefore less able to report on their thought processes. This again highlights the research problem with regard to externalizing mental events, here especially difficult in young children. From the design of research reported in the literature, there is still no way of knowing whether the skills exist but are not being verbalized, or whether the skills have

not yet developed. One of the major foci of this paper is the comparison of overt and covert cognitive events in the same samples of children at the age at which metacognitive processes are hypothesized to emerge as well as at later (older) ages. In addition to comparing the sophistication, flexibility, variability of the passive knowledge versus active behaviour, it is intended to compare what a child says (or can say) about his general knowledge of processes we call metacognitive, their description of their own processes when triggered by an (empirical) problem to solve, and an experimenter's observation of the metacognitive processes the child went through. To this end, the Metacognitive Knowledge Assessment Questionnaire was used to assess passive knowledge in an attempt to compare this with the Metacognitive Interview which was used to assess active use of that knowledge. Both questionnaires were compared with performance on the empirical tasks, as overt evidence of application of that active use of that knowledge.

A related problem has been noted as well (Baxt, 1985). In transferring research methodology from adult subjects to children, several methodological problems have been perpetuated. One is to repeat the memory research paradigms, even though these do not parallel every day memory tasks, even among adults (Bransford et al., 1977). Moreover, puzzle-type tasks are repeatedly used, rather than problems with no immediate solution (Kitchener, 1983) which are more likely to elicit metacognitive behaviour. The other related issue addresses the importance of

making the experimental task meaningful to the child and within her developmental capabilities. Some discrepancies noted in the literature have been attributed to failures in this area (Brown, 1978a, 1978b). Also, the research designs have often been taken from the memory models and have been used to investigate metamemory or metacognition.

In the study designed for this dissertation, a concerted effort was made to find stimuli that were age-appropriate in terms of both difficulty and interest level. This initially posed some problems given the wide disparity in age levels in the three grades being tested. To circumvent the issue of difficulty level, two tasks were chosen, one intended as an easy (but age-appropriate task) in order to establish a baseline level of metacognitive performance, yet to be interesting and challenging at even the youngest age level. The second task was designed to see how far the child's abilities could be stretched beginning at an easy level, roughly equal to that of the first task, but stretching way beyond the upper limit of difficulty of the first task. Furthermore, if awareness of metacognitive activities is related to new, novel, and skill-taxing situations (Flavell, 1979), then this second task would allow the child greater conscious access to his metacognitive functioning at the time. With regard to the meaningfulness and intrinsic interest of the tasks, both the empirical tasks have a game-like quality to them and, (it is hoped) have a sufficient challenge to keep the child's interest.

With regards to the measures used for validation, two of these are measures commonly used to assess the performance of these three age groups and the third was developed by Brown (1978a) to assess the metacognitive performance of grades three through to university.

Therefore, this study has been designed keeping in mind the criticisms of the body of research literature, to date. The first aim of this project has been to address these criticisms and to formulate a paradigm for measuring metacognitive functioning that would provide reliable and valid assessment and enable workers in applied settings to screen applicants for retraining or enrichment programs.

A second aim of this investigation is to refine our understanding of the link between metacognitive and personality functioning. It has been pointed out - both in the literature (Brown, 1978a; Hagen, 1971; Torgeson, 1977) and in this discussion - that factors of intelligence, experience and cognitive maturation do not, by themselves, sufficiently distinguish between efficient and inefficient users of metacognitive processes. Personality characteristics have been suggested as a means of further refining our explanation of metacognitive functioning. It remains to elaborate the aspects of personality functioning to be considered.

1.5 Metacognition and Personality

Although past research (see Brown & Campione, 1977) has demonstrated that in both normal and ER populations prompting

leads to strategy usage, this does not necessarily imply that the skill is there but has not been efficiently used. Were this the case, the literature on generalization would be more positive (Brown & Campione, 1977). In addition, subjects who do not spontaneously use the strategies, once prompted or instructed would be able to demonstrate strategy usage at least as skillfully with the same level of performance as non-spontaneous users. Yet this is not the case (Brown & Smiley, 1978b). While strategies, and even metacognitive reflection, can be induced (Belmont & Butterfield, 1971; Brown et al., 1973; Brown & Smiley, 1978) and while maintenance of these activities can sometimes be demonstrated (Brown, 1978) once-skill-deficient subjects do not seem to be able to extrapolate to new situations (Brown & Campione, 1977). Furthermore, even when cognitive maturation, intellectual and experiential factors are considered as far as possible -- what remains are non-defined factors reflecting individual differences in approaches to problem-solving. Gerber (1983) has suggested that in differentiating functions normally subsumed under the term "strategy", consideration should be given to aspects more associated with such theoretical constructs as "cognitive style". He suggests that it is important to differentiate these concepts. It is the contention of this paper that it is precisely the understanding of the contribution of what is normally referred to as cognitive style, that will begin to provide this missing link in the understanding of metacognitive processes.

Intuitively, it would seem that metacognition would have four important or basic contributing factors -- intelligence, development, experience, and personality variables. Each of these areas has received attention in the literature. However (up to 1987 and with the exception of the developmental factor), this attention has been in the form of an expression of interest without specifically tying down a relationship. Sternberg (1981, 1983, 1985) and Hagen (1971) have outlined the necessity of examining the IQ-metacognitive link.

Wong (1982b) examined the incidence of organized strategies and self-checking behaviours in selecting retrieval cues in samples of gifted, normal-achieving and learning disabled children. The stimulus was Brown and Smiley's (1977, 1978) Japanese Folk Tales (a different tale from the one used in this study) and the children were asked to select 12 of the 54 pre-selected ideas units they would like to have as retrieval cues if they were asked to remember the story. Results suggested that gifted children spontaneously generated adaptive and efficient strategies. These children selected significantly more 4-point ideas units as retrieval cues than did the learning disabled or normally achieving children. Also, both normally achieving and gifted students were spontaneously self-checking and thorough, whereas learning disabled students were not. Pertaining to the present discussion, the results point to a link between differences in metacognitive skill use and efficiency and differences in IQ. Further investigations are

needed to define the nature of this connection.

The link between prior experience and metacognition has received little attention. Extrapolating from the Brown and Smiley (1978) study, it is possible to speculate that prior experience with cognitive and metacognitive strategies improves the use of these strategies, improves performance, and facilitates generalization. At this time, this is only speculation and needs to be demonstrated. However, a study by Versonder and Voss (1985) may shed some light on this issue. Versonder and Voss (1985) used a multiple trial, paired associate procedure, in which the learner predicted his recall, the listener predicted and heard the learner's recall, and the observer only predicted the learner's recall. Their findings indicate that in such an experimental situation, the learner had virtually no advantage in predicting his own recall compared to the listener. However, both performed better than the observer. The results suggest experience, here of the immediate task, does play some part in metacognitive performance. Further investigation would be required to understand why the learner had no advantage over the listener. Intuitively, the link between prior experience and metacognition would seem to be a positive and important one. It is to be hoped that this link will receive further attention. Until more information is available in this area, the interaction between metacognition and personality will remain speculative.

The personality-metacognition link has also received scant

attention. Repeated mention has been made of the need to examine this association (Brown, 1978; Hagen, 1971; Torgeson, 1977). However, until recently, this recommendation has remained as a note in the last paragraph of an otherwise metamemory-oriented paper. Slife's (1985) study demonstrating the close link between metacognition and depression remains the exception in this area. He reported that metacognitive functioning was affected by depression. Moreover the deeper the depression, the more impaired was the metacognitive functioning of his subjects. However, depression can be viewed from both a cognitive and a personality perspective and so its importance in the metacognition-personality literature requires further investigation.

Work by Borkowski and his colleagues (Borkowski et al., 1983) have isolated the impulsivity-reflectivity dimension as having an important role to play. An impulsive responding style has been associated with inefficient problem-solving behaviours, failure to generalize newly-learned strategies, and an inability to exercise self control in social situations (Ault, 1973; Borkowski et al., 1983; Denney, 1973; Kendall & Finch, 1979). Simply put, children who delay responding until many possibilities have been considered are reflective, those who respond quickly and are less accurate are called impulsive (Kagan, 1966). Borkowski (Borkowski et al., 1983) concluded that impulsivity influences metamemory and metamemory serves as the mediator between tempo and strategic behaviour. In their

study both strategy transfer and metamemory scores were higher for reflective than for impulsive children. Furthermore, correlations between metamemory and strategy use remained significant when cognitive tempo was partialled out but the cognitive tempo-strategy use correlations were nonsignificant when metamemory was partialled out. Thus, Kurtz & Borkowski (1985) hypothesized that an impulsive style impedes metamemorial development but in the end poor metacognition rather than an impulsive response style is normally responsible for failures in strategy transfer. They divided 130 children from grades 4, 5 and 6 into 3 groups. Prior to training the children were assessed on metamemory, cognitive tempo summarization skills and teacher ratings of impulsive behaviour in the classroom. One group received prose summarization instruction, a second group received summarization instruction and also metacognitive training about the importance of a reflective learning style. A third group received no instruction. Then, children were again measured with respect to the dependent measures of cognitive tempo, summarization skills, and teacher ratings of impulsivity. Children in both training groups achieved better performance than children in the no-instruction group. Furthermore, the children in the group where training included the instruction in the importance of metacognition were the best performers of all. Similar findings are reported by Stober (1984). Furthermore, although executive and strategy training improved the summarization skills of the children in Borkowski's

(Borkowski et al., 1983) study, results suggested that the child's original cognitive tempo did not change overall in spite of changes in performance and in use of metacognitive strategies. The data is inconsistent in this regard but perhaps warrants further investigation.

Finally, Kurtz (Kurtz et al., 1987) used Latent Variable Partial Least Squares (Lohmoller, 1983, 1984) to estimate the model and the results led them to suggest causal relationships between metamemory and strategy acquisition and furthermore to suggest a causal relationship between early metamemory and cognitive tempo in the sample years. In addition, a general measure of metacognitive knowledge in their early sample predicted use of a specific but unrelated strategy in their older sample. Based on their results, they suggest that the impulsive and/or metacognitively inefficient child will tend to lag further and further behind as academic development progresses. Thus, the results demonstrated that a factor which crosses the cognitive/personality psychology boundary, namely impulsivity/reflectivity, has influence on metacognitive performance from both a cross-sectional and a developmental perspective.

Therefore, an integration of the thinking of three of the foremost writers leads to a suggestion of the important contributions of personality issues in metacognitive functioning. If, indeed, personality characteristics have an important part to play in efficient metacognitive functioning,

does metacognition, like personality, show changes with maturation?

Yet, consider the demonstration by Brown and Smiley (1978) that, even though normal subjects who do not spontaneously use metacognitive strategies can be trained to do so, their performance never comes to equal that of spontaneous metacognitive strategizers. This discrepancy suggests some essential difference between the two groups of subjects which is not related to acquired knowledge of the strategies themselves. Nor does it appear to pertain to practice or familiarity with the use of a strategy, although it may relate to familiarity with their deployment in different situations. It also suggests some factor in addition to cognitive maturation, since the subjects were matched for mental age. Unquestionably, there is a strong correlation between IQ and metacognitive efficiency (Hagen, 1971; Campione & Brown, 1978). Metacognitive ability is absent in ER children. However, the relationship cannot be one-to-one, since children of average or above average intelligence show a varied pattern of metacognitive skills (Wong, 1982b). Also, if one reflects on one's own experiences, depression, exhaustion, emotional crises all interfere with our metacognitive efficiency -- in spite of the fact that our IQ or our experience bases remain unchanged.

In attempting to account for the differences noted in the Brown and Smiley (1978) study, the issue of personality factors comes to mind. If intellectual level and experience with the

task were held constant, would we be able to detect differences in metacognitive efficiency? Even without the supporting research literature most people -- lay and professional alike -- would expect to find detectable differences. The question is: are these detectable differences significant? And what factors would account for these differences?

It is the central argument of this thesis that personality factors account for a major portion of this difference. It has been noted, when reviewing the developmental literature that metacognition emerges relatively late in cognitive development. Furthermore, it emerges or begins to emerge, at roughly the same time as self-awareness and awareness of others. Could it be that there is more than a chance connection between the two? Furthermore, could there be an underlying -- or at least strongly associated personality factor or factors -- one which may take metacognitive actions and organize them into a cohesive, usable set of skills. This would suggest that the various "meta's" -- metacomprehension, metamemory, social metacognition and so on, are interrelated. Support for this hypothesis comes from the demonstrations that (different samples of) LD children who tend to have fewer metacognitive skills and to deploy them less efficiently or less strategically are also low on the "meta" skills required for social interaction (Cobb, 1972; Dodge et al., 1984).

It seems logical, then, to posit an underlying "meta" ability -- that is an underlying, perhaps developing ability to

take that important step back and reflect on what one is doing, saying, and even thinking. This ability is surely cognition-related. Furthermore, it is probably tied to cognitive development in that it is more available to the child who has achieved the stage of formal operations than to the child who is still functioning in the concrete operations stage. Undoubtedly, it is also linked with IQ. Perhaps there is a threshold such that children who score below some yet-to-be defined cut-off IQ level will show metacognitive deficiency whereas children who score above will show a more variable pattern. But these "meta" operations and skills cannot be reduced to issues of either IQ or cognitive maturation alone. It is the contention of this paper that the ability to use metacognitive skills and to use them efficiently is related to a basic developing awareness of the self -- akin to the metacognitive experiences elaborated by Flavell (1979). And this belongs more to the domain of personality characteristics -- cognitive style, personality traits, and so on.

Suppose, for a moment that there is a central organizing feature which organizes our perception of ourselves, of the world around us and integrates and organizes our interaction with and adaptation to the outside world. In the area of personality functioning, the aspect of the individual normally accorded this organizing function has been called the "ego" -- that part of the personality which is said to be the mediator between the person and his environment, whose prime function is

the perception of reality and adaptation to it (Hinsie & Campbell, 1973). "The various tasks of the ego include: perception, including self-perception and self awareness...adaptation to reality...thinking; and a general synthetic function manifested in assimilation of external and internal elements, in reconciling conflicting ideas, in uniting contrasts, and in activating mental creativity" (Hinsie & Campbell, 1973, p. 247). A metaphysical concept, difficult to evaluate, the hypothetical structure of ego could nonetheless have as part of its function the activities subsumed under the term metacognition. Adaptation to reality, for example, requires the ability to recognize the external reality, the ability to reflect on the fit between present functioning and reality demands, and the ability to select and apply modes of behaviour accordingly. The central hypothetical feature would be self-awareness, the awareness of self as object and agent in relation to the environment. This central feature to the concept of ego is also pivotal to metacognition. However, the concept of ego contains several other elements relevant to the understanding of metacognition. A brief encapsulation of the issues in ego psychology will elucidate.

1.5.1 Metacognitive Functioning and the Ego

In 1985, the literature was just beginning to emerge from a theoretical confusion around the terms "self" and "ego". The "self" is seen as comprised of the sum of the internal images of oneself and of significant others, the feelings associated with

those images, and the capacity for action in the environment guided by those images (Masterson, 1988). The 'ego' is that part of the personality which is responsible for the perception of reality and adaptation to it (Hinsie & Campbell, 1973). Ideally, a measure of self functioning rather than ego functioning would have been preferred since metacognition describes one's awareness of one's self as a problem-solver. However, it was not possible to find a valid measure of self functioning and it was possible to find more than one valid measure of ego functioning. In addition, there was an overlap in the literature of the time between ego and self, a strong theoretical literature backing the concept of ego functioning, and sturdy descriptions of the developmental aspects of ego functioning especially in Jane Loevinger's test (Loevinger, 1970). Moreover, the concept of ego had an apparent relationship with metacognition. Therefore, ego development rather than self development was selected for inclusion in this study.

Ego functioning can be looked at from at least four perspectives (Freedman et al., 1972): 1. the strength of ego boundaries, 2. ego defensive operations, 3. development of the ego, and 4. ego functions, their strengths and deficits. Of these four it is the last two, ego development and ego functions, which are pertinent to the present discussion.

The following discussion is provided to elaborate the parallels between certain facets of ego functioning and

metacognitive functioning and to provide a framework for understanding the measurements chosen to assess personality characteristics. The first part of the discussion will define ego functioning as it is used in this project. The discussion will conclude with an overview of thinking about ego development, important in the understanding of test selection and data analysis, and finally, of thinking about ego functions and dysfunctions pertinent to an understanding of the rationale for the selection of tests.

The definition of ego has been a problem within psychoanalytic schools of thought (see Appendix E for an elaboration of the history of ego theory and an overview of the conceptualizations of construct 'ego'). Early thinkers saw the ego as synonymous with the self. Freud conceptualized self as "ich" - the whole self plus the self as the ego or agency of the mind. He considered the understanding of the self or the soul to be critical to the practice of psychoanalysis. A schism within his group of followers lead to two distinct schools of thought, each one emphasizing one of Freud's two aspects of self. Matters were further complicated by the limited translation of "ich" as "ego". The ego was seen as a sort of executive, a sentinel monitoring the organism's functional and homeostatic state, and the brains of the operation, coordinating internal and external information and interfacing between the two (Masterson, 1988). To complicate matters, some theorists in the late 1940s and early 1950s, using Freud's earlier writings,

developed a sense of the ego that was once again synonymous with the self and included self perception, self awareness, regulation of self esteem, etc. (Erikson, 1950; Kohut, 1971; Sullivan, 1953).

For the purposes of this thesis, these two views are not seen as antithetical. The ego is seen as the executive monitoring portion of the personality with the functions ascribed to it by Freud and the ego psychology school. This ego is then seen as one essential part of the self system. As defined by Erikson, "the ego, then, is an 'inner institution' evolved to safeguard that order within individuals on which outer order depends. It is not 'the individual', nor his individuality, although it is indispensable to it" (Erikson, 1950, p. 194). The working definition used will be that of Loevinger who writes of the ego in terms of "interpersonal relatability, conceptual complexity, moralization of judgement, achievement motivation, and recognition of oneself as origin or pawn of destiny" (Loevinger, 1970, p. xii).

1.5.1.1 Ego Development

The process of ego development has been conceptualized by many authors (Hartmann, 1958; Jacobson, 1964; Kohlberg, 1964; Mahler et al., 1975; Sullivan, 1953) and in these presentations stage theories are a particularly popular method of depicting development. Two representatives of stage theories of ego development have been selected for exposition -- the early stages will be represented by the work of Margaret Mahler and

her associates (1975) and a lifespan perspective will be described using Jane Loevinger's (1970) writings (see Appendix E). They are selected as the most succinct and, in the case of Mahler's theory, most frequently quoted. Loevinger's theory has been additionally selected since it lends itself readily to operationalization and indeed is the basis for one of the measures used in this study to assess ego development. Mahler's (1975) theory posits three stages of development with subdivisions, spanning the years from birth to age three. Loevinger's (1970) six stages describe development throughout the lifespan and are a distillation of the writings of other theorists. The two have been integrated for a deeper understanding of the first three years considered by ego psychologists to be central to later (adult) healthy ego functioning.

In reading the descriptions of these stages it is important to keep in mind several issues. Of critical importance is the fact that although these descriptions are often based on in vivo observations, they remain theoretical. Related to this, the ages of demarcation are approximate and will vary from individual to individual and even from theory to theory. They are intended as guidelines only. It is also important to remember that the stages being described do not represent a straight line along which all individuals will pass in a lifetime. While it may be that adults who have not successfully negotiated the stages inherent in the first three years of life

will later have serious emotional difficulties, many adults never attain the final two stages of Loevinger's and other lifespan developmental theories. Furthermore, although an adult may be functioning at a given level, evidence of functioning at earlier levels and scattered evidence of functioning at later levels may be present simultaneously. Thus, these are not lockstep, discrete stages. Finally, the level at which an individual is functioning does not, per se, define whether or not she is mentally healthy, although adults functioning below level three would in Loevinger's schema have difficulty working and living within North American society and would likely be institutionalized. However, the majority of individuals in our society generally function on a day-to-day basis within level three or four and this functional level by and of itself gives no indication of whether the individual is well adjusted or mentally healthy (Loevinger, 1970). (See Appendix E for details of stages of ego development.)

In the descriptions of the stages of ego development it is easy to recognize people and characteristics of people around us; the stage descriptions seem to encourage this kind of easy classification. While this can be a seductive trap, the stage analyses do afford easier operational definitions of ego functioning than do the older psychoanalytic theories. Key words and themes are repetitive throughout the descriptions and these will become the focus around which our operational definitions will be built. These central developmental issues

are accurate perception, impulse control, the development of independent functioning and an independent world view, a gradually deepening appreciation of other people and their unique position in the world, and the ability to deal with multiple issues/possibilities - that is, cognitive complexity. These developmental issues along with the issues defined by ego functions will be seen to become the core of the characteristics chosen for measurement. Furthermore, it is these characteristics of the ego that are hypothesized to correlate with metacognitive functioning.

1.5.1.2 Ego Functions

It is necessary, then, to define ego functions and conditions of ego dysfunction. The functions of the ego include the relation to reality (the sense of reality, reality testing, adaptation to reality), control and regulation of instinctual drives, object relationships including interpersonal relationships, synthetic or integrative function (the function of binding, uniting, coordinating, creating, simplifying, generalizing), primary autonomous functions (perception, intuition, comprehension, thinking, language, motor development, learning, intelligence), and defensive functions (Freedman et al., 1972).

In the examination of issues of ego weakness, two issues predominate, issues which will become of importance in the examination of the results of this study. The first category, of concern in the analysis of the data of adolescents and adults

is the nonspecific signs of ego weakness evident due to the primitive structural and defensive states of borderline patients. The second category of more central concern to the present discussion, covers specific aspects of ego dysfunction. These include lack of anxiety tolerance, poor impulse control and a lack of developed channels for sublimation (Kernberg, 1977). Kernberg (1977) defines anxiety tolerance as the degree to which the individual can tolerate a load of tension additional to that habitually experienced by her without developing an increase in symptoms or generally regressive behaviour. Impulse control he (Kernberg, 1977) defines as the degree to which the individual can experience instinctual urges or strong emotions without having to act on them against her better judgement and/or interest. Finally, Kernberg (1977) defines sublimatory effectiveness as the degree to which the individual can invest herself in values beyond her immediate self-interest or beyond self-preservation.

In Loevinger's (1970) description, the mature and secure ego is defended in an adaptive way against the onslaught of aggressive and sexual impulses which are present in all of us. The individual can then observe, think, remember and judge. These functions are lost when the individual becomes acutely anxious or is under (extreme) pressure from the impulses. The modern or current view of anxiety is that it is a warning signal to the ego that the individual is in psychological danger. With sustained danger and/or emotional pain, maladaptive defenses are

said to develop to protect the ego or the self from fragmenting. These danger situations can be roughly characterized as the fear of abandonment, the fear of bodily annihilation, feeling unloved, the fear of castration, and the fear of loss of self esteem. A simplified example may be needed to clarify at this stage. Perhaps because of early training, an individual may develop an attention to detail, orderliness as a defense against aggressive strivings. Within limits this is not restrictive and may even be adaptive if, for example, the individual chooses a profession in surgery or accountancy. On the other hand, a housewife unable to express her anger at her husband for fear of abandonment, who excessively tidies and cleans until two in the morning, changing dish and bath towels each time they are touched, has developed a clearly maladaptive defense against the anxiety initiated by the fear of danger (Loevinger, 1970).

It is therefore an ego function to perceive and signal danger through the experience of anxiety. Conversely, the presence of anxiety tied either to a specific situation or as a general aspect of an individual's functioning, signals difficulties in ego functioning. If ego functioning is impaired, say by the threatened loss of self-esteem in a problem-solving situation, then difficulties in the areas of impulse control, interpersonal relating, synthetic functioning, etc., may also be expected. And the nature of these characteristics might be expected to depend on the general level of ego functioning prior to being presented with the anxiety-

provoking situation.

1.6 Summary

This overview of the ego presents a picture very similar, although perhaps not identical, to metacognitive functioning. Both describe an executive component overseeing the functioning of the individual utilizing cognitive functions of thinking, remembering, judging. Both attempt to describe that part of us which reflects on our behaviours and which relates to and affects the world around us, and integrates the messages from the external world.

More specifically, key themes in the development of effective ego functioning such as accurate perception, impulse control, the development of independent functioning and an independent world view, a gradually deepening appreciation of other people and their unique position in the world, and the ability to deal with multiple issues or possibilities are also critical to metacognitive development. Without these abilities effective metacognitive functioning would be impossible. It would seem that metacognitive functioning may be a part of ego functioning. If the explicitly psychoanalytic aspects of the ego, that is the defensive functions, are removed then conceptualizations of ego functioning and metacognitive functioning seem closely related.

It is the central argument of this thesis that it is this component of functioning - the ego - which encompasses both the cognitive and the personality characteristics which underlies

all metacognitive activities. Some theoretical support is offered in the writings of Brown (1978a) who as part of a discussion of metamemory suggested that awareness of the self as agent (in the learning process) is related to such concepts as locus of control, self-esteem, learned helplessness, achievement need, and level of aspiration.

From these descriptions, several research constructs can be culled to measure ego. The first of these constructs might include awareness of reality, perceptual acuity, anxiety level and ability to withstand the onslaught of anxiety-provoking situations, organizing ability, and ability to delay or impulse control. Also part of this list would be self esteem or self esteem regulation.

In attempting to operationally define the personality characteristics to investigate in this study, two approaches were followed. Definition began with the basic understanding of ego functioning presented above but characteristics were also selected which are acceptable to psychologists who do not necessarily believe in the tenets of ego psychology. All characteristics chosen for measurement have established methods of intervention where deficits are detected. Thus the characteristics selected to represent the constructs of ego functioning include a measure of anxiety, anxiety tolerance, perceptual acuity or reality testing, impulse control, cognitive complexity, and organizing ability. Self esteem regulation measures will also be included.

Stages of ego development will be measured by Loevinger's (1970) scale of ego development, the Washington University Sentence Completion (WUSC). The measurement of ego strength was approached through the measurement of anxiety level. Anxiety level is considered by means of two measures -- a paper and pencil scale, the State Trait Anxiety Inventory for Children (STAIC) (Spielberger, 1973) and also Rorschach (Exner, 1986) indices. Autonomy is also included for measurement via two indices. The first is a paper and pencil measure designed to assess social desirability, the Children's Social Desirability Scale (CSD) (Crandall, 1965), the second is a Rorschach (Exner, 1986) index of cognitive developmental differentiation. Self esteem regulation will be viewed by means of a Rorschach (Exner, 1986) index.

Therefore, this thesis examines the relationship between effective metacognitive functioning and personality characteristics. However, it was considered necessary to first generate a valid and reliable method of measuring metacognition. Therefore, a metacognitive battery was designed which includes a student's self reports of her knowledge about general metacognitive issues and her self report of her metacognitive activities during a problem-solving task. In addition, the battery includes observations of her behaviour and, from these observations, inferences about her metacognitive activities. Moreover, intrarater reliability, re-test reliability and concurrent validity estimates will be obtained on the measures

in this battery.

Hypothetically, then, results would expect to show close associations between effective and efficient metacognitive functioning and low levels of anxiety, lower need to please others, good perceptual acuity, good interpersonal functioning, a good ability to deal with cognitive complexity, good self-esteem regulation, good impulse control, and autonomous functioning. Hypothetically, it is expected that these relationships will be found between all measures of metacognition - the Metacognitive Knowledge Assessment Questionnaire, the Metacognitive Interview and the behaviour ratings - and all the tests chosen to profile the personality characteristics. Additionally, from the theoretical exposition, it is predicted that the results will show a developmental trend, with the younger children evidencing less effective and efficient metacognitive functioning and lower scores on measures of ego strength, and higher anxiety levels and need to please others.

The study has also been designed to demonstrate the lag between passive knowledge and active behaviour. Therefore, it can be expected that scores on the MKAQ will be higher than scores on the MI. Furthermore, this gap is expected to be larger within the younger age group and to diminish in the older age group.

Chapter Two

Method

Chapter 2 will describe the research design. The development of the two measures of metacognition, the Metacognitive Knowledge Assessment Questionnaire and the Metacognitive Interview, will be detailed. The characteristics of the sample will be given, the research instruments described, and the research protocol will be presented in detail. (Figure 1 presents a schematic description of the research design.)

Insert Figure 1 about here

2. General Description of Design and Procedure

The aim of this study is to assess the degree to which personality characteristics play a part in an individual's ability to efficiently use age-appropriate metacognitive skills. This very central aspect of the study is in direct response to suggestions by previous researchers (Hagen, 1971; Brown, 1978a; Torgesen, 1977) that personality issues play a major part in this usage. However, it is unclear at this stage whether these personality characteristics can be characterized as enduring and stable (traits) or are related to more transient tendencies (states). For this reason, although the main focus was to profile enduring characteristics, two measures were also selected to screen for the involvement of state characteristics.

Selected gifted and average Grades 3, 6 and 8 students were assessed on a battery of tasks and tests designed to measure

Figure 1. Schematic Representation of the Study

Measures Used:

MKAQ - Metacognitive Knowledge Assessment Questionnaire

MI - Metacognitive Interview

WUSC - Washington University Sentence Completion Test

Rorschach

STAIC - Spielberger State-Trait Anxiety Inventory for Children

CSD - Children's Social Desirability Scale

MFF - Matching Familiar Figures Test

their awareness of metacognitive issues, their awareness of their own metacognitive performance and an observer's assessment of their metacognitive performance. The battery includes the Metacognitive Interview (MI) an interview schedule designed to assess the child's awareness of her metacognitive manoeuvres during a just-administered experimental task. The second part of the battery is the Metacognitive Knowledge Assessment Questionnaire (MKAQ), designed to assess the individual child's awareness of general metacognitive issues. The battery also includes two experimental (cognitive) tasks selected because their scoring procedure allows for observation of metacognitive performance in addition to their cognitive accuracy. In an attempt to broaden the somewhat narrower foci of earlier studies, and to focus on metacognition rather than, say, metamemory, the experimental tasks were selected to be of a general problem-solving nature and to de-emphasize individual cognitive processes, such as memory.

Five measures were also selected to validate the efficacy of this battery in measuring metacognitive processes.

2.1 Subjects

Subjects were drawn from schools in the Carleton Board of Education, a school board servicing suburbs of the Ottawa-Carleton region. The area is relatively large and schools draw from a wide cross-section of families. Care was taken to select schools which draw from catchment areas similar with respect to SES, and ethnic and social backgrounds. All the selected

schools have a French immersion component to their program.

Twenty-gifted and 20 average students were selected at each of Grades 3, 6 and 8 levels. Half the children in each group were males, the other half were females. The original intent was to select children from Grades 2, 6 and 9 in order to match for CA and MA (see Appendix F), however, pragmatic issues made this impossible. With respect to the Grade 2 children, identification procedures within the board were such that it would not be possible to ensure that sufficient children would be identified in time to meet the numbers required for the sample. With respect to the students in Grade 9, these children were already being instructed in metacognitive skills and therefore their inclusion would have biased the sample.

All gifted children had been tested individually on the Wechsler Intelligence Scale for Children - Revised (WISC-R) (Wechsler, 1974) within 12 months of the study. By definition, their WISC-R score was 130 or above. Average children were defined by their Canadian Cognitive Abilities Test (CCAT) score falling between the 34-68 percentiles (90-110 standard scores) on all three scales of the CCAT (Verbal, Quantitative, and Non-verbal). Furthermore, within the average group, students were excluded from the study if they had repeated a year. Within both gifted and average groups, students with identified psychiatric handicaps and students with physical handicaps sufficiently severe to interfere with testing were also excluded.

2.2 Instrumentation

2.2.1 Metacognitive Assessment

Metacognitive assessment was undertaken in two parts: assessment of metacognitive awareness immediately following a problem-solving task and assessment of metacognitive knowledge in general. For all the tasks and tests, metacognitive and personality, it was considered important to find instruments which would be suitable across all age levels in order to eliminate the problems caused by parallel forms and correlated tests.

2.2.1.1 Self Report Measures

It is important to assess self-reports of metacognitive awareness. By its very nature, metacognition is an internal process, and only by observation of its behavioural manifestations can we infer its existence. That is, if we witness a child having difficulty with a task and, mid-way, changing the strategy she has been using, we assume she has been using the metacognitive skills of monitoring and flexibility of strategy use. Supplementation by self report is essential. However, the use of verbal reports of internal processes as a measure of these processes is a controversial subject.

Some (Nisbett & Wilson, 1977) have argued that verbal reports are fraught with too many difficulties to be considered reliable. These difficulties would include, but not be limited to, a desire to please the examiner, an inability to know our own perceptual and memorial processes and/or an inability to

correctly know our own feeling states. Nisbett and Wilson (1977) suggest subjects' reports may not be an accurate reflection of their thought processes but instead may be based on implicit a priori theories about a causal connection between a stimulus and a response. However, it must be noted that Nisbett and Wilson (1977) reviewed social psychological literature pertaining to attitudes and opinions, usually about subjective states, not literature describing experiments in which subjects are asked to process a problem-solving task with concrete stimuli and to arrive at a solution (not an opinion about internal states). Furthermore, Nisbett and Wilson (1977) seem to hold that the psychologists' a priori theorizing about the processes experienced by the subject is more accurate than the subject's own report of her experiences.

By contrast, there are those who would suggest that to obtain a valid description of a subject's experiences you need only to ask her - that this, indeed may be the only valid report (Brown, 1962; Kelman, 1966). A more moderate and reasoned position is taken by Ericsson and Simon (1980) who have derived a model of verbalizing procedures based on human-information processing theory. Generally, although they define many difficulties with verbalization, they hold that verbalizing is as important as any other behaviour that can be observed, with similar limitations.

This means that we will not assume that the verbalized description accurately reflects the internal structure of

processes or of heeded information, or that it has any privileged status as a direct observation (Ericsson & Simon, 1980, p. 217).

Self-reports are seen as one part of a data gathering process and Ericsson and Simon (1980) hold that part of the analysis of a person's behaviour is an understanding of what they say they are doing as well as an observation of what they do. Certainly, from a developmental perspective, it is critical to understand the relationship between a person's understanding of an intellectual concept, and their perception of their own behaviour in relation to that concept.

Because developmentally passive knowledge is hypothesized to precede active awareness (Brainerd, 1973), the concern is of special importance when the advocates are children. While there is no doubt that the child's perception of what she has done or would do is important information (Ericsson & Simon, 1980), it would seem equally important to compare the child's verbalization with an observation of her actual behaviour. In fact, Brown (1977, 1978a) suggested avoiding accepting a single response as the criterion measure in the metamemory literature. She (Brown, 1978a) suggested the efficacy of measuring a child's awareness of metamemory by the use of multiple responses with the inclusion of adequate justification, much as Kreutzer et al. (1975) have done. As Brainerd (1973) has argued, the child may have the knowledge but not be able to verbalize. On the other hand, the use of dichotomous responses such as yes/no or

true/false also has drawbacks. Kuhn's (1974) study using Piagetian conservation studies concluded that any dichotomous choice method is sensitive to response bias which Brown and Campione (1972) have demonstrated to be developmentally sensitive. Brown (1978a) recommended the use of convergent operations of demonstrated reliability and validity and this is exactly what the first half of this thesis has set out to do. Although the context is metacognition rather than metamemory, the caveats still hold.

Metacognition was assessed by means of two self-report measures. The Metacognitive Interview (MI) is a structured interview designed to tap a child's impression of her metacognitive processes during each of the two cognitive tasks. The MI was administered immediately following each of the empirical tasks. The Metacognitive Knowledge Assessment Questionnaire (MKAQ) is a three part general knowledge questionnaire with paragraph completion, open ended and dichotomous questions. Finally, metacognition was also assessed by means of the scored observations of metacognitive behaviour on the two cognitive tasks.

2.2.1.1.1 The Metacognitive Knowledge Assessment Questionnaire (MKAQ)

The MKAQ is a self-report questionnaire in three parts: Section A contains paragraph completion questions; Section B consists of short answer questions; and Section C contains true-false items (see Appendix G). Before beginning to complete the

MKAQ, the child was reminded that the purpose of the study was to understand how people solve problems and that this questionnaire was made up to learn more about how she solves problems (see Appendix H). Each of the two questions in Section A asks the student to solve a particular problem which has day-to-day validity. For example, one of the questions suggests to the child that she has a math exam in school the next day. It is suppertime and she suddenly notices that she has left her math textbook at school. The child is requested to write at least six sentences describing how she would feel in the situation, what she would be thinking about, and what she would do as she tries to solve the problem in the situation. The second section, Section B, contains 18 short answer questions. Again the child is asked to solve a problem situation such as how to put together a jigsaw puzzle or how to approach a difficult math problem. The child is instructed to respond in one sentence or one idea. The final section, Section C, contains 15 true/false items such as "I never have enough time to check my answers after I have finished a test" (see Appendix I for a copy of the MKAQ and its scoring system).

The MKAQ was developed specifically for this study. Questions were generated by a colleague who was also working in the area of metacognition, a research assistant and this author. The submissions were edited on a theoretical basis and five more questions were added. The resulting first version of the MKAQ, administered to 20 children in a pilot study, was formatted with

20 true/false items in Section A; 2 paragraph completion items in Section B; and 20 short answer items in Section C.

During the process of the pilot study, the author and her supervisor attempted to reconcile the individual items for sections A and C into one of six metacognitive processes being studied (see Appendix D). The results were conflicting and disappointing. To attempt a more valid categorization, the author used a Q-sort method; the items were separated into strips, one un-numbered item per strip. Two colleagues and the supervisor of this thesis were asked to sort the items into six piles -- one pile per process. Both colleagues were graduate students in psychology, one MA and one PhD. The PhD student had prior knowledge of metacognitive issues, the MA student did not. The supervisor, of course, had prior contact with the literature on metacognition. The MA student had difficulty sorting the 40 items, and in fact may not have fully understood the instructions. The two more sophisticated sorters had greater than 80% agreement with this author. Items were selected for future versions of the MKAQ if two out of three sorts allocated them to the same metacognitive process.

When the data had been collected from the pilot study subjects and the MKAQ protocols had been scored, items in Sections A and C were analyzed with respect to their efficiency. In both sections, some items were retained on which both gifted and average, young and older subjects were successful. For the remainder, items which were not correctly completed by the Grade

8 gifted subjects, but correctly answered by the younger and/or average students were deleted. However, one question in each section not correctly answered by the majority of Grade 8 gifted subjects were retained in order to avoid creating an artificial ceiling. In all, four items in Section A and six items in Section C were eliminated yielding 16 items and 14 items, respectively. The remaining items were unevenly divided between the metacognitive processes being measured so that one process had only two items. In order to ensure that the number of items were roughly equal in each process (within 1 item) two items were added to Section A and one item was added to Section C. Items were reworded on the basis of comments from the students during the pilot study. There was insufficient time to repeat the Q-sorts before proceeding with data collection for the main study. In the version prepared for this study, Section A became the paragraph completion items, Section B comprised 18 short answer questions, and Section C was 15 true/false questions. Presenting the closed format (true/false questions) last was considered to provide the least bias of students' answers (see Appendix G). Scores for metacognitive components were analyzed individually as well as summed across the three sections.

The scoring system involved scoring sections A (paragraph completion) and section B (short answer) according to a two dimensional grid with the six metacognitive processes along the right hand side and six related processes along the top. The six metacognitive processes were problem definition, planning,

strategy selection, flexibility, evaluation, and monitoring. The six related processes were clarity, specificity, reflectiveness, organization, accuracy, and conceptualization. (See Appendix J for a definition of the additional processes and Appendix K for an example of the scoring grid.) Each question was separately scored according to a three-point system ranging from 0 to 2. Section C (true/false) was scored using the same range but on a unidimensional system employing the six metacognitive processes only.

To assess concurrent validity, the MKAQ was compared with the observations from the empirical tasks and the four measures selected for concurrent validation (see below). Furthermore, re-test reliability, with a lapse of six weeks was calculated. The Metacognitive Knowledge Assessment Questionnaire and its scoring systems are both new and the scoring system may be more complex than was anticipated. For this reason, 20 of the protocols were re-scored by the author and intrarater reliability obtained.

2.2.1.1.2 The Metacognitive Interview (MI)

Flavell (1979) alluded to several levels of awareness of metacognitive variables. The first two aspects of the person variable, the trait aspects of self awareness and the self-other differentiation aspects will be measured by the Metacognitive Knowledge Assessment Questionnaire. However, the state aspects of metacognitive awareness requires independent evaluation and for this purpose an interview schedule was devised.

This interview schedule has been called the Metacognitive Interview (MI) (see Appendix K). It consists of six questions administered immediately after each of the two experimental tasks. The questions were framed to measure the individual child's awareness of her own metacognitive processes during the activity of solving the problem. The questions were open-ended and the child's responses were recorded verbatim and audio recorded for additional accuracy. An example of the questions is, "If you were describing this game to a friend, what would you tell him or her?"

Stober's (1984) Concurrent Questionnaire provided the framework for the current model. In addition to her three questions, items were generated by the author and a colleague. Probes were devised to be minimally intrusive.

Verbal probes are tricky to design - they can vary along several dimensions - concurrency versus retrospection, the generality or particularity of the events that are to be reported, and in the comprehensiveness of the topics to be covered in the response (Ericsson & Simon, 1980). Researchers attempt to deal with these problems by including contextual information in the verbal probe (to aid retrieval and ensure greater completeness) or to provide the subjects with a fixed set of alternatives (to guard against subjectivity when the verbal reports are analyzed). However, when constructing a probe, it is difficult to be sure that the underlying conceptual formation corresponds to the conceptual understanding in the

subject's mind. The more fixed the alternatives offered the subjects, the less it is possible to detect from the subject's responses whether or not the concept in the subject's mind corresponded to the concept in the experimenter's mind. Ericsson and Simon (1980) point out the usefulness of verbal probes and contextual aids in studies of long term memory. However, they hasten to underline the questionable use of specific probes in studies where subjects are asked to report on immediately preceding cognitive processes of relatively short duration.

Ericsson and Simon (1980), in a detailed discussion of the design of concurrent or retrospective verbal probes to tap processes which occur during problem solving, mention a caution which requires inclusion in this context. They suggest that if a process is automated, details, especially of earlier aspects of the process, may become generalized and therefore lost in a verbalization. Automation describes the phenomenon by which processes, once they have become highly practiced, become increasingly automatic. Automation greatly speeds up the process, thus rendering intermediate aspects unavailable to short term memory and to verbal reporting. Metacognitive processes would, at least in the older child, be largely automated. Probes or questions designed to elicit awareness of metacognitive activity would have to be designed to target specific aspects of the metcognitive process which could be linked by the examiner to form an inferred picture of the

student's level of metacognitive development. However, metacognition is a relatively new and theoretical concept. At this stage, it is difficult to design questions which would be assured of paralleling the subject's processes.

To circumvent this problem, questions were formulated to target known important points in a problem-solving process such as the beginning, end or points at which one is "stuck". These questions were then pre-tested on a pilot sample of 20 children. After examining these students' responses, a further three questions were generated. Discussion resulted in deletion of three items as too specific or intrusive, yielding a total of six items (plus two structured probes) for the version prepared for this study.

Designing probes and questions to tap a child's awareness of metacognitive issues in general (and awareness of their own metacognitive processes in particular) was undertaken with care. Of great concern was the effect one would have on the other and that each would have on task performance. Therefore, administrations of the MKAQ and the MI, and the two experimental tasks were both counter-balanced and their results were analyzed for order effects. In addition, design of the questions themselves was also given long deliberation.

In formulating the questions for the MI, the issue of probing using a "thinking aloud" as versus a "retrospective" format was also given lengthy consideration. Ericsson and Simon (1980) hypothesized that, when a thinking aloud procedure is

used, the information being verbalized is part of the information being attended to at that time. However, if the information is not verbally encoded, verbalization will require recoding making demands on processing capacity and processing time. While neither of the empirical measures selected for use in this study were timed tests, the number of items or tries, a subject took to achieve the criterion was from the beginning intended as a dependent measure. In fact, the two empirical measures were chosen for their scoring method which allows item by item analysis.

Ericsson and Simon (1980) also examined the effect of verbalization on tasks requiring visual encoding. "There is compelling evidence to support the distinction between a visual representation or code and a verbal or symbolic representation or code when subjects are presented with drawings or a picture" (Ericsson & Simon, 1980, p. 231). After reviewing the literature, Ericsson and Simon (1980) suggested that in such a case the additional processing required slows down task performance, changes the structure and course of task performance and also influences what is remembered of the task.

Furthermore, when the subject is asked to verbalize information that would not be attended to in the usual course of processing, or that could not be easily encoded in a verbal format, it is highly likely that the course and structure of the cognitive processes may be changed by verbalization. From their literature review, Ericsson and Simon (1980) concluded that it

is not only possible that verbalization will change the thought processes, but it is also likely that the subjects will give a less complete account of their processes. From the current state of theorizing about metacognition, it must be assumed that most metacognitive processing is carried out beyond awareness and thus asking subjects to verbalize their thought processes as they complete an empirical task would be likely to change their performance on this task in some unmeasurable way. The author was therefore hesitant to use a method of probing which might change the pattern of responses to an unknown degree and in an unmeasurable way.

On the other hand retrospective reports depend largely on the contiguity of the process and the reporting of the process. Ericsson and Simon (1980) cautioned that if the task is structured so that similar information is attended to repeatedly, the retrieval of specific information may be hampered by retroactive interference. They fear that in such an instance, the more current information may be generalized to cover the whole procedure, glossing over early, different details which may get lost in this generalization.

However, a review of the literature found no effects from verbalizing after the completion of the task - with two caveats. The first is that the subjects must not be alerted to the verbalization requirement before they begin the task since this may change the way the task is encoded and processed. This would be a problem in this research protocol since children were

administered the Metacognitive Interview (MI) after each cognitive task. For the second administration, the child could anticipate the subsequent questions. Counterbalancing the order of presentation was used to overcome this difficulty as far as possible. Secondly, verbalization should occur immediately after processing - or as soon as possible after the completion of the task and, finally, the probes must be worded carefully so as to be aimed at eliciting retrospective memory of the subjects' own cognitive processing and not ask them to generate hypotheses about the experiment, which may or may not be related to these processes.

Scoring proved to be somewhat troublesome for this questionnaire. Questions were originally generated to yield at least one item per metacognitive process. However, with only six items, the yield, per process, seemed meagre. Therefore, it seemed senseless to score these responses according to the six processes, only. The system which had been devised to score the paragraph completion items of the MKAQ was therefore adapted for use with the MI (see Appendix L).

As with the MKAQ, reliability and validity data was collected on the MI. Reliabilities were obtained for the MI and the MKAQ in the same way. In order to obtain intrarater reliabilities, the author selected 20 of the protocols to re-score. The protocols were selected at random but so that three came from each of grade 3-average, grade 3-gifted, grade 6-average, and grade 6-gifted groups. From each of the grade 8

gifted and average groups, four protocols were drawn. Re-test reliabilities were obtained by administering the MI twice, with a six-week interval, to a separate sample of children, drawn from grade 3, 6, and 8, gifted and average classes. Validity measures are described below.

2.2.2 Validation Measures

2.2.2.1 Concurrent Validity

Noted in the metacognitive literature is the tendency to develop, in a vacuum, instruments to measure metacognitive skills. These instruments are often very creative, with good face validity. However, with a few notable exceptions (Brown, 1978a; Kurtz & Borkowski, 1985; Wong, 1986), reports of reliabilities and validities are absent.

This is perhaps a tradition within experimental psychology unlike psychometric psychology. A measure is found to test a hypothetical model. This measure will have good face validity but will rarely be assessed for validities or reliabilities. For this reason, one of the experimental tasks chosen to evaluate external validity is a task used previously (see Neimark & Lewis, 1967; Cameron, 1976; Stober, 1984). In addition, this task has been employed in studies linking conceptual tempo with metacognition -- a relation which will also be explored here. Furthermore, one of the aims of this study is to attempt to establish a model for studying metacognition and this includes finding a valid measure, or a valid method of measuring, metacognition. Merely replicating

the work on the Pattern Matching Task did not seem to be sufficient validation. Thus, in addition to selecting two cognitive tasks whose scoring would allow observation of metacognitive activities, to assess external validity, five techniques were selected to derive concurrent validity estimates. Three of these five techniques have previously been used in the literature to establish the existence of metavariabiles. These three techniques are: Brown's Japanese Folk Tales (Brown & Smiley, 1977, 1978); Kreutzer's Preparation Object (Kreutzer et al., 1975); and Markman's Magic Trick (Markman, 1977). Due to the nature of early studies in this area all were used in studies examining metamemory. In order to assess concurrent validity using non-verbal, visual stimuli, the Numbers Backwards subtest from the WISC-R (Wechsler, 1974) and the Proteus Maze Test (Porteus, 1950) were employed.

2.2.2.1.1 Japanese Folk Tales (Brown & Smiley, 1977, 1978)

The most popular of these five measures is Brown's Japanese Folk Tales (Brown & Smiley, 1977, 1978; Brown & Palencsar, 1982; Brown et al., 1978; Wong, 1982b). Brown actually used four Japanese folk tales in several studies and kindly made all four available for use in this thesis. One of these four, "The Dragon's Tear" was chosen for use as a validation measure as it is the only one which would be comprehensible to the grade three children in this study. In the remaining three folk tales the language and syntax were considered to be too sophisticated for this young group - sufficiently so as to pose different encoding

problems at the three grade levels and, therefore, to interfere to differing and unknown degrees at each level.

"The Dragon's Tear" (see Appendix M) is 390 words long with Dale-Chall reliability scores of 5.2 - that is, the fifth grade (U.S.) level (Brown et al., 1978). Brown (personal communication) reported that they had used it with grade four children and that it might be useful with the grade three children in our system. The story had been divided into 59 idea units rated into four levels of importance to the theme by separate groups of approximately 30 college students (Brown & Smiley, 1977). The procedure used for administration in this study was slightly different from the standard Brown administration in that a tape recording of the story was not played for the children. Here, the children were given a copy of the story to read; the story was read to the grade three children. The children were then given the idea units of the story, each typed on an individual index card in the same sequential order as they appeared in the text. The students were then asked to select from the 59 idea units the 12 units they considered to be the most important ideas in the story. The accuracy scores on this test were compared with scores derived from the two measures of metacognition.

2.2.2.1.2 Preparation Object (Kreutzer et al., 1975)

The second task chosen to validate the metacognitive questionnaire and interview is Kreutzer's (1975) Preparation Object. This particular task was selected since it has often

been used to demonstrate planning activities (Kreutzer, 1975; Brown, 1978a) and because it is so frequently quoted in the literature that it has become something of a standard. To be sure it has been used to assess metamemory functioning, but then, this is the case for most of the tasks in the literature. Since metamemory is theoretically one of the many metacognitions, it may be argued that the choice of this task was too narrow, but not inaccurate.

The often-quoted Kreutzer et al. (1975) study probed the metamemory skills of 80 children evenly divided between kindergarten, grades one, three and five. There were equal numbers of boys and girls. In an elaborate interview study, several situational problems were posed to the children and their metamemory skills noted in their explanations of problem solving. In the Preparation Object problem, the following situation was posed to the child.

Suppose you were going ice skating with your friend after school tomorrow and you wanted to be sure to bring your skates. How could you really be certain that you didn't forget to bring your skates along to school in the morning? Can you think of anything else? How many ways can you think of?

In the rare cases when the child responded that she didn't skate, Kreutzer (1975) suggested posing a formally equivalent problem involving a different object - for example, a ball. The child was encouraged to give multiple answers. If the child

gave no relevant substantive answers, his score was "none". If he produced one or more appropriate answers each answer was scored according to a three level hierarchical system (see Appendix N for an explanation of the scoring system).

Kurtz et al. (1982) had concerns similar to the ones expressed in this paper on the lack of available information on the psychometric properties on the methods of metamemory measurement. Kurtz et al. (1982) gave 55 second graders a seven-item metamemory battery separated by a six-week interval. The seven items included four items from the Kreutzer et al. (1975) memory scale, including the Preparation Object question, a memory monitoring task and two new sub-tests designed to assess children's knowledge about input/output processing strategies. Pearson product-moment correlations on the Preparations Object subtest was $r = .49$ ($p < .01$). Kurtz et al. (1982) also correlated strategy use and IQ with metamemory (as measured by the seven-item battery). Point biserial correlations of strategy use and the metamemory battery were significant on both a maintenance task ($r_{pb} = .39$, $p < .01$) and a generalization task ($r_{pb} = .26$, $p < .05$). Correlations between the vocabulary subtest of the WISC-R and the metamemory battery were also significant ($r = .46$, $p < .001$). Scores on the Preparation Object technique were compared with scores from the metacognitive battery, the MKAQ and the MI.

2.2.2.1.3 "Magic Trick" (Markman, 1977)

Another technique that is frequently used for "meta-

assessment" is Markman's "Magic Trick". Originally used by Markman (1977) to assess the degree of constructive processing in first, second, and third graders, the magic trick involves presenting the children with instructions made clearly incomprehensible by deleting information needed to understand the task. The child has successfully completed the task if she notices that the instructions are inadequate with minimal probing (see Appendix O for stimulus and probes). In Markman's (1977) study, third graders noticed that more information was needed, with minimal probing. First graders often needed a demonstration of the instructions or to enact the instructions before they became aware that a problem existed.

The child's cooperation was enlisted by asking them to serve as consultants to someone who was writing instructions for children. They were asked for their advice on the clarity and completeness of the instructions. Markman (1977) structured the instructions in this manner on the assumption that children could then attribute their failure to understand the instructions to problems within the material rather than their own inadequacies. Markman (1977) also chose a magic trick as a vehicle for her study of the child's active involvement in the process of understanding, because magic carries with it the expectation of incomprehensibility and this was expected to reduce the child's reluctance to admit that she had not understood.

The Markman (1977) Magic Trick was selected because it is

well known and often-quoted in the "meta-" literature as a measure of meta-comprehension (Brown, 1978a). Markman (1977) defines comprehension of instructions as the understanding of how, from a starting point, the actions to be executed will successively transform each of a series of stages until the goal is reached. The successful problem solver is mentally applying the instructions at each stage to test for comprehension and applicability. Metacognitively, the successful problem solver is evaluating her possibility of success given the information he has at each stage.

Markman (1977) does not give an account of her scoring system although it was not difficult to design one given her description. Scores on the Magic Trick were correlated with scores on the MI and the MKAQ.

2.2.2.1.4 The Porteus-Maze Test (Porteus, 1950)

The selection of the Porteus Maze Test Vineland Revision (Porteus, 1950) to validate planning ahead was based largely on the dissertation by Ajchenbaum (1983). Ajchenbaum's (1983) study examined the relationship between metacognitive abilities and intelligence and further examined the validity of methods used to assess metacognition. Successful negotiation of the task requires the ability to plan ahead repeatedly, and to be reflective, rather than impulsive (Ajchenbaum, 1983). The first maze chosen was the one on Year XIV; the second was the Adult I maze. To negotiate the mazes the children were required to find their way out from the center of the maze without making more

than one wrong turn (see Appendix P for a sample of the stimulus). Correlations were calculated with the scores on the MKAQ and the MI.

2.2.2.1.5 Numbers Backwards (Wechsler, 1974)

The Numbers Backwards subtest of the Wechsler Intelligence Scale for Children - Revised (WISC-R) was selected as a second measure of metacognition using a non-verbal stimulus (see Appendix Q for sample stimulus and scoring system). The Numbers Backwards test was used by Ajchenbaum (1983) as a cognitive task to observe metacognitive behaviour. The reasons for emphasizing a non-verbal aspect of metacognition was to circumvent any handicaps students may have had with verbal stimuli and to allow for the distinction noted by Ericsson and Simon (1980) between visual and verbal stimuli. Correlations were performed between the Numbers Backwards test and the MKAQ and the MI.

The correlations to derive concurrent validity estimates were performed separately for the MKAQ, and the MI. The argument, here, is that no interaction is expected. Furthermore, what is required is a picture that as clearly as possible presents the limits of concurrent validity for each test of metacognition. Were all the measures to be included in the same analysis, the risk is that a strong measure might capture more of the variance and mask the relation with a weaker measure.

2.2.2.2 External Validity

The assessment of external validity was planned using two

experimental tasks, the Kemler Hypothesis Formation Task (Kemler, 1978) and the Pattern Matching Task (Neimark & Lewis, 1967). The two cognitive tasks were selected primarily because they are problem-solving in nature, requiring a varied series of cognitive operations to successful completion, and because the scoring process for each allows examination of the mental operations undertaken to reach completion.

Previously, this author (Baxt, 1985) examined the implications for metacognitive research of the researcher's implicitly or explicitly held theories of memory processing. To circumvent this issue and the issues involved in general in testing with verbal material, it had originally been intended to present experimental tasks with both verbal and non-verbal stimuli each having one easy, one difficult task. However, time constraints precluded such an approach. Instead, two tasks were selected which both have non-verbal, visual stimuli, the argument being that the manipulation of verbal stimuli would be more likely to bias against students who are recent or first-generation immigrants.

The idea of choosing one easy and one difficult task is unique to this study. This author was struck by Flavell's (1979) assertion that awareness of metacognition emerges under conditions of a novel or extremely difficult task or stimulus. In providing an easy and a difficult task, it was intended to have a baseline task, which all of the children in the sample would be able to complete without excessive effort and one task

which will be difficult enough to stretch the skills of all the subjects. In addition to testing Flavell's (1979) hypothesis, by testing with an easy and a hard task, it was intended to control for differences in performance which are due to differences in knowledge levels. Furthermore, to ensure reaching a sufficient difficulty level, administration of the Kemler Hypothesis Formation Task (Kemler, 1978) was transformed to make one of the solutions impossible (see below).

2.2.2.2.1 Kemler Hypotheses Formation Task (Kemler, 1978)

The Kemler Hypotheses Formation Task (Kemler, 1978) was selected because it meets all the criteria of an experimental task for this investigation. It is a non-verbal, cognitive task which is intrinsically interesting and motivating across all the grade levels in the study. Furthermore, it is challenging -- even for the adults to whom the test was administered on a trial basis. Finally, it is sensitive to developmental changes -- that is, older children tend to perform better than do younger children.

The Kemler Task requires children to discern which item (of a set) differentiates between a pair of figures. In order to successfully complete this task, the child must form, check, and where appropriate, eliminate hypotheses, aided by ongoing examiner feedback regarding the correctness of her response. Deductive reasoning and planning processes yield success; random selection does not. Although it is possible to administer this task using memory aids and therefore to eliminate the memory

skill required, it was feared such an approach would render this task too easy. Therefore, the aids were not introduced and so, in addition to deductive reasoning, memory skills were required to successfully complete the series of tasks.

The stimuli were pairs of laminated cards each representing a picture of a girl from her hips to her crown. The pictures of the girls were identical and, indeed, were represented as depicting identical twins. The Task involves the presentation of five series of the pairs of these cards, a sample set, three test sets in which a solution is possible and one final set, not part of Kemler's (1978) original instrument, in which a solution is not possible. The items include pieces of jewelry, head gear, items of clothing, and a balloon. Each item can appear in two forms: 1. crown or party hat; 2. beaded necklace or medallion; 3. belt buckle or belt bow; 4. brown or purple hair ribbons; 5. sun glasses or clear glasses; 6. watch or bracelet; 7. round or elongated balloon; 8. stripped or dotted jersey. In the practise set the child is required to make a choice between four (pairs of) items.

Each child was tested individually. The cards were presented in the context of a game. The identical twins were called Amy and Betty and the children were told that it is impossible to tell them apart; even their friends and teachers have difficulty knowing Amy from Betty. Therefore the teacher has provided the twins with different items of clothing so that they can be identified -- and the clothing items are named. The

children are then told that the twins decided to play a trick on their friends and to exchange clothing many times during the day. However they promised their teacher to keep one item constant - that is to keep one item of clothing that they would not exchange - and the teacher would know the identity of this item. The cards were presented in pairs and the game was to discern the twin's secret - that is, what item Amy wears and never switches.

Each time a pair of cards was presented and the child made a choice she was told whether the response was correct or incorrect. Amy (that is, the correct card) was identified, but not the correct item of clothing. After administration of the practise set, four further sets were administered -- one set requiring choices between 3 (pairs of) items - eight pairs of cards in the set, another set requiring choices between five (pairs of) items - 14 pairs of cards in the set, a third set in which the choices are made between eight (pairs of) items - 16 pairs of cards in the set, and a final set in which the choices to make were again five (pairs of) items - eight cards in the set. At the beginning of each new set, the child was told the pictures represent a new day for the twins and therefore a different "secret" item was to be identified.

The second set of five items was included following a pilot study in which 20 children (12 Grade 8's, four Grade 6's, and four Grade 3's) were presented with the experimental tasks. In conceptualizing the study, the aim was to find a basal level

task and a task which would stretch the skill of each child. Originally, the Kemler Hypotheses Formation Task had been intended as the easy task and the Pattern Matching Task (see below) as the more difficult of the two. In fact, results from the pilot study indicated exactly the opposite effect -- the children found the Kemler Task to be by far the more difficult, especially the eight-item set! However, a sufficient number of the older children were able to successfully negotiate the task in the eight-item set and to complete it early enough, so that an examination of their response record did not yield a clear understanding of their metacognitive processes. Therefore the second five-item set was introduced, using the same cards as in the first five-item set, but changing the correct clothing item at random intervals throughout the set -- that is making it an "impossible" task to solve correctly. The gain, here, was envisaged as twofold: 1. there would be no ceiling on the difficulty level of this task and 2. if nowhere else in the children's records, at least in this set, the metacognitive strategies used would be evident in the response record.

For each pair of cards, the students attribute choice was recorded. Formal scoring included the number of hypotheses required to reach a (correct) solution and the number of repeated hypotheses (see Appendix R for an example of the stimuli, the record sheet, and the instructions).

Kemler's (1978) own work with the task has demonstrated differences in the deployment of goal-directed strategies in

elementary school-aged children across a range of age levels. Children over the age of 7 tended to use the stimulus information efficiently and to permanently reject failed hypotheses. On the other hand although five-year-olds were able to use the stimulus information appropriately, they tended to resample previously rejected hypotheses (Kemler, 1978). Furthermore, group ability differences have also been noted in the literature. Ferguson (1985), for example, using the Kemler Hypothesis Formation Task, found differences between learning disabled and average students at the Grade 3 and 5 levels in terms of strategic problem-solving behaviours.

2.2.2.2.2 Pattern Matching Task (Neimark & Lewis, 1967)

The Pattern Matching Task (Neimark & Lewis, 1967; Stober, 1984) was also chosen because it also met the criteria that had been set out for this study. It is a task with non-verbal, cognitive stimuli, with definite clear-cut goals, with the possibility of success. It is again both intrinsically interesting and challenging at all grade levels. It would have been equally valid to have chosen an administration of this task to make it an impossible task. However, the ceiling on this task was low, relative to that on the Kemler, and so it was decided to retain the task in its original format. As with the Kemler Task, administration and scoring offer a permanent record of the steps taken and hence the cognitive strategies employed by the child as she successfully solves the problem. From these steps and strategies, it was intended to infer metacognitive

skills.

This task has already been used in a study of metacognition among average students at the Grades 4 and 6 level (Stober, 1984). Although in Stober's study the Pattern Matching Task was used only as a cognitive experimental task on which to hang the metacognitive dependent variables measured by her Concurrent Questionnaire, it was intended to compare results of Stober's study with the results of this study.

The Pattern Matching Task was originally devised by Neimark and Lewis (1967) to examine the development of logical problem solving skills during childhood. The task was later altered (Cameron, 1976; McKinney, 1975) and used to look at the interaction of conceptual tempo and problem-solving skills. Stober (1984) extended the number of problems in the Pattern Matching Task and used it in her dissertation examining the relationship between conceptual tempo and metacognition.

In solving the task, the students are asked to select a response alternative from eight possible choices. In order to successfully solve the problem, the child must make use of the available feedback and logical analyses in order to reduce the alternatives in a systematic way and obtain the correct alternative efficiently -- that is in the least number of choices. The process is analogous to that used in games such as "Fish" or "Twenty Questions".

The materials consist of eight 4" x 6" index cards per problem, each containing a circular pattern composed of eight

black and white dots. In addition there is a problem board with eight hinged shutters, also arranged in a circle. There is one (large) card per problem which is arranged behind the problem board such that a circular pattern of black/white dots appears behind the shutters. The large cards represent the problem(s); the index cards represent the solution alternatives. There are two sets, each with four subsets, of eight alternatives each. In addition, there is a practice set containing four items, with eight alternatives each.

The problem board is presented to the child perpendicular to the table at table height. One of the eight patterns that is presented as a solution alternative is hidden behind the problem board, with each shutter of the board concealing one of the eight dots. The eight response alternatives for that problem are laid out in front of the child and the child's task is to figure out which of the presented eight patterns lies behind the closed shutters by opening the shutters one at a time. Opening the shutters provides the child with the information needed to eliminate one or several alternatives. For example, if the child opens the top shutter and a black dot is revealed, she can then eliminate all the index cards which do not have a black dot at the top. She eliminates these cards by turning them face down. The child is instructed to arrive at the solution by opening as few shutters as possible. The task is designed so that the opening of certain shutters (which is different for each problem) will provide more information than others. In

this way the child's approach to problem solving can be examined. Does she select the most efficient and effective strategies, or is her approach random? Does she improve with practise (experience) and does she therefore make use of feedback? Does she alter an ineffective strategy when feedback tells her she has been ineffective or does she persevere? Analysis of her record can be in terms of the cognitive strategies she has employed, as in the previous studies (Cameron, 1976; McKinney, 1975; Stober, 1984) and/or can be in terms of the metacognitive processes described above.

Each child was introduced to the task with an extensive training involving four problems in accordance with previous administrations of the pattern matching task (Cameron, 1976; Stober, 1984). The training problems consist of two four-dot four alternative problems, one four-dot six alternative problem and one eight-dot eight-alternative problem. The pattern-matching board for the four and six alternative sets was a standard manilla file folder, with holes cut in its face covered by a moveable cardboard strip (see Appendix S for a representation of the stimulus materials, a copy of the record sheet, and the instructions used in the training and test problems of the Pattern-Matching Task). The training session stressed several issues. First the correspondence between the dot pattern on the solution alternatives and the dot pattern behind the pattern board were stressed so that the child could easily transfer from the dot positions on the cards, to the dots

behind the shutters on the board. Second, the child was instructed in the differences between helpful and non-helpful moves so that the child could understand that a "helpful" move was one where alternatives could be eliminated, whereas, using a "non-helpful" move, no alternatives could be eliminated. However, no strategy was demonstrated to distinguish a helpful from a non-helpful move. Finally, a strategy for eliminating alternatives, namely turning over the discarded choices, was demonstrated to help the children work through the problem-solving process relatively efficiently. This behaviour solved two problems. First it aided some children, especially the younger ones, in realizing when they had solved the problem. Without this visual aid Stober (1984) thought that some children might be unaware of the necessity to eliminate alternatives, may not realize when they had solved the problem unless all the shutters were open. In addition, the turning face-down of incorrect patterns after responding facilitated response recording and gave a permanent record of their problem-solving behaviour without influencing that behaviour.

The Kemler Task and the Pattern Matching Task were employed as experimental tasks. They are both cognitive problem-solving tasks generally scored to yield information about children's cognitive behaviours. In this study they were used as general problem solving tasks whose methods of recording would also permit the examination of the child's metacognitive processes. The original intention was to correlate both cognitive success

and metacognitive efficiency scores derived from the Kemler Task and the Pattern Matching Task with scores from the metacognitive battery. However, problems with Pattern Matching scores necessitated excluding them from the analyses. These problems will be elaborated in Chapter III.

2.2.3 Personality Measures

Generally, it is hypothesized that personality characteristics are a major contributing factor in the discrimination of metacognitively efficient from metacognitively inefficient people. Maturity and more specifically ego maturity is the organizing concept around which this description can be fitted. It is, as yet, unclear, which factors are more relevant - state or trait characteristics, and both have been included.

In deciding which assessment tools were to be used, the first step was to generate characteristics considered to be related to metacognition. The basis for this list was a theoretical understanding of metacognition and a thorough literature review, as well as a knowledge of personality assessment in both the clinical and empirical spheres. The list was then narrowed to include those characteristics essential to and more obviously linked with metacognition. Tests were then found to assess each of the characteristics which are discussed below in the descriptions of the test.

2.2.3.1 Matching Familiar Figures (MFF) (Kagan, 1966)

The Matching Familiar Figures Test (MFF) (Kagan, 1966) is a perceptual, match-to-standard test in which the child is

simultaneously presented with a "standard" drawing of a familiar object and six "variants" of the drawing, with one of the variants being identical to that standard. The child's task is to select the alternative that is an exact duplicate of the standard. It is a test most commonly used to differentiate experimentally between impulsive and reflective children. The dimension of reflectivity-impulsivity is concerned with "the degree to which the subject reflects on the validity of her solution hypotheses in problems that contain response uncertainty" (Kagan & Kagan, 1970, p. 1309). Response uncertainty is defined as a situation in which several response alternatives exist simultaneously, requiring the individual to evaluate each solution individually prior to responding. In such a situation two distinct styles emerge - reflectivity and impulsivity. The reflective child typically delays before trying a solution hypothesis and actively considers the differential validity of the available alternative solutions. On the other hand, the impulsive child reports his first hypothesis with little critical analysis of the potential accuracy of his response (Kagan, 1966).

The impulsivity-reflectivity dimension is considered an important one in the study of the interaction between personality factors and metacognition. In fact, for many this is the first personality issue to be linked with metacognitive efficiency (Stober, 1984). Considering the importance of delay and reflection in the metacognitive process -- reflection over

the abilities and knowledge we bring to the current problem, reflection over which of the available solutions is best, reflection over the accuracy or success of that choice -- this emphasis is not surprising.

On the MFF, impulsive and reflective children are identified on the basis of their response times to first choice and the total number of errors made. For each specific example, median splits on the latency and error scores form the basis for this classification. Operationally, reflective children are defined by having latencies above the sample median for response time and by having error scores below the sample median. Impulsive children are defined by obverse scores. That is, reflective children show long decision times and low error scores, while impulsive children show short decision times and high error rates. Two other patterns can be derived from the MFF median split procedure. The first of these may be as labelled "fast-accurate" children -- children score below the error and latency medians; and slow-inaccurate children -- children who score above the error and latency medians.

Recently, investigations have begun to focus on two problems which emerged in relation to the MFF (Stober, 1984). These two issues centre on the low reliability of the MFF error score, and two methods of analyzing the MFF data.

With regards to the first, Cairns and Cammock (1978), on the basis of 30 items chosen from three earlier versions of the MFF produced a 20-item test (MFF20) which improves on the

reliability of the MFF error scores by providing a more discriminative index. According to the authors, this test is suitable for 7 to 12 year olds; however, further research has extended the age range as far as 16 years of age (Gorski, 1982). Psychometric evidence presented reveals internal consistency and re-test reliabilities that exceed those reported for the original MFF.

The second methodological concern focuses on the statistical implications of the data culled from both the MFF and MFF20 and arises from the lack of available standardized norms. The dual median-split procedure for analyzing data uses sample-generated medians as the cut-off points. Thus children classified as impulsive in one sample may be considered reflective in another (Messer, 1976). This procedure may therefore confound both interpretation and generalizability of results. Norms are being developed for the MFF, based on solicited data from North American researchers, but reliable North American norms are not yet available (Stober, 1984). Regarding the MFF20, preliminary norms are available based on a sample of children in Ireland.

A further problem with both the MFF and the MFF20 is that with the median-split procedure, approximately thirty per cent of the total sample, those non-extreme children classified as fast-accurate or slow-inaccurate, are often dropped from consideration in those studies. This not only wastes potentially valuable information concerning the relative

contributions of latency and errors in predicting other variables (Ault et al., 1976; Messer, 1976), it also wastes valuable information about problem-solving style (Stober, 1984).

As an alternative to the dual median split procedure, Block et al. (1974) suggest that error and latency scores should be maintained in their continuous form and considered separately when relating them to specific cognitive or personality variables. There are two advantages of this approach: (1) it avoids the interpretive problems associated with confounding the relative sources of variance contributed by both errors and decision time and (2) by using error and latency scores in their continuous form, the researcher is provided with information on the degree of reflectivity-impulsivity.

Kagan et al. (1964) actually originally proposed that neither speed nor accuracy alone were sufficient to account for individual differences in impulsivity-reflectivity. Rather, they stressed their interconnection in the formulation of the reflectivity-impulsivity dimension. A model by Salkind and Wright (1977) integrates both speed and accuracy while maintaining MFF error and latency scores in their continuous form. In the Salkind and Wright (1977) model, individual MFF performances can be evaluated along the two orthogonal and continuous dimensions of Impulsivity (or style dimension) and Efficiency (an ability dimension). The Impulsivity dimension ranges from slow accurate (reflective) to fast inaccurate (impulsive) performance; the Efficiency index ranges from fast

accurate to slow inaccurate performance. Scoring formulas for these dimensions are based on standard score combinations of individual MFF20 latency and error scores. Thus, Impulsivity is defined by the formula $Z_e - Z_l$, that is the standard score of errors minus the standard score of latency; efficiency is defined by the formula $Z_e + Z_l$, that is the sum of the standard scores of errors and latency.

Stober (1984) stresses the 3-fold advantages of this model. First it does not depart from the original conceptualization by Kagan which stressed the joint contributions of both speed and accuracy. Second, it provides continuous scores from all subjects, thereby avoiding the loss of information inherent in the dual median split procedure. Finally, classifying subjects along the independent dimensions of Impulsivity and Efficiency is an improvement over latency and error classifications, which have been characterized by a high degree of overlapping variance. However, to date, no studies have examined the relative benefits of the three different methodological approaches to examining conceptual tempo: 4-fold classification of Impulsivity/Efficiency, raw MFF (20) error to latency scores and the Impulsivity Index.

In this study, the MFF20 was administered. Analyses proceeded using the derived Impulsivity and Efficiency scores (see Appendix T for a copy of the administration procedure, sample stimulus, and score sheet).

2.2.3.2 The Speilberger State-Trait Anxiety Inventory for Children (STAIC) (The "How I Feel Questionnaire") (Speilberger, 1970)

The STAIC is a self-report measure of anxiety in children. The questionnaire, a modification of an adult scale, consists of two separate scales of 20 items each. The state scale measures relatively transitory symptoms of anxiety; the trait scale assesses a more stable and enduring anxious personality characteristics.

It has been well documented that the anxiety interferes with such areas of cognitive functioning as perception, memory, and analysis and synthesis (Casteneda et al., 1956; Turner, 1983). It seems reasonable to assume that anxiety also interferes with metacognitive functioning. It is assumed that even brief, transitory states of anxiety will interfere with cognitive functioning. However, it is more importantly hypothesized that children who habitually or characteristically do not efficiently employ metacognitive skills, especially if they can verbalize knowledge of these skills, will manifest high trait anxiety scores.

The scale items are arranged in 3-response-choice format and are scored from 1 to 3 with 3 representing the presence of anxiety symptoms. Thus, scores on each scale range from 20 to 60. Items reflecting the presence of anxiety are counterbalanced with items reflecting the absence of anxiety in order to avoid a response set. Sex and grade norms are available.

In her review of children's anxiety scales, Vargo (1984) reports that content validity of the STAIC was evaluated in terms of the selection procedure used to determine the final set of items. Each item was evaluated against a combined criterion defined in terms of internal consistency and concurrent validity. Internal consistency was based on item remainder correlations while concurrent validity was determined by correlations with other measures of anxiety. Concurrent validity was assessed by means of correlations with the Children's Manifest Anxiety Scales ($N = 75$, $r = .75$) and the General Anxiety Scale for Children ($N = 75$, $r = .63$) (Platzek, 1978).

Vargo (1984) further reports that evidence of construct validity of the state scale of the STAIC comes from studies which have demonstrated an increase in state anxiety associated with the stress of school integration (Edwards, 1972), experimentally produced failure (Landry & Poole, 1972, in Vargo, 1984) and a verbal conditioning experiment (Montuori, 1978, in Vargo, 1984).

Evidence of the divergent validity of the STAIC is reported in terms of its negative correlations with measures of ability (California Test of Mental Maturity, mean $r = -.19$) and achievement (California Achievement Test, mean $r = -.23$) (Spielberger, 1973). Evidence of convergent validity is limited. Correlations between both scales and GPA are moderate; correlations of both scales with teacher ratings show no

relationship. As Vargo (1984) points out, this alone may not invalidate the scale. Typically, there is less concordance between adults' ratings (e.g., parents or teachers) and self-report than between peer-ratings and self-report or between clinical observation and self-report. Furthermore, the present author would add that the situation is confounded when raters are asked to judge with regard to an internal emotional state and not concrete behaviours.

Estimates of reliability are reported for internal consistency and stability. Item remainder correlation coefficients range from .23 to .61 for the state scale and from .20 to .51 for the trait scale. Eight-week re-test stability coefficients reported for a sample of 246 elementary school children were lower for the state scale (males, $r = .21$; females, $r = .47$) than for the trait scale (males, $r = .65$; females, $r = .71$). This would be expected from the nature of the scales. While these scores are only moderate, and even for the trait scale account for less than 50% of the variance (Vargo, 1984), this would be of more concern in an outcome study than in the present design. Where re-test reliability coefficients are low, it is more difficult to conclude that change after treatment or after a lapse of time is due to anything other than the instability of the test. Again, this is especially so given the age of the sample, at which considerable changes are to be expected, even in an eight-week period and even for so-called trait scales (see Appendix U for a sample of

the STAIC protocol).

2.2.3.3 The Children's Social Desirability Scale (Crandall, Crandall & Katkovsky, 1965)

The Children's Social Desirability Scale (CSD) is a 48-item True, False, self-report questionnaire which was designed to assess a child's desire to appear socially acceptable. The manual predicts no correlation with behaviour - presumably with behaviour aimed at appearing socially correct.

Individual interviews with a young pretest sample led the authors (Crandall, Crandall & Katkovsky, 1965) to suspect that children below the 6th grade often have difficulty dealing with the true-false format of the CSD questionnaire. Two reasons were given (Crandall, Crandall, & Katkovsky, 1965): younger children tend to be unfamiliar with tests, especially those using a true-false format; also, some of the younger children did not know the meaning of several of the words appearing in the items, some were unable to read well. As a result, a special form of the CSD was devised for individual oral administration to children below the sixth grade. However, in line with the decision in the present study to avoid parallel forms, the grade 3 (age 8) children were read each question and asked "Is that true about you or is it not true about you?"

Pre-testing suggested to Crandall, Crandall and Katkovsky (1965) that it was inadvisable to administer the question form to children below the third grade (U.S.). However, other researchers (e.g., Klein, Gould, & Corey, 1968; Allaman, Joyce,

& Crandall, 1972) later administered the test to children as young as six years of age, with valid results.

The decision to include a measure of children's social desirability response tendencies is a complex one to justify. It has long been recognized that a component of maturity is an ability to be aware of social expectations but to not be bound by them. Thus, it would be expected that younger individuals show more of a tendency to respond to such a questionnaire in socially desirable ways and, indeed, this is the case (Crandall, Crandall, & Katkovsky, 1965). Therefore, this questionnaire is included partly as a measure of maturity and autonomy. Related to this, but more importantly, it is also hypothesized that if a child is expending a lot of time and energy in investigating and responding to the expectations of a situation then she cannot be devoting energy to a realization and analysis of her own reactions to a problem-solving situation and therefore, by definition cannot be calling on and using metacognitive skills.

In such an instrument, reliabilities are important but tricky to evaluate. While it is critical that a questionnaire be chosen that measures a stable characteristic, it is equally critical that this questionnaire be sensitive enough to measure what may very well be subtle differences between the three groups under investigation. There is not much to choose from in children's social desirability questionnaires; this questionnaire represents what is considered to be the best selection.

Reliabilities appear to be respectable. Uncorrected split-half (odd-even) reliability coefficients range from .69 to .90 for subsamples of boys and girls at various grade levels. Corrected by the Spearman-Brown prophecy formula, correlations are .82 to .92. Re-test reliability was examined only in part of the total sample. The direct questionnaire form of the CSD was readministered after a one-month interval to 63 of the younger children. The correlation was .90. The true-false form of the questionnaire was re-administered to 98 10th graders after a similar one-month interval and produced a correlation of .85. Thus, children's social desirability response tendencies as measured by the CSD questionnaire are demonstrably consistent over a one month interval as well as consistent from item to item within the test itself.

Concurrent, congruent, construct, content validities are not reported. Instead, the authors have chosen to establish predictive validity, correlating the questionnaire with a variety of standard variables such as sex, grade and SES differences, and ethnicity (Crandall, Crandall, & Katkovsky, 1965) (see Appendix V for a sample protocol).

2.2.3.4 The Washington University Sentence Completion Test (WUSC) (Loevinger, 1970)

The WUSC was developed by Loevinger and Wessler in the 1960's based on the theoretical constructs of ego psychology which formulates stages in development of perception of self and others. It was chosen as a measure of ego development. The

WUSC is said to be able to place individuals at a specific point along the continuum ranging from an impulsive cognitively dichotomous (good/bad) world-view, through conformity to an integrated, cognitively complex and ambiguity-tolerant world-view. It purports to assess an individual's approach to life problems and an ability to perceive the varying complexities of life situations.

The WUSC consists of a two-page questionnaire with 36 sentence stems and space for writing a completion. At the request of the school system, from which the present sample was drawn, (two) items with a suggested sexual content were excised yielding 34 items. The resulting format takes about 15 minutes or less for junior high school seniors to complete. Items were read to grade 3 children and their responses written for them.

The Sentence Completion test and its categorized manual have been taken through many stages of development yielding considerable psychometric data. Care was taken to ensure that the publication manual was usable by untrained as well as trained raters and that resulting interrater reliabilities were within acceptable ranges. Using the publication manual and comparing individual item ratings, trained and experienced raters (6) achieved a median agreement of 77% (range = 60-86%); self-trained, minimally experienced graduate students (2) achieved a median agreement of 78% (range = 63-91%); and self-trained, completely inexperienced undergraduate students achieved a median agreement of 81% (65-94%). Correlations for

all ratings were .75 to .76. While this figure is somewhat low, given the abstract nature of the concept being measured and the gross divisions between categories, it is not surprising. In fact, when Loevinger and her colleagues added half-steps between each category, interrater correlations increased (these correlations are not reported).

The scoring system also suggests that protocols are given an overall rating - the Total Protocol Rating or TPR. Correlations on the TPR ranged from .90 to .96 for the trained, experienced raters and .89 to .92 for the self-trained, minimally experienced raters.

With regard to validity, construct validity, only, is mentioned. The TPR has been compared to measures of IQ ($r = .45$ for boys, $r = .47$ for girls); age ($r = .74$ for boys, $r = .69$ for girls); of verbal fluency ($r = .58$ for TPR, $r = .65$ for the sum of the item ratings); and to an interview assessment of ego development, called I-level ($r = .58$ and $.61$ for 2 sets of interviewers, $r = .81$ for the ratings of the two interviewers). The figures suggest good construct validity. They suggest that the test is not significantly related to IQ or to verbal fluency, which is to be expected. These correlations are not inconsequential. However, it is unlikely that any paper and pencil measure using verbal stimuli would be uncorrelated with intelligence and especially with verbal fluency. Furthermore, these correlations are relatively low. The test is moderately correlated with age, as ego development would be. The

correlations with the sets of interviews are disappointing, however, these I-level interviews generally have lower correlations with other paper and pencil measures of I-level and of ego skills (see Appendix W for a sample protocol).

2.2.3.5 The Rorschach

The Rorschach is a familiar but often misunderstood so-called "projective" assessment instrument. In the comprehensive system developed by Exner (1986), the Rorschach is conceptualized and used substantially differently.

Previously, it was held that the ambiguous stimuli (and instructions) in the 10 cards caused the subject to project his fantasies and therefore his personality in his responses. This view of the Rorschach was based on psychoanalytic theory -- the prevailing thinking of the time. As such the Rorschach was viewed as a way to tap unconscious processes.

With the support and cooperation of the five main systematizers of the Rorschach, Exner developed a comprehensive system to utilize the best of the existing methods and based his system on a cognitive model of psychology. As such he views subjects' responses as characteristic of cognitive style -- that is, an individual's characteristic way of approaching problem-solving. A further advance in his system, made possible by his cognitive approach, is his ongoing and constant work to ground Rorschach scores, and combinations of scores, in empirical validation. His work provides evidence regarding the degree of reliability of these scores in addition to their validities and

so doing gives the investigator an idea of the limits of interpretation. Finally the psychometric data have been tabulated for children aged five and older, as well as for adults.

The Rorschach consists of 10 standard cards. The subject is instructed to tell the examiner what the ink-blot on the cards look like to her. Unlike traditional administrations, the Exner system (Exner, 1986) does not encourage an unlimited number of responses to each card, but rather suggests two or a maximum of three responses as adequate. When all 10 cards have been administered, subjects are shown each card a second time in order to ascertain where the responses were seen and how they were perceived. Responses are scored using a clearly defined system according to their location on the blot, to the chromatic and achromatic characteristics of the blot that have been utilized, according to the degree of organization in the response, the content of the response and the bizarreness of the response. The responses are additionally scored along two dimensions -- diffuseness and specificity, and relative frequency or infrequency of the occurrence of that response (see Appendix X for a sample scoring protocol, descriptions of scoring procedures, interpretations, reliability and validity estimates for scores used in this study).

The Exner method has not been used in studies other than those to validate his scoring and interpretation systems. Therefore, in this project, where possible, the characteristics

to be gleaned from Rorschach scores have been measured by paper and pencil tests, as well. Results were analyzed separately.

A principal component analysis was performed on the Rorschach scores both to reduce the number of variables and to observe the essential structure of the scores which were selected. The principal component(s) were correlated with scores derived from the metacognitive battery used here, the MKAQ, the MI.

A sample of 20 Rorschach protocols were scored by a second psychologist to establish interrater reliability. After much searching, a Ph.D. candidate at the University of Ottawa was found who was willing to double score the protocols. Unfortunately, her previous experience was limited to class work and about 20 protocols during a practicum placement. Eight practise protocols were scored by this second scorer and checked by the main investigator. It was found that her training had been excellent but that she lacked the experience to make some of the finer judgement calls such as Form-Determinant versus Determinant-Form, Developmental Quotient-vague, and some of the special scores. Each of these 8 protocols were then used as a vehicle for training. The problems cleared up to some degree. The Developmental Quotient-vague was considerably improved, the other difficulties were less improved. However, these judgement calls are debated even by experienced Rorschach scorers, much less inexperienced ones. Therefore, although the problems persisted, somewhat, it was decided to proceed with double

scoring the criterion protocols.

2.3 Procedure

A description of the research project was submitted to the ethics committee of Carleton University and the Research Advisory Committee of the Carleton Board of Education. The project was approved by both committees. The principals of four elementary and three middle schools, selected by School Board personnel, were contacted. A meeting was held with each principal to review the purpose of the study, the types of tests involved, and the subject requirements. The School Board provided lists of gifted students previously identified by Board selection procedures. These gifted students were matched with a group of similarly aged average students.

Letters were sent to 170 families requesting the participation of their son or daughter in the study (see Appendix Y). In all 120 families responded agreeing to allow the participation of their child in the study. The sample was divided so that 20 average and 20 gifted students were selected from grades three, six and eight. The students in each group were divided equally among males and females. Timing proved to be a problem. At the beginning of testing in January 1987, Grades 6 and 8 students had already been tested and selected for the gifted programs. However, testing for the grade 3 children began only in January and results were not available until late spring. Therefore, testing began with grade 6 children, proceeded to the grade 8 children and ended with the grade 3's.

Two examiners were used, one the author of this paper, the other a colleague with related interests in metacognition. Due to the critical nature of tester style (Schafer, 1948), testing responsibilities were divided between the two testers and were not counter-balanced. Therefore, one tester undertook the two experimental tasks, the administration of the Metacognitive Interview and administration of the validity measures. Administration of IQ measures, for her study, were undertaken by school board employees. The second tester administered the Metacognitive Knowledge Assessment Questionnaire, the personality measures, and the MKAQ for the reliability data with administrations separated by six weeks. This second tester also administered the MI (and empirical tasks) to obtain re-test reliability data.

Due to concern about the possible and unknown effects of the exposure to metacognitive issues in the MKAQ on the MI and vice versa, the order of administration of these two tests were counterbalanced. Half the subjects in each cell (10) were given the personality measures and the MKAQ first, and separated by at least one week, the experimental measures and the MI. The other half of the children were administered the MI (and the experimental measures) followed by the MKAQ (and the personality measures). Within each cell, subjects were randomly assigned to one of the two conditions (see Tables 1 and 2 for the demographics of the main sample).

Insert Tables 1 and 2 about here

Table 1. Characteristics of sample

Sex	N
Female	52
Male	57
Total	109
School	
East	41
West	68
Total	109
Order	54
	51
Total	105
Program	
Gifted	56
Average	53
Total	109
Grade	
3	33
6	40
8	36
Total	109

Table 2. Characteristics of sample

Grade by Program

Program	Grade			
	3	6	8	
Gifted	16	20	19	55
Average	17	20	17	54
Total	33	40	36	109

Grade by Sex

Grade	Sex		
	Male	Female	
3	15	18	33
6	19	21	40
8	18	18	36
	52	57	109

Program by Sex

Program	Sex		
	Male	Female	
Gifted	28	27	55
Regular	24	30	54
	52	57	109

N = 109

Prior to any testing, the children received a partial explanation concerning the nature of the experiment and their part in it (see Appendix Q). Since setting the stage is so important (Schafer, 1948), the wording was standardized and did not vary. Questions asked during the testing were answered within the context of the initial explanation and parents and children were offered a debriefing session when the study was completed.

The sessions in which the experimental measures were administered took approximately 40 minutes to complete. Due to the unknown effects of the administration of the impossible set of the Kemler Task on the children's motivation, presentation of these two tasks was counterbalanced and children were randomly assigned to one of the two orders of presentation. The testing in which the MKAQ and personality measures were administered were actually split into two parts with a total time of approximately 1-1/2 to 2 hours. In the first of these sessions, the child was given an explanation of her participation in the research project and was given the individually administered tests -- the MFF and the Rorschach. This session ended with administration of the STAIC anxiety measure. Where possible, the remaining paper and pencil measures were administered in small groups, by grade, and, where possible, by ability level. A total of 120 children were administered the MKAQ and MI. Due to incomplete protocols, a total of 91 MKAQ and MI tests were scored and entered into the analyses. Due to absences 112 MFF

and 113 STAIC were administered. All protocols were valid. With regards to the CSD, 120 were administered but one protocol had more than 10 unanswered items and so was not scored. (See Appendix Z for a description of the testing sessions.)

Approximately 18 months later a separate sample of 110 children was again drawn from the Carleton School Board and in the same manner as the first sample of 120 children. Within grade and program levels these 110 children were randomly assigned to be administered the Metacognitive Knowledge Assessment Questionnaire or the Kemler task plus the Metacognitive Interview. Testing proceeded with the same set of instructions. Six weeks later each child was re-tested using the identical procedure. Several factors results in a reduction in the sample size for the second administration. Two third-grade children balked at the (second) testing. Twenty-six children were absent on the day scheduled for their re-test session. By the time they had returned to school, the lapse of time had been too long. Therefore, 84 children received two administrations of either the MKAQ or the MI. Of these, 81 protocols were complete and usable. In all, 47 children received the MKAQ twice, 34 children received the MI twice (see Tables 3 and 4 for characteristics of this sample).

Insert Tables 3 and 4 about here

In summary, a measure of Metacognitive Knowledge (MKAQ) and a measure of metacognitive experience (MI) were designed and

Table 3. Characteristics of the Re-test Sample - Metacognitive Knowledge Association Questionnaire (MKAQ)

Grade by Program

Program	Grade			
	3	6	8	
Gifted	1	9	10	20
Regular	10	10	7	27
Total	11	19	17	47

Grade by Sex

Grade	Sex		
	Male	Female	
3	6	6	12
6	10	8	18
8	11	6	17
	25	22	47

Program by Sex

Program	Sex		
	Male	Female	
Gifted	13	8	21
Regular	14	12	26
Total	27	20	47

N=47

Table 4. Characteristics of the Re-test sample - Metacognitive Interview (MI)

Grade by Program

Program	Grade			
	3	6	8	
Gifted	3	6	11	20
Regular	5	5	4	14
Total	8	11	15	34

Grade by Sex

Grade	Sex		
	Male	Female	
3	4	4	8
6	5	6	11
8	7	9	16
Total	16	10	35

Program by Sex

Program	Sex		
	Male	Female	
Gifted	8	12	20
Regular	8	6	14
Total	16	18	34

N = 34

administered to 109 gifted and average children in grades 3, 6 and 8. Both tests were re-scored to derive estimates of intrarater reliability. A second sample of eighty-one children were administered either the MKAQ or the MI twice with an interval of six weeks and re-test reliabilities were calculated.

Twenty of the 109 children were administered five tasks commonly used in previous studies to assess metameory or metacognition. Concurrent validity coefficients were obtained. External validity was assessed from indices of metacognitive behaviour derived from the administration of the cognitive tasks.

Both measures of metacognition were entered as dependent variables in a canonical correlation. Covariates were personality measures selected to assess aspects of ego functioning hypothesized to be important in efficient metacognitive functioning.

It was expected that both the Metacognitive Knowledge Assessment Questionnaire (MKAQ) and the Metacognitive Interview (MI) would have intrarater and re-test reliabilities at or above the .60 criteria. Validity coefficients were expected to be in the same range, thus establishing both measures as reliable and valid.

Grade and program were expected to show high correlations with the metacognition measures. Anxiety (STAIC 1 and 2) and a people pleasing coping style (CSD) were expected to have negative correlations within the criterion range. Impulsivity-

reflectivity (MFF) and ego development (WUSC) were expected to show strong associations with the measures of metacognition. Hypothesis concerning Rorschach variables were held in abeyance until the outcome of a principal component analysis could define the components to be analyzed. In general a correlation within the defined range was expected with the two tests of metacognition.

Chapter three will present the results of the statistical analyses.

Chapter Three

Results

3. Review

This explorative study was structured to help define a model of metacognition and a way of empirically validating that model. The second major focus of the investigation was to explore the extent of the association between metacognitive efficiency and personality variables. This chapter will describe the results of the data screening and statistical analyses.

3.1 Statistical Procedures

3.1.1 Reliabilities

Intrarater reliability was determined in the following way. The MKAQ and the MI were scored before any of the other measures. When all the tests had been scored (a process that took 20 months), and after an interval of four months, the same scorer selected and rescored 20 of each test. The 20 rescored protocols of each test were selected at random with the following constraint: three each were chosen for grades 3 and 6, gifted and average; four each were chosen from grade 8, gifted and average.

Using a separate sample of children, the MKAQ and the MI were administered twice with an interval of six weeks to determine re-test reliabilities. Forty-seven subjects were tested on the MKAQ and 34 on the MI.

3.1.2 Validities

Selecting from the literature on metacognition, four

anecdotal, but apparently successful methods for assessing metacognition were administered to measure concurrent validity. These included one of Brown's Japanese Folk Tales, The Dragon's Tears (Brown & Smiley, 1977), Preparation Object (Kreutzer et al., 1975), Markman's Magic Trick (Markman, 1977), and Numbers Backwards (Weschler, 1974). These procedures were administered to 20 children. Porteus Mazes were also administered by a second examiner. Protocols were not readable and so the test was not used in the analyses.

Two cognitive measures were chosen to reflect external validity, the Pattern Matching Task and the Kemler Task. The need for two was explained by the attempt to examine metacognitive behaviour on a challenging task in comparison to metacognitive behaviour on an easy task. By using both, it was also expected that a clearer picture of the relationship between metacognitive behaviour, metacognitive experience and metacognitive knowledge would emerge.

3.1.3 Personality Correlates

The main focus and unique aspect of this investigation was an attempt to determine if personality development and functioning played any part in metacognitive efficiency across the ages included. The study was planned to describe the relationship between metacognitive development, cognitive (problem-solving) success, and personality characteristics. The argument was that since metacognition is, by definition perspective taking (Flavell, 1975) and self awareness (Brown,

1978a; Flavell, 1979; Flavell & Wellman, 1977), then some aspect of personality, especially ego and self development must be involved. The conceptualization seemed clear. Finding a measure was more difficult. Measures of self development were non-existent; by contrast strong measures of ego development were available. The Washington University Sentence Completion test (WUSC) was selected as the measure of ego development. For aspects of self functioning, Rorschach scores Ma (Human Movement, active), Mp (Human Movement, passive), a (active), p (passive), (2) (pairs), and Fr (reflections) were used. (See Appendix X for a description of the scoring and interpretation of the Rorschach scores used in this study.)

Additional measures were selected to reflect aspects of personality functioning that are generally accepted as interfering with or contributing to cognitive performance: impulsivity (Matching Familiar Figures Test - MFF), and anxiety (Speilberger's State-Trait Anxiety Scales STAIC 1 and 2). In addition, a test was selected to assess a people-pleasing coping style (the Children's Social Desirability Scale - CSD), and the Rorschach Comprehensive System from which several scores (in addition to those mentioned above) were selected. A schematic description of the study would be as follows.

Insert Figure 1a about here

Intrarater reliability was calculated for the WUSC. Interrater reliability was calculated for the Rorschach.

Figure 1(a). Schematic representation of the study (including sample sizes)

Measures used:

MKAQ - Metacognitive Knowledge Assessment Questionnaire
 MI - Metacognitive Interview
 WUSC - Washington University Sentence Completion Test
 STAIC (1&2) - Spielberger State-Trait Anxiety Inventory for Children
 CSD - Children's Social Desirability Scale
 MFF - Matching Familiar Figures
 Rorschach, The Comprehensive System

3.2 Analyses Planned a Priori

3.2.1 Preliminary Considerations

Correlations were performed between administration order 1 (MKAQ followed by MI) and administration order 2 (MI followed by MKAQ).

For reliability and validity analyses, a coefficient value of .60 or above was considered to be acceptable. Although .60 might be considered low in relation to clinical psychometric instruments, the measures here were being used not for clinical assessment but for empirical exploration. Furthermore, with the exception of the WUSC, all were either new tests or were being used in a new context. Therefore, a cut-off of .60 was considered adequate for the purpose of this investigation.

3.2.2 Reliabilities

Correlations were planned between first and second administrations of the Metacognitive Knowledge Questionnaire (MKAQ) and the Metacognitive Interview (MI) to determine re-test reliabilities. Correlations were performed between scoring 1 and scoring 2 on the MKAQ, MI, WUSC and Rorschach tests to determine intrarater and interrater reliabilities. Cronbach's alphas were calculated for the MKAQ and the MI to assess internal consistency.

3.2.3 Validities

Principal component analyses were undertaken for both the MKAQ and the MI to reduce the number of variables and to look at the internal structure of the tests.

Correlational analyses were performed separately for the MKAQ and the MI with the validity measures to determine concurrent validity. Canonical correlation of the MKAQ and the MI with the Pattern Matching and Kemler Tasks were performed to determine if a relation exists between metacognition and performance.

3.2.4 Personality Correlates

A principal component analysis was performed on the Rorschach to reduce the number of variables and to develop a smaller set of uncorrelated components. By using the variables in meaningful clusters, it was hoped to get a clearer picture of the relationship between the Rorschach variables and metacognition.

Since this study was designed with multiple dependent and independent variables canonical correlations were applied to determine the nature of the association between metacognition and personality characteristics. The dependent variables were the three metacognitive components, the covariates were the personality variables.

3.3 Results

3.3.1 Measures of Metacognition: The Metacognitive Knowledge Questionnaire (MKAQ)

3.3.1.1 Data Screening

Initial screening of the MKAQ data revealed several compromised variables. Three variables were skewed: one (Monitoring) was both skewed and peaked. To improve linearity,

square root transformations were carried out for the Evaluation, Monitoring, and Clarity scales. Even with transformations, Monitoring remained unusable. Over half of the protocols had a score of zero on this scale.

A principal component analysis was performed to reduce the number of dependent variables and to reduce the MKAQ to its essential structure, or core component(s). The principal component analysis yielded one component for the MKAQ. No rotation was required. A t-test was performed to calculate the effects of the order of presentation of the two metacognitive measures. No differences were noted between the two groups ($t = .00$; $p \leq 1.000$).

3.3.1.2 Reliabilities

Intrarater reliabilities for the MKAQ were generally high: with the exception of .57 on the Flexibility scale, correlations ranged from .77 (Problem Definition) to .94 (Accuracy and Specificity) (see Table 5). Based on this finding, the Flexibility scale was dropped from the analyses. On the other hand, re-test reliabilities were generally disappointing (see Table 6). Only the Planning scale met or exceeded the .60 cut-off, although all the scale totals and section B had correlations of .73 or above. To look more closely at the re-test results, the correlations were repeated twice more, once analyzed by grade, once by program. The sample was too small to analyze both grade and program at the same time.

Insert Tables 5 and 6 about here

Table 6 shows the relationship between intrarater reliability and grade. Among the grade 3 students, seven coefficients met or exceeded the .60 cut-off. Among the grade 8 students the number was five. Unexpectedly, in the grade 6 group, the number was only one.

These results are somewhat perplexing. One possible explanation is that the grade 3 and grade 8 children are either at the end or in the middle of several converging developmental stages -- cognitive, self, and so on. However, at age 12 the grade 6 students would be entering a new set of developmental stages. It is generally held that the beginning of each stage is disruptive for the child (Ginsberg & Oppen, 1969). Previously achieved milestones, skills, abilities, are disrupted to eventually be re-organized into a new pattern in the subsequent stage. It is possible that this explains the anomalous findings among the grade 6 children -- a pattern that seems to pervade the results of this study.

Among the gifted students, only two scales received scores above the .60 cut-off (see Table 6). However, in the regular stream group nine scales achieved acceptable reliability coefficients. A possible hypothesis is that the brighter children recognized the test from its first administration and given no explanation for its re-presentation, tried to think up "different" answers for their second set of responses. However,

Table 5. Intrarater Reliabilities - Metacognitive Knowledge Assessment Questionnaire

Total Section A	.94**
Total Section B	.89**
Total Section C	.89**
Problem Definition	.77**
Planning	.82**
Strategy Selection	.82**
Flexibility	.57**
Evaluating	.81**
Monitoring	.90**
Clarity	.84**
Specificity	.93**
Reflectivity	.82**
Accuracy	.85**
Organization	.88**
Conceptualization	.85**

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

Table 6. Re-test Reliabilities - Metacognitive Knowledge Assessment
Questionnaire

	Total Sample	Gifted	Regular	3	6	8
Section A	.59	.45	.68	.67*	.33	.57*
Section B	.74	.69	.72	.83**	.72**	.63**
Section C	.54	.44	.58	.72*	.33	.65**
Problem Definition	.55	.30	.68	.57	.45*	.28
Planning	.61	.59	.61	.48	.45*	.57*
Strategy Selection	.57	.42	.67	.49	.10	.73**
Flexibility	.49	.26	.56	.23	.48*	.46
Evaluating	.49	.39	.56	.60	.46*	.30
Clarity	.53	.50	.52	.47	.23	.64**
Specificity	.55	.37	.65	.74**	.27	.47
Reflectivity	.56	.60	.51	.44	.39	.58*
Accuracy	.50	-.00	.72	.61*	-.02	.43
Organization	.54	.47	.60	.82**	.48*	.53*
Conceptualization	.58	.45	.67	.60	.21	.58*
Problem Definition Total	.73**					
Planning Total	.81**					
Strategy Selection Total	.93***					
Flexibility Total	.79**					
Evaluating Total	.79**					

* $p \leq .05$
 ** $p \leq .01$
 *** $p \leq .001$

this explanation cannot completely account for the results. When Rorschach subjects taking the Rorschach under re-test conditions were instructed to give different answers, and did so, their structural summaries remained unchanged (Exner, Alumni Workshop, 1990).

Therefore, with the exception of the protocols from the regular-stream children, the number of scales achieving the .60 criterion was disappointing. Moreover, when analyzed separately by grade and program, the results were perplexing. Yet the scales that represented summed scores, Sections A, B and C, and all the scale-total scores (see Table 6) tended to produce higher and acceptable re-test coefficients. Therefore, it was decided to perform a Pearson product-moment correlation on the principal components of the test and the re-test of the MKAQ, to see if the correlation of these weighted combinations of scores yielded higher coefficients. The sample size was too small to do a principal component analysis on the MKAQ scores of the re-test sample. Therefore, the standardized weights from the principal component analysis of the MKAQ scores in the main study were used to weight the scores in each of the administrations of the MKAQ in the re-test study. A Pearson product-moment correlation of .66 ($p \leq .01$) was then obtained between the two administrations.

Cronbach's alpha was calculated for the MKAQ (see Table 7). Inter-item correlations were essentially zero. Inter-item covariances were 53.93. The square multiple correlations for

all scales ranged from .75 (Evaluation) to .90 (Planning). The alpha's if each scale was deleted in turn were all .95 or above. The analysis of variance was significant ($df = 105, 1060$, $p \leq .0000$). Corrected item to total correlations were all high. The lowest were the Evaluation (.69) and Flexibility scales (.76) suggesting that these scales are not as closely related to the main structure of the test. The Flexibility scale has been a problem throughout the analyses which may yield information about the construct which will be discussed in Chapter 4. Overall alpha was .96. It would seem the MKAQ is internally highly consistent.

Insert Table 7 about here

3.3.1.3 Validities

Initial screening of the data in the concurrent validity battery revealed that of the 14 scores, all but two were within acceptable limits of the requirements for linearity. The two scores which were discarded were Preparation Object - Skates 4 which had no cases, and Preparation Object - Self 2 which had one. No transformations were required.

A regression analysis was performed with the MKAQ single component as the dependent variable and the 12 validity scores as independent variables. Five of the correlations were significant (see Table 8). Three of the five significant coefficients were scores from the Preparation Object technique (Total, Notes and Other), one was from Numbers Backwards, and

Table 7. Cronbach's Alpha - Metacognitive Knowledge Assessment
Questionnaire (MKAQ)

	Corrected item - total correlation	Squared Multiple correlation	Alpha if item deleted
Problem Definition	.89	.83	.95
Planning	.93	.90	.95
Strategy Selection	.91	.87	.95
Flexibility	.76	.79	.95
Evaluation	.69	.75	.96
Clarity	.90	.84	.96
Specificity	.89	.84	.95
Reflectivity	.88	.82	.95
Accuracy	.91	.88	.95
Organization	.85	.83	.95
Conceptualization	.88	.81	.95

one was from Markman's Magic Trick. Another way of saying this, is that 3 of the 4 techniques chosen to examine concurrent validity had significant correlations with the single component of the MKAQ. This suggests promising construct validity, that is, the MKAQ seems to be measuring metacognition as defined by earlier investigators. However, the R^2 was .72 and the F was not significant. Prediction is therefore limited and interpretation should proceed with caution.

Insert Table 8 about here

It is somewhat surprising that the Japanese Folk Tale correlated so poorly with the MKAQ component. It may be that, after all, this test required more sophisticated processing and was more academic in format and requirements than the other tests. Therefore, it may have been too difficult for the younger children.

Concerning external validity, initial screening of Pattern Matching and Kemler test scores revealed problems with all of the Pattern Matching scores. Fifteen of the sixteen scores were both peaked and skewed. In both sections A and B of the Pattern Matching task, scores for mean time, total number of moves, number of gambling moves, number of non-informative moves, average bits of information, number of omissions and number of incorrect insertions were both skewed and peaked. In section B, the score for the number of focusing moves was also both skewed and peaked. Even with transformations, none were usable. For

Table 8. Concurrent Validity - Metacognitive Knowledge Assessment Questionnaire (MKAQ)

	MKAQ
Preparation Object - Total'	.53**
Preparation Object - Skates 1	.29
Preparation Object - Skates 2	.15
Preparation Object - Skates 3	.02
Preparation Object - Note 1	.57**
Preparation Object - Note 2	-.09
Preparation Object - Self 1	-.07
Preparation Object - Self 1	.53**
Numbers Backwards	-.48*
Folk Tales	.06
Magic Tricks	.44*

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

the Kemler Task, two scores are customarily derived; mean time (X), and number of trials to criteria (TC). An additional score was developed to look at the metacognitive activity. The score was labelled R for repetitions and described the number of times the child went back and repeated a response that had already been shown to be incorrect. All 3 scores -- R, X and TC required transformations to improve linearity. Using the natural log transformation, R and X were usable.

Correlations were performed using the MKAQ component as the dependent variables, and the Kemler R and X as independent variables. Table 9 lists the results. The cognitive success scores show no relationship to the metacognitive scores. The metacognitive behaviour scores show a low but significant correlation with the MKAQ component. This adds weight to the suggestion that the MKAQ is measuring metacognitive activity.

Insert Table 9 about here

Therefore, the Metacognitive Knowledge Questionnaire is an internally consistent test which appears to be measuring metacognition as it has been previously defined. In spite of a complex scoring system, intrarater reliabilities are generally good. Moreover, summed scores, but not individual scores, are reliable over time. However, interpretation of the questionnaire must be made with caution since the parameters of its stability over time remain unclear and prediction of the

Table 9. External Validity - Metacognitive Knowledge Assessment
Questionnaire (MKAQ)

	MKAQ
Mean time (KX)	-.07
Repetitions (KR)	-.23**

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

MKAQ from the battery of validity scales was poor.

3.3.2 Measures of Metacognition: The Metacognitive Interview (MI)

3.3.2.1 Data Screening

Initial screening of the MI suggested that kurtosis and skewness were within acceptable ranges. One score on both the Metacognitive Interview - Kemler (MIK) and the Metacognitive Interview - Pattern Matching (MIPM), Flexibility, required square-root transformation. One score on MIPM, Monitoring, was dropped since even with transformation values were unable to meet the requirement for linearity. Approximately half of the values for this variable were zero.

Principal component analyses with one varimax rotation were performed separately for the MI administered immediately after the Pattern Matching Task (MIPM) and the MI administered immediately after the Kemler Task (MIK). Two components emerged for each, but the components were not identical. For the Pattern Matching Task, the two components were.

Component 1	Component 2
Planning	Monitoring
Strategy Selection	Flexibility
Specificity	
Conceptualization	
Reflectiveness	
Organization	
Clarity	

Problem Definition

For the Kemler Task the two components were:

Component 1	Component 2
Reflectiveness	Problem Definition
Specificity	Flexibility
Clarity	
Planning	
Conceptualization	
Strategy Selection	
Organization	
Monitoring	

3.3.2.2 Reliabilities

Intrarater reliability on the MIPM was disappointing. Only two scales, Problem Definition (.61) and Planning (.66) achieved or exceeded the criterion of .60. Intrarater reliability on the MIK was more promising. Five of the 10 scales had correlations at or above the .60 level: Problem Definition (.78), Planning (.60), Strategy Selection (.70), Reflectiveness (.66), Conceptualization (.62) (see Table 10).

Insert Table 10 about here

In the planning of the re-test aspect of this study, it had been assumed that administration of the MI would be equivalent for both the Kemler and the Pattern Matching. Therefore, unfortunately, no re-test data were obtained for the MIPM.

Table 10. Intrarater Reliabilities - Metacognitive Interview (MI)

	Pattern Matching	Kemler
Problem Definition	.61**	.78**
Planning	.66**	.60**
Strategy Selection	.36	.70**
Flexibility	.34	.23
Monitoring	.21	.50**
Clarity	.41*	.53**
Specificity	.43*	.51**
Reflectiveness	.54**	.66**
Organization	.37	.49**
Conceptualization	.53**	.62**

* $p \leq .05$
 ** $p \leq .01$
 *** $p \leq .001$

However, re-test reliability data for the Kemler administration was good. Eight of the 10 scales yielded correlation coefficients of .60 or above: Problem Definition (.72), Planning (.80), Strategy Selection (.67), Clarity (.77), Specificity (.69), Reflectiveness (.73), Organization (.90), Conceptualization (.77) (see Table 11).

Insert Table 11 about here

Since this is an exploratory study, scores were retained if they met the requirement for linearity and either intrarater reliability or re-test reliability or both. Scores remaining were: Problem Definition, Planning, Strategy Selection, Clarity, Specificity, Reflectiveness, Organization and Conceptualization.

Due to the aforementioned problems with linearity and with intrarater reliability for the values obtained from the Pattern Matching administration of the MI, the Pattern Matching scores were dropped entirely from the analyses.

The investigator who was administering the MI for the main study noted a low ceiling effect for the Pattern Matching Task. This investigator, when scoring the protocols also noted the relative lack of difficulty the older and the higher IQ students seemed to be having in responding to the Interview questions to the Pattern Matching Task. Metacognition has been hypothesized to be a largely automatic process and just out of consciousness unless the process is slowed down in some way -- either by its

Table 11. Re-test Reliability - Metacognitive Interview -
Kemler (MI-K)

Problem Definition	.72**
Planning	.80**
Strategy Selection	.67**
Flexibility	.14
Monitoring	.48*
Clarity	.77**
Specificity	.69**
Reflectiveness	.73**
Organization	.90**
Conceptualization	.77**

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

novelty or by its difficulty (Flavell, 1975). Therefore, it is very possible that because of its low ceiling effect, the Pattern Matching was not a good task to elicit awareness of metacognitive processes.

A new principal component analysis was again computed for the eight remaining MIK scales. The two new components were:

Component 1	Component 2
Reflectiveness	Problem Definition
Specificity	
Clarity	
Planning	
Conceptualization	
Strategy selection	
Organization	

Because of the unexpected differences in the results from the MI using the Kemler and the Pattern Matching tasks, these two sets of scores were correlated. Table 12 lists the correlation coefficients which, although significant, are generally low, ranging from .12 (Flexibility) to .52 (Problem Definition). Therefore, even though the questions and scoring were identical, the two administrations of the MI yielded surprisingly unrelated results. In other words, they may have measured something different. Since order effects were virtually nonexistent, the most likely hypothesis is that the lack of shared variance is due to the differences in the cognitive tasks, themselves. This further suggests that an

individual's metacognitive activity at a given point in time is determined at least in part by the demand characteristics of the setting.

Insert Table 12 about here

Cronbach's alpha was calculated for the MIK. Inter-item correlations were .07; inter-item covariances were 7.46. The squared multiple correlations ranged from .46 (Flexibility) to .83 (Planning) (see Table 13). The alpha's if the scale were deleted were all .82 or above. However, the corrected item to total correlation suggested that interpretation of one scale be made with caution. Problem Definition (.32) had a weak relationship to the overall score. This scale formed the second component on the MIK, and so these results support the results of the principal component analysis, suggesting that the scale is more tenuously related to the main body of the test. Nonetheless, analysis of variance results were significant ($df = 107,756$; $p \leq .0000$) as was Hotelling's T-square ($p \leq .0000$). The alpha was .87. Results suggest the MI is promising but that the Problem Definition scale should be used with caution. More work is required to elaborate the strengths and weaknesses of this test.

Insert Table 13 about here

Table 12. Correlations of administrations of the Metacognitive Interview - Pattern Matching (MIPM) with the Metacognitive Interview - Kemler (MIK)

	Kemler
Pattern Matching	
Problem Definition	.52**
Planning	.51**
Strategy Selection	.37**
Flexibility	.12
Monitoring	.21*
Clarity	.45**
Specificity	.50**
Reflectiveness	.51**
Organization	.37**
Conceptualization	.53**

* $p \leq .05$
 ** $p \leq .01$
 *** $p \leq .001$

Table 13. Cronbach's Alpha - Metacognitive Interview - Kemler
(MI-K)

	Corrected item - total correlation	Squared Multiple correlation	Alpha if Scale deleted
PD	.32	.76	.90
P	.72	.83	.84
SS	.70	.76	.84
F	-	-	-
E	-	-	-
Cl	.87	.80	.83
SP	.86	.81	.83
R	.89	.81	.82
AE	-	-	-
O	.75	.69	.84
CO	-	-	-

3.3.2.3 Validities

To assess concurrent validity, a regression analysis was performed separately for the two principal components derived from the MIK. Dependent variables were the two MIK components; independent variables were the 12 scores from the concurrent validity battery.

As can be seen from Table 14, only three correlations reached significance. The R^2 of .76 was not significant. Only Markman's Magic Trick correlated significantly with the first MIK component. The essential metacognitive activity involved in the Magic Trick is monitoring. It would seem that even without the Monitoring Subscale, the MIK is assessing the monitoring aspect of metacognition as previously defined by Markman (1977).

Insert Table 14 about here

Table 14 also lists the coefficients for the correlation of the second MIK component with the validity measures. Again two techniques, PO-Note 1 and Numbers Backwards correlated significantly with this component. Again, the predictive power was poor ($R^2 = .48$) and nonsignificant. PO notes refers to the use of a note to remember to take the skates to school. A note is a relatively common (external) mnemonic. This validity variable correlated significantly with the second MIK component which is composed exclusively of the Problem Definition subscale suggesting that the MIK is assessing the Problem Definition aspect of metacognition as defined by Kreutzer et al. (1975).

Table 14. Concurrent Validity - Metacognitive Interview -
Kemler (MIK-1 and MIK-2)

	MIK-1	MIK-2
Preparation Object - Total	-.104	.066
Preparation Object - Skates 1	-.277	-.192
Preparation Object - Skates 2	-.159	-.040
Preparation Object - Skates 3	-.296	-.053
Preparation Object - Note 1	.330	.414*
Preparation Object - Note 2	.022	-.353
Preparation Object - Self 1	-.049	.161
Preparation Object - Other	-.144	.129
Numbers Backwards	.254	.428*
Folk Tales	.161	-.028
Magic Tricks	.412*	.325

* $p \leq .05$
 ** $p \leq .01$
 *** $p \leq .001$

The second MIK component also correlated significantly with the Number Backwards subtest of the WISC-R (Wechsler, 1974). A priori hypotheses had anticipated the association to be between Numbers Backwards and the Monitoring Scale. The unexpected correlation found here supports the connection between the MIK and metacognition as defined by previous authors and in addition suggests that completion of the task may require continuous problem redefinition or reminding oneself of the nature of the task at hand.

From the results, it seems clear that the MIK is measuring the monitoring and problem definition aspects of metacognition. However, it did not correlate with the Folk Tales techniques. Neither the MKAQ nor the MI showed a relationship with the aspect of metacognition measured by the Japanese Folk Tales.

With regards to external validity, Table 15 shows that there was no relationship between the MIK and the measures in the external validity battery.

Insert Table 15 about here

The absence of a relationship between the Kemler repetitions score and the MIK suggests that the Interview may be measuring something other than explicit metacognitive behaviour. While it may measure an aspect of metacognitive thinking that also underlies the concurrent validity measures, it may not describe the behaviours elicited by the cognitive task. Possibly, the children answered as they thought they were Table

Table 15. External Validity - Metacognitive Interview (MIK)
with the Kemler Task

Kemler Task	MIK-1	MIK-2
Mean time (KX)	.05	.00
Repetitions (KR)	-.11	-.14 ($p \leq .07$)

* $p \leq .05$

** $p \leq .01$

*** $p \leq .01$

supposed to, not necessarily describing what they actually did. This hypothesis of the difference between metacognitive thinking and overt metacognitive behaviour will be elaborated in Chapter 4. It must also be remembered that the Kemler-R score is a new construct with no available psychometric data. That it showed a significant correlation with the MKAQ is partial support for its concurrent validity. That it showed no correlation with the MIK may say nothing significant about either the MIK or the K-R!

Although the Metacognitive Interview - Kemler shows promise, further work needs to be done before interpretations can be made with confidence. It is a relatively internally consistent test, with good re-test reliability. However, the scoring needs improvement. Moreover, the extent to which it is measuring metacognition as had been defined by other investigators remains unknown.

Finally, the relationship between the MKAQ and the MIK was examined in a set of regression analyses, one for each grade level and program level. Table 16 presents the findings. It will be noted that all of the correlations at each grade level are small and nonsignificant. Furthermore, although only the multiple R at the grade 8 level was significant ($p \leq .05$), the pattern was such that prediction was best at the grade 8 level and poorest at the grade 6 level. This partly supports the hypothesis that the similarity between knowledge and application would be greatest among the older children. Once again, however, there is not a clear developmental trend. At the grade

6 level, the prediction was weakest. The hypothesis here remains that these children are entering a new (set of) developmental stages and patterns are not clear. This will be elaborated in Chapter 4.

Insert Table 16 about here

Table 16 also shows the correlations and multiple R's between the MKAQ and the MI for program. Again, there is partial support for the hypothesized relationship between intelligence and the ability to use metacognitive knowledge in behaviour. To the extent that the MIK is measuring what the children actually did (as opposed to what they said they had done) this relationship is closer for the gifted than the average. The R^2 for the gifted group and for the first component of the MIK and the MKAQ are both significant. The MIK and MKAQ relationship is not significant for the second component (Problem Definition).

It is noteworthy that the MIK and especially the MKAQ are internally sound tests with acceptable psychometric parameters for their components. With respect to the subscales, problems arose with either re-test and/or intrarater reliabilities. Two scales, in particular, Flexibility and Monitoring, were consistently problematic. This may suggest that measurement of the processes contributing to metacognition is difficult. It may also suggest that Flexibility and Monitoring are not related

Table 16. Correlation between the Metacognitive Knowledge Assessment QUestionnaire (MKAQ) and the Metacognitive Interview (MIK)

	Grade 3	Grade 6	Grade 8	Gifted	Average
	MKAQ	MKAQ	MKAQ	MKAQ	MKAQ
MIK-1	-.04	.23	.04	.29**	.15
MIK-2	.34	.13	.39	.21	.10
Multiple R	.35	.25	.40*	.39*	.17

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

to metacognition in the same way as the other processes. This hypothesis will be elaborated in Chapters 4 and 5.

3.4 Personality Measures

3.4.1 MFF, CSD, STAIC, WUSC

3.4.1.1 Data Screening

The initial screening of the personality measures (other than the Rorschach which will be handled separately) indicated that only two scores were both peaked and skewed. The Matching Familiar Figures (MFF) - total time (MFF-T) and MFF mean latency (MFF-X) both met linearity requirements with natural logarithmic transformations. The CSD, STAIC 1 and 2, MFF error scores, and the WUSC score were all usable in their raw form. MFF ratios were calculated for MFFr (reflective) and MFFi (impulsive).

3.4.1.2 Reliability

Intrarater reliability was calculated for the Total Protocol Rating of the Washington University Sentence Completion Test. The double scoring was accomplished in the same way as the reliability check for the MKAQ and the MI. After the Loewinger tests had been scored and after an interval of 2 months, 20 protocols were selected and rescored by the same investigator. The protocols were selected to represent even distribution across the cells but at random within the cells. The intrarater reliability for the Total Protocol Rating (TPR) was .80.

3.4.1.3 Canonical Correlations

It had been planned to run one canonical correlation to

compare the metacognitive components with the personality variables. The reality of only 80 valid Rorschach protocols made separate analyses of the Rorschach mandatory. Eighty cases would have limited the analyses to a maximum of eight variables but eleven variables were available for the canonical correlation. Therefore, the first canonical correlation included the 3 metacognitive components (the single MKAQ component and the two components from the MIK) as dependent variables and program, grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, WUSC, as covariates. Unfortunately, only 86 cases were accepted and so the results of this analysis are suspect. However, the results of this first canonical correlation will be reported here since those results were used to guide decision-making concerning the variables to be included in subsequent canonical correlations.

The first canonical correlation was .72 (68% of the variance); the second was .57 (31% of the variance); the third was .17 (1.8% of the variance). All three correlations were significant (MKAQ, $p \leq .000$; MIK-1, $p \leq .000$; MIK-2, $p \leq .015$). With all three canonical correlations included, the Roy-Bargman stepdown F was 6.252 ($p \leq .000$). With the first canonical correlation removed the F was 3.88 ($p \leq .001$). With the first two canonical correlations removed, the F was 3.538 ($p \leq .002$). Therefore, all 3 pairs of canonical variables contributed to the significant relationship between the two sets of variables but the third variate captured less than 2% of the variance and

therefore will not be interpreted even though regression analysis yielded a significant F ($p \leq .015$).

Data on the first two pairs of canonical variates appear in Tables 17a, b, c, 18 and 19. Shown in the tables are the correlations between the variables and the canonical variates, standardized canonical variate coefficients, within-set variance accounted for by the canonical variates (percent of variance), redundancies and canonical correlations.

Insert Tables 17a, b, a, 18, and 19

Total redundancy indicates that the first pair of canonical variates was moderately related, but the second pair was only minimally related; interpretation of the second pair is marginal.

The variables in the covariates that were significantly related to the first canonical (metacognitive) variate were program ($t = -2.15$; $p \leq .03$); grade ($t = 4.625$, $p \leq .00$ and STAIC1 ($t = -2.144$, $p \leq .035$). The variables in the covariates that were significantly related to the second canonical (metacognitive) variate were program ($t = -2.540$, $p \leq .013$); grade ($t = 3.681$, $p \leq .000$); and CSD ($t = 2.274$, $p \leq .026$). The standardized coefficients and the correlations suggest strong relationship between program, grade and STAIC 1 and MKAQ, and a moderate relationship between program, grade and CSD and MIK-1.

Therefore, program and grade seem to be clearly related to both measures of metacognition. There may also be a relationship

Table 17a. Standardized Canonical Coefficients and Canonical Correlations between the three Canonical Variables and Program, Grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, and WUSC - ROOT 1

Dependent Variables	Standardized Canonical Coefficient	Correlations with Canonical Variate
M1	.68166	.48679
MI1	.55909	-.53082
MI2	-.05589	.62726
Covariates		
Grade	.89611	.86583
Program	-.41870	-.46725
MFF-r	-1.17510	-.36897
MKK-i	1.20606	-.37914
STAIC 1	-.12452	-.08672
STAIC 2	.06475	-.12877
CSD	.20289	-.10359
WUSC	.11211	.63080

Table 17b. Standardized Canonical Coefficients and Canonical Correlations between the three Canonical Variables and Program, Grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD and WUSC - ROOT 2

Dependent Variables	Standardized Canonical Coefficients	Correlations with Canonical Variables
M1	.56777	.22832
MI1	-.52365	-.35575
MI2	-.88376	-.77406
Covariates		
Grade	.41579	.18883
Program	.46191	.43236
MFF-r	-4.01200	.23667
MFF-i	4.29279	.23145
STAIC 1	-.85191	-.67733
STAIC 2	.07888	-.13772
CSD	-.38173	-.21188
WUSC	-.15888	-.19310

Table 17c. Standardized Canonical Coefficients and Canonical Correlations between the three Canonical Variables and Program, Grade, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD and WUSC - ROOT 3

Dependent Variables	Standardized Canonical Coefficients	Correlations with Canonical Variables
M1	.60728	.48679
MI1	-.72277	-.53082
MI2	.51131	.62726
Covariates		
Grade	-.50562	-.23531
Program	-.48223	-.45780
MFF-r	-6.45979	.31995
MFF-i	-5.74654	.32206
STAIC 1	-.21831	-.15921
STAIC 2	.19450	.15004
CSD	-.46670	-.32492
WUSC	.59445	.38456

Table 18. Regression Analysis for Within Cells Canonical Correlation - Metacognitive Components with Grade, Program, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, WUSC

Dependent Variable	Squared Multiple R	F	Significance of F
MKAQ	.39379	6.25242	.000
MI1	.35753	5.35615	.000
MI2	.21228	2.59381	.015

Table 19. Redundancies - Metacognitive Components with Grade, Program, MFF-r, MFF-i, STAIC 1, STAIC 2, CSD, WUSC

Canonical Variate	Variance explained by canonical variables of the covariates - Dependent variables	Variance explained by canonical variables of dependent variables - Covariates
1	10.93257	22.72373
2	3.67344	8.54135
3	.27145	.85490

between state anxiety as measured by the STAIC 1 and the MKAQ and between a people pleasing coping style as measured by the CSD and the first component of the MIK. The last two relationships are understandably negative.

In the first canonical correlation only 91 cases had been accepted but 11 variables had been entered. Therefore the results could be called into question. Under strict application of statistical rules, 91 cases would permit the entry of a maximum of 9 variables. For this reason a second canonical correlation was applied to the MKAQ, MIK-1, MIK-2 as dependent variables and the independent variables which had shown a significant correlation as covariates. The covariates were: program, grade, STAIC1, CSD and the WUSC. The WUSC was included in case a small but significant relationship existed which had been masked by the inclusion of nonsignificant covariates in the first canonical correlation.

Tables 20a, b, c, 21, 22, 23 show the correlations, standardized canonical coefficients, R^2 and redundancies for this second analysis. The first canonical correlation was 73.68 (52% of the variance); the second was .52 (27% of the variance); the third was .13 (2% of the variance). The third canonical correlation was not interpreted although all three were significant ($p \leq .000$). The correlations between the dependent and canonical variables indicate high relationship between MKAQ and MIK-1 and the first canonical variable; a high (negative) correlation between MIK-2 and the second canonical variable.

Again, there is a high negative correlation including the MIK-2. The only variable in the second MIK component was Problem Definition. An explanation for this repeated finding will appear in the section on re-defining metacognition. Correlations with the third canonical variable were divided among the three components. The covariates that were significantly related to MKAQ were grade ($t = 5.26, p \leq .000$), program ($t = -2.33, p \leq .02$), with STAIC1 approaching significance ($t = -2.33, p \leq .06$). The covariates that were significantly related to MIK-1 were grade ($t = 4.54, p \leq .000$), program ($t = -3.31, p \leq .004$), and CSD ($t = 2.69, p \leq .01$). The redundancies indicate that the covariates explain approximately 15% of the variance of the first canonical variable; 40% of the variance of the second. The dependent variables explain 23% of the variance of the first canonical variable, 7% of the variance of the second. The pattern is therefore similar to that in the first canonical correlation analysis. The MKAQ component is related to grade, program, and (negatively) to state anxiety. The first MIK component is related to grade, program and (negatively) to a people pleasing coping style.

Insert Tables 20a, b, c, 21, 22

Perusal of Table 20 shows an interesting result. Although the WUSC had not been significantly correlated in either canonical correlation analysis, the test did show an acceptable

Table 20a. Standardized Canonical Coefficients and Canonical Correlations between the three Metacognitive Variables and Program, Grade, STAIC 1, CSD and WUSC - ROOT 1

Dependent Variables	Standardized Canonical Coefficient	Correlation with the Canonical Variable
M1	.650	.835
MI1	.580	.785
MI2	.011	.153
Covariates		
Grade	.822	.844
Program	.467	-.526
STAIC 1	.051	-.009
CSD	.235	-.094
WUSC	.130	-.630

Table 20b. Standardized Canonical Coefficients and Canonical Correlations between the three Metacognitive Variables and Program, grade, STAIC 1, CSD and WUSC - ROOT 2

Dependent Variables	Standardized Canonical Coefficient	Correlation with the Canonical Variable
M1	.598	.282
MI1	-.464	-.301
MI2	-.884	-.782
Covariates		
Grade	.360	.286
Program	.484	.382
STAIC 1	-.804	-.687
CSD	.447	-.303
WUSC	-.157	-.151

Table 20c. Standardized Canonical Coefficients and Canonical Correlations between the three Metacognitive Variables and Program, Grade, STAIC 1, CSD and WUSC - ROOT 3

Dependent Variables	Standardized Canonical Coefficients	Correlation with the Canonical Variable
M1	.610	.473
MI1	-.748	-.541
MI2	.508	.604
Covariates		
Grade	.638	-.229
Program	-.211	-.564
STAIC 1	-.199	-.190
CSD	.572	.436
WUSC	-.701	-.616

Table 21. Regression Analysis for Within Cells Canonical Correlation - Metacognitive Components with Program, Grade, STAIC 1, CSD, and WUSC

	Squared Multiple R	F	Significance of F
MKAQ	.3907	10.8999	.000
MIK-1	.3527	9.2693	.000
MIK-2	.1858	3.8790	.003

Table 22. Redundancies - Canonical Correlation - Metacognitive Components with Program, Grade, STAIC 1, CSD and WUSC

Canonical Variate	Percent of the Variance of the Dependent Variables	Percent of the Variance of the Covariates
1	23.36	14.62
2	7.14	4.47
3	.48	.32

(.63) correlation with the first canonical variate. It was hypothesized that the grade effect was so powerful overall, that no interpretable relationship would be found if grade were entered first.

Therefore it was decided, post hoc, to perform a regression analysis on the MKAQ in which grade was entered first and then the WUSC scores were entered. The R^2 change with the entrance of the Loevinger variable was .04. The 4% increase in additional variance captured, while significant ($p \leq .0000$) is not appreciable. This suggests that most of the variance in the MKAQ related to development is accounted for by chronological maturation (age maturation) with a small amount contributed by ego development.

3.4.2 Rorschach

3.4.2.1 Data Screening

Initial screening of the Rorschach data revealed several compromising problems. Transformations were required on 18 of the 32 Rorschach scores in order to improve linearity. Twelve of these scores were both peaked and skewed; the remaining six were skewed only. Using the natural logarithm, 13 of these 18 scores were then able to meet the linearity requirement and were entered into the analyses.

The scores that were entered for the principal component analysis on the Rorschach were Developmental Quotient vague (DQv), Developmental Quotient Plus (DQ+), Human Movement Active: Human Movement Passive (Ma:Mp), Active: Passive (a:p), Whole

percepts (W), Common Detail percepts (D), Unusual Detail percepts (Dd), Human Movement (M), Human Movement minus (M-), Lambda (L), Space minus (S-), Form Dimension (FD), Organizational Activity frequency (Zf), Organizational Activity style (Zd), Form Quality Plus (F+%), Extended Form Quality, (all responses) (X+%), Perceptual-Mediation Distortion, (all responses) (X-%), Populars (P) (see appendix X for an explanation of the interpretation of these scores). Unfortunately, the scores relating to self concept, (2) (pairs) and Fr (reflections), were not usable. However, the requirements were met by the FD (Form Dimension) score, which relates to a psychological activity involving self inspection, or a least self-awareness. The principal component analysis with varimax rotation yielded a scree plot that suggested 5 clear components. The first was clearly an active/passive component. The Active: Passive ratio and the Human Movement Active: Passive ratios were the only scores to load on this component. The second component seemed to be a cognitive inclusiveness and reflectiveness component: W (Whole percepts), Zf (Organizational Frequency), Zd (Organizational Activity style), DQv (Developmental Quotient Vague), FD (Form Dimension), and L (Lambda) (negative) loaded on this factor. The third component appeared to be a cognitive specificity component: its loadings were X+, F+ (Form Quality Plus, all responses and Form responses only), and X- (Form Quality Minus, all responses) (negative). The fourth component was confusing, having loadings of both M and M- (Human Movement

and Human Movement minus), both in the same direction. The other two loadings on this component were Dd (unusual detail) and DQ+ (Developmental Quotient Vague). The fifth component clearly related to an active involvement in organizing and/or in making sense of the environment. Its loadings were Zd (Organizational Activity) and P (Populars) (negative).

3.4.2.2 Reliability

Using a criterion of .70 or above, fifteen of the 32 interrater reliability coefficients were within acceptable limits (see Table 23). This discrepancy is likely due to the relative inexperience of the second rater. Scores that met none of the criteria for linearity or interrater reliability were dropped from the analyses. The exception was P (Popular). This score was critical to the analyses. The Popular (P) score relates to the ability to perceive and respond to the commonplace features of the blots. This ability to recognize the commonplace and important features of a situation was thought to be essential in the problem definition aspect of metacognition. Since this was an exploratory study and the results of the interrater reliability had been questionable, it was decided to retain this score.

Insert Table 23 about here

3.4.2.3 Canonical Correlation

It was not possible to use the Rorschach components in the larger canonical correlation. Using a cut-off of 12 responses

Table 23. Rorschach - Interrater Reliability

T	1.0**
DQr	.50*
DQ+	.56*
Ma	.60**
Mp	.86**
a	.71**
p	.83**
2AB	.62**
M-	.74**
S6	.16
LV2	-.17
WSG	-.06
P	.41
X+	.67**
F+	.62**
X-	.77**
S-	.33
Xu	.70**
Zf	.93**
Zd	.51*
W	.96**
D	.96**
Dd	.73**
M	.89**
L	.42
FD	.66**
(2)	.17
Fr	.30
MOR	.80**
es	.80**
aes	.79**
EA	.76**

* $p \leq .05$
 ** $p \leq .01$
 *** $p \leq .001$

considered marginally valid (Exner, 1978), 80 valid protocols were obtained. Had the Rorschach been used in the larger canonical correlation with its sensitivity to missing data, only 80 cases would have been available for analyses thus limiting the number of variables to a maximum of 8. It was therefore decided to analyze the Rorschach data separately.

Therefore, a separate canonical correlation was performed between the three metacognitive components as dependent variables and the five Rorschach components as covariates. No outliers were identified. The first canonical correlation was .39 (15% of the shared variance); the second was .35 (12% of the shared variance); the third was effectively zero. None of the canonical correlations was significant.

3.5 Summary

Therefore this study met its objectives, with some caveats. Two measures of metacognition were developed which are internally consistent, with adequate re-test reliabilities and generally good concurrent validities. Intrarater reliability was good for the MKAQ but revealed problems with the MI scoring. Both tests show developmental trends, although the pattern will require some explanation, and a clear relationship with intelligence. Both tests are sounder for summed and composite scores, more questionable for individual subscales. More work is needed on both if they are to be used in clinical assessment. For the purposes of this exploratory study the psychometric parameters were sufficiently strong to proceed with the

Chapter 4

Discussion

The statistical results reported in Chapter 3 essentially confirm the research hypotheses raised in Chapter 1. Two measures of metacognition were developed. The Metacognitive Knowledge Questionnaire (MKAQ) assesses a child's general fund of metacognitive knowledge. The Metacognitive Interview (MI) assesses metacognitive experience during a problem-solving task. Psychometric data for both suggest that neither is yet in a form that can be used for clinical assessment. However, given the exploratory and theoretical nature of this study, both have sufficient intrarater and re-test reliabilities and concurrent validities to be used in the statistical analyses of this project. Both tests were subjected to principal component analyses and the components entered into the canonical correlations.

Results of the canonical correlations with the metacognitive components as dependent variables and grade program and the personality variables as covariates, indicate that chronological age and intelligence account for much of the variance. However state anxiety and a people-pleasing coping style were also significantly related. A separate regression analysis indicated that ego development may also be implicated.

Therefore, in general, the results indicate support for the research hypotheses. However, within this overview, some interesting patterns emerged which require explanation. Chapter

4 will be devoted to those explanations.

4. Measures

4.1 The Metacognitive Knowledge Assessment Questionnaire -- MKAQ

Essentially, this study can be divided into two main parts. The first part, and the core of the study has been the development of the measures of metacognition and the examination of their psychometric properties. The second part of the study has been an attempt to determine what part, if any, personality characteristics play in metacognitive efficiency and inefficiency. The results of both aspects can be used to develop a model for thinking about and measuring metacognition.

The first section, development of measurements of metacognition was partly successful. The MKAQ questionnaire is clearly a sturdy instrument. It has only one factor and the internal consistency is high. However, procedures to investigate reliability and validity revealed interesting anomalies.

4.1.1 Metacognitive Knowledge Assessment Questionnaire (MKAQ) - Reliabilities

In spite of a complex scoring system, intrarater reliability is high. Thus the cohesiveness of the measure is not in question. However, further investigation needs to be undertaken to see if it is possible to train new scorers and to calculate interrater reliabilities. The MKAQ was not scored for person, task and strategy variables (Flavell, 1979). Future

undertakings might attempt to score for these scales and to see if it is possible to score the questionnaire for the strength of self-other differentiation.

In this investigation, there were clearly problems with re-test reliability. Reliability coefficients for summed scores and for the principal components were low but acceptable. Coefficients for individual process scales were disappointing. Similar results were reported by Nandi (1991), Clements and Nastasi (1990), Swanson (1992a), and Ormond et al. (1990). When the results were analyzed separately by grade and program levels, interesting and perhaps informative patterns emerged. The number of acceptable re-test coefficients was highest for grade 3 and lowest for grade 6 and gifted students. The coefficients for the grade 8 and regular-stream students were in the middle. At first glance this may seem to be contradictory and confusing. However, it seems clearly related to the developmental and intelligence aspects of metacognition noted in Chapter 3 and elaborated below.

It is likely that the 6-week interval in the re-test reliability study was too short for the grade 6 students and maybe for the grade 8 students, as well. Whether one talks about cognitive development or personality development, the child at age 11 to 12 is entering a new developmental stage and is going through rapid changes (Ginsburg & Oppen, 1969; Loevinger, 1976). The changes can be unsettling so that they do not yet have sufficient control over their new skills to be able

to stabilize their external responses. It is possible that for this age group the changes are reflected in the instability of their re-test scores. Grades 3 and 8, on the other hand, are in the middle or at the end (rather than the beginning) of their Piagetian stages and theoretically that they have had time to consolidate their gains and to feel comfortable with their new skills and therefore to be able to use them as needed.

Moreover, unlike the MI which has less of the appearance of a test, the structure and content of the MKAQ has very much the appearance of a school-type test. With academic tests, students would be unaccustomed to having the identical test administered a second time. Those that recalled the first test may have been puzzled at the request to answer the same questions again. This would set up different demand characteristics for the second test. For the children who remembered the first administration, presumably the older and/or more intelligent children, this second administration would in some way be a different test. Similarly, those children who remembered the previous items may have spoiled the second set of answers. Indeed, frequently, the older and gifted-stream children received lower scores on the second administration.

The MKAQ also questions metacognitive awareness in a less direct way than the MI. The MI essentially asks what the child did, how she would describe it to a friend. The MKAQ, on the other hand is more remote: it asks about tasks in the abstract. This is because the MKAQ was designed to measure the child's

fund of general knowledge about metacognitive processes; the MI was designed to explore the child's metacognitive experience during the cognitive task. The metacognitive knowledge/metacognitive experience is a split generally accepted in the literature at this point (Flavell, 1979; Jiannong, 1990; Kinsbourne, 1992; Kreutzer et al., 1975; McBride, 1991; McLain et al., 1991; Ormond et al., 1991; Presley et al., 1984; Yuang-cheng, 1991). It may be that given the developing child's egocentricity what develops first is a sense of their own (metacognitive) experience which is closer to their personal knowledge base. Later to develop is an observation of the behaviour of others and therefore of general metacognitive knowledge which further acts on the self knowledge, refining and expanding it. Ideally, this again acts on the general knowledge and so on in an expanding and increasingly differentiated spiral. Adolescence has been characterized as a time of self doubt which may cause the adolescent to be more easily threatened in the security of her self knowledge. Add to this the re-test demands, which would be unusual for her and hypothetically the pattern observed in the test re-test of the MKAQ may be the result.

4.1.2 The Metacognitive Knowledge Assessment Questionnaire (MKAQ) - Validities

Of more concern are the problems with validity. Regression analyses were run separately for each of the three metacognition components (MKAQ, MIK-1, MIK-2) on the validity measures.

For the MKAQ, the overall R^2 was not significant but significant correlations were noted between the MKAQ and PO-total, PO-Notes 1, PO-other, Numbers Backwards and Magic Tricks.

The questions in MKAQ require planning and analysis similar to that in Preparation Object. In PO the child must find a mnemonic or strategy to aid in remembering to take her skates to school the next day. In Section A, which can account for about two-thirds of the subscale scores of the MKAQ, the child must find a strategy to get home (with no money), and to study mathematics (with no text). The demands of the situation are to find a strategy to aid in a relatively normal/conceivable situation. The similar demand characteristics likely result in similar metacognitive activity. This could explain the correlations noted, here.

The Numbers Backwards test was included as a non-verbal, visual measure of metacognition. Although the instructions are verbal, unlike the Japanese Folk Tales and Markman's Magic Trick, what is manipulated in the test is not. The relationship between the Numbers Backwards and the MKAQ component suggests that the test is able to examine non-verbal aspects of metacognition as well as the more customarily measured verbal aspects. Of course, it is curious that Numbers Backwards did not correlate with the first and stronger of the two MIK components. This may be because the monitoring subscale was deleted from the MIK analyses. Monitoring is an essential activity in the execution of Numbers Backwards.

The results indicate that the MKAQ test shows a correlation with the validity measures. Moreover, it does so across the different types of validity measures. This suggests that the MKAQ is measuring metacognition -- as operationally defined by previous authors. However, prediction of MKAQ scores from the validity measures was not significant, so use of this test is limited without further investigation to understand more precisely what the MKAQ measures relative to other tasks or instruments.

4.1.3 The Metacognitive Knowledge Assessment Questionnaire (MKAQ) - Summary

The MKAQ clearly needs more work if it is to be a useful clinical tool or a more informative research instrument. Additional information is needed about short term reliability. If it is so sensitive to changes, the time parameter needs to be studied and perhaps lengthened. If the test is useful only for younger children, the age range also requires specification. Following, and perhaps included in investigations of this nature, there needs to be further examination of the scoring system, training of new scorers, and an examination of interrater reliability. Scoring for person, task and strategy variables, as well as self-other dimensions should be attempted. Training studies would also provide useful information with regards to the MKAQ's sensitivities to changes in the individual.

Correlations with validity measures are encouraging.

However, the associations were not strong enough to reach predictive significance suggesting that the MKAQ is also measuring something different from that measured by previous metacognition assessment techniques. It is also possible that techniques such as Numbers Backwards measure something in addition to metacognition, for example, memory. It may also be that the number of independent variables resulted in significant and non-significant correlations which cancelled each other out. What is required, at this stage, is a study designed to look specifically at the validity correlates of the MKAQ to assess whether or not predictive validity is actually higher than it appeared to be in this study. If predictive validity remains low it is important to ask whether the MKAQ is measuring an aspect of metacognition not previously assessed in the literature. Answers to questions of convergent, divergent and construct validity would be important here. Clearly, more work is needed to understand the pattern of validities observed in this study.

Metacognition is a construct which consistently poses problems in measurement (see Chapter 5). Therefore, in spite of the caveats noted above, the results of this investigation into the parametric characteristics of the MKAQ suggest that it warrants further scrutiny.

4.2 The Metacognitive Interview - (MI)

The second measure of metacognition, the Metacognitive Interview - Kemler, presented a different picture, altogether.

Internal consistency is reasonable. The measure has one main component, one single-variable component. Clearly, again, the measure is sturdy although interpretation of subscales, especially Flexibility and Problem Definition should proceed with caution.

It is of interest that the two factors of the MI are slightly different for the two different cognitive tasks, the Kemler and Pattern Matching. One explanation that would appear to fit most of the questions in this section has to do with the nature of metacognition, itself. Perhaps metacognition is a valid, useful, sturdy concept. Perhaps, too, metacognition has several components. But perhaps, the measurement of these components as distinct entities, is difficult. Instead, it is possible that the components of metacognition are part of a pattern. On their own, their variability limits their meaning but together they form a pattern or total that is consistent and meaningful. Furthermore, the integrity of the pattern depends on the contribution of the components but the weighting of the components in relation to the whole may vary depending on several factors. In a given situation, which components have priority or stand out clearly depend, in part, on the metacognitive skills of the individual. But perhaps, they also depend on the demand characteristics created by the examiner and the task (this investigation), or more generally, the demand characteristics of the surroundings, the problem to be solved, and perhaps the consequences or rewards pursuant to

solving the problem. As Rueda and Mehan (1986) conclude, "metacognition...is not general skills that are applied uniformly in all contexts, but are context specific practices that make their appearance on some but not all occasions of interaction" (Rueda & Mehan, 1986, p. 161). This view of metacognition would explain the fact that two different factors emerged for the Metacognitive Interview. As outlined above, it may also help to explain the low re-test coefficients for the individual processes in the MKAQ.

Another possible explanation for the different sets of components relates to the difficulties encountered with the Problem Definition, Monitoring, and Flexibility scales. All three scales showed problems with linearity, re-test reliability or both. Monitoring and Flexibility were dropped from both measures. Children tended to score zero on the Monitoring scale. Problem Definition showed a weaker relationship with the other scales in the MIK as evidenced by its separate place in a second component and by the results of the analysis for internal consistency.

It is possible that the components of metacognition do not all emerge at the same time. Observations during scoring of the protocols suggest that, developmentally, strategy selection may be the first metacognitive activity to emerge. It is not that young children are not aware of the other metacognitive activities - Section C of the MKAQ (true-false items) yielded better results with other scales than did the open-ended

questions of Section A. However, even in Section C, younger children tended to receive zero scores for Monitoring and lower scores for Flexibility. Similar results were found in Nandi's (1991) investigation. It is possible that Problem Definition is a later emerging component. This is supported by the work of Ormond et al. (1991). These investigators found that among their early adolescent subjects, there was little recognition that decision-making activity involves a clear specification of goals (problem definition), consideration of options (flexibility) and checking (monitoring) before taking action to implement a decision. Other authors (e.g., Schoenfeld, 1983; Bransford, 1986) report similar findings. It is possible that Flexibility and Monitoring are even later to emerge. Theoretically, the emergence of Flexibility and Monitoring could signal the beginning of what might be called "true" metacognition - that is, the executive function that investigators are beginning to pursue but have not yet measured.

4.2.1 The Metacognitive Interview (MI) - Reliabilities

Intrarater reliabilities for the Metacognitive Interview - Kemler were low, possibly due to the nature of the scoring system. There are two considerations here.

First, the scoring system was initially designed for use with the Metacognitive Questionnaire and applied with only minor changes to the Metacognitive Interview. After administration of the MI to 14 children in the pilot study, some questions were deleted (see Chapter 2). However, the instrument remained

largely intact. After using the modified scoring system to score 177 protocols, the author noted that the fit between the scoring system and the test was poor. The wording of the questions often elicited a wide range of responses from the children -- responses not directly linked to the component supposedly under scrutiny. In and of itself, a question sufficiently open-ended to elicit a wide range of responses is not bad. However, the adaptation of the scoring system allowed only one precise componential interpretation for each question. The poor fit increased the difficulty in scoring. This difficulty was especially noticeable on the question, "Is there another way to solve the task? Take a moment, what other ways might you suggest?", designed to elicit a response on the Flexibility scale. Few responses indicating flexibility were recorded anywhere in the protocols -- perhaps because of the nature of the test, as has been noted above. However, when response-flexibility was observed, more often than not it was embedded in the answer to: "If your friend was having difficulty understanding what to do, how would you describe what you did?" or "Are there any important things you may have forgotten to tell your friend about the game?". These two questions were planned to elicit information about Problem Definition and Planning. While the examiner tried to be consistent in her scoring, she was aware of the temptation to score the Flexibility question to indicate flexibility when it had been demonstrated earlier. This temptation was present to a lesser

extent with the other questions, as well. The extent to which this interfered is not known.

Second, because the scoring system for the MI had been adapted from an early edition of the scoring system of the MKAQ, some of the scores were less than optimally differentiated. The Monitoring and Evaluation Scales were especially problematic in this regard. However, the Reflectiveness and Conceptualization scales were also difficult to differentiate based on the scoring system. While these scoring problems also continued to plague the MKAQ, its greater flexibility built into the standardized scoring facilitated the differentiation process. However, the MI did not allow for this flexible approach. The author was aware of attempting to maintain standardization of scoring, while giving the children scores that would reflect their work. In practical terms, the danger was that too many scales would have values of zero. Again the effect on accuracy is not known but to the extent that it effected standardization, it most certainly will have also effected intrarater reliability.

Re-test reliabilities for the MIK were generally good. Eight of the 10 scales had acceptable reliability coefficients. The two that did not meet the criteria were Flexibility and Monitoring. The difficulties with the Flexibility scale have been discussed above. The Monitoring scale was a problem on all administrations of the MKAQ and the MI. Most children scored zero on the Monitoring scale. In general, this may be due to the poor differentiation in the scoring system between

Monitoring and Evaluation.

More directly related to the problem with the Monitoring scale, and on a more theoretical level, it may be that Monitoring is not on the same level as the other metacognitive abilities. It is perhaps at a superordinate level and is not achieved until later in development. Indeed, the results of this study suggest that Monitoring may represent the executive level of metacognition.

What may also be relevant, here, is the nature or context of the two tests. The structure of the MKAQ is very similar to tests that are administered in school. In this context, identical tests are not generally re-administered. In fact, test questions are often a matter of great security before the fact. Thus a second administration could impose subtly different demand characteristics. On the other hand, the format of the MI is very similar to questions being asked of children in daily life: "Where did you go?", "What did you do?" and so on. The type of administration feeds into this similarity: the MKAQ is a paper and pencil test. The MI is a set of oral questions asked of the child by the examiner. In this context what could be more natural than the same questions repeated over and over! In the context of the current argument, the naturalistic style and content of the MIK would not have imposed different demand characteristics. This may account for the relatively better re-test results.

4.2.2. The Metacognitive Interview (MI) - Validities

With regard to the concurrent validity of the Metacognitive Interview-Kemler, the correlation matrix suggested a significant relationship between the MIK-1 and the Magic Trick technique. These findings would lend support to the expectation that the MIK is related to the monitoring aspect of metacognition as previously defined by Markman (1977). Two cautions must be noted. The first is that the R^2 is not significant. Therefore, although an association exists, prediction of the MI from the other metacognitive techniques is not reliable.

The relationship noted between MIK-2 and the validity measures requires explanation. It must be remembered that the content of the MIK-2 component is Problem Definition. With only one scale, the component is likely to be unstable. However, another issue may be of importance, here. In the discussion above, it was suggested that to respond to questions on Problem Definition and Planning, all the children had to do was give back to the examiner the instructions that had just been read to them. Thus, the Kemler Task may not have been able to elicit Problem Definition information.

Finally, defining the problem before starting to solve it is a metacognitive activity that appears spontaneously relatively late in development (Bransford et al., 1983; Ormond et al., 1991; Schoenfeld, 1983). Therefore, it is not surprising that the children in this sample, especially the younger children achieved low scores on the Problem Definition

scales of both the MKAQ and the MIK. In particular, the MIK, with its open-ended questions and limited requirement for the child to do the defining, would yield lower scores. For a late-emerging skill such as problem definition a multiple-choice or true false or Likert-type question would produce more information with regards to what the younger child can recognize rather than spontaneously produce.

The second MIK component showed a significant (negative) correlation with Preparation Object - Note 1. PO-Note 1 refers to the use of any written reminder. This is a fairly common mnemonic that is external to the self. It is not as concrete as the use of the skates (for example putting them near the door). However, it is also not as internal a mechanism as either of the reminders coded in the self categories - that is, the use of some internal technique such as imaging, or the realization that the excitement of going skating would probably obviate forgetting the skates. This suggests that the second MIK component may be measuring a more concrete, external, developmentally earlier aspect of metacognition. Furthermore, in a sense it is only one step removed from the question, which defines the problem for the child. The response does not need to include a definition of the problem, and does include a solution very close to the problem as defined by the examiner. As such, it is very close to the Problem Definition responses noted on the MIK. Therefore, it may be erroneous to see the relationship as existing between MIK - Problem Definition and

PO-Skates. It may be more helpful to suggest that the MIK is measuring a concrete, developmentally more basic approach to metacognitive activity. The second MIK component also showed a significant correlation with the Numbers Backwards subtest of the WISC-R. This further supports the assertion that the MIK is measuring an aspect of metacognition as has been previously defined. It further suggests that to be successful in this test, the child (or adult) must be continuously reminding themselves that the task at hand is to repeat the numbers backwards.

It is also curious that the Japanese Folk Tales method of assessing metacognitive activity favoured by Brown and her associates did not correlate with any of the three metacognitive components. In spite of consideration given to selecting the least sophisticated of the Folk Tales, it may be that the language of this test is too complex for the grade 3 and regular stream grade 6 children. It will be recalled from the summary in Chapter 1, that the results of studies in the developmental of metacognition indicate that type of stimulus and/or the encoding factor determine the age at which metacognition can be reliably detected. In addition, the task required bringing into consciousness two aspects of the task simultaneously -- reading with understanding and evaluating. Kinsbourne (1991) has written of the difficulties this dual attention imposes -- especially on the younger child. Of course, Markman's Magic Trick makes similar demands, but that is with the spoken, not

the written word. Developmentally, this makes it an easier task. Thus the Folk Tales may have been an inappropriate choice. Or, it may be that these tests, the MKAQ and the MI, do not tap into that level of refinement of metacognitive activity assessed by the Japanese Folk Tales.

Neither MIK-1 nor MIK-2 could be predicted from the Kemler task scores. In other words, neither the success (number of trials) nor the behaviour (number of repetitions) score showed a significant relationship. The correlation with the behaviour score in both instances was in the right direction, that is negative, but was small and not significant. Why would the MKAQ passive knowledge component correlate better with the behavioural measure than did the report of behaviour? It is suggested that the students may have reported what they would, or thought they should do, not what they actually did. Eagle (1967) demonstrated that it is the strategy that the individual actually employs that determines the outcome -- not what she was instructed to do. Perhaps it should also be added, not what she said she did. As Brown (1980) has suggested, there is often a gap between what children indicate they know and what they actually do. Her team demonstrated that only 28% of their ER subjects used the strategy they had predicted was best. Among their regular stream subjects, the older children (grade 3) were more likely to adopt the strategy they had predicted to be best, but the prediction-performance relationship was not a perfect one (see Brown, 1978a). As has been noted above, children

answering questions on the MIK tended to parrot back the examiner's instructions and it may be that they thought they were giving the examiner what she wanted to hear -- regardless of whether or not it was what they had done.

Repeatedly, investigations (eg., Campione & Brown, 1977; Kontos, 1983; Nandi, 1991; Slife, 1985) have shown mixed findings concerning the relation of metacognition to cognitive success. Nandi (1991) suggests that correlations may depend on the type of task and the age of the subject. Therefore, the lack of significant findings in this area of this study is compatible with past findings.

A further regression was performed on the MKAQ using MIK-1 and MIK-2 as predictors. This analysis was split by grade and by program. From the literature (eg., Brown, 1978a, 1980) it was expected that correlation between the two tests would be highest for the oldest and brighter children, and lowest for the youngest and regular stream children. The prediction was based on the gap between passive knowledge (MKAQ) and active utilization of that knowledge (MIK) which is hypothesized to be greater among younger children. In fact, this was not the pattern that emerged. What emerged was a pattern similar to the one that emerged when the MKAQ re-test results were analyzed by grade.

As predicted, the relation was highest for the grade 8 students ($R = .40$, $p \leq .05$). This was also the only significant association. It was second strongest for the grade 3 students

($R = .35$, $p \leq .15$). The correlation was weakest for the grade 6 group ($R = .25$, $p \leq .33$). This partially fits the hypothesis -- there is a close, significant association between the two aspects of metacognition among the highest grades and a less close, nonsignificant relation between the tests at the lowest grade. This makes sense: 8 and 9 year olds do not have the same capacity to decenter and observe themselves, to keep two thoughts in mind as do 14 and 15 year olds (Kinsbourne, 1992). But what of the grade 6 students? Why is it so difficult to predict passive knowledge from active behaviour among this age group? The answer may lie in the same area as that outlined in the discussion of the re-test results above. It may be that the disorganization that this group is experiencing at the beginning of a new cognitive developmental stage is paralleled in the metacognitive domain. Their behaviour, thoughts, strengths, wax and wane from one minute to the next and are not predictable -- therefore no predictable relationships could be found. On top of this disorganization, the task was requiring them to decenter and look at what they were doing, developmentally a difficult task (Kinsbourne, 1992). The results are supported by the findings of McLain's (1991) research.

McLain's group (McLain et al. 1991) also found an uneven pattern in their examination of metacognitive development. Their fourth graders scored highest on the measure of metacognitive awareness, the Index of Reading Awareness (Paris, 1987). However, their fifth graders achieved the second highest

scores and the third graders the lowest scores. The authors suggest that metacognitive awareness may increase before the fourth grade, and then remain stagnant for a time prior to the onset of Piaget's formal operations stage. The results of the investigations under discussion here suggest that the awareness may not become stagnant but does in some way become less usable. What seems clear is that "...conceptualizing metacognitive awareness as increasing steadily with age may be erroneous" (McLain et al., 1991, p. 86).

Another interesting pattern emerged. For the grade 8 students, the significant association was only with MIK-2 and MKAQ ($p \leq .02$). For the grade 6 students, there was no significant relationship, but the relationship was stronger between MIK-1 and MKAQ ($p \leq .21$). For the grade 3 students, the relationship was significant only between MIK-1 and MKAQ ($p \leq .05$). Considering the small sample size, it is not possible to make conclusive statements about this pattern: further research would be required to test the following hypotheses. However, as outlined above, it is possible that it is only among older children that problem definition and flexibility emerge as metacognitive behaviours. Younger children may be aware of problem definition and flexibility activities, but be unable to use these components spontaneously in problem solving. In fact, for younger children, when scoring these tests, the examiner noted an absence of problem definition answers, especially in the paragraph completion section of the MKAQ where there are no

prompts or cues. On the basis of her experience scoring the tests, she hypothesized a sequence of the emergence of the metacognitive components beginning with strategy selection and planning and only later encompassing problem definition and flexibility, then monitoring.

If this development sequence exists, the age gaps in this sample are too wide to make any conclusive statements. Further research on a sample of children in which age groupings were narrower would be required.

The hypothesis was more clearly supported for the intelligence factor. The relationship was strongest for the gifted children ($R = .39$, $p \leq .02$) and weakest for the regular stream children ($R = .17$, $p \leq .47$). In essence, there was no relationship between MKAQ and MIK for the regular stream children. Furthermore, significant among the gifted children, prediction of passive knowledge from active behaviour was good from both MIK-1 and MIK-2. In contrast, among the regular stream students neither association was significant, although the relationship between MIK-1 and MKAQ was closer. This may mean that brighter children of all ages have more knowledge of the hypothetically higher-level components and are more able to use their knowledge of components and metacognitive issues in overt behaviour. But because of the sample size, it was not possible to split the analysis by grade and program at the same time, so it was not known whether this relation is accounted for mainly by the grade 8 scores.

4.2.3 Metacognitive Interview (MI) - Summary

In its present form, the Metacognitive Interview is of limited clinical or experimental use. The test needs to be rethought as a truly concurrent interview and the format of the questions needs work. If they are to be retained to measure the components of metacognition individually, they require rewording. Finally, the scoring systems needs to be revamped and reliability assessed. Re-test reliability is good, as is internal consistency. Both MIK components showed associations with the tests in the concurrent validity battery. Therefore, the Interview does assess metacognitive activity as elicited by both verbal and non-verbal stimuli. However, the associations suggest that interpretation of the MIK be confined to monitoring and to concrete, external aspects of metacognition.

Therefore, in spite of some promising findings, the best use of the MIK is probably as a basis for the development of a truly concurrent interview.

4.3 Metacognition gets personality

This study began with the intention of investigating the personality components of metacognition. The measures and the model of metacognition were developed as a means of making use of a disparate literature. At this point, what can be said of the connection between personality characteristics and metacognition?

However the canonical correlations are structured, program

and grade are always significant. These findings agree with those of Nandi (1991), who tested the same sample with the same measures but employed a different scoring system for the tests. Variably, in other canonical correlations, STAIC1 and CSD are also significantly related to the metacognitive measures. The WUSC has also shown a tenuous relationship with the measures, specifically with the MKAQ.

Two canonical correlations were applied to the metacognition components and the personality measures, excluding the Rorschach. The first included all the personality variables. The second looked at the association between the metacognition components and grade program, STAIC 1, CSD and the WUSC. Root 1 was made up of MKAQ and MIK-1; the second was MKAQ and MIK-2. The first two roots accounted for 98% of the shared variance. The first root is accounted for mainly by grade, the second mainly by STAIC 1. The canonical correlation is significant and the proportion of variance between the variables in the two sets and the canonical variates for the set is good. Redundancies are acceptable. Development, intelligence and the personality variable of state anxiety account for 24% of the variance. While this is informative and acceptable, clearly much of the variance remains not yet accounted for.

Therefore, the first canonical variate would appear to be mainly a developmental variable and this is significantly related to the metacognition components. This finding suggests that there is a strong developmental component to both tests.

But is there a strong ego component? It was difficult to determine this from the results of the canonical correlation because of the high intercorrelation between the Washington Sentence Completion Test (ego developmental) and grade (age or general development). At the risk of increasing the possibility of a Type 1 error, a separate regression analysis was performed entering grade first and then entering the WUSC. In both cases the F was significant. The increase in R^2 was small but significant. Therefore, it would seem there is a small but discernible ego component to the metacognitive components as well as a contribution from general development. Due to the high intercorrelation between grade and the Loevinger test this did not emerge in the canonical correlation -- grade captured most of the variance. Further, any empirical measure of ego development will be unable to capture all the many and complex threads of ego development (Loevinger, 1970). Although care was taken to select the best possible measure of ego development, it is possible that this particular paper and pencil test is not particularly sensitive to the overlap between ego development and metacognition. With increasing knowledge about the nature of metacognition and ego development, it may be possible in the future to choose more appropriate instruments to assess the correlation between these two constructs.

Moreover, the association between the WUSC and the MKAQ may be small because the MKAQ measures metacognitive knowledge not metacognitive functioning. The expected correlation would be

between the MI and the WUSC. The lack of empirical association may be because the MKAQ is a stronger test and captured more of the variance in the canonical correlation. Therefore the strength of a correlation between ego development and metacognitive development remains largely unknown. However, to a small degree, ego development is related to metacognition as assessed by this investigation.

Also related is a people-pleasing coping style -- in a negative manner. This, of course, makes sense: the individual who is looking outward to exhibit the socially desirable behaviour of the moment, has more difficulty looking inward to be self reflective. The CSD was also selected as a measure of autonomy from the dictates of interpersonal expectations, a hallmark of ego maturation (Loevinger, 1970). Therefore an inward looking, self-directed style was also related to metacognition. It also supports the findings of the small but significant association between ego development and metacognition.

Similarly, anxiety is considered by ego theorists to be a signal of ego disruption (Loevinger, 1970; Mahler et al., 1975). Trait anxiety would signal profound problems with ego integration. State anxiety would indicate momentary disruption of ego functions. The findings suggest that metacognition may have no association with profound ego disintegration, but may vary reliably with more superficial ego disturbance. Taken together the results suggest an interplay between ego function

and metacognition. The precise nature of this connection remains unknown. One unusual finding requires explanation. The second Metacognitive Interview - Kemler (MIK) component, comprised of Problem Definition generally showed a negative relationship with the covariates. If metacognition is really related to adaptation, then why would Problem Definition have the opposite relationship to the covariates in comparison with the other metacognitive factors as measured by the MIK? Since this finding was not observed for the MKAQ, it seems likely that this is an artifact of the MIK. It must be remembered that the sample size was relatively small and the component contains only one variable and for these reasons may be unstable. With that caution in mind, the instructions for the MIK were quite clear so that all that was left for a student to do in the relevant Problem Definition question was to parrot back the instructions. As such, Problem Definition in this instance would not have been related to self reflection and inward looking, hence the negative correlation.

Also, from the results of the internal consistency regression, Problem Definition was less related to the other scales in the MIK. It has been suggested in Chapters 3 and 4 that the MIK is measuring a rudimentary aspect of metacognition and that Problem Definition is a metacognitive activity that may emerge relatively late in development. It is possible that the children whose scores on the MIK were high were more concrete and less metacognitively developed and differentiated.

Therefore high scorers on the MIK could suggest a less mature form of metacognition and as such be negatively related to more sophisticated aspects of metacognitive development, intelligence, and ego development.

Two personality measures, the MFF and the Rorschach, did not show any association with the metacognition components. This failure to find an association is puzzling and requires explanation.

Looking first at the Matching Familiar Figures Test, initially it seemed that impulsivity would be antagonistic to metacognitive functioning. After all, reflectivity and self-awareness would seem to be so closely, if negatively, related. The lack of an association with metacognition -- even with the adjusted ratios -- came as a surprise. While the lack of available norms may pose a problem with regards to the stability of classification, three other explanations will be offered here that are more germane to the present discussion.

Much of what is metacognition goes on automatically, as a fairly quick response, at a pre-conscious level. The MFF really measures speed and accuracy. Speed may not be an issue in metacognition. If the sample had been larger and it had been possible to examine the relation between the MFF and metacognition scores among the regular stream children only, a different pattern might have emerged. In other words, the intelligence and speed of processing may have confounded the issue.

On a related note, there would be a higher expectation of a correlation between the MI and the MFF than between the MKAQ and the MFF. Impulsivity would be more likely to interfere with metacognitive experience and behaviour than with metacognitive knowledge, unless the level of impulsivity were extreme. The lack of association with the MIK may be explained by the hypothesis offered earlier that the Interview appeared to assess what the children said they did rather than their actual experience or behaviour. Or it may be that the strength of the program and grade variables masked a smaller relation between the MI and the MFF.

The other variable measured by the MFF is accuracy. As was mentioned above, it has been demonstrated repeatedly (eg., Campione & Brown, 1977; Slife, 1985) that the link between metacognition and cognition is complex. Therefore, it is perhaps less surprising that no link could be demonstrated here. In reality, the MFF measures supposed behavioural correlates of impulsivity and reflectivity -- it does not measure impulsive, that is, unprocessed thought. While this might be difficult to operationalize it is this aspect of impulsivity that might be more expected to have a relation with metacognition. Previous studies have shown correlations (e.g, Kurtz & Borkowski, 1985; Stober, 1984) but these measured (behavioural observations of) metamemory and failures in strategy transfer, not metacognition, which may account for their different results. Furthermore, the research by Kurtz and Borkowski (1985) used teacher ratings of

impulsivity, not the MFF, to assign children to training groups. The study did not compare reflective to impulsive children, but looked at the effects of training (in metacognition) on their group as a whole. The authors note an anomalous finding in their conclusions. For their subjects, cognitive tempo did not change with instruction, even though an increase in the use of metacognitive strategies improved performance. This suggests that, at the very least, the link between impulsivity/reflectivity is a complex one.

Finally, impulsivity is considered an indication of ego boundary pathology or primitive ego development (Loevinger, 1970). It is hypothetically possible that impulsive behaviour or an impulsive style is an aspect of personality that is not related to metacognition simply because it is too profound or may present too profound a disturbance. Metacognitive efficiency in any individual may assume a minimum level of ego functioning below which there is no correlation because metacognitive behaviour is not present. In this way, metacognition may only be associated with more superficial aspects of personality functioning.

Of more concern to the examiner was the lack of significant correlations with the Rorschach variables. At first this seemed to undermine the major thrust of the study. However, there are several, equally compelling ways of looking at these findings.

The first is that the Rorschach, using a non-representative stimulus and purporting to elicit projective responses may not,

in fact, tap into metacognitive activities. There is no need for problem definition, planning, strategy selection, and although some subjects monitor and evaluate their responses, there is no instruction or real need to do so in the context of the test. In fact, the format of the test discourages it. To be sure, Rorschach scores are measures designed to look at processes important in metacognitive functioning -- but in the context of deep personality structure (Exner, personal communication). It seems, from the results of this study that metacognition may be related to the more superficial aspects of personality. In part, this is supported by the relation between metacognition and state anxiety and the lack of a relation between metacognition and trait anxiety and the lack of correlation with impulsivity.

Given the content of the five components that emerged from the principal component analysis of the Rorschach, it seemed impossible that these components would not bear an association with metacognition. For example, the first component was activity/passivity described as contributing to metacognitive efficiency (Gerber, 1983). However, the meanings of these labels may differ. For example, the passivity referred to by the Rorschach really refers to a person who lives in their head rather than in the world. However, it is possible to live in one's cognitions and still be metacognitive. Again, the discrepancy between metacognition and cognition surfaces.

Furthermore, the constructs, as measured by the Rorschach,

may relate to deep structure or characterological issues rather than more superficial skills. To explain further, it is possible for an individual to have developed characterological structure the benefits (or consequences) of which are not immediately available for day-to-day observation or use, or which the individual chooses not to use. The work of Li (1989) supports this hypothesis. All the adults in his study used metacognitive skills but there was room for improvement in all cases. In other words, his subjects were not making full use of their metacognitive skills.

The choice not to use metacognitive skills is more easily explained as it relates to motivational factors. It is possible for an individual to have adequately developed character structure such that an outward interactive, yet self-aware, self-reflective personality structure is available to them. However, perhaps fatigue, disinterest or time pressure results in those aspects of their personality being under-utilized in a specific situation.

It is also possible -- especially in children whose development is less steady -- that an individual has developed or is developing a strong and adequately mature personality structure and can function well on a day-to-day basis but use of skills is interfered with by anxiety, or depression. The relationship in this study between metacognition and state anxiety and the lack of a relationship with trait anxiety supports the suggestion. Furthermore, Main's (1991) findings suggest that in her sample of children judged to be secure, relatively advanced metacognitive monitoring was noted. The reverse may also be true. Fonagy et al. (1994) demonstrated that, among other factors, good problem solving

ability, task-related self-efficacy and planning ability appear to protect children from stress and from the transgenerational replication of disadvantage.

Conversely, an individual may have developed a very fragile ego structure. She may function well in a limited way or in a limited environment. She may be adequately metacognitively efficient in this environment, as long as it is familiar and circumscribed. Yet, the individual may have structural weaknesses that would only show up with age, or major stress. It may be these individuals whose metacognitive skills are most easily affected by the stresses but more research is needed before such a statement can be made. Some support is offered these hypotheses by the work of Slife (1985) who demonstrated that among his subjects, the deeper their depression, the greater the metacognitive impairment.

Therefore, it would appear that personality factors do account for some of the unexplained variance in metacognition. Metacognition, as assessed in this study, would seem to be related to more superficial, rather than deep structure personality or ego variables. However, even after development, grade, and these personality factors are taken into consideration, a large portion of the variance remains unexplained. In Chapter 5, a model of metacognition incorporating the notion of "levels" of metacognition is developed. In the context of that model, and assuming measures for the levels, the overlap between levels of metacognition and levels of self or ego functioning can perhaps be empirically established.

4.4 Measurement: An "ill-structured problem"

Analysis of the Metacognitive Knowledge Assessment Questionnaire (MKAQ) in this investigation revealed problems that appear to be reflected in other reports (Clements & Nastasi, 1990; Nandi, 1991; Swanson, 1992a). It appears that it is possible to produce a measure of metacognitive knowledge that has reasonable re-test coefficients -- as long as the correlations are between sums of scales or principal components. Reliability for individual subscales appears to be more problematic. Brevity of the scales may be a contributing factor. It is also possible that metacognition is both a reliable and valid construct which can be consistently measured. However, its contributing processes may not be evident in the consistent pattern that early researchers (eg., Brown, 1978a; Sternberg, 1981, 1983) had hypothesized to be the case. The activation of these contributing processes, and therefore their measurement may depend on the demand characteristics of the particular problem situation. This hypothesis will be elaborated in Chapter 5.

In this vein, although the measures of metacognition designed for use in this study employed questions related to everyday life events, all the problems were soluble. Puzzle-type problems are less likely to elicit metacognitive activity than ill-structured problems (Kitchener, 1983). Since other measures (Clements & Nastasi, 1990; Ormond et al., 1991; Swanson, 1992a) use similarly constructed items, this may account for the weak properties of the individual subscales.

Measurement of the metacognitive processes during a problem-

solving task was problematic from the outset. Much consideration was given the choice of juncture at which to initiate measurement. There was equal concern about measurement during or after the task. In the end it was decided to assess metacognition after completion of the task. However, the questions and the scoring system were set up to examine the process of thought as it had been during the problem-solving process. In retrospect, it might have been better to have used a protocol which scored utterances the children were encouraged to make during the problem-solving process. Alternatively, it may have been better to score those utterances the children did make spontaneously.

However, the best course of action would have been to find a way of questioning the children during the problem-solving process without interfering with that process. In general, it was easier to score grade 8 and gifted students' protocols than younger or regular-stream children. This may be due, in part, to the older child's better ability to tap into those processes that are conscious and to verbalize these -- especially after the fact.

Kinsbourne (1992) notes that "to relate what one is doing to the explicit knowledge that one is doing it calls for the ability to hold two things in mind at the same time" (Kinsbourne, 1992, p. 266). The ability to decontextualize is a necessary condition for the ability to embed information in new contexts. Mounond (1986) has suggested that the emergence of this ability underlies the sudden increment in cognitive skills at age 6 to 7 years of age. Even as late as grade school, the perceptual hierarchy exerts a retarding influence when non-salient features require

consideration.

In the younger child, brain mechanisms may not be sufficiently developed to accomplish this dual focus. The second set, the less salient information is relegated to inattention. Once not attended to, it is more difficult to retrieve. Thus for the younger children, they were being questioned expecting some awareness of what they had done -- when they probably had been unable to attend to what they were doing during the process of doing it. Thus, that information would pass from storage and it would not be possible to glean insight into their metacognitive activity. The original argument against a stream of consciousness type of interview had been that the reporting of metacognitive activities would interfere with cognitive functioning (that is, the performance on the task). In other words the same argument was being used, in reverse. In retrospect, the metacognitive information was of more importance and the nature of the information obtained from the MIK cannot now be clearly defined.

4.5 Recommendations

As a first step, measurement of metacognition really needs to progress from a restructuring of the concept and perhaps some new nomenclature. The number of processes being labelled metacognition confounds and confuses an understanding of the construct. In addition, metacognition has been defined in vague and general ways (Kitchener, 1983; Kuhn, 1983). As Kitchener (1983) lists, it has variously been referred to as 'cognitive

monitoring' (Flavell, 1979), 'executive processes' (Brown, 1977), 'self communication' (Meichenbaum & Asarnow, 1979), 'knowledge about knowledge' (Brown, 1977). Studies repeatedly measure metamemory but discuss metacognition, as though the two were synonymous. As Kuhn (1983) has pointed out, the definitions have tended to blur the distinction between knowledge about the task or problem itself and knowledge about what strategy is appropriate to apply in a problem situation. Kitchener (1983) adds a further blurring - between knowing about one's individual cognitive processes and when to apply them and knowing about knowledge.

However it is defined, metacognition needs to be looked at from many perspectives and each set of results used to modify a model of the whole concept. Ideally, a team, or co-ordinated group of teams, could look at metacognition from different vantage points -- preferably on the same sample. Also, since metamemory and metacognition are often used interchangeably in the literature, it may also be useful to measure both on the same sample to measure the extent of the correlation. Finally, it would be advisable to replicate the measurement of metacognitive knowledge and metacognitive experience on the same sample, perhaps with narrower age gaps and a broader overall range of age.

The latter measure would be best collected during, not after, the performance of a problem solving task. With some adults there may be no difficulty in collecting this

information, post hoc. However, with children, and especially younger children, the differences between the two sets of data may be quite large.

The active/passive dimension of metacognition requires closer examination. What does this mean -- active in terms of behaviour

or active in terms of cognition? Investigation of this parameter would require measurement of conscious and nonconscious aspects of metacognition, an issue outlined in Chapter 5.

In relation to state anxiety, it would be interesting to discover if the findings concerning anxiety noted in this study can be replicated. If the findings are reliable, what are the situations that interfere with metacognition? How much anxiety, for which individuals, at what ages? Trait anxiety usually underlies state anxiety such that people with the former are more prone to the latter. Is there an interactive effect with metacognition such that individuals who manifest both are more metacognitively impaired than individuals who manifest only state anxiety?

The choice of experimental task is important and requires re-examination. Studies in metacognition to this point have tended to use puzzle-type problems for which all elements are known and a specific answer exists. This specific solution is possible if a set of techniques or strategies are applied. As Kitchener (1983) has pointed out, this type of task draws behaviour from the cognitive level of functioning. It is

involved. However, if the objective is to assess (executive) metacognitive functioning, it might be best to employ what Kitchener (1983) calls ill-structured problems. She defines these as problems for which there is no single, unequivocal solution which can be determined at the moment by using a particular decision-making procedure. It may be that no perfect solution exists. A reasonable solution may be the one that creates the best fit given the current level of knowledge and expertise of the individual.

It would also be informative to investigate more closely the association between metacognitive development and ego development. What are the manifestations of metacognition in relation to different stages of ego development? In this context, it would be interesting to match a group of children for ego developmental stage and assess them with respect to their general metacognitive knowledge and their actual use of metacognitive skills during both a puzzle-type task and an ill-structured problem (Kitchener, 1983).

It would also be important to follow up on the issue of the association of self functioning with metacognitive functioning. At the time of the conceptualization of this thesis, self psychology was still in its toddler stage: most theories of the time put the self as a part of the ego (e.g, Sullivan, 1953). In the 1950s, the work of Kohut (1977) in the United States and the Object Relations theorists in the United Kingdom (Fairbairn, 1954; Winnicott, 1971, 1986; Bowlby, 1969, 1973, 1986, Kernberg,

1986) began to look at the self as a viable entity. However, these two groups remained within the psychoanalytic or neo-analytic spheres and really did not communicate with psychology and certainly not with experimental psychology. Therefore, at the time of the design of this study, the concept of self seemed more related to metacognition but the concept was difficult to operationally define, and no paper and pencil measures of self were available. Some interview measures were available such as Warren's (1969) I-level interview, but these had specific biases such as the diagnosis of juvenile offenders and the scoring system was arduous with questionable interrater reliability.

Therefore, ego was selected as an analogous construct -- with some justification. Psychologists were writing of the self as a part of the ego. But more importantly, as mentioned in Chapter 1, there are aspects of ego functioning - such as synthesizing and the distinguishing between inner and outer - that fit well into a model of metacognition. And the results have supported this line of thinking. There is an aspect of metacognitive functioning that is related to ego functioning, of metacognitive development that is related to ego development.

However, it may be more profitable from this point to examine more closely the association between self and metacognition. The field of self psychology has expanded greatly in the past ten years. Much of the responsibility for this expansion is due to the work of psychologists and so much of the research is within a psychological framework.

Experimental literature now exists on self development especially in infancy and on impediments to self development (see Stern, 1985), and measures of self functioning are now available (Barclay, 1991; Yardley, 1987).

Furthermore, it would seem that it is now possible to describe a substantial difference between self and ego which warrants this added investigation. From a review of the more recent literature (eg., see Masterson, 1988) it would seem that ego and self, although closely related, are really quite distinct entities. Ego emerges early. Some would say from birth (Hartmann, 1958). There seem to be aspects of ego that are available from birth in a primary, undifferentiated, undeveloped form. These would be sight, hearing, and the other apparatuses of primary autonomy. This perspective closely links the ego to a biological and constitutional basis. As the ego develops it does so in a vertical as well as a horizontal way. There are many theories of ego development (e.g, Erikson, 1950, 1968; Mahler et al., 1975) which describe the stages of upward development of the ego, with lateral development and differentiation during the consolidation of each stage.

The self, although related, especially to what used to be called the observing part of the ego, is quite different. It would seem to be tied not to biological basis but to social and environmental processes. We know who we are from the reactions of those around us - first our mothers or both parents and later the wider society. The self is composed of (awareness of)

bodily sensations, feelings, the image of one's body, the sound of one's name, the continuity of one's memories - all leading to an experience of oneself as a unique and separate person having a continuous existence. Important in this is a definition of self versus nonself. Also important is a feeling of activity and initiative. One's self is experienced as both an object and an agent (Masterson, 1988).

Therefore, future investigations into correlates of metacognitive functioning would do well to look at personality functioning in more detail. In particular self development and self functioning should be explored as possible correlates of metacognitive functioning. However it is accomplished, if metacognition is ever to be useful in an applied setting, an entire model needs to be captured in a usable way. Research results must be examined in light of a model, and the model refined as a result of the research findings.

The next chapter will provide an overview of the current status of the research literature in metacognition and to elaborate future directions for research. A model of metacognitive development will be offered.

Chapter 5

Future Directions

Chapter 5 will outline the current status of the literature on metacognition. Where new areas of investigation have emerged, more extensive description of their results will be given. A proposed model of metacognition will be elaborated and the chapter will close with an extensive discussion of suggested directions for future metacognition - personality research.

5.1 Metacognition Then and Now

5.1.1 Déjà Vu All Over Again

The concept of metacognition has appeared in the literature since approximately 1960. In many respects, the literature of the first 27 years is substantially different from the literature of the past 7 years.

Until about 1986 or 1987 (PsychLit) published articles and book chapters numbered about 65. These could be broadly categorized under two headings. Under the first heading was a series of studies demonstrating the existence of metacognition with some attempt to define the parameters of metacognition. The parameters were largely defined in terms of differences between and within groups. Studies looked at differences between age groups (Byrd & Gholsen, 1985; Paris & Jacobs, 1984), between groups with differences in scholastic ability (Kaufman et al., 1985) and within groups with scholastic problems (Byrd & Gholsen, 1985; Johnston & Winograd, 1985; Kaufman et al., 1985; Slife et al., 1985). Other investigations demonstrated

the difficulty in teaching metacognitive skills (eg., Brown & Barclay, 1976; Brown et al., 1973; Brown & Palencsar, 1982; McGuinness, C., 1990) and the limited transfer effects (eg., Brown et al., 1977).

The second category of publication was comprised of largely theoretical articles or position papers, incorporating results from the small-scale studies mentioned above (e.g., Brown, 1975, 1977, 1978a; Flavell, 1976, 1979; Flavell & Wellman, 1977; Sternberg, 1985; Wong, 1986). These position statements argued for the existence and applicability of metacognition. The population under discussion was almost exclusively children, usually young children. Metacognition was compared to, and usually described as a "director" of cognition. Articles were variably on metacognition and metamemory, without distinction between the two. Many different perspectives on the process were described leading to a variety of definitions and a plethora of subprocesses. Meaning and organization needed to be introduced into the conflicting and overlapping descriptions. It would appear that many investigators shared this author's need for order since a substantial portion of the literature since 1987 has attempted to grapple with these issues.

As of August, 1994, and extending back to 1987, the number of books and book chapters on metacognition have numbered 137. The number of journal articles in the same seven year period numbers 300 and appears to be growing at the rate of approximately five each month (PsychLit). Although from the

listings available here, most of the writing appears to originate in the United States, there is a growing number of international investigators looking at the same issues. Metacognition is being investigated in every industrialized country, east or west, suggesting that metacognition is a universal phenomenon. As a superordinate phenomenon, hypothetically it only emerges after more basic needs are met. This might explain why researchers in third world countries have not yet produced studies on metacognition.

By far the largest category of more recent publications is the replication and expansion of previous work. Included among these papers is continued research into the picture of metacognition in specific groups such as the learning disabled (Montague, 1992; Montague & Blos, 1990; Montague et al., 1991; O'Neill & Douglas, 1991; Swanson, 1992b; Wright & Cashdan, 1991); the gifted (Dover & Shore, 1991), the learning disabled gifted (Montague, 1991), autistic children (Leckham & Perna, 1991), and other patient populations (Lorenc et al., 1992). However, studies of the picture of metacognition in early childhood and among the developmentally handicapped have all but disappeared. Perhaps the issue of metacognition among the developmentally handicapped is now well established in the literature. Perhaps, also, this line of research does not shed much light on metacognition itself. Metacognition is so bound up with issues of IQ and MA it may be that a cut-off exists below which metacognition is simply not spontaneously available

to the individual. Developmental studies now seem to focus on lifespan development and so the number of studies on adolescents (e.g., Ormond et al., 1991) and senior populations (Ponds et al., 1992; Rabbitt & Abson, 1991) is increasing.

There are also studies which look for the picture of metacognition in other contexts, such as language (e.g., Bacon, 1992; Hall et al., 1987); writing (Englert et al., 1992), under unusual conditions (Nelson et al., 1990) and in unusual populations such as handicapped students (Gartner et al., 1993; Jones, 1992), autistic children (Leckham & Perna, 1991) and athletes (Russell, 1990).

Some studies attempt to push forward our understanding of specific aspects of metacognition such as organization (Melot, 1992); feeling of knowing (Costermans et al., 1992; Reder, 1992) and metacognition in relation to Piagetian theory (Vianello et al., 1991). As well, there continue to be literature reviews (e.g., Paris et al., 1988) and theoretical position papers (e.g., Borkowski et al., 1989; Hresko & Rei, 1988; Scharnhorst & Buchel, 1990; Slife, 1987b; Westerman, 1987; Wong, 1991).

An area of investigation to emerge recently is the exploration of the neuropsychological correlates of metacognition. Theoretically, metacognition has been linked to frontal lobe functioning (Dennis, 1991; Janowsky et al., 1989a, 1989b; Schachter, 1989) and to pre-frontal lobe functioning (Kinsbourne, 1992).

Empirically, Pappas et al. (1992) have demonstrated that

Alzheimer's patients were as good as normal controls with regards to the accuracy of their confidence ratings and with regards to their estimations that their confidence ratings were correct. However, their feeling of knowing was impaired. Prevey (Prevey et al., 1991) examined feeling of knowing in right- and left-temporal lobe epilepsy patients. Significant differences were found between patients and controls on tests of memory and metamemory but not differences between right and left temporal lobe patients. Beatty and Monson (1991) looked at feeling of knowing and metamemory in multiple sclerosis patients and found that metamemory was also affected in their patient sample but feeling of knowing was not. Thus, in patients in whom there is temporal lobe involvement or in whom diffuse lesion(s) might be expected, the picture is not clear.

Frontal lobes appear to be critical for metacognitive activities such as planning, controlling and monitoring one's own cognitive processes. Deficits in these activities are evident both in pure frontal-lobe patients, who have normal object-level memory but impaired metamemory (Janowsky et al., 1989a, 1989b; Shimura & Squire, 1988) and in patients who have frontal lobe dysfunction coupled with other brain dysfunctions (Janowsky et al., 1989a). Shimamura and Squire (1986) demonstrated that patients with Korsakoff syndrome were impaired in making feeling of knowing predictions both about general information facts and about newly learned material while other amnesic patients were as accurate as normal controls. They

concluded that the impaired metamemory exhibited by patients with Korsakoff's syndrome reflects a cognitive impairment that is not normally observed in other forms of amnesia. It may also be hypothesized, without positing a specific neuronal site for feeling of knowing, that this is an aspect of metacognitive functioning which may be more vulnerable to neurological insult.

McLynn and Schacter (1989) point out that amnesic syndromes can occur as a consequence of various types of neurological impairment. Afflicted patients have normal or near normal intellectual, linguistic and perceptual function and yet are unable to remember recent events and learn many types of new information. Patients with so-called "pure" amnesias, in which there is neither behavioural nor neurological evidence of frontal lobe involvement, appear to be aware of their memory deficits. This is in marked contrast to other amnesic syndromes that are characterized by unawareness of memory deficits. Studies also show that amnesic patients without frontal lobe damage are aware of their deficits. The authors conclude by acknowledging that there is greater incidence of unawareness following right- than left-hemisphere damage, but point out that further investigation is needed to understand this phenomenon.

Kinsbourne (1992), on the other hand, makes a good theoretical argument for a link between metacognition and pre-frontal lobe functioning. He points out that a key aspect of metacognition is the ability to hold two things in consciousness at the same time. Particularly, this depends on developing the

ability to override control by the immediate stimulus environment which enables the child to enlarge the range of information on which she draws and enables her to detach attention sufficiently from the here and now to enable the re-experiencing of a previous event.

This depends on pre-frontal lobe maturation. He writes that "metacognitive ability depends on being aware of task requirements and social expectations and being able to modify one's behaviour accordingly, maintain task orientation and self monitor" (Kinsbourne, 1992, p. 270). These are executive processes that involve the pre-frontal lobes. He goes on to state that self-regulation is not necessarily conscious, Further, the self-regulation that involves conscious appraisal of what one is doing and deliberate devising of strategies to improvement - that is, what has been called metacognition - is particularly slow to develop. Metacognition calls for the ability to hold two things in consciousness at the same time - to attend simultaneously to two unrelated objects of attention. This requires increased neuronal capacity which becomes available through maturation. He suggests that "self-consciousness could be present much earlier, but only become usable instrumentally (and demonstrable experimentally, brackets this author's) as mental capacity increases" (Kinsbourne, 1992, p. 271). He points out that normal children use memory aids as early as 5 years of age - but the conscious and deliberate use of strategies is a post-childhood phenomenon.

Thus, although the evidence is scattered, the arguments are strong linking metacognition and neurological functioning. Particularly clear is frontal lobe involvement but pre-frontal lobes may be implicated, as well. Feeling of knowing seems to be affected regardless of the site of the lesions - at least with the sites reported thus far. With such widespread neurological involvement it may be that rather large lesions are required before metacognitive functioning is disrupted. Of course, our measurements are still rather primitive and depend to a large extent on gross impairments, so this statement is perhaps premature. It is also noteworthy that the Shimura and Squire (1988) study which reported "meta"-impairment were investigating metamemory which is theoretically but one aspect of metacognition. The distinction may or may not be an important one, as has been mentioned throughout this paper. It remains to be demonstrated what deficits are required to be present before metacognitive impairments are observable.

It is also important to note that the studies quoted above describe neurological pathology in adults. It is probable that the pattern of metacognition-related neuroanatomy during maturation is substantially different (Dennis, 1991). The suggestion in no way invalidates the findings in the literature on adults. However, it does suggest that an ancillary pattern critical to the understanding of the nature of metacognition has yet to be delineated.

In summary, it is one thing to say that cognitive skills

have a concomitant neuropsychological pattern. It is another to say that some skills require general neuronal maturation. But it is quite another to say that the skill or set of skills is dependent upon a specific narrowly defined neuronal pattern. Metacognition may be the expression of a diffuse interpretative network.

Thus by far the largest group of recent publications is still trying to define and describe what metacognition is. There remains some confusion between metamemory and metacognition. Diverse theoretical positions are used. Of concern, there is no attempt to determine how the findings of a study fit into a model of metacognition. We are still operating mainly on an empirical basis.

5.1.2 Applications of Metacognition

There is a smaller group of publications which appear to take the existence and description of metacognition for granted and write about applications. There are some cross-cultural studies (Armour et al., 1992; Schneider et al., 1986; Topping et al., 1989; Wang, 1993). However, by far the majority of studies in this area relate to the school system. In fact, metacognition has now found its way into textbooks on curriculum (Ashman & Conway, 1989; Campione et al., 1988; Davis & Rimm, 1989; Gilhooly et al., 1990; Hughs & Hall, 1989; Schwartz, 1989). For over 6 years, Ottawa area and Eastern American schoolboards have been holding workshops designed to introduce teachers to metacognition and to train them in its instruction

(personal communications). Other textbooks that include chapters on metacognition are on cognition (Jones & Idol, 1990; Matlin, 1989), on educational psychology (Lefrancois, 1988; Weinstein et al., 1988; Kuhn et al., 1988), on creativity (Glover et al., 1989), and on life span development (Lefrancois, 1987).

5.1.3 Measurement Instruments

New since 1987 are studies which examine the psychometric properties of instruments designed to measure metacognition. There seems to be some agreement on the need to develop a standardized reliable measure that can be used to look at the construct across groups. In this way it may be possible to build a more reliable and valid and ultimately more useful picture of metacognition. Two types of instruments have been reported in the literature, although unfortunately they do not appear in the same study, that is on the same sample. The first type looks at metacognitive knowledge, and the second at metacognitive experience.

The first of these questionnaires was adapted by H. Lee Swanson (1992a) from the work of Kreutzer, Leonard and Flavell (1975). It is a measure of metacognitive knowledge containing 15 items. The questionnaire was administered individually to 96 grades 4 and 5 children classified as gifted, high average and low average. Responses were tape recorded. Thirteen of the 15 questions asked the child to comment on an aspect of metacognitive knowledge involving person, task or strategy

variables (Flavell, 1975). For example, Question #14 asks, "Is there any reason why adults are smarter than children? Why?". Two of the questions are filler-items. They relate to problem-solving in general and not directly to metacognition.

Data from the questionnaires were scored according to 5 response categories outlined in Kreutzer et al. (1975) ranked from 0 to 5 according to the degree of metacognitive awareness: more advanced levels received higher ranks. It is interesting to find another multi-dimensional scoring system which attempts to take into consideration knowledge, task, time, relativity, and motivation variables in the scoring of each question. It seems that there is something about metacognition that prompts the use of a multi-level design in the scoring system. Interrater reliability was above 96%; Cronbach's alpha was .92. No other reliabilities or validities were reported. Four composite scores were created to classify the 15 questions. The children in this study were also administered the Canadian Test of Basic Skills (CTBS) and a Piagetian task to look at construct validity. Results indicated that gifted children's inter-correlational patterns reflect more independence among mental processing, metacognition and problem solution when compared to high and low IQ children.

The second questionnaire was also based on the 1975 paper by Kreutzer et al. (Ormond et al., 1991). Similar to the MKAQ used in the present study, it contained both closed (multiple-choice and true-false) and open-ended questions. Of the 30

items, 19 measured a subject's knowledge of person, task and strategy variables in decision making; 11 were filler items. One point was given for each correct answer to a closed question. For open questions one point was given for the identification of each decision making step based on the GOFER model (goals, options, facts, effects and reviewing). Scores for open and closed questions were combined.

Interrater reliability was 93%; Cronbach's alpha for the Person scale was .26; for the Task scale was .55, and for the Strategy scale was .56. The reliability for the full scale was .74. The authors suggest that the lower reliabilities on subscales were at least partially due to the brevity of the scales. No other reliabilities or validities were reported. The Flinders Adolescent Decision Making Questionnaire (Mann et al., 1988) was administered to the 84 students aged approximately 12 and 15. Task, strategy knowledge and total scores were well correlated with decision-making style and decision-making performance.

Jacobs and Paris (1987) developed a multiple choice instrument called the Index of Reading Awareness (IRA) to measure metacognition in reading. At that time little work was undertaken to determine the psychometric properties of the instrument. McLain et al. (1991) obtained preliminary reliability and validity data on the scale on a sample of 145 children in third, fourth and fifth grades in the mid-west. Cronbach's alpha of .61 suggested limiting further use of the

scale. Reliabilities of the subscales ranged from .15 to .32. Criterion related validity was assessed using the Woodcock Reading Mastery Test - Revised (Woodcock, 1987). Only moderate associations were found.

Clements and Nastasi (1990), on the other hand, designed an instrument based on Sternberg's (1985) metacomponents. Although it was not designed to do so, its structure suggests that it additionally assesses metacognitive experiences. Theirs was a dynamic assessment tool, one that used prescribed - that is, standardized - administration procedures. The test was named the Metacomponential Interview. Five of the seven of Sternberg's (1985) metacomponents were used - Nature, Selecting/Combining, Representing, and Monitoring. The choice was based on the results of their 1988 (Clement & Nastasi, 1988) study which suggested that these processes were most relevant to one's understanding of the nature of a problem and its solution. Each problem was designed so that successful solution depended on relatively intensive use of a single metacomponent. Items were presented in a random order. After the 84 early and middle school children had read each problem, they were given the opportunity to solve it on their own. If they were not successful, they were provided with a series of five successively more specific prompts, each one getting closer to giving away the answer.

Raw scores were the number of required prompts and these were transformed so that a higher score indicated that fewer

prompts had been required. Transformed scores were summed across items assessing each metacomponent. Again a somewhat multidimensional aspect was used to introduce the scoring system. Utilization measured the number of prompts necessary for the child to exhibit use of the metacomponent. Correctness referred to the number of prompts necessary for the child to respond correctly.

Problems were designed based on Steinberg's (1985) suggestion: analyses, syllogisms, mathematics, logic and sequencing problems. That is, unlike the other tests outlined here, they were not related to every day life and, as such, may have been less meaningful. Nonetheless, considerable work went into their design. Three criteria were used to select items: first, logical criteria were established for each metacomponent. Second a pilot study was undertaken to ensure that empirical data could demonstrate that children presented with an item benefitted most from the prompts directed at the metacomponent being measured by that item. Finally, several items were eliminated because of their unacceptable difficulty level.

Cronbach's alpha for subscales ranged from .29 to .73. The reliabilities for the two total scores (utilization and correctness) were .84. Intercorrelations among subtests was fairly high indicating from 14% to 49% shared variance between pairs of subtests. Interrater reliability was reported as high but no figures were given. Construct validity was assessed using Markman's (1977) two tasks for measuring comprehension

monitoring. All scales, except Nature, showed low but significant correlations with the Markman techniques. With the exception of the Nature scale, correlations were between .40 and .50. As predicted, behaviours indicative of selecting/combining were relatively frequent across all subtests; however, for each category of metacomponential behaviour, the highest percentage was elicited by the corresponding subtest.

The authors suggested that the children's responses to the problems and the prompts were consistent with the metacomponents the tasks were designed to elicit. Also, the prevalence of selecting/combining across subtests may help to explain the shared variance among the subtests. Pearson product moment correlation analyses indicated moderate associations (Markman $r = .14$ to $.53$; CAT $r = .30$ to $.49$) between the total metacomponential scores and both the Markman and CAT scores. The latter may be due to shared metacomponential functioning or knowledge.

The authors concluded that the evidence was strong enough to support the use of the global measure of metacomponential functioning but did not support the use of the subscales. However, the high internal consistency of the subtests is promising. The authors point out that consonant with previous research, this instrument fails to provide clear delineation of all the metacomponents (Clements & Nastasi, 1988; Sternberg, 1985). They further question whether the metacomponents operate as separate processes in intellectual activity - or whether

separate metacomponents exist but are fewer and/or different from those proposed by Sternberg.

From the three instruments described here, interesting patterns emerge. It is striking how many of the test developers have either implicitly or explicitly used Flavell's model from his seminal article (1975). The tendency has been to use the metacognitive knowledge category as a theoretical base (Ormond et al., 1991, Swanson, 1992a) with further differentiation of metacognitive knowledge into person, task and strategy variables. One study (Clements & Nastasi, 1990) used Sternberg's (1985) theoretical model to design their test. Although the test was based on Sternberg's (1985) metacomponents, due to its format it actually appears to have also measured metacognitive experience.

It is gratifying to see large samples being tested and to see psychometric data being obtained and published for these tests. However, it can be noted that most report only internal consistency and interrater reliabilities. Ormond et al. (1991) and Swanson (1992a) attempt to deal with construct validity and but none of the three report statistics for re-test or split-half reliabilities or divergent validity. It is also noteworthy that most authors devise their questions so that content is meaningful. Unfortunately, the test for metacognitive experience appears to have been contained items whose content was more formal or academic.

It is fascinating that all three test developers report

findings similar to those in this study - that is, their analyses also support the existence of a reliable, valid variable which has been called metacognition. However, very limited support exists for the reliability of the individual components. These findings give further credence to the hypothesis outlined earlier. That is, metacognition may be a valid phenomenon for which component parts can be identified. However, the appearance, duration, and combination of these component parts is problematic and may depend on factors such as maturation, task, and examiner variables.

Finally, two tests (Swanson, 1992a; Clements & Nastasi, 1990) use a multidimensional scoring system. This may be in response to the multidimensional aspects of metacognition and an attempt to capture the various levels of metacognitive functioning. The same approach was followed to develop the scoring system used in this study. The real intention behind these multidimensional scoring systems may be an attempt to capture the superordinate, executive level of metacognitive functioning. To date, no study has clearly accomplished this. Perhaps what is impeding progress in this area is the lack of a comprehensive model of metacognition from which studies can be planned and with which results can be compared. The following section will develop a complex but tentative model of metacognition intended as a model for future models rather than as a definitive description.

5.2 A Proposed Model of Metacognitive Development

Any model of metacognition should include an expanded understanding of the characteristics of the so-called executive level. At least one study (Swanson, 1992a) suggested that the reliable central variable they have measured is the executive function of metacognition. It may be, instead, that what they have measured is the core of metacognition made up of the activities or components such as Problem Definition, Planning, Strategy Selection, etc. appropriately weighted for that task at that time. Executive function may be an elusively different process and not captured by the puzzle type tasks (Kitchener, 1983) that have been used. The evidence suggests that at least two levels of metacognition exist dependent on cognitive maturation. The lower level would include conscious, deliberate metacognitive activity such as strategy selection, the second would encompass the executive or monitoring aspect of metacognition which may or may not be conscious.

Borrowing from a model of intelligence (Gardner, 1983), it may be that the development of metacognition is along modular lines. Cognitive accomplishments can and do occur in a wide range of domains such as spatial visualization, verbal comprehension, numerical fluency, etc. In each domain there is hypothesized to be a series of steps from novice through apprentice to expert through which any individual may pass. However, throughout development, these domains are relatively independent of each other. Individuals can differ widely regarding the speed with which they pass through these domains

and success in one domain in no way guarantees success in another. The idiot savant or child prodigy are extreme examples of this. A more day to day example can be found in developing infants. Walking and talking are two domains that rarely, if ever, make their appearance at the same time.

Kitchener (1983) has developed a 3-tier model of cognitive processing for what she terms ill-structured problems, that is, problems for which there is no single, unequivocal solution determined by using a particular decision-making procedure. Each level is built on and depends on the preceding level. At level one she lists the pre-monitored cognitive processes on which knowledge of the world is built. These would be the domains as defined by Gardner (1983). At level two Kitchener places metacognition defined as the processes which are invoked to monitor cognitive processes when an individual is engaged in level one activity. In her definition of metacognition she includes knowledge about cognitive tasks, about particular strategies that may be invoked to solve the task, of when and how the task should be applied, and the success or failure of any of these processes. This is the level of metacognition that is generally described by most investigators. It is not, however, the executive level which many researchers have tried to examine. Rather, it may be that this is the first level at which metacognitive behaviour appears. The skills can be used for puzzle solving but not for ill-structured problems. Epistemic cognition, which she characterizes as the processes an

individual invokes to monitor the epistemological nature of problems and the truth of alternative solutions, is the third and highest level. It includes the individual's knowledge about the limits of knowing, the certainty of knowing and the criteria for knowing. It also includes the strategies used to identify and choose between the types of solution required for different problems. It is tempting to see this as the elusive executive level, but it is more likely one level higher (see Figure 2).

Therefore, adapting these two theories to metacognition, it is possible that the activities that make up metacognitive efficiency develop up in a discrete fashion isolated from and not highly interdependent on each other. Within each, there is a progression from novice to expert, simple to differentiated. It is not until the individual has matured cognitively, that an umbrella function over all other metacognitive activity develops which integrates these behaviours. It is this umbrella function that is the executive function and for which the term 'metacognition' might best be reserved. Thus, it may be possible to observe metacognitive behaviours quite early in development. It may be that they emerge differentially - some before others - and incrementally, as well as simply as Brown (1975) has hypothesized. As they emerge they may improve problem solving performance on puzzle-type tasks (Kitchener, 1983). However, these may be fragments, and true metacognition cannot emerge until the formal operations stage. The executive level may not emerge until at least the end of the formal

operations stage and may not emerge in all individuals.

Figures 2 and 3 describe a tentative model of metacognition that might be useful in conceptualization, in planning studies, and in explaining research findings. The model is best read starting from the boxes on the right-hand side of Figure 2. Feedback from the environment provides content to metacognitive knowledge. Metacognitive knowledge of person task and strategy and metacognitive experience(s) feeds into an awareness of ourselves and others as metacognitive beings. Our knowledge of ourselves expands our knowledge of others which further increases our knowledge of ourselves, and so on in an ever more elaborated and differentiated way. In Figure 2 it is represented in a linear design, but it is probably best conceptualized as an ever increasing, widening and more complex spiral (see Figure 3). Also, progression through the spirals is not unidirectional. Theoretically, a child (or an adult under stress) may regress to earlier developmental configurations, for instance at the beginning of a new developmental stage. However, during maturation the overall line of progression would be upwards. Knowledge and experience of ourselves and others feeds into metacognitive activity, that is, thought and behaviour.

Insert Figures 2 and 3 about here

Initially, with the more primitive levels of self and other

Figure 2: A proposed model of metacognition

Figure 3. A Proposed Model Of Metacognition: Developmental Diagram

differentiation, metacognitive activities are rudimentary. They would encompass such basic metacognitive skills as strategy selection and planning but there may be others, as well. With increased knowledge and experience and self-other differentiation, these basic metacognitive skills become elaborated. During this process new metacognitive skills are added (see Figure 3). The new skills likely require greater perspective taking and are increasingly based on inner directedness. They probably include problem definition and flexibility - and may include others. They almost certainly include Brown's (1978a) level of metacognitive activity: assessing capability limitations and knowledge inference. By the time the child is able to be more flexible in her metacognitive activity she is beginning to enter the executive level which is probably the level of true metacognition as it has been conceived and described. This level is characterized by monitoring skills and may be evident in behaviour when it is possible to observe purposeful re-evaluation (as opposed to trial and error) - that is, a re-examination of plans, strategies and definitions. It is not that monitoring behaviour does not appear earlier. Rather, monitoring at this level has a wider expanse of perspective and is likely more tied to the problem, maybe as one of a class of problems, rather than to a specific strategy. What is clear is that this level of sophistication of monitoring requires the ability to be cognitively abstract. Empirically, this has been demonstrated

to be unavailable to the pre-adolescent child (Brown & Smiley, 1978b). Further maturation would bring the individual to the level of epistemic cognition, which includes the ability to reflect on the limits of knowledge, the certainty of knowing and the criteria of knowing (Kitchener, 1983) (see Figure 2).

According to this model, the research into metacognitive functioning has, to date, been examining higher order, more complex aspects of metacognition. To some extent, this may explain the inconsistent and often contradictory results in the empirical developmental literature. To investigate the components of metacognition in their embryonic stages, different paradigms and stimuli must be developed.

5.3 Personality and Metacognition

One of the main foci of this investigation was the examination of an hypothesized link between personality characteristics and metacognition. Correlations were found between metacognition and ego functions, here defined as state anxiety and a people-pleasing coping style. A weaker link was found between metacognitive development and ego development.

Since approximately 1985, a few studies have been published looking at the connection between personality issues and metacognition. The research seems to have originated equally in the United States and Europe. Several papers look directly at such personality variables as shyness (Cheek & Melchior, 1990), attribution (de Beni, 1991), and depression (Slife, 1985). Slife (1985) reported that, among his subjects both, induced and

naturally occurring depression interfered with metacognitive functioning but not with cognitive functioning. Furthermore, the deeper the depression, the greater the interference. Peixoto (1992) demonstrated that trait anxiety interfered with both academic performance and self-monitoring.

It is clear that other investigators also hypothesize an association between personality characteristics and metacognition. Equally clear is the finding that a link exists, both in this study and in those reported above. The personality variables selected for correlation with metacognition have been those which had previously been found to interfere with cognitive functioning, for example depression and shyness. Since metacognition is now being seen as a construct with its own separate characteristics and development, perhaps the aspects of personality which facilitate or hinder its use also require re-examination. The possible choice of personality variables then becomes wider. Instead of using discrete categories or diagnoses, such as depression or anxiety, perhaps it is both necessary and possible to look at a broader, underlying construct which either overlaps with or encompasses metacognition. This construct would be the "self".

5.3.1 The Personality Link - An Ongoing Problem

Until recently the operational definition of metacognition has been one of conscious, deliberate processing. Although allusion has been made to unconscious aspects of metacognitive activity (eg., Flavell, 1979), the attempts at measurement have

been of the observable behaviour or inferences from self reports of such aspects as feeling of knowing. The focus of this study is also of observable events. Confusion exists in the literature with most authors assuming that metacognition is deliberate self-monitoring or as Kinsbourne has defined it, "holding two things in consciousness simultaneously" (Kinsbourne, 1992, p. 271).

Yet Kinsbourne (1992), among others, acknowledges the fact that not all self regulation is conscious. However, no one seems clear on whether the nonconscious aspects of self regulation belong to the preconscious or the unconscious. Furthermore, the question of how much of this non-conscious self regulation is metacognition has not yet been asked, empirically. At this point in the development of thinking about metacognition, it is important to raise the question and to develop a heuristic for finding an answer.

There are several investigators who appear to be interested in the aspects of self - of some inner experience not easily available to others and perhaps not available to consciousness - which nevertheless guides conscious thinking and behaviour. Closely associated with these writings are the papers exploring the nature of consciousness and of inner experience and the difficulties in measuring this. The effective use of introspective techniques is critical to the study of metacognitive phenomena. While the lower order metacognitive skills are generally available to consciousness, it has been

proposed that the higher-order executive function is a non-conscious process (Clements & Nastasi, 1990). Viewed from this perspective, how accessible this executive function is to empirical investigation may depend largely on the effectiveness of introspective techniques that can be developed.

5.3.1.1 Measurement of the Nonconscious Aspects of Metacognition - A Place for Introspection?

One method which has been used to investigate inner experience is introspection. However, due to the powerful influence that behavioural methodology has exerted on research (Lieberman, 1979) this method fell into disrepute. After reviewing the historical arguments against the use of introspection, Lieberman (1979) concludes that most are either invalid or no longer possess their original force. He concluded that the benefits from the wider use of introspection would seem likely to outweigh the costs.

One use of introspection would be the relatively informal, anecdotal level to identify potentially interesting phenomena (eg., Bainbridge, 1974; Montague, 1972; Newell & Simon, 1972). A more direct approach has been to observe the extent to which a subject's introspections accurately predict his or her own subsequent behaviour. Kroll and Kellicutt (1972) in a study of rehearsal in verbal memory asked their subjects to indicate (by pushing a button) when they were rehearsing. Simultaneously, they asked them to count backwards by sevens. The correlation between completed counts and recall was only .30 whereas the

correlation between button pushes and recall was .94. Therefore, although estimates of rehearsal based on introspection are inherently more subjective than those based on visible behaviour, at least in this situation they were also considerably more accurate.

Lieberman (1979) suggests that there are advantages to a limited return to the use of introspection including a diminution in the unnecessary tensions within psychology and the discovery of new principles of behavior. However, he cautions that the use of introspection is limited simply because much of the brain's function is not available to consciousness and is also limited in accuracy. Although many examples of accurate introspection exist in the literature (Hart, 1965, Reder, 1987), many examples of these two caveats exist in the feeling of knowing literature. Two examples are given here: Reder and Rutter (1992) found that although feeling of knowing judgements are reportedly, and by definition, based on a feeling that the correct answer to an unrecalled item is known, for their subjects it may be more accurate to say that it is based on a recognition of aspects of the question. Glenberg et al. (1982) demonstrated that readers who failed to find a contradiction in a test, nevertheless rated their comprehension as high. In addition, Nelson et al. (1986) demonstrated that among their undergraduate students the individual's own feeling-of-knowing predictions were more accurate than predictions derived from normative feeling of knowing ratings (obtained in a previous

study) but were less accurate than predictions derived from normative item difficulty. Introspection in these cases did not yield the most accurate information.

Therefore, Lieberman (1979) cautioned that whenever possible, verbal reports need to be supplemented with other circumstantial or behavioural evidence. He suggested that the ultimate criterion for evaluating any form of introspective data must be their usefulness in predicting future behaviour. Johnson and Raye (1981) proposed a model which they call "reality monitoring" which looked at the methods by which individuals determine the source of information - internal vs. external. Their summary of relevant research is encouraging as far as the tractability of the inherent problems is concerned.

Therefore, mental events are not simply a form of behavior and behavior is not merely an observable form of mental events. In addition, there is much empirical evidence to suggest that processing goes on beyond conscious awareness. Lackner and Garrett (1973), for instance, used a dichotic listening paradigm. In the attended channel, subjects heard ambiguous sentences. In the unattended channel one group of subjects received ambiguous sentences while another group had neutral or irrelevant input. The first group could not report what they heard through the attended channel, but they favoured the suggested reading of the ambiguous sentences more than the control group. Dennett (1978) concluded that the influence of the unattended channel on the interpretation of the attended

signal can be explained only on the hypothesis that the unattended input is processed all the way to a semantic level, even though the subjects cannot report this, and have no awareness of this. He went on to suggest that the absence of introspective evidence that a certain analysis has been performed is never reliable evidence that no such analysis has been performed.

Knox et al. (1974) studied highly hypnotizable college students in conditions of normal wakefulness, hypnosis without anaesthesia, and under hypnosis with suggested anaesthesia and asked for verbal reports of pain and suffering. Subjects were able to distinguish between felt sensory pain and concomitant suffering in verbal reports on numerical scales. Suggestions of hypnotic anaesthesia reduced sensory pain and suffering in "open" reports in about 90% of the group as a whole and eliminated both completely in 3 subjects. However, "hidden" reports during hypnotic anaesthesia obtained through automatic talking were not significantly different from those obtained in the hypnosis without anaesthesia condition. The authors proposed the existence of two levels of cognition - consciousness and hidden consciousness with processing of information occurring at dissociated levels of consciousness.

Thus, there is empirical evidence that some important information processing can be beyond awareness. Kehlstrom (1987) has pointed out that research on subliminal perception, implicit memory, and hypnosis indicates that events can affect

mental functions even though they cannot be consciously perceived or remembered. In an attempt to describe nonconscious processing, he described two variants on information processing theory. Since the role played by introspection depends on the model of mental functioning that is used and since these models represent an improvement over the Levels of Processing (LOP) models used by early researchers in metacognition, the two models are presented here.

5.3.1.2 Alternative Models of Information Processing

The first, Anderson's (1976) Adaptive Control of Thought (ACT) postulates a single unitary memory store. The contents of this memory store are classified into declarative and procedural knowledge. Declarative knowledge structures - the individual's fund of general and specific factual information is further classified as either episodic (autobiographical) or semantic (abstract knowledge) in nature. Procedural knowledge is the repertoire of skills, rules, strategies that operate on declarative knowledge in the course of perception, memory, thought and action.

According to this theory consciousness is identified as a temporary structure known as working memory, similar to the primary memory of the classical model but with much larger capacity. The model holds that people can become aware of declarative knowledge and that this awareness depends on the amount of activation possessed by the representation in question. However, the model holds that procedural knowledge is

not available to introspection under any circumstances - it is unconscious.

The second model, the Parallel Distributed Processing Group (PDP) (1986), or connectionism model postulates the existence of a large number of processing units, each devoted to a specific but simple task. Each unit when activated, excites and inhibits others along a rich network of associative links. This pattern of mutual influence continues until the entire system relaxes to a steady state of activation that represents the information being processed. Information about an object or event is distributed across the processing system, rather than localized in a particular unit. The activation of individual processing units can vary continuously as opposed to discretely. Therefore, it is not necessary for an object to be fully represented in consciousness before information about it can influence experience, thought, action. For this reason, the PDP model may be more useful to a theory of consciousness and to a model of metacognition.

In contrast to traditional information processing theories, which posit a unitary processing system operating under a single set of rules and under the control of a central executive, PDP models assume that various systems (such as those supporting perception and language) operate independently and under different rules. Only some modules are thought to be accessible to awareness and subject to voluntary control. In this schema, metamemory may be but one aspect of metacognition. There may be

other "metas", each with its own rules. However, it may be necessary to combine PDP with at least one other model to account for the executive function of metacognition.

Finally, PDP models abandon the traditional assumption that information is processed in a sequence of stages. Parallel processing permits a large number of activated units to influence each other at any particular moment in time, so that information can be analyzed very rapidly. Both the number of simultaneously active processing units and the speed at which they pass information among themselves may exceed the span of conscious awareness. Therefore, consciousness is a matter of time, rather than activation. Processing systems tend to reach a steady state very rapidly, perhaps within 1/2 a second. At this point of relaxation, the information represented by the steady state becomes accessible to phenomenal awareness. Information may also reach consciousness if the relaxation process is slowed by virtue of ambiguity in the stimulus pattern. However, in this case the contents of consciousness will shift back and forth between alternative representations. According to the PDP model, unconscious processing is fast and parallel; conscious processing is slow and sequential. The model also appears to consider all information processing including the higher mental functions involved in language, memory and thought, to be unconscious.

Kehlstrom (1987) suggests that these two models (and others) may apply at different levels of the cognitive system.

Germane to this discussion, both models appear to agree that the cognitive unconscious encompasses a very large portion of mental life. Some cognitive procedures are innate, domain specific and hardwired into the nervous system and operating outside of conscious awareness and voluntary control. Others are skills acquired through experience and these processes are initially accessible to consciousness but later become unconscious by virtue of practice, that is they become automatic.

Unconscious procedural knowledge has also been described as automatic or routinized as opposed to controlled or effortful (Hasher & Zacks, 1979; LaBerge & Samuels, 1974; Posner & Snyder, 1975; Schneider & Shiffrin, 1977). Automatic processes are unconscious, and the individual has no introspective access to their principles of operation - or even the fact that they are in operation (Kehlstrom, 1987). Therefore individuals may reach conclusions about events and act on these conclusions without being able to articulate the reasoning behind them. Cognitive activity is involved in these processes but it is said to be unconscious and beyond introspective awareness.

Kehlstrom (1987) concludes with a provisional taxonomy of nonconscious mental structures and processes. He suggests that consciousness can no longer be identified with any particular perceptual-cognitive function such as perception, memory, etc. Rather, consciousness is an experiential quality that may accompany any of these functions. Consciousness is, of course, necessary for voluntary control, as well as for communicating

one's mental states to others. However, it seems that it is not necessary for complex psychological functioning.

Furthermore, within the domain of procedural knowledge, there are complex processes that he believes are inaccessible to introspection under any circumstances. Perhaps because they are innate or are routinized, they operate on declarative knowledge without either conscious intent or conscious awareness and in so doing construct the individuals ongoing experience, thought and action. These processes are unconscious and can be known only indirectly, through inference.

Declarative knowledge, on the other hand, is available to phenomenal awareness and can be known directly by means of introspection. However, there is also a class of preconscious declarative knowledge structures. Although activated to some degree by current or prior perceptual inputs, and therefore able to influence experience, thought and action, they do not cross the threshold required for representation in working memory, and therefore for conscious awareness. However, unlike automatized procedural knowledge, these percepts and memories would be available to awareness under ordinary circumstances.

Finally, in addition to unconscious cognitive rules and skills operating on declarative representations and preconscious declarative representations that serve as sources of spreading activation, the phenomenon of hypnosis and related states seem to exemplify a category of subconscious declarative knowledge. These are mental representations, fully activated by perceptual

inputs or acts of thought, above the threshold ordinarily required for representation in working memory and available to introspection under some circumstances. They seem, however, to be inaccessible to working memory. These he described as dissociated from conscious awareness. When such dissociative phenomena occur, they imply that high levels of activation, although presumably necessary for residence in working memory, are not sufficient for conscious awareness. Paraphrasing William James (1890), Kehlstrom states that "...in order for ongoing experience, thought and action to become conscious, a link must be made between its mental representation and some mental representation of the self as agent or experience - as well, perhaps as some representation of the environment in which these events take place. These episodic representations of the self and context reside in working memory, but apparently the links in question are neither automatic nor permanent, and must be actively forged. In cases of subliminal perception and the amnesic syndrome they appear not to be encoded in the first place; in cases of implicit memory observed in normal subjects, they appear to have been available at one time, but no longer; in certain phenomena of hypnosis, they appear to be temporarily set aside. Without such linkages certain aspects of mental life are dissociated from awareness; and are not accompanied by the experience of consciousness" (Kehlstrom, 1987, p. 95).

In a manner not yet defined, metacognition corresponds to aspects of the individual's internal images of themselves and of

other people in their environment. Elements of the self image are not conscious although they may be unconscious in the sense of being repressed (Masterson, 1988), or dissociated, or merely out of consciousness from lack of use, or through automatization. The processes by which these images are constructed and maintained would correspond to the procedural knowledge in the ACT model. Understanding an individual's metacognitive structure requires assessing this knowledge, yet according to the ACT model this information would be inaccessible under any circumstances. The PDP model on the other hand suggests that consciousness is determined not by function but by time. According to this theory, both procedural and declarative knowledge could have both conscious and unconscious aspects. The PDP model further postulates that unconscious processing is fast and parallel, conscious processing is slow and sequential. Although this may be simplistic -- some material may be blocked from achieving consciousness under most circumstances -- it does suggest that much of what is beyond immediate consciousness can be made available to consciousness by slowing the processing. One method for achieving this could be introspection.

5.3.1.3 Metacognition and Nonconscious Functioning

One aspect of metacognition is knowledge about metacognitive activities, in oneself, and in others. This refers both to metacognitive knowledge in general and to awareness of these activities or the need for these activities

during the solution of a problem. General metacognitive knowledge is not a problem in this discussion of the nonconscious. It is either conscious or preconscious and easily retrievable once the individual has developed the cognitive capacity to use it spontaneously. The metacognitive experience, on the other hand, relates to aspects of the self that are generally not held in consciousness but nonetheless operate to guide metacognitive activity or behavior. Aspects of this metacognitive experience may be blocked from consciousness, as in Rueda and Mehan's (1986) observations of metacognitive activity in social situations in their learning disabled children. This behaviour would be labelled clinically as manipulative and require considerable therapeutic intervention to bring to awareness, if at all. Other aspects of this experience, relating to less noxiously viewed, more 'normal' day-to-day functioning may be beyond immediate consciousness but could be accessed with reasonable ease by means of introspection.

Therefore, it would appear that the arguments against using introspection as an empirical tool no longer carry the weight they did at one time. Although data gleaned from introspection can be either accurate or inaccurate, or both, supplementation with observable information can reduce many of the dangers. This would allow access to previously inaccessible material.

Yet a considerable amount of processing takes place beyond conscious awareness. If introspection is limited, how much of

this processing can be made available to empirical investigation? It is here suggested that the degree to which processes are irretrievable remains theoretical. With training and current techniques, it may be possible to increase the availability of so-called unconscious material. For example, procedural knowledge may be available through a combination of introspection and observations. Moreover, in addition to introspection, it may be possible to improve our inferential methods for obtaining preconscious and unconscious material.

The importance of this line of thinking to investigations of metacognition cannot be underestimated. In the model of metacognition being created, here, it is hypothesized that lower level metacognitive skills -- such as strategy selection -- can be both conscious and automatic. Automatic metacognition may be based on modelling and would almost certainly include defenses or coping styles. While these automatic metacognitive activities would in theory be available to introspection, in the young child they probably cannot be accessed, due to the younger child's neurological immaturity and the resultant difficulty in holding two thoughts in consciousness at the same time in order to reflect on their activity. At the other extreme, in the adult, these basic level metacognitive skills have become automatic but can be available to consciousness either when the difficulty level of the problem slows processing, or through the use of introspection.

Speculatively, the higher order metacognitive skills,

problem definition, flexibility and monitoring, pose more of a conundrum. Theoretically, these activities would cut across declarative and procedural categories and may more usefully be thought of as sub-modules within the larger module of metacognition. In the course of every day problem solving they should best be conceptualized as belonging to preconscious functioning. Even in more deliberate information processing what may be available to consciousness is the activities themselves. The principle behind the activities may be what has here been called subconscious, that is, not available to working memory but available to introspection or a combination of introspection and observation with feedback.

If metacognitive functioning can be demonstrated to be linked to the self, then investigators must have some method for assessing self-functioning. And this self-functioning must be assessed in relation to metacognitive functioning. Much of both metacognitive and self-functioning are in the domain of procedural automatic knowledge and by definition go on beyond immediate consciousness. If a model for researching preconscious or nonconscious functioning can be developed, it is here that experimental introspection may prove to be an invaluable additional tool in the research of metacognition.

5.4 Conclusion

In conclusion, interest in the study of metacognition has expanded rapidly since the mid-1980s. Numerous articles and books are now in print which take for granted the existence of

metacognition and which assume a broader base of knowledge than may, in fact, be available. These articles apply the construct in cross-cultural studies, in textbooks and in school curricula. However, the largest single category of publications might best be described as continuing the attempt(s) to define what metacognition is, and the nature of its parameters. In this vein, there continue to be investigations to understand the link between learning disabilities and metacognition (Wong et al., 1989), maturation and metacognition (eg., Cross & Paris, 1988; Li, 1989; Lyon & Flavell, 1993) and giftedness and metacognition (eg., Bouffard-Bouchard et al., 1993). There continue to be theoretical papers which pull together the findings of the empirical studies (eg., Slife, 1987b; Wong, 1986) and some authors attempt to build models of metacognition (Kitchener, 1983; Borkowski et al., 1990). In addition, there are now empirical and theoretical articles which attempt to define the neuropsychological correlates of metacognition (eg., Kinsbourne, 1992; McLynn & Schacter, 1989; Shimamura & Squire, 1986), and studies which examine in greater refinement assumptions about feeling-of-knowing phenomena (eg., Costermans et al., 1992; Leonesio & Nelson, 1992; Reder & Rutter, 1992). There also continue to be attempts to develop a reliable and valid measure of metacognition (Ormond et al., 1991; Clements & Nastasi, 1990; Swanson, 1992a).

At least one editor (Nelson, 1992) has collated a series of articles on metacognitive issues in such a way as to examine the

construct from many perspectives. Although nowhere in the text does he present a model of metacognition, the book taken as a whole provides an implicit model, which provided considerable clarity to the model being developed in this paper.

The first part of this paper aimed at providing a structure and theoretical model for thinking about metacognition. This author, like others (eg. Kuhn, 1983), struggled with the lack of structure in the nomenclature, the lack of cohesiveness of the findings and the difficulties surrounding assessment. The suggestion throughout this paper has been that the term metacognition be clearly distinguished from the other "metas" such as metamemory and that the term be reserved for the superordinate function, perhaps the executive function.

To pursue the empirical interests in this study two measures of metacognition were developed. The first, the Metacognitive Interview (MI), had been intended as a self report of metacognitive experience during the execution of a cognitive task and collected immediately after the completion of that task. Statistical analyses revealed many problems with the measure. Although re-test reliability was adequate, intrarater reliability was poor. Concurrent validity estimates showed some relation with metacognition as has been defined by earlier authors. However, prediction is weak. Despite these concerns, the MI was used in the analyses of the results of this exploratory study. It was suggested that any additional work on the test be aimed at making it a true concurrent instrument,

that is, with questions and probes designed to be administered during the completion of a problem-solving task in order to assess the child's metacognitive processing at that moment in the problem-solving.

The second test, the Metacognitive Knowledge Assessment Questionnaire (MKAQ), was intended as a measure of general knowledge about metacognition. It fared somewhat better than the MI. Intrarater reliability coefficients were high. Re-test reliabilities were adequate with correlations performed on composites of subscales such as total scores or the principal component. Re-test reliability difficulties with individual subscales were similar to those noted by other authors (Clements & Nastasi, 1990; Nandi, 1991; Ormond et al., 1991; Swanson, 1992a) and revealed potential reliability problems among the older and gifted groups. Validity coefficients were encouraging. Although prediction was poor, it was clear from the results that the MKAQ is measuring metacognition as has been defined by previous investigations. The MKAQ shows promise but it could not be used as a clinical assessment instrument until the re-test parameters and predictive powers can be improved. Both instruments (MKAQ and MI) showed strong, consistent correlations with intelligence and maturation.

The contribution of personality factors to metacognitive efficiency had been the second major thrust of this project. While not conclusive, the findings indicate that further investigation in this area might be fruitful. The results of

the canonical correlations suggest that metacognition as measured here may not be associated with deep personality structure issues such as trait anxiety or the variables measured by the Rorschach. However it is clearly inversely associated with state anxiety and with a people-pleasing coping style. The small, but significant, association with ego development is supported by the understanding of state anxiety and people-pleasing as indicators of the (lack of) strength of ego functioning (Masterson, 1985).

Nonetheless, it is proposed that further investigations look at the relation between self and metacognition, since that construct is closer to the nature of metacognition than is the construct of ego. Since self-functioning has conscious, preconscious and unconscious elements, an argument has been made to return to the use of introspection plus observation to illuminate the aspects of metacognitive self-functioning not immediately available to consciousness,

Integrating the results of the study with other recent findings, a tentative model of metacognition was described. It is hoped that this model, or the idea of building a model, will encourage future researchers to plan their investigations and to fit their results into such a structure. The model attempts to take into account the possibility that there are many levels of metacognition, the distinction between metacognition and cognition, metacognitive development, levels of consciousness in metacognitive activity and the contribution of personality

factors to metacognitive efficiency. Conceptualizing metacognition in this fashion is consistent with current models of cognition, provides plausible explanations of past results (often contradictory) and generates useful hypotheses for future systematic study of metacognition.

In summary, this study met its stated objectives. Due to measurement difficulties common in this area, results are not as definitive as was hoped at the outset. However, at least one measure of metacognition has emerged as potentially useful. Intelligence and maturation are clearly important factors in metacognitive efficiency and knowledge. In addition personality factors appear to play a role although it is too early to develop a personality profile(s) of the metacognitively efficient individual. Finally, a working model of metacognition was developed which advances previous models, integrates the existing research data, and provides many testable hypotheses to direct future research.

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Appendix A
Flavell's Model

Appendix A

Flavell's Model

Metacognitive Knowledge

Metacognitive knowledge is "that segment of a child's or adult's stored world knowledge that has to do with people as cognitive creatures and with their diverse cognitive tasks, goals, actions and experiences" (Flavell, 1979, p. 906). It consists of knowledge or beliefs about what factors act and interact in what ways to effect the course and the outcome of cognitive activities. Flavell includes three major categories of these variables: those to do with person, task or goals, and strategy or action.

The first category, person variables, refers to everything an individual comes to know about himself and about the nature of people as cognitive processors (Flavell, 1979). Flavell (1979) and Flavell and Wellman (1977) were the first to elaborate the person variables in any detail and their model was the starting point in conceptualizing the measurement of personality variable in metacognition. Person variables are subclassified into trait (metacognitive knowledge) and state (metacognitive experience) aspects. Remaining, for the moment with the metacognitive knowledge classification, trait aspects refer to enduring aspects and abilities -- the previously acquired knowledge about the self and others.

This category of person variables has also been divided

into three aspects -- universal aspects of cognition as well as inter- and intra-individual differences (Flavell, 1979). Universal aspects of cognition are just that, items of cognitive functioning that are general enough to apply to anyone, at different points in time. As an example, an individual might be aware that understanding or memory now does not necessarily predict understanding or memory later. Knowledge about interindividual differences, differences between people, may include such items as the awareness that one friend is better at certain types of cognitive tasks than another. Intraindividual differences are best described as "cognitive self awareness" (Flavell, 1979) or a "mnemonic self concept" (Flavell & Wellman, 1977) which would include the self awareness that it may be easier to learn by listening than by reading. It may include the awareness that the subject is better at certain types of cognitive memory tasks than at others.

The task variables refer to the information available to an individual during a cognitive undertaking including those characteristics of the task which make retrieval easier or harder. Factors involved in task variables are related to characteristics of the stimulus or characteristics of the goal. Characteristics of the stimulus, the body of information, refers to whether it is easy or difficult to store and/or to retrieve. Thus information could be abundant or meagre, familiar or unfamiliar, redundant or densely

packed, well or poorly organized, or interesting or dull. "The metacognitive knowledge in this category is an understanding of what such variations imply for how the cognitive enterprise should best be managed and how successful you are likely to be in achieving its goal" (Flavell, 1979, p. 907).

The second set of task variable factors includes metacognitive knowledge about task demands or goals. Clearly for any body of stored information, some retrieval demands are more demanding and difficult than others. However, even if the input data remain the same, different retrieval problems make different demands on the learner. Knowledge of these differences contributes to metacognitive efficiency.

In the strategy category of metacognitive knowledge, there is considerable knowledge to be acquired about which strategies are likely to be effective in achieving which goals in the different types of cognitive tasks. Strategies include metacognitive as well as cognitive strategies (Flavell, 1979). Either can involve internal as well as external procedures, cues, and retrieval targets.

As Flavell (1979) and Flavell and Wellman (1977) point out, most metacognitive knowledge actually concerns interactions or combinations of two or three of the various types of variables. As an example, you might recognize that you make better use of one strategy than does your friend -- especially on particular types of tasks.

Flavell (1979) suggests that metacognitive knowledge is therefore not essentially different from other knowledge stored in long term memory. Thus some metacognitive knowledge may be used as a result of deliberate, conscious memory search for example, for an effective strategy. However, perhaps more commonly, some of it may be unintentionally and automatically activated by retrieval cues in the task situation. Importantly, he notes that such knowledge may govern the course of some cognitive enterprise without entering consciousness, although it also may give rise to conscious experience. When activated, metacognitive knowledge can be accurate or inaccurate, or it can fail. Importantly, metacognitive knowledge "....can lead you to select, evaluate, revise, and abandon cognitive tasks, goals and strategies in the light of their relationships with one another and with your own abilities and interests with respect to that enterprise. He further postulates that this metacognitive knowledge can lead to any of a wide variety of metacognitive experiences concerning self, tasks, goals, and strategies and can also help you interpret the meaning and behavioural implications of these metacognitive experiences" (Flavell, 1979, p. 908). This is the essence of the metacognitive aspect of knowledge and a good encapsulation of the knowledge aspect of metacognition.

The second class of cognitive monitoring phenomena is metacognitive experiences. These are any conscious cognitive

or affective experiences that accompany and pertain to any intellectual enterprise and include the ability to monitor these experiences in the here-and-now. Metacognitive experiences are related to the state side of the state/trait dichotomy of the person variables, the transient processes and states mentioned in Flavell and Wellman's (1977) paper. Like metacognitive knowledge the experience differs from other types of experiences in content and function, not in form and quality. The experiences can occur at any time before, during or after a cognitive undertaking. These experiences can be brief or lengthy, simple or complex. For example, in coming across a label pertaining to a new constellation of psychological concepts confusion may be temporary, until the new term can be seen in the light of previously acquired information. Or, if many facets of the concept are new, it may be necessary to puzzle for some time until each part is understood and fit into the whole.

Flavell (1979) suspects that metacognitive experiences are likely to occur in situations which stimulate much careful, very conscious thinking. In particular, the experiences may be expected to arise in situations where each step requires careful planning and evaluation or where decisions and actions are weighty and risky -- and especially, perhaps, where inhibitors of reflective thinking are absent. In such situations, thoughts and feelings about our own thinking can be more accessible and the kind of quality

control that metacognitive experiences can supply can be useful.

For Flavell (1979) metacognitive knowledge and metacognitive experience form partially overlapping sets. Some experiences have knowledge as their content, and/or base, some do not. Some knowledge may become conscious and comprise such experiences, some may not. From Flavell's description, it may be supposed that metacognitive experiences are the most important component of the metacognitive complex. They can have far-reaching effects on metacognitive knowledge, on cognitive goals/tasks and/or actions/strategies. On the basis of metacognitive experiences, the metacognitive knowledge base may be augmented. Additionally, the experience might bring increased information about the relationship between goals, means, or task outcomes. Then metacognitive experience and such new information might serve to modify the metacognitive knowledge base. The experiences could lead to the formulation of new goals or the modification of old ones and could activate strategies aimed at either cognitive or metacognitive goals.

In summary, Flavell presents a model which aims at an integration of two major categories of processes: metacognitive experience and metacognitive knowledge. The latter category includes knowledge about person, task and strategy variables. The focus in his model is the interaction of person and environmental factors. As such he assumes the

existence of metacognitive skills and does not examine their emergence and refinement through development. Nor does he elaborate the intraindividual variables.

Appendix B
Brown's Model

Appendix B

Brown's Model

Brown's subdivision of metacognition is along somewhat different lines from that of Flavell and emphasizes the individual or person variables involved in the process. Although she frequently uses the term "metacognition", the outlines described by Brown are based on a description of metamemory since the research she reports as support for her theory is the area of metamemory. Nonetheless, perhaps due to the symbiotic relationship between metamemory and metacognition, the structures or frameworks of the two tend to be highly similar. The models are considered to encompass the same processes/ structures for the purpose of this paper. The processes to be used in the present research will be based on the understanding elaborated in her 1978 paper. In 1978, Brown defined metamemory as "...the whole gamut of information a person has concerning the workings of his own memory, information essential for the predicting, planning, monitoring and checking activities that accompany mnemonic acts" (Brown et al., 1978a). Generally, she refers to metamemory as the person's monitoring of his own memory processes for the purposes of solving a problem. Her emphasis is increasingly on the problem-solving goal of metamemory processes and she, more than Flavell, elaborates the different steps and accompanying metacognitive activities involved. In this paper, she discussed a 3-part system, each part having several

subsections. Briefly the three parts refer to variables pertaining first to the individual's ability to assess his/her own capacity limitations, and the ability to predict - which refers to readiness to recall, task difficulty, and outcome of strategic activity. The second part refers to the planning for remembering and adjustment of activity according to this planning. Finally the third part refers to the individual's checking and monitoring of his/her own activity. Flavell's classifications of person, task, and strategy are all covered in this system. However, even from this brief description it is clear that the thrust or focus is different, i.e., more person-centered. Furthermore, Brown extends the idea of metacognition to directly encompass such processes as planning and checkback.

Brown's first category, assessing the system's capacity limitations can be defined as the problem of knowing or coming to know, what you do or do not know. This Brown (1975) considers to be a very basic form of metacognition and the ability to monitor one's own understanding of messages, either spoken or written, to be "...an essential prerequisite for all problem-solving activity" (Brown, 1975, p. 83). Thus (quoting Holt, 1964) Brown suggests that the good student may very well be the one who can say, and frequently does, that he does not understand. This indicates the self-monitoring process at work.

Metacomprehension, the first factor listed in this area,

Brown (1978a) defines as the individual's determination of his own state of ignorance or enlightenment with regards to a specific task. Again, as an example, the understanding of a new psychological concept would be comprehension. The realization that you do or do not understand the new concept would be classed as metacomprehension.

Knowledge inference is the second factor influencing the assessment of the system's capacity limitations and refers to the awareness of the general state of one's own knowledge and the possible limits on that knowledge. For instance, the mature problem solver would be aware of the fact that he could expect himself to know his family's address, but that it would be unlikely for him to know Pierre Berton's address. This estimation involves quite complex forms of reasoning. Adults are aware of the state of what they know, and what they are able to know. Children, on the other hand, do not know as much as adults do, and are less aware of the state of their knowledge. In addition what they do know is often in a state of incompleteness or disorganization, with large existing gaps and they lack the system possessed by adults for inferring knowledge from their own incomplete data (Brown, 1975).

The third factor is problem identification -- that is identification of the exact nature of the problem. This requires identifying all facets of the problem before proceeding with resolution -- and this can be a very complex process which depends on very complex metacognitive

introspection. This identification depends, at least to some extent, on the individual's existing state of knowledge about tasks in general and about this task in particular. It depends also, on what implication this has for cognitive strategizing. This can be a difficult task even for the experienced adult who has a repertoire of knowledge to back up his decisions. It must be much more so for the inexperienced child.

In this first category, the last subsection is that of confidence. Empirically, confidence is defined as the ability to predict potential accuracy prior to performance. It is a measure of how confident the subject is that he or she is right in his/her choice of response. This prediction of potential accuracy prior to performance is to be distinguished from confidence in accuracy following a performance which will be considered in the next section.

The second category Brown considers, that of prediction, has four components: 1. prediction before performance; 2. span estimation; 3. estimation of task difficulty; and 4. predicting the outcome of strategic activity. Brown (1978) suggests that "...the ability to accurately assess performance after a response is made contrasts sharply with the ability to predict accuracy prior to a retrieval attempt" (p. 86). The greater difficulty of prediction is due to the greater abstraction involved -- i.e., it is more difficult to imagine cognitive acts that have not occurred. This element of

prediction is a complicated aspect of metacognition. From Brown's analysis this prior prediction is present from the beginning of the metacognitive process. It begins with what has been called a "feeling of knowing" experience -- a recognition that a gap in knowledge exists which must be filled. This, Brown is careful to point out, must be distinguished from the active attempts to fill the gap.

The third element in prediction is that of span estimation -- the prediction or estimation of one's own memory capabilities. Operationally this has been quite narrowly defined as the ability to predict how many items of a list, exposed to the subject, she would subsequently be able to recall.

The fourth form of prediction which Brown considers is that of estimating task difficulty. This refers to a subject's knowledge of the aspects of a task which facilitate retrieval or make it more difficult. These task elements refer to characteristics of the stimulus which might facilitate encoding such as having it appear in some form of organization, for example a story or a list of paired opposites, rather than an arbitrary list of words. Also relevant would be knowledge of task demand, for example the gist recall would be easier than verbatim reporting. Brown includes in this category, the ability to recognize the important elements in a prose passage and presumably the recognition that the ability to recognize and retain these

would facilitate recall.

The final element of prediction considered by Brown is the ability to predict the outcome of some strategic activity thus facilitating strategy selection. Here she is interested in the child's appreciation of strategic intervention in memory tasks. For the purposes of her discussion, she includes not only accurate prediction about the outcomes of a particular strategic intervention, but also the willingness to adopt a particular strategic intervention once it has been deemed appropriate.

Brown's third category describes the ability to plan ahead and the knowledge about the efficiency of such planning. This refers to the ability to consider task-relevant aspects before beginning to problem-solve. Planning for future recall can refer to either simple behaviour or to complex patterns of strategic activity. Brown considers two elements. The first of these refers to the ability to differentiate between those situations which will require an active attempt at remembering and those where memorization is not required. The second refers to apportionment of study time and how this is accomplished.

Brown's fourth and final category is that of monitoring and checkback. Checking and monitoring involve looking for internal consistency, reality testing or testing to see that a response or procedure abides by the rules of common sense or ensuring that the rule being followed is appropriate to the

task.

In summary, Brown's model of metacognition is implicitly closely allied with the LOP model of memory.

Appendix C
Sternberg's Model

A third model builder, more recent to the area of metacognition, is Robert J. Sternberg. Sternberg appears to have arrived at his interest from a completely different perspective. A detailed cognitive theory builder, Sternberg's approach to metacognition appears to have come from an interest in the structure of intelligence and particularly in the attributes of the gifted subject (Sternberg, 1981, 1983, 1984, 1985). His model of intelligence is based on an information-processing approach. He terms it a "componential theory", preferring the use of "components" to "factors". A component he defines as "an elementary information process that operates an internal representation of objects or symbols" (Sternberg, 1981). A factor, he defines as a latent source of individual differences (Sternberg, 1981). In his view, a componential theory is a dynamic process-oriented theory in contrast to the static, product-oriented one of the factor-analytic model.

Furthermore from a statistical perspective, a componential theory is based on within individual rather than between individual differences. Finally, although both the regression techniques used in componential analyses and the factor-analytic techniques used in factor analysis both derive from the general linear model, the inferential machinery for regression analyses seems to be more well-developed than is that for factor analysis. He argues that the results of standard (nonconfirmatory) factor analyses are subject to

arbitrary rotation, whereas the results of standard regression analyses are not, and regression analyses yield unique solutions, whereas factor analytic ones do not.

Having said all this, Sternberg acknowledges the complementarity of componential and factorial analyses seeing them as two perspectives on the understanding of intelligent behaviour.

Sternberg (1981) describes performance components as those processes used in the execution of a problem-solving strategy. "In essence, performance components execute what metacomponents plan" (Sternberg, 1981, p. 89). The potential number of performance components is large, however Sternberg (1981) describes seven he considers to be general across a range of inductive reasoning and problem-solving tasks. These seven examples are:

1. encoding: the storage in memory of the terms of the problem for retrieval and use later.
2. inference: the detection of one or more relations between two objects in a given domain.
3. mapping: the relating of aspects of one domain to those of another domain.
4. application: the use of relations inferred in one domain as mapped to another to make predictions about what will happen in the second domain.
5. comparison: the comparison of the prediction generated in applications to alternative options that are presented.

6. justification: the verification of the best of the presented options even if it is not ideal.

7. response: the communication of the solution to the problem.

Although Sternberg has been criticized for his use of the term "components" in relation to his theory of intelligence (see Neisser, 1983), this criticism is not germane to the present discussion since the interest here is in Sternberg's structural theory as it relates to metacognition rather than intelligence. For the purposes of this paper it is less critical that Sternberg uses the term "components" rather than "processes".

Sternberg (1983) distinguishes information processing theories of intelligence from other theories of intelligence in terms of the "level of processing" to which they seek to ascribe the antecedents of intelligence performance. Depending on the theory, levels can range from the perceptual motor level to the level of complex problem solving. Although no theorist would choose only one level to describe intelligent behaviour, most theorists seem to emphasize a single level or a fairly narrow set of levels in their theories. Information processing theorists also usually attempt to deal at least to some extent with a broader range of processing than do psychometric theories of intelligence. Information processing theories range from an extreme of simplicity such as Jensen's (1979) to the other extreme of

complexity for example Anderson's (1976). Sternberg (1983) considers his theory to be in the mid-range, but closer towards the complex end of the continuum. "Componential analysis takes place at 3 tiers of analysis that serve clearly distinguishable functions: metatheory, theory and task models" (Sternberg, 1983, p. 4).

Appendix D
Description of (6) Metacognitive Processes

Appendix D

Definition of (6) Metacognitive Processes

Metacognition or the knowledge and awareness of one's own thinking process has been found to consist of several sub-processes as well as an overall knowledge dimension. The following is a description of the metacognitive processes deemed relevant to the current study. These processes are selected from the work of Campione and Brown with the mentally retarded and the enhancement of study skills. The writings of Flavell and Wellman in the area of metamemory and the research of Sternberg and his colleagues directed primarily with the intellectually gifted. Consequently key processes were synthesized from these two separate literatures. What follows is an operationalized definition of each process.

Problem Definition

Central to metacognition is the subject's need to have a clear understanding of what the key issues are in any problem before beginning to solve it. For example, in the case of material to be studied for an exam in history, problem definition might involve estimating the amount of material to be learned, estimating the amount of time available, and estimating the amount of work necessary to learn the material.

Planning Ahead

Planning ahead refers to the ability to predict what will be required in order to successfully complete a task. This planning represents the process of deciding to allow the time

required to complete the task, where to obtain the information required, and what steps are involved. For example in studying for the history exam, planning ahead might include deciding to allow a certain amount of time to learn the material, and when, deciding whether or not to use study aids, deciding how to fit this studying in with your other activities.

It will be noted that these first two facets of the larger process of metacognition are highly interrelated. In fact, it must be the rare occasion where one appears without the other (although it is possible to think of problem definition without planning ahead but not vice versa). It is probable that both are in a circular process, necessary before proceeding to the next aspect of metacognition.

Strategy Selection

Strategy selection is that aspect of metacognition which involves choosing between the multitude of available cognitive strategies. Using the same example of studying for a history test, strategy selection might involve which study aids to use (e.g., note taking), which memory aids to use (e.g., memorizing, association), and which time table to use.

Flexibility (of Strategy Use)

Flexibility refers to the capacity of an individual to alter her plans or strategies as either the demands of a task change, or if the effectiveness of the strategy choice is called into question. Again, using the example of the history

test, should the teacher decide to include an extra chapter, study strategies would have to be amended. Or perhaps, using a set of study strategies, the exam was unsuccessfully completed. Then it would seem logical to alter study plans for the next history exam.

Evaluating

Evaluating is a process with two distinct parts. One aspect of evaluating involves prediction of success prior to attempting a task. The second aspect is the awareness of how well one has performed on a task, after completion. Here, on the history test being used as an example throughout the description of these processes, the first aspect of evaluating might involve predicting how well one can do on the forthcoming exam. The second aspect might involve evaluating, post hoc, how well one has done.

Checking

This aspect refers to the ability to check one's progress in an on-going manner during the problem solving process. It is distinguished from flexibility in strategy use in that it does not necessarily indicate change. Furthermore, it is different from evaluation in that it doesn't necessarily include a decision regarding success -- that is, the quality of performance. Rather, it is a process that depends on awareness of the need to monitor or check one's progress. Again using the example of the history exam, the checking process might include the recognition of the need to quiz yourself, or to have someone else quiz you to check your retention.

Appendix E
Ego Development

It has been pointed out (Loevinger, 1970; Rapaport, 1959) that the term "ego" did not originate with Freud. In fact, Freud eschewed terms of Latin origin such as "ego" in favour of words taken from common speech (Loevinger, 1970). Before the advent of Sigmund Freud, many words were used to delineate the concept - the "I", the "me", the "self" and from this broader perspective, concludes Loevinger (1970), the origins of the concept can be seen to be in ancient Greek, Hebrew, and Hindu writings. During this period the concept of ego was defined as person, self, or consciousness. At first, Freud did not directly confront the existing definition of ego (Rapaport, 1959). Later, however, he broke with the tradition of defining ego as synonymous with the self and made it one part of the tripartite personality structure - id, ego and superego. At this point in his thinking, Freud included as part of the ego both conscious and unconscious elements and defensive function. Later theorists, such as H.S. Sullivan (1953), would develop Freud's earlier thoughts and revert to a definition of ego synonymous with self resulting in a definitional confusion which existed until recently. Writers such as Symonds (1951) and Erikson (1950) see the dichotomy as spurious.

In 1939, Hartmann (Hartmann, 1958) introduced the concept of inborn apparatuses of primary autonomy that, with development, came to serve the ego. These primary apparatuses - perception, intention, object comprehension, thinking,

language, recall phenomena productivity, motor development and so on therefore also introduce the concept of innate ego developmental ability. Importantly, Hartmann (1958) also introduced the concept of normal development to psychoanalytic study. He elaborated on the importance of the mother-child relationship and introduced the concept of the child's development from a fused, symbiotic relationship in which mother and child are 'perceived' (by the child) as one, to the stage in which the mother is perceived (by the child) as existing only to fulfil the child's needs, through to the stage of object constancy - that is constant mental representation of the caretaker, regardless of the state of need. Hartmann made many other contributions not germane to the present discussion; however it is important to underline that these ideas were introduced after Freud had completed his work, although they grew out of his writings.

As Loevinger (1970) has pointed out in the first part of the 20th Century, apart from these changes occurring within analytic circles, and stimulated by Darwin's discoveries, the topic of ego development was commonly taught in undergraduate courses. Even more recently, non-analytic child development texts have taken an atheoretical approach, teaching normal and deviant development from a wholistic approach, thus blurring the lines between intellectual development, ego development, cognitive maturation or psychosexual development.

In her historical overview, Loevinger (1970) points out

that in the fifties in North America, there were many changes to and rebellions against Freud's writings. The objections were many and varied, among them Harry Stack Sullivan's objection to the mystical meaning built into many psychoanalytic terms. Instead of the term "ego", he used the term "self system". He defined and elaborated his thinking about the self system (Sullivan, 1953) sufficiently to bring it within the scope of measurement. Sullivan's work along with that of Piaget formed the basis for the attempts at measurement of late ego theorists - Clyde Sullivan, Douglas Grant, and Marguerite Warren (Sullivan, Grant, & Grant, 1957), Kenneth Isaacs (1956), Robert Peck (Peck & Havighurst, 1960), Laurence Kohlberg (1964), O.J. Harvey, David Hunt and Harold Schroder (Harvey, Hunt, & Schroder, 1951), Margaret Mahler (1975), and many others (Loevinger, 1970). The terms by which they called the concept of ego differed slightly from author to author, the sequence of stages are not exactly the same and the perspectives from which they approached their studies also differed. For example, Kohlberg's (1954) vantage point has been "moral development" while Harvey, Hunt, and Schroder (1951) talk about cognitive complexity and Mahler (1975) describes the process of separation-individuation. However, in common they are all describing an abstract continuum that is both a normal developmental sequence and a dimension of individual differences in any age group. To some degree, all are concerned with impulse control and character development,

with interpersonal development, and with cognitive preoccupations, including self concept. All the theories are developmental in content and represent wholistic views of personality. All prefer to see behaviour in terms of meaning and purposes - as opposed to more abstract and obscure concepts such as psychic energy or cathexis which pervade psychoanalytic writings. And although the sequence of stages is not identical from author to author there are many recurring similarities. The term 'ego' is both sufficiently broad and sufficiently abstract to encompass all these similarities and all these aspects of a multifaceted, complex concept (Loevinger, 1970).

In the first weeks of life, the autistic stage (Mahler, 1975), the child's world is said to be egocentric - it is an extension of the in utero experience where she and her mother were physically one. Following birth, the physical union is no longer a reality but to the infant, at first, the semblance of unity continues. During these weeks, physiological needs and bodily sensations predominate. The infant is concerned only with maintaining a positive balance between pleasant and unpleasant sensations, or homeostasis. According to Hartmann (1958) even at this age, the seeds of ego development -- the tools as it were -- are present in the autonomous functions of the ego. That is, the ego has innate givens upon which it can rely and which develop together with the constitutional givens. Examples of these inborn ego apparatuses would be

perception, intention, understanding of relationships around him, thinking, language, memory, productivity, motor development, etc. Gradually, the child becomes able to distinguish his own from his mother's tension-reducing operations and to separate pleasurable from painful experiences (Mahler, 1975).

By the age of two or three months, the infant is aware of someone in the external world who is satisfying his needs. However, even during this period, the infant is said to retain her belief that she and this need-satisfying object are one and the same physical entity. This stage, which most ego psychologists call the symbiotic stage, is said to be a prerequisite for normal growth. The stage lasts approximately from a few weeks of age to nine months (Mahler, 1975).

In the security of this symbiotic stage, the infant constructs for herself a stable sense of the world around her and of the significant people in it. The reliability and stability of these object relations, as they are called, are proposed to form the basis of the child's ability to form relationships throughout her life. She also comes to learn that she and this object are separate. During this second stage, the infant develops the capacity to endure some delay of gratification. She is aided in this by the memory of pleasurable experiences which can now tide her over during times of frustration. Through this maturation of relations between the internal and external world by the age of ten

months the external care-giver is so distinct that she can no longer be experienced as interchangeable with the toddler. According to Mahler (1975) these first two demarcations in development, the autistic and the symbiotic, occur during the period from birth to ten months, approximately. According to Loevinger (1970), "...intellectual development, psychosexual development and later adjustment all depend on successful solution of the problems of this period, as much as does ego development" (Loevinger, 1970, p. 4).

During Mahler's (1975) third stage lasting from approximately ten months to three years of age, the child develops an awareness of her own separate existence. This implies an awareness of psychological as well as physical separateness. It is divided into four phases. The first two last from 10-18 months of age; the second two occupy the next 18 months of life.

In the first phase, differentiation, the child who has experienced a safe environment, during his symbiotic fusion with his mother, begins to move away from this fusion and reliance on mother to explore. In this exploration she is aided by maturational processes such as locomotion. Although this thesis does not provide the forum to elucidate the controversy still ongoing between object relations and classical analytic theorists (Bowlby, 1969; A. Freud, 1949; Klein, 1952, Spitz, 1949), the following can be said at this juncture. Whether one postulates a primary drive toward

socialization (Bowlby, 1969) or a secondary drive toward affiliation arising out of the association of the satisfaction of physiological needs with the mothering figure (A. Freud, 1959; Erikson, 1950), clearly at the end of the differentiation phase the child has developed a bond of attachment to mother in addition to the dependency tie.

From this time until 16 months of age, she is in the practising phase and is exploring the world beyond her relationship with her mother. She begins to investigate the physical world around her and to test her mother's reactions. Although this may provide a welcome freedom to the mother, Mahler (1975) reminds us that it is important to allow the child to lengthen the anchoring rope only as she feels able to do so. Mother's presence is needed to reinforce approved behaviours and to set limits by chastising some behaviours and approving others. Otherwise the child will have the feeling she is being cut adrift.

During the practising period, the child behaves as though she is oblivious to her mother's presence. At 16 months, as she enters the rapprochement phase, she often seems to exhibit behaviour appropriate to an earlier stage as she once again shows a reluctance to separate from her mother. The mother may resent the increased dependency at this stage, and the resulting rebuff, or the birth of the next child, is hypothesized to lead to depression later in life. Conversely, the mother may welcome the increased dependency, delaying the

child's individuation process.

In the fourth phase, separation-individuation, the child establishes herself as female (or himself as male) child, separate from her mother. Her relationship with her environment can now be undertaken independent of her states of need. She is developing a joy in autonomous functioning and the beginning of language and representational thought.

In Loevinger' (1970) description the period spanning 10 months to three years of age is characterized by the child's assertion of her growing sense of herself and is dominated by impulses. The impulses, though restrained by the environment, affirm the sense of herself through the feedback provided by immediate rewards and punishments. In other words, she learns who she is through the definitions of her behaviour offered by the world around her. Other people are perceived primarily as a source of supply. During this period there is cognitive confusion as well as cognitive simplicity but no true cognitive complexity.

In summary, Mahler (1975) postulates three stages in the first three years of life. In progressing through these three stages, the child develops from a psychological union with mother through an exploration of her environment (both physical and human) into a separated and individuated existence. During the first 18 months, that is, the first two stages, and the first three phases of the third stage, the bond between mother and child remains intense. During the

final phase of the third stage, the child is developing a sense of herself as a separate and separately functioning individual.

The first step in the direction of individuality is the control of impulses and the first step in the control of impulses is the point at which the child becomes capable of delay when it is to her immediate advantage. People at this stage understand the concepts of blame, but they tend to blame others, or circumstances, or some part of themselves for which they do not feel responsible. They understand that there are rules - but the chief rule is - 'don't get caught'. People at this stage are concerned with controlling and being controlled, with sharing, with domination and with competition. They are sometimes manipulative (Loevinger, 1970).

Most children around school age, or during the early school years progress to the next stage, that of conformity. This stage is well recognized and has been described in detail by many authors (Erikson, 1950, 1959, 1968; Kolberg, 1964). During this period the child identifies herself with authority, her parents first, later other adults, and then peers. This is the period of the greatest cognitive simplicity. There is a wrong way and a right way - the latter usually being that which is conventionally and socially approved (Loevinger, 1970).

Superficial appearance is of paramount importance and

disapproval becomes a powerful social sanction. In line with this, cognitive preoccupations are taken up with appearance - reputation, consumer products, the correct appearance, belonging. Individual differences are scarcely perceived and those that are recognized are seen only in banal terms. Inner states are seen in terms of gross demarcations of feelings - love, hate, etc.; people are differentiated in terms of social group classification. People at this stage of development constitute either a majority or a large minority in almost any social group (Loevinger, 1970).

Loevinger (1970) calls the next level the conscientious stage. Transition to this, her fourth stage appears to occur between the ages of 16 and 20. Notable in this stage is a heightened consciousness of self and inner feelings and the perception of multiple possibilities in situations. Rules are seen to have exceptions or to hold only in certain contingencies. Once these complexities are introduced into development, they continue to be evident in higher stages (Loevinger, 1970).

At this stage motives and consequences are more important than rules, per se. Psychological causation is perceived and what should be is clearly distinguishable from what is. Inner states and individual differences are vividly differentiated. At this stage, unlike at lower stages, individuals spontaneously refer to psychological development in themselves and in others. Also, unlike at lower stages, the

conscientious person is reflective and describes herself and others in terms of reflexive traits (below the conscientious level the only reflexive trait that appears is self-consciousness). Furthermore, this reflectivity includes the ability to be truly self-critical, not rejecting of the self as are people at lower levels (and depressed people at all levels). The individual who is operating basically at the conscientious level is aware of choices, strives for goals, is concerned with living up to goals and with improving herself. Moral issues now include questions of priorities and appropriateness, and are separated from conventional rules and from aesthetic standards or preferences. Achievement is important but is no longer measured in terms of competition and social approval but now becomes a question of one's own inner standards (Loevinger, 1970).

The next level, the autonomous stage, is marked by a heightened sense of individuality and a new perspective on the dependence-independence conflict that characterizes ego development. During this stage comes the recognition that even though one may be physically and financially independent, one remains emotionally dependent on or interdependent with others. Relationships with other people now seem to take priority over the striving for achievement and responsibility for the self and the excessive moralism of the previous stage. The moralism of previous levels begins to be replaced by an awareness of inner conflict, however, at this stage the

conflict remains only partly internal - if only certain external circumstances would change, there need be no conflict. However, conflict is being recognized as a part of the human condition (Loevinger, 1970).

In this stage, also, the individual begins to recognize other people's needs for autonomy. Moral dichotomies become replaced by the awareness of complexity and the multifaceted nature of real people and real situations and there is an acceptance that not all problems are solvable. There is a deepening respect for other people and an acceptance of their need and ability to make their own mistakes in order to arrive at their own solutions. Striving for achievement is beginning to be replaced by a striving for self fulfilment. The individual at this stage begins to see the world in terms of social problems beyond his own scope and strives to be objective about himself and others. Few people reach this and the next stage (Loevinger, 1970).

The sixth and last stage Loevinger terms the integrated stage - the stage at which conflicts are resolved at a higher order. This stage corresponds to Maslow's (1954) stages of self actualization. It is achieved by few individuals.

Appendix F

Metacognitive Knowledge Assessment Questionnaire (MKAQ):

Sample Protocol

GENERAL KNOWLEDGE QUESTIONNAIRE

CARLETON UNIVERSITY

DEPARTMENT OF PSYCHOLOGY

STUDENTS QUESTIONNAIRE

I am interested in understanding how students learn. The following pages contain questions which will help me in understanding what helps you to learn and to solve problems.

Please answer the questions honestly and try to answer every question, even if you are not sure of your response. There are no right or wrong answers, so whatever answers you give that really tell me how you would handle the situation, are O.K. Your answers will be for our research only, and therefore will be between you and me. They will not be seen by anyone else.

The results of this study will help others improve how they approach problems. Thanks for your co-operation in completing this questionnaire.

SECTION A

358

In this section, I would like you to imagine yourself in two situations. I would like you to tell me what you would be thinking about and what you would do as you try to solve the problems in these situations. There are two questions in this section, each requiring an answer in at least six sentences or statements.

1. Suppose you find yourself in the Rideau Centre and you have lost the person who was going to give you a lift home. Suppose you were counting on them to give you a lift and so you have spent all your money. How would you go about trying to find your way back home?

Now, I would like you to imagine yourself in another situation. Tell me what you would think about, and what you would do, as you solve this one.

359

2. Suppose you have an exam in math, tomorrow, but you have forgotten your math textbook at school. It is after 5:00 p.m. What would you do?

NOW THAT YOU HAVE FINISHED SECTION A, PLEASE LET ME KNOW BEFORE PROCEEDING TO SECTION B.

In the following questions I would like you to tell me what you would do in the situation I have described. Let's do one together....

Often, in the middle of doing a math problem, I find my mind wandering and then I

O.K., now continue on your own. Please answer every question. I am here to answer any questions you may have.

1. Let's suppose you have been given a large puzzle and it is all in pieces. How would you decide what to do?
2. With this puzzle in pieces, how would you decide if it is too easy or too hard for you to do?
3. Suppose the puzzle was very hard, what would you do next?
4. What is the first thing you would do to begin to put it together?
5. Suppose there are three programs on T.V. that you want to watch and they are all on at the same time. You do not have a VCR, (let's say) neither do any of your friends. What would you do?

6. Suppose you have been trying to decide between these three programs for about ten minutes and still can't make up your mind. What would you do?

7. Suppose you have a math test in school. You have finished all the questions. What do you do next?

If you have a story or book to read for class, do you do anything differently than if you were reading the same book at home, just for yourself?

8. What would you do differently, and why?

9. Suppose on this math test you are told that one problem has more than one way to solve it. You get points for the number of ways you can think of. Do you think you could

	<u>YES</u>	<u>NO</u>
a) find all of the solutions	_____	_____
b) some of the solutions	_____	_____
c) only one of the solutions	_____	_____

11. Do you think you could find as many solutions as most of the other people in your class?

	<u>YES</u>	<u>NO</u>
a) more	☐	☐
b) less	☐	☐
c) the same amount	☐	☐

12. Do you think your solutions would be as good as theirs?

<u>YES</u>	<u>NO</u>
☐	☐

13. Suppose there were a T.V. program which is directly related to one of your school subjects (e.g. history or english). Would you do anything differently when watching that program from watching, say Miami Vice, Bill Cosby, or Family Ties?

<u>YES</u>	<u>NO</u>
☐	☐

14. What would you do differently, if anything?

15. Suppose you have a math problem to solve and it is very hard. How would you start to solve the problem?

16. When you have completed this problem, how would you know if your answer is wrong?

17. Do you spend time thinking about the math problem before you begin to solve it?

YES

NO

☐☐

18. Suppose the math test has more than one problem on it. How would you begin to complete this test?

SECTION C

I would like to know which of these sentences applies to you. If you think it describes you, please put a check mark in the "TRUE" box. If you think it does not describe you, please put a check mark in the "FALSE" box.

Let's do the first one together.

	<u>TRUE</u>	<u>FALSE</u>
I always understand instructions about (math) problems at school.	☐	☐

Fine, now continue on your own. Please check an answer for each statement. I am here to answer any questions you may have.

- 10 -

	<u>TRUE</u>	<u>FALSE</u>
1. When I am given a problem to do, I think that the sooner I begin answering it the better, since that way I won't forget the answers that are in my head.	☐	☐
2. When I can't solve a problem, the first time, I		
a) stop	☐	☐
b) go on to something else	☐	☐
c) other	☐	☐
3. I read through the whole problem, at least once, before starting to answer it.	☐	☐
4. Even if I think my answer is not correct, I usually leave it, anyway and go on to something else.	☐	☐
5. If I try to solve a problem and it doesn't work, I try to see if there is another way to solve it.	☐	☐
6. When I am having trouble completing a problem, I often find myself daydreaming.	☐	☐
7. If I don't understand the instruction in class I try to do the problem, on my own, anyway.	☐	☐
8. I never have enough time to check my answers on a test.	☐	☐
9. I have a pretty good idea of how many of the answers on a test. I got right.	☐	☐
10. I am probably as good as my friends at solving problems at school.	☐	☐

- 11 -

	<u>TRUE</u>	<u>FALSE</u>
11. I am better at solving some kinds of problems than others (for example, riddles, or puzzles, or math problems, or problems between friends).	☐	☐
12. I think that (basically) I would solve all problems in much the same way.	☐	☐
13. I don't think there is much difference between solving a math problem and learning a list of words in spelling.	☐	☐
14. I always listen when the teachers give instructions (in class) but I sometimes have trouble knowing what to do when I start an exercise.	☐	☐
15. When I am doing a test in school, I always check my answers after I have finished the whole test.	☐	☐

Appendix G
Introductory Remarks
Examiner 1 and Examiner 2
Testing Schedule

Examiner 1

I am conducting a research project as part of my studies in Psychology at Carleton University.

The purpose of this study is to discover how much children/ students know about the ways they learn and solve problems.

I will be asking you to do two thinking games. At the end of each game you will be asked some questions about what you have just experienced. Feel free, however, to talk during the game about what you are doing or thinking.

With your permission, I would like to tape record your responses to help us not lose any important information. Would this be okay? I want to reassure you that your answers are only for this study and will not be discussed with your teachers or parents.

I will also be timing your answers with a stopwatch. It is not to see how fast you play the game but just to get an idea of how long it takes students to play this game.

Examiner 2 (Where Examiner 2 was the first examiner?)

Hi, my name is Sue. Let me explain to you why I called you out of class today. I believe you took a letter home, asking you to be a part of a research project? And your parents agreed to your participation? Did they discuss this with you? How do you feel about taking some time now and next week to be a part of this study? It will mean playing some games and answering some questions and none of it has anything to do with your marks or your standing in the class. And the answers you give will stay with me and my friend - they won't be given to your teacher, your parents, or anyone else.

You see, I am completing my Ph.D. degree at Carleton University and as a part of the requirements for that degree, we have to complete a very large study. I am working with another woman, whom you will meet later (or have met already), and we were both interested in studying the same thing. What we wanted to study was how children learn, and particularly how they learn to solve problems. It would probably make sense to you if I say that people solve problems differently. You're going to look at things differently from the way I do, or your best friend does. And your mom may look at problems different from the way your dad does, but when I say problems I don't just mean school-type problems. I mean everyday-type problems, too, like what do you buy your mom for her birthday or how do you make up when you've had a fight with your best friend. So we're interested in finding out what makes someone

a reasonably good problem solver because if we can discover this, then we can turn around and help children who are having a hard time solving problems, like the children in a slow learner class.

So I want to thank you for helping me with this study. Some of it you will enjoy doing, some you may not. I'd like you to just do your best. If you have any questions, please don't hesitate to ask me.

Introductory Remarks, Examiner 2 (Where Examiner 2 was the second examiner).

Hi, my name is Sue.

I believe you met with a friend of mine about one week ago - you played some games and answered some questions? (If necessary - do you remember the game about the twins?) She probably explained what we are doing. Can you remember what she told you? (The students were then explained only those aspects which they had not been told before or which they did not remember, as per the explanation outlined above).

Data Collection Testing Sessions

Session 1 (or 3)	Session 2 (or 1)	Session 3 (or 2)
Kemler Hypothesis Formation Task	Matching Familiar Figures	Children's Social Desirability Scale
Concurrent Interview		Loevinger Sentence Completion Test
Pattern-Matching Task Concurrent Interview	Rorschach	Paragraph Completion Test
(half the students were administered the tests in this order, half the reverse order)	Spielberger State-Trait Anxiety Scale For Children	Metacognitive Knowledge Assessment Questionnaire

Appendix H

Metacognitive Knowledge Assessment Questionnaire (MKAQ):

Six Additional Processes Used in Scoring System

Additional Dimensions -- Definitions

Score 0, 1, 2

Clarity: Dimension: vague -- clear

This dimension refers to the clarify of definition of the particular metacognitive process being scored. For example, if discussing problem definition, what is being scored is the degree of clarity of the definition of the problem. Or, if discussing strategy selection, the score would be for the clarity with which the strategy was delineated.

Specificity: Dimension: random -- specific

This dimension refers to the specificity of the response to the problem at hand. Therefore, when discussing strategy selection, the score describes whether the strategy selected is specific to the task at hand or a randomly selected strategy which may or may not be applicable to many situations. When scoring monitoring, again, specificity refers to the degree to which the monitoring procedure is specific to the task at hand.

Reflectiveness: Dimension: rote   repetition   --
reflective

Reflectiveness refers to the degree to which the child has an internalized awareness of a problem that needs solving. This dimension is more inferred than the other dimensions. What is being measured, here, is an indication that the child has processed the problem internally and has come up with a personalized account rather than a rote repetition.

Therefore, when scoring problem definition, the tester is looking for a personalized definition of the problem rather than a rote repetition of the instructions.

Organization: Dimension: disorganized -- organized

This dimension refers to the degree of organization in the response. Therefore, what is being scored, here, is not the content of the response but the structure of it.

Conceptualization: Dimension: no concept of self as problem solver -- good concept of self as problem solver

This dimension refers to the evidence of the presence of a conceptual plan. What is being measured, here, is the ability to present an overview not so much in abstract terms, as in a larger perspective which nonetheless zeroes in on the essential elements of the problem in terms of the metacognitive process under discussion. This is the hardest dimension to score perhaps because it contains aspects of the other four dimensions. Therefore, when scoring problem definition, conceptualization refers to the degree to which the material indicates conceptual understanding of the problem. Or, when scoring planning, this dimension refers to the presence of a good conceptual plan.

Appendix I

Metacognitive Knowledge Assessment Questionnaire (MKAQ): Scoring System and Sample Score Sheet

CARLETON UNIVERSITY
DEPARTMENT OF PSYCHOLOGY
STUDENTS QUESTIONNAIRE

I am interested in understanding how students learn. The following pages contain questions which will help me in understanding what helps you to learn and to solve problems.

Please answer the questions honestly and try to answer every question, even if you are not sure of your response. There are no right or wrong answers, so whatever answers you give that really tell me how you would handle the situation, are O.K. Your answers will be for our research only, and therefore will be between you and me. They will not be seen by anyone else.

The results of this study will help others improve how they approach problems. Thanks for your co-operation in completing this questionnaire.

NAME: Manual
GRADE: 3, 6, 8
DATE: Fall/Winter
                     1987/1988

SECTION A

In this section, I would like you to imagine yourself in two situations. I would like you to tell me what you would be thinking about and what you would do as you try to solve the problems in these situations. There are two questions in this section, each requiring an answer in at least six sentences or statements.

1. Suppose you find yourself in the Rideau Centre and you have lost the person who was going to give you a lift home. Suppose you were counting on them to give you a lift and so you have spent all your money. How would you go about trying to find your way back home?

The problem is to find a means of getting home. This means either finding the person s/he came with, or finding money for a bus or a phone call, or finding transportation home (eg., police, taxi, bus). The essence of the problem is arranging to find her/his way home in a large, confusing, impersonal setting, far from home. If the child leaves on her/his own, a secondary problem is connecting with the friend to let them know s/he is safe.

Score 0, 1, 2

		Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	<u>A1</u>
Section A								
/6								
1.	PD	1	2	2	2	1	1	9
	PA	1	2	2	1	2	1	9
	SS	2	1	2	1	2	1	9
	F	2	2	2	2	2	2	12
	C/M	1	2	2	1	2	1	9
2.	PD							
	PA							
	SS							
	F							
	C/M							

A1: I would look all over for him. I would look in almost every little store. If I can't find him I would go into the biggest stores and get them to announce on the radio something like "Would _____ please come to the front door. A friend is waiting for you". If no one comes then I would go into a store and ask if I can use their phone to call someone to pick me up. If no one would let me then I would go out and see if the car is still there. If it is gone then I would ask someone if I could borrow money to use a pay phone or take the bus home.

Score 0, 1, 2

		Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	A1
Section A								
/6								
1.	PD	1	1	1	2	2	1	8
	PA	2	2	2	2	2	1	11
	SS	2	2	1	2	2	1	10
	F	0	0	0	0	0	0	0
	C/M	0	0	1	0	0	0	1
2.	PD							
	PA							
	SS							
	F							
	C/M							

A1: First I would wait a bit in case that person showed up. If he/she didn't I would:

Find a store clerk who could call a taxi for me.
 Wait for the taxi outside.
 Tell the taxi the address of my home.
 When I got home I would tell him to wait while I got money.
 I would then pay the driver and thank him.
 Then I would try and phone the person who was supposed to drive me home and tell him/her I made it home all right.

Score 0, 1, 2

		Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	A1
Section A								
/6								
1.	PD	2	2	2	2	1	1	10
	PA	1	2	1	2	1	1	8
	SS	1	1	1	2	1	1	7
	F	2	2	1	0	0	1	6
	C/M	0	0	0	0	0	0	0
2.	PD							
	PA							
	SS							
	F							
	C/M							

A1: I would be thinking about how much trouble I'd be in for getting home late and then I'd try to figure out a way to get home. I could come out of the Rideau Centre and walk into the nearest grocery store and call a taxi which would take me home. Once at home I'd tell the driver to wait while I went in to get the money from my mother. I guess I could also ask someone if I could borrow a quarter to call home and get my mom to pick me up. I always keep an extra quarter with me anyways, in case I have to call home. I could also walk to my dad's office which is a block away from the Rideau Center and wait for him to drive me home or borrow change for the bus.

Score 0, 1, 2

382

		Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	<u>A1</u>
Section A								
/6								
1.	PD	1	0	1	1	0	0	3
	PA	0	0	0	0	1	0	1
	SS	1	1	1	0	1	1	5
	F	1	1	1	1	0	1	5
	C/M	0	0	0	0	0	0	0
2.	PD							
	PA							
	SS							
	F							
	C/M							

A1: I would call a friend or my parents or a relative.
 I would borrow bus fare.
 I would walk home.

Now, I would like you to imagine yourself in another situation. Tell me what you would think about, and what you would do, as you solve this one.

2. Suppose you have an exam in math, tomorrow, but you have forgotten your math textbook at school. It is after 5:00 p.m. What would you do?

The problem is to get the information necessary to review before the exam - either by retrieving the book, or by finding a good, realistic alternate source (eg., friend's text, older sibling's text). While it is possible to elicit the help of others - friends, parents, siblings, trying to get an alternate time for the exam or a sick note is not acceptable. It is important to remember that, given the hour, the school is likely to be closed.

NOW THAT YOU HAVE FINISHED SECTION A, PLEASE LET ME KNOW BEFORE PROCEEDING TO SECTION B.

Score 0, 1, 2

	Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	A2
Section A /6							
1. PD							
PA							
SS							
F							
C/M							
2. PD	1	2	2	1	1	1	8
PA	1	1	2	1	1	1	7
SS	1	1	2	0	1	1	6
F	1	1	1	0	1	1	5
C/M	0	0	1	0	0	0	1

A2: First I'd freak. I've done this before. OK, I would try to see if the school was open and if it wasn't I'd still freak. I would study from my definitions and workbook and freak. I guess I would hate myself for doing this and try to study with someone else. Oh - that wouldn't work - what a dumb idea!

Score 0, 1, 2

		Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	A2
Section A								
/6								
1.	PD							
	PA							
	SS							
	F							
	C/M							
2.	PD	0	0	2	0	2	1	5
	PA	2	1	2	1	1	1	8
	SS	2	1	2	1	1	2	9
	F	2	1	2	1	2	2	10
	C/M	2	2	2	0	2	2	10

A2: I would study as much as I could from my notebook. I might call a friend and ask them to tell me the topics that I need to know in the text. If it was a very important exam, I might go to a friend's house and use the text together. Since I listen most of the time in class I think I wouldn't worry too much about not having a text. In the morning I might rush to my locker and study a little from the text. I wouldn't do anything too desperate because it is my own fault.

Score 0, 1, 2

	Clarity	Specificity	Reflectiveness	Accuracy/Effectiveness	Organization	Conceptual	A2
Section A /6							
1. PD							
PA							
SS							
F							
C/M							
2. PD	1	0	0	0	1	1	3
PA	1	0	0	0	0	0	1
SS	1	1	0	1	1	1	5
F	1	1	1	1	1	1	6
C/M	0	0	0	0	0	0	0

A2: I'd see if I could get in school.
I'd study with a friend (possibly over the phone).

In the following questions I would like you to tell me what you would do in the situation I have described. Let's do one together....

Often in the middle of doing a math problem, I find my mind wandering and then I

O.K., now continue on your own. Please answer every question. I am here to answer any questions you may have.

- (1) Let's suppose you have been given a large puzzle and it is all in pices. How would you decide what to do?

0 Put it together
 0 I would do all the edges and then the familiar parts
 1 I would think about which way would be the quickest, most realiable way to do it
 2 I would look at the cover
 2 I would see if I hade space enough to put the puzzle together
 1 I would see if there were similar colours and then divide them into colours and also separate the outside edges from the rest.

- (2) With this puzzle in pieces, how would you decide if it is too easy or too hard for you to do?

1 I would check the age group
 1 Begin and see if you are doing it well or not
 2 My decision would be based on how confused I was by the puzzle
 0 I would ask my mom
 0 I would decide by trying it
 1 I would find ou how many pieces there are and how varied the picture is (no explanation)
 2 It would be easy if I didn't have to think very much and would be too hard if after a long while I was not getting anywhere
 1 I would decide by putting a few pieces together and see if it took me too long
 2 If all the pieces looked similar and confused me just by looking at it

- (3) Suppose the puzzle was very hard, what would you do next?

0 Not do it
 0 Try it a little while longer and if I still couldn't get it, I'd quit
 1 I would ask for help or wait until I found I was ready to try
 1 Try a little while longer
 1 Ask for help
 2 I would start putting the easiest pieces together and gradually get to the harder pieces
 2 Sort into edge pieces
 1 I would do a little, bit by bit, until it is finished
 2 I would attempt it but if I couldn't do it I would get help

- (4) What is the first thing you would do to begin to put it together?

1 Turn the pieces right side up
 2 Look at the picture
 0 I'd find two pieces that fit together and work from there
 1 The edges
 2 I'd sort out the edge pieces from the rest
 2 I'd sort out all the pieces into different colours
 1 Sort all the pieces out
 2 I would assemble the outside the puzzle seeing as all the pieces would have straight edges therefore being easier to find

- (5) Suppose there are three programs on T.V. that you want to watch and they are all on at the same time. You do not have a VCR (let's say) neither do any of your friends. What would you do?

0 I'd change channels in the commercials and watch all three
 0 I'd just pick one and not waste time
 2 I would watch the one that most interests me
 1 I would watch the one I have never seen before
 1 I would watch the one I find first
 2 I would choose 1 and watch it because most shows come back as repeats sooner or later
 2 I would decide which one is less likely to be on again and watch that one
 1 Have me and 2 friends watch different shows and tell each other what happened
 2 I would pick the most entertaining or educating one depending on the mood I was in

- (6) Suppose you have been trying to decide between these three programs for about ten minutes and still can't make up your mind. What would you do?

0 I would not watch any of them
 0 Out of sheer desperation, I would pick from a hat
 1 I would make a snap decision or try to watch all 3 by continuously changing the channel
 1 I would ask my friend (family) which they want to watch
 1 I'd call up 2 friends and ask them to watch 2 and tell me about them
 2 I one was part of a serial I'd watch it, or if it was likely to be repeated or rerun, I'd rule it out
 2 I would weigh my thoughts good/bad and find out which one I would prefer to watch
 2 I'd watch the first few minutes of each to decide which is best

- (7) Suppose you have a math test in school. You have

finished all the questions. What do you do next?

- 0 Get out a book and read
- 0 Ask the teacher to mark you
- 1 Read it over/Look it over
- 2 Check it over

- (8) If you have a story or book to read for class, do you do anything differently than if you were reading the same book at home, just for yourself?

- 0/0 Yes/I wouldn't enjoy it as much - probably finish it faster
- 1/0 Yes/I'd have to read it for a set date, that's all
- 2/1 Yes/I would read it more carefully/pay more attention/read slowly
- 2/2 Yes/I would take notes
- 2/2 Yes/I would try to remember when I was reading

- (9) What would you do differently, and why?

- (10) Suppose on this math test you are told that one problem has more than one way to solve it. You get points for the number of ways you can think of. Do you think you could

	<u>YES</u>	<u>NO</u>
a) find all of the solutions	<u>0</u>	—
b) some of the solutions	<u>2</u>	—
c) only one of the solutions	<u>1</u>	—

- (11) Do you think you could find as many solutions as most of the other people in your class?

	<u>YES</u>	<u>NO</u>
a) more	<u>0</u>	—
b) less	<u>0</u>	—
c) the same amount	<u>2</u>	—

- (12) Do you think your solutions would be as good as theirs?

<u>YES</u>	<u>NO</u>
2/1/0	0

- (13) Suppose there was a T.V. program which is directly related to one of your school subjects (e.g., history or english). Would you do anything differently when watching that program from watching, say Miami Vice, Bill Cosby or Family Ties?

- 1/0 Yes/I wouldn't laugh as much
- 2/1 Yes/I'd probably pay more attention
- 0/0 Yes/Depending on how interested I was I'd probably change the channel

- 2/1 Yes/I'd try to remember what they said
- 2/2 Yes/I'd take notes

(14) What would you do differently, if anything?

- 2 I would pay more attention and try to remember what is happening and possibly take notes

(15) Suppose you have a math problem to solve and it is very hard. How would you start to solve the problem?

- 2 Figure out exactly what the question was asking
- 0 Think harder
- 2 Do an estimate
- 1 Leave it until last
- 0 Ask the teacher
- 0 I would just try something and if it didn't work I would try something else
- 1 I'd start in the ones' column
- 1 Step by step
- 1 Think of all the facts involved
- 1 Read it over a few times and then proceed to solve it
- 2 Try to remember if I ever did anything like this before
- 2 By breaking the problem down into sections I could get a grasp on and solving the pieces
- 2 Apply any concepts I had learned in class. Look at and analyze the givens. Attempt the problem

(16) When you have completed this problem, how would you know if your answer is wrong?

- 0 When I get the test back
- 0 I would ask the teacher
- 1 I would know if it was totally ridiculous, having no sense whatever, eg. a bird measuring 100m
- 2 I would do the problem in reverse, e.g., if it is add I would subtract
- 2 I would do the problem several times and If I got a different answer I would know something is wrong
- 1 By checking it over
- 1 By doing it again

(17) 0 No
2 Yes

(18) Suppose the math test has more than one problem on it. How would you begin to complete this test?

- 0 At the hardest problem working down to the easiest
- 0 I would do the ones with the most marks first

- 1 I would start at the beginning and work to the end
- 2 I would do the easiest one first
- 2 I would first do the ones I know best
- 2 Read all the problems
- 2 I would read it over first and solve the ones I am sure of, then continue to tackle the others

MKAQ

Section A

Score 0,1,2

#0 = , 1 = , 2 =

	Clarity	Specificity	Reflectiveness	Accuracy/ Effectiveness	Organization	Conceptualization	SUM
A1							
PD							
PA							
SS							
F							
E							
C/M							
A2							
PD							
PA							
SS							
F							
E							
C/M							
SUM							

MKAQ

Section B

	PD	PA	SS	F	E	C/M
1.		[ ]				
2.					[ ]	
3.				[ ]		
4.			[ ]			
5.			[ ]			
6.				[ ]		
7.						[ ]
8.	[ ]					
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12.					[ ]	
13.	[ ]					
14.			[ ]			
15.		[ ]				
16.						[ ]
17.		[ ]				
18.		[ ]				
Total	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

MKAQ

Section C

	PD	PA	SS	F	E	C/M
1.			F[ ]			
2c.				T[ ]		
3.		T[ ]				
4.			F[ ]			
5.				T[ ]		
6.				F[ ]		
7.			F[ ]			
8.		F[ ]				
9.					T[ ]	
10.					T[ ]	
11.					T[ ]	
12.			F[ ]			
13.	F[ ]					
14.	T[ ]					
15.						T[ ]
Total	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Score 0, 1, 2 Metacognitive Knowledge Assessment Questionnaire

Problem Definition

	0	1	2
Clarity	Vague, no clear picture of the problem definition.	Definition of problem is less vague but not totally clear. Clarity may be lost in detail.	Clear and concise and relevant definition of problem. Problem is stated clearly.
Specificity	No understanding of the definition of the problem or definition not related to the problem. May seem to be defining a problem other than this one	Definition of the problem is adequate but not specific to the central or essential nature of the problem or its difficulty.	Definition of the problem is correct and clearly defines the essential "core" of the problem and its difficulty level.
Reflectiveness	No definition of the problem or definition totally inaccurate or the answer is a "rehash" of the question.	Rote descriptions of what steps were taken without a personalized definition. Or the problem is defined in a stereotypic way	A personalized understanding and expression of the problem
Accuracy/Effectiveness	No definition of the problem or definition is totally inaccurate	Problem definition is adequate (eg., "getting the information") but not accurate (eg., "getting the text")	Problem definition is "right on"
Organization	No organization evident in response	Some attempt at organization of the response evident but does not follow through to the end. Starts well or ends well but not both	Highly organized presentation. The problem is clearly stated at the beginning.
Conceptualization	No conceptual comprehension of the problem	Some conceptual comprehension of the problem evident but not well articulated	Very good conceptual comprehension of the problem, well articulated

Planning

Clarity	Either no plan articulated or the plan verbalized is so vague that it is difficult to see or the detail irrelevant. May be a series of unrelated strategies	Some plan articulated; still vague but has more definition. The detail is relevant but the plan may get lost in the detail	Detailed articulation of a plan of attack. Detail is relevant and clear and the process of the plan is clear statement of systematic plan
Specificity	No plan of attack or the plan is not specific to the problem Detail irrelevant	The plan given is adequate but does not address the core/essential aspect of the problem. Detail is relevant but not specific to essential nature of the problem	The plan given is relevant and specific to the core/essential aspect of the problem
Reflectiveness	No awareness of a personal need to plan according to the difficulty level of the problem	Demonstrates some awareness of need to evaluate the problem and to plan accordingly but does not articulate it clearly. No personalized analysis or overview	Articulated awareness of need to evaluate the task and to plan the attack. The plan given clearly reflects a personalized overview of the problem and related plan
Accuracy/ Effectiveness	No plan given or plan given is clearly not effective for solving the problem	Plan given is adequate but is not the most effective way to solve the problem. The job would get done, but in a longer amount of time, or in a more confused manner	Plan given is effective and gets the problem solved well and efficiently
Organization	No plan or no organization in the plan - no idea of beginning or end in problem-solving process A list of statements without connecting plan	Some attempt at organization in response and/or plan verbalizes either beginning or end but not both and steps in between are not articulated or connected	Highly organized response and plan Verbalizes both beginning and end point in problem solving process and the steps in between are sequential. Plan is clearly laid out and steps follow each other in sequence
Conceptualization	Indicates no awareness of accurate conceptual plan of attack	Ideas of accurate conceptual plan is present but poorly articulated	Clear conceptualization of accurate plan of attack.

Strategy Selection

	0	1	2
Clarity	No verbalization or intent to use strategy or strategy is too vague to be understood	Verbalizes intent to use strategy but strategy is vaguely delineated (but relevant)	Strategy outlined is relevant, clear and detailed
Specificity	No verbalized intent to use a strategy or strategy given is not relevant to the nature of the problem	Verbalized intent to use strategy but approach to strategy random, not specific to the essential nature of the problem and/or its difficulty level	Strategy given is specific to the essential nature of the problem and the difficulty level
Reflectiveness	No strategy articulated or no personalization evident in the description of the strategy or strategy inappropriate to the problem	Strategy given is a step by step description of what was done, or a stereotypic strategy for the situation (something a parent might have taught) without a personal involvement in selecting a strategy	Strategy clearly reflects a personal involvement in the problem solving process, eg., in a unique, original idea, or in the way in which the strategy is verbalized
Accuracy/ Effectiveness	No strategy given is clearly ineffective	Strategy given is adequate but efficient	Strategy given is both effective and efficient
Organization	No strategy selection or answer strategy is not organized	Organization of strategy and/or response is poor. Starts well or ends well but not both	Appropriate and organized strategy and response. Starts and ends well
Conceptualization	No conceptualization of strategy/task match - need to select strategy based on problem type and difficulty level	Poorly articulated awareness of need to select strategy based on problem type and difficulty level	Well articulated awareness of need to select strategy based on problem type and difficulty level

Flexibility

Clarity	No verbalization of alternate strategy use or strategy is too vague to be understood. And/or perseverates	Verbalizes alternate strategy but is vague but strategy addresses a different part of the problem (ie does not persevereate)	Alternate strategy outlined is clear and detailed and is applicable to a different aspect of the problem (ie does not persevereate)
Specificity	Strategy outlined is the same as the first or is not appropriate to the nature of problem or to a different aspect of the problem	Strategy outlined is clearly different from the first strategy but does not address the specific nature of the problem or its difficulty level	Strategy verbalizes is different from the first and clearly specific to an essential aspect of the task and difficulty level - and to a different aspect of the problem
Reflectiveness	No second strategy articulated. No personalization of alternate strategy or does not address a different aspect - ie., perseverates	Second strategy given reflects minimal personalized involvement with the selection of a problem-solving strategy. It may be a rote description or be stereotypical. However it does address a different aspect - it does not perseverate	Second strategy clearly reflects a personal involvement in the problem-solving process, eg., in a unique, original idea, or in the way in which it is verbalized and is a different aspect
Accuracy/Effectiveness	No second strategy given or strategy is clearly ineffective	Strategy given is adequate but not efficient	Strategy given is both effective and efficient
Organization	No appropriate alternate strategy given and/or response of strategy is poorly organized. Neither starts nor ends well	Alternate strategy given but response and/or strategy is poorly organized. Starts well or ends well - but not both	Appropriate alternate strategy given and strategy and response are well organized. Starts and ends well
Conceptualization	No demonstrated awareness of possibility of and need for more than one approach	Partly articulated awareness of possibility of and need for more than one approach	Clearly articulated understanding of possibility of and need for more than one approach

Evaluating

Clarity	No evaluation of own performance - either prediction or post hoc or evaluation is unclear in response	Clearly engages in evaluation although this is not clearly stated. Often seen in the process of the responses	Evaluation of own performance stated clearly
Specificity	Either no evaluation of own perfor- mance or evaluation not adequate. Not related to the task. Evaluation may be random or judgemental comments	Evaluation of own performance given is adequate but does not address core/essential aspects of the task	Evaluation of own performance given is specific to the essen- tial aspects of the task
Reflectiveness	Is unaware of effectiveness of own problem definition, plan or strategies	Gives indication either verbally or the process of the response that s/he is aware of the effectiveness of own problem definition, plan or strategies. And/or is minimally reflective and personally involved	Is aware of problem definition, effectiveness plan and strategies would be (prediction) and has stopped to reflect on effective- ness post hoc. Is clearly reflective and personally involved in evaluation
Accuracy/Effectiveness	Evaluation of own performance inaccurate or inadequate	Evaluation of own performance is adequate but not accurate or is relevant to the strategies suggested but not to the overall plan	Evaluation of own performance - either prediction or post hoc or both is accurate
Organization	Evaluation of own performance is haphazard or given only once	Evaluation of own performance is not given at each step but at beginning or end, or is either prediction or post hoc but not both	Evaluation of own performance is both prediction and post hoc or is consistently given at each step where relevant
Conceptualization	No understanding of the need for the process of evaluating	Some understanding of the need for the process of evaluation - usually post hoc, but not prediction	Clearly articulated understanding for the need for the process of evaluation

Monitoring and Checking

	) 0			1	2
Clarity	Vague or confused method of keeping track -- essentially no method	Method articulated but not clear	Clear, concise method of keeping track of performance		
Specificity	No verbalized intent to keep track or method given random and not related to this task	Clear intent to keep track but strategy random, vague, not specific to task or difficulty level	Verbalized at least one attempt at monitoring, specific to task and difficulty level		
Reflectiveness	No awareness of process or need to have process of monitoring and checking	No clear awareness of need to monitor but gave one example of doing so or the methods given were rote descriptions of what was done, not personalized	Aware that s/he is giving an example that includes checking/monitoring -- gives at least two examples, clearly personalized		
Accuracy/Effectiveness	Method given inappropriate or ineffective to solve problem	Method given is adequate but not the most effective	Method given is adequate and highly effective		
Organization	No organization of monitoring method and/or response -- or inappropriate method	Appropriate method given but method and/or response is poorly organized -- starts well or ends well but not both	Monitoring method clearly suggested, appropriate and organized		
Conceptualization	No method given or repeats strategy used	Method given but clearly does not understand the concept of metacognition -- keeps track of success of each step but not of overall plan/strategy	Well articulated method -- clearly understands the concept of metacognition -- keeps track of success of each step as well as of overall plan/strategy		

Appendix J
Metacognitive Interview (MI)
Sample Protocol

CONCURRENT INTERVIEW PROTOCOL

NAME: _____

DATE: _____

PATTERN MATCHING/KEMLER

SCORE

COMMENTS:

Define Problem

Planning

Strategy Selection

Monitoring

Evaluating

Flexibility

QUESTION

1a) If you are going to ask your friend to play the game you just completed, tell me in at least six sentences, what would you tell him/her to do? Put it in your own words. (Tell me more; what else)

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TASK: PM KEMLER

- 1b) If your friend was having difficulty understanding what to do, how would you describe what you did?

- 1c) Are there any important things you may have forgotten to tell your friend about the game?

---

2. Is there another way to solve the task? Yes ____ No ____
Take a moment, what other ways might you suggest?

---

3. Did you keep track of how you were doing on the game? Yes ____ No ____
How did you keep track of how you are doing on this game? How do you do it? How would you explain it to your friend?

TASK: PM KEMLER

4a) How would you rate your performance on this task? (1 - 10)

---

b) Did you do better or less well than you expected?

4c) If you had to play like this in a week's time, how would your performance compare? Would you do.....better

about the same
worse

---

5) How well do you think you did on this task compared to how your friend would do?

---

6) Is there any difference between the two tasks? Yes ____ No ____
If so please describe these differences.

Appendix K
Metacognitive Interview (MI):
Scoring System and Sample Score Sheet

METACOGNITIVE INTERVIEW

Problem Definition: Question 1 a) b)

CLARITY (A)	vague - concrete no clear picture of problem no differentiation inappropriate detail	- some understanding of problem but but can't articulate clearly - some attempt at abstraction, at differentiation - detail appropriate but lost in detail	clear definition abstract differentiated appropriate detail with an example
SPECIFICITY (B)	random description	understanding of the definition of the problem but can't articulate concisely with specific detail and inclusive	specific definition of problem and inclusive
REFLECTIVENESS (C)	incomplete or incorrect repetition of instructions or activity, or problem	rote repetition of instructions or accurate description of activity but not of problem	personal expression of problem
ORGANIZATION (D)	no organization evident in response	some attempt at organization evident at beginning but does not follow thru to end	highly organized presentation
CONCEPTUALIZATION (E)	no conceptual comprehension of the problem	some conceptual understanding of the the problem evident but not well articulated	very good conceptual comprehension of the problem, well articulated

Planning: Question 1 a) b) c)

CLARITY (A)	responses indicate no plan	some indication of plan but not clear	clear articulation of plan
SPECIFICITY (B)	answer not sufficiently detailed and specific inaccurate specifics	answer gives some detail of plan but still not specific	detail specific to this problem and inclusive
REFLECTIVENESS (C)	no awareness of personal need to evaluate difficulty level of task in plan	demonstrates some awareness of need to plan; articulate it clearly; rote description of plan	articulated awareness of need to plan personalized plan, description of plan
ORGANIZATION (D)	no organization evident in response no idea of beginning or end in problem solving process	some attempt at organization begins or ends well, but not both	highly organized presentation, gives beginning and end in problem-solving process
CONCEPTUALIZATION (E)	indicates no awareness conceptual overview of problem	ideas of conceptual plan present but vague/poorly articulated	clear conceptual understanding of a plan well articulated

Strategy Selection: Question 1 a) b) c)

CLARITY (A)	no verbalization of intent to use strategy	verbalizes intent to use strategy but is vague, confused or global	strategy outlined clear
SPECIFICITY (B)	random approach no verbalized intentions to use strategy, inaccurate specifics paucity of specifics	non specific verbalized intent to use strategy but approach to strategy random or insufficiently detailed and specific; doesn't differentiate this task from others	verbalized at least one strategy specifically outlined with accurate detail Differentiates this task from others
REFLECTIVENESS (C)	no awareness of need to select strategy based on problem type and difficulty level	rote description of strategy - comes from instruction	personalized description of strategy
ORGANIZATION (D)	no organization	selection of appropriate strategy, poorly organized	appropriate and organized strategy selection - beginning & end described
CONCEPTUALIZATION (E)	no awareness of need to select strategy based on problem type and difficulty level	poorly articulated awareness of need to select strategy based on problem type and difficulty level	awareness of need to select strategy based on problem type and difficulty level
Flexibility of Strategy Use: Question 2 - Is there another way to solve the task?			
CLARITY (A)	no verbalization of alternate strategy use	verbalizes alternate strategy but is vague	alternate strategy outlined is clear and detailed
SPECIFICITY (B)	strategy verbalized is same as 1st, poorly detailed or detail not pertinent to this task	strategy is not sufficiently detailed strategy verbalized is clearly different from 1st strategy but may not differentiate this task from others or may be only strategy if not articulated above	strategy verbalized is different from 1st, and clearly differentiates this task from others or is sufficiently detailed
REFLECTIVENESS (C)	no demonstrated awareness of possibility of more than one approach	rote description of alternate strategy	clear awareness of possibility of more than one approach and personalized description
ORGANIZATION (D)	no alternate strategy selection provided or poorly organized	appropriate alternate strategy selection some organized	appropriate and strategy selection well organized
CONCEPTUALIZATION (E)	no alternate strategy or alternate strategy not based on problem type and difficulty level	poorly articulated awareness of need to select alternate strategy based on problem type and difficulty level	awareness of possibility of more than one approach - based on problem type and difficulty level

Monitoring/Checking: Question 3 - Did you keep track of how you were doing on the game?

CLARITY (A)	vague or confused method - essentially "no" method	method articulated but not clear	clear, concise method of "keeping track" of performance
SPECIFICITY (B)	random approach no verbalized intention to use method to keep track	verbalized intent to keep track but strategy random not specifically (detailed) to this task. Global method specific to this task	verbalized at least one monitoring method specifically outlined
REFLECTIVENESS (C)	no awareness of process or need to have process of metacognition	"no" did not keep track but gave an example or "yes" but method given not personalized some metacognitive process	"yes" did keep track plus offered a clear example, clearly personalized
ORGANIZATION (D)	monitoring method offered disorganized	monitoring method given has some organization starts well or ends well but not both	monitoring method suggested is (highly) organized
CONCEPTUALIZATION (E)	no method given	method given but clearly does not understand concept of metacognition	well articulated method clearly understanding concept of metacognition
Evaluating: Question 4 a) b) c) How would you rate your performance on this task? etc. 5 How well do you think you did on this task to how your friend would do?			
CLARITY (A)	No evaluation of own performance	unclear or conflicting evaluation	clear and consistent evaluation
SPECIFICITY (B)	can see no difference between the 2 games or the differences seen are not specific to the playing of these 2 games	can see difference between the 2 games and the differences are accurate and specific but not essential to the playing of the 2 games	can see at least 1 difference between the 2 games and the differences are accurate, specific and essential to the playing of the games
REFLECTIVENESS (C)	answer indicates no personal need to conceptualize a difference between the 2 games	answer indicates a personal need to conceptualize a difference between the 2 games but this difference comes out as rote	answer indicates a personal need to conceptualize a difference between the 2 games. Answer is clearly personalized
ORGANIZATION (D)	answer is disorganized	answer shows some attempt at organization but is poor. Either starts or ends well but not both	good organization. starts and ends well
CONCEPTUALIZATION (E)	sees no difference between games	States there is a difference between the games but cannot conceptualize this difference or can conceptually 1 or 2 differences but not similarities	Can accurately state all the essential differences between games and/or can see the superordinate similarities

Subject # _____ Grade _____

Order K/PM: PM/K

	Clarity	Test K:PM Specificity	Accuracy/ Effectiveness	Reflectiveness	Organization	Conceptualization	Sum	GRAND TOTAL
Problem Definition								
1(a)								
1(b)								
6								
Planning								
1(a)								
1(b&c)								
Strategy Selection								
1(a)								
1(b&c)								
Flexibility								
2								
Evaluation								
4(a,b,c) & 5								
Monitoring								
3								
Sum								
TOTAL								

Appendix L

Dragon's Tears

(Brown & Smiley, 1977, 1978)

Sample of Stimulus and Scoring System

THE DRAGON'S TEARS

FAR AWAY IN A STRANGE COUNTRY THERE LIVED A DRAGON. AND THE DRAGON'S HOME WAS IN A DEEP MOUNTAIN CAVE; FROM THE CAVE HIS EYES SHONE OUT LIKE HEADLIGHTS. VERY OFTEN, WHEN THE PEOPLE LIVING NEARBY WERE GATHERED IN THE EVENING BY THE FIRE, ONE WOULD SAY: "WHAT A TERRIBLE DRAGON IS LIVING NEAR US." AND ANOTHER WOULD AGREE, SAYING: "SOMEONE SHOULD KILL HIM." WHENEVER CHILDREN WERE TOLD ABOUT THE DRAGON, THEY WERE FRIGHTENED. BUT THERE WAS ONE LITTLE BOY WHO WAS NEVER FRIGHTENED. ALL THE NEIGHBORS SAID: "ISN'T HE A FUNNY LITTLE BOY." WHEN IT WAS ALMOST TIME FOR THIS FUNNY LITTLE BOY'S BIRTHDAY, HIS MOTHER ASKED HIM: "WHOM WOULD YOU LIKE TO INVITE FOR YOUR BIRTHDAY PARTY?" THEN THAT LITTLE BOY SAID: "MOTHER, I WOULD LIKE TO ASK THE DRAGON." HIS MOTHER WAS VERY MUCH SURPRISED AND ASKED: "ARE YOU JOKING?" "NO," SAID THE LITTLE BOY VERY SERIOUSLY, "I MEAN WHAT I SAY: I WANT TO INVITE THE DRAGON." AND, SURE ENOUGH, ON THE DAY BEFORE HIS BIRTHDAY, THE LITTLE BOY STOLE QUIETLY OUT OF HIS HOUSE. HE WALKED AND HE WALKED AND HE WALKED TILL HE REACHED THE MOUNTAIN WHERE THE DRAGON LIVED. "HELLO. HELLO. MR. DRAGON." THE LITTLE BOY CALLED DOWN THE VALLEY IN HIS LOUDEST VOICE. "WHAT'S THE MATTER? WHO'S CALLING ME?" RUMBLED THE DRAGON, COMING OUT OF HIS CAVE. THEN THE LITTLE BOY SAID: "TOMORROW IS MY BIRTHDAY AND THERE WILL BE LOTS OF GOOD THINGS TO EAT, SO PLEASE COME TO MY PARTY. I CAME ALL THE WAY TO INVITE YOU." AT FIRST THE DRAGON COULDN'T BELIEVE HIS EARS AND KEPT ROARING AT THE BOY. BUT THE BOY WASN'T FRIGHTENED AT ALL AND KEPT SAYING: "PLEASE, MR. DRAGON, PLEASE COME TO MY PARTY." FINALLY THE DRAGON UNDERSTOOD THAT THE BOY MEANT WHAT HE SAID AND WAS ACTUALLY ASKING HIM, A DRAGON, TO HIS BIRTHDAY PARTY. THEN THE DRAGON STOPPED ROARING AND BEGAN TO CRY. "WHAT A HAPPY THING TO HAPPEN TO ME." THE DRAGON SORBED. "I NEVER HAD A KIND INVITATION FROM ANYONE BEFORE." THE DRAGON'S TEARS FLOWED AND FLOWED UNTIL AT LAST THEY BECAME A RIVER. THEN THE DRAGON SAID: 'COME, CLIMB ON MY BACK AND I'LL GIVE YOU A RIDE HOME.' THE BOY CLIMBED BRAVELY ONTO THE BACK OF THE FEROCIOUS DRAGON AND AWAY THE DRAGON WENT, SWIMMING DOWN THE RIVER OF HIS OWN TEARS. BUT AS HE WENT, BY SOME MAGIC, HIS BODY CHANGED ITS SIZE AND SHAPE. AND SUDDENLY -- WHAT DO YOU KNOW? -- THE LITTLE BOY WAS SAILING BRAVELY DOWN THE RIVER TOWARD HOME AS CAPTAIN OF A DRAGON-STEAMBOAT.

THE DRAGON'S TEARS

1	Far away in a strange country	2.11	2
2	there lived a dragon.	3.41	4
3	and the dragon's home was in a deep mountain cave,	2.15	2
4	from the cave his eyes shone out like headlights.	1.26	1
5	Very often, when the people living nearby	2.07	2
6	were gathered in the evening by the fire.	1.67	1
7	one would say: "What a terrible dragon is living near us!"	2.44	3
8	And another would agree, saying: "Someone should kill him."	1.59	1
9	Whenever children were told about the dragon,	2.85	3
10	they were frightened.	3.11	3
11	But there was one little boy who was never frightened.	3.85	4
12	All the neighbors said: "Isn't he a funny little boy?"	1.44	1
13	When it was almost time for this funny little boy's birthday,	2.52	3
14	his mother asked him: "Whom would you like to invite for your birthday party?"	3.74	4
15	Then that little boy said: "Mother, I would like to ask the dragon."	3.67	4
16	his mother was very much surprised and asked, "Are you joking?"	1.70	1

2.

17 "No," said the little boy very seriously,	1.52	1
18 "I mean what I say;	1.59	1
19 I want to invite the dragon."	2.11	2
20 And, sure enough,	1.15	1
21 on the day before his birthday,	2.37	2
22 the little boy stole quietly out of his		
house,	2.67	3
23 He walked and he walked and he walked	2.44	3
24 till he reached the mountain where the		
dragon lived.	3.19	3
25 "Hello, Hello. Mr. Dragon."	3.04	3
26 the little boy called down the valley in		
his loudest voice.	1.82	2
27 "What's the matter?	1.22	1
28 Who's calling me?"	2.82	3
29 rumbled the dragon,	2.26	2
30 coming out of his cave.	1.52	1
31 Then the little boy said: "Tommorrow is		
my birthday	3.56	4
32 and there will be lots of good things		
to eat,	1.52	1
33 so please come to my party.	3.82	4
34 I came all the way to invite you."	1.85	2

35At first the dragon couldn't believe his		
ears	3.07	3
36and kept roaring at the boy.	2.52	3
37But the boy wasn't frightened at all	2.48	3
38and kept saying: "Please, Mr. Dragon, please		
come to my party."	2.41	2
39Finally the dragon understood that the boy		
meant what he said	3.26	4
40and was actually asking him,	2.11	2
41a dragon,	1.22	1
42to his birthday party.	1.96	2
43Then the dragon stopped roaring and began		
to cry.	3.41	4
44"What a happy thing to happen to me."		
the dragon sobbed.	2.74	3
45"I never had a kind invitation from any-		
one before."	2.89	3
46The dragon's tears flowed and flowed	3.22	4
47until at last they became a river.	2.96	3
48Then the dragon said:	1.82	2
49"Come, climb on my back and I'll give you		
a ride home."	3.37	4
50The boy climbed bravely onto the back of		
the ferocious dragon	3.04	3
51and away the dragon went,	2.30	2

52swimming down the river of his own tears.	3.26	4
53But as he went,	1.89	2
54by some magic,	2.26	2
55his body changed its size and shape.	3.22	4
56And suddenly --	1.82	2
57what do you know! --	1.22	1
58the little boy was sailing bravely down		
the river toward home	3.70	4
59as captain of a dragon-steamboat!	3.70	4

THE DRAGON'S TEARS

- 1 Far away in a strange country
2 there lived a dragon.
3 and the dragon's home was in a deep
mountain cave,
4 from the cave his eyes shone out like
headlights.
5 Very often, when the people living nearby
6 were gathered in the evening by the fire.
7 one would say: "What a terrible dragon is
living near us!"
8 And another would agree, saying: "Someone
should kill him."
9 Whenever children were told about the dragon
10 they were frightened.
11 But there was one little boy who was never
frightened.
12 All the neighbors said: "Isn't he a funny
little boy?"
13 When it was almost time for this funny
little boy's birthday,
14 his mother asked him: "Whom would you
like to invite for your birthday party?"
15 Then that little boy said: "Mother, I
would like to ask the dragon."
16 His mother was very much surprised and
asked, "Are you joking?"

17 "No," said the little boy very seriously,
18 "I mean what I say;
19 I want to invite the dragon."
20 And, sure enough,
21 on the day before his birthday,
22 the little boy stole quietly out of his
house,
23 He walked and he walked and he walked
24 till he reached the mountain where the
dragon lived.
25 "Hello, Hello. Mr. Dragon."
26 the little boy called down the valley in
his loudest voice.
27 "What's the matter?
28 Who's calling me?"
29 rumbled the dragon,
30 coming out of his cave.
31 Then the little boy said: "Tommorrow is
my birthday
32 and there will be lots of good things
to eat,
33 so please come to my party.
34 I came all the way to invite you."

35At first the dragon couldn't believe his
ears

36and kept roaring at the boy.

37But the boy wasn't frightened at all

38and kept saying: "Please, Mr. Dragon, please
come to my party."

39Finally the dragon understood that the boy
meant what he said

40and was actually asking him,

41a dragon,

42to his birthday party.

43Then the dragon stopped roaring and began
to cry.

44"What a happy thing to happen to me."
the dragon sobbed.

45"I never had a kind invitation from any-
one before."

46The dragon's tears flowed and flowed
47until at last they became a river.

48Then the dragon said:

49"Come, climb on my back and I'll give you
a ride home."

50The boy climbed bravely onto the back of
the ferocious dragon

51and away the dragon went,

52swimming down the river of his own tears.

53But as he went,

54by some magic,

55his body changed its size and shape.

56And suddenly --

57what do you know! --

58the little boy was sailing bravely down

the river toward home

59as captain of a dragon-steamboat!

Appendix M
Preparation Object
(Kreutzer et al., 1975)
Sample of Stimulus and Scoring System

Appendix M

Preparation Object

Suppose you were going ice skating with your friend after school tomorrow and you wanted to be sure to bring your skates. How could you be really certain that you didn't forget to bring your skates along to school in the morning? Can you think of anything else? How many ways can you think of?

Scoring System

In the Kreutzer et al. (1975) study, the three-level hierarchical scoring system consisted of categories, subcategories, and minimally distinguishable responses. Finally, the response protocol as a whole was scored for the presence or absence of something called "Preparation".

The three level scoring system operates as follows. First the total number of responses that are at least minimally different or distinguishable from each other are identified. The child is credited with the number of distinct responses that can be identified. Each of these responses is then assigned to one of four major categories (Skates, Note, Self, or Others). The response is further assigned to one of the subcategories of that category (with the exception of the category of others). There are four subcategories for the Skates category, three for the Note category, and two for the Self category.

The four categories and their subcategories were selected

by Kreutzer and his co-workers (1975) to reflect the variety of preparation for retrieval resources available to an individual in many real-life situations: inner-mental-symbolic (self); outer-mental-symbolic (others), outer-physical-symbolic (note), and other physical non-symbolic (skates).

Appendix N
Magic Trick
(Markman, 1977)
Sample of Stimulus and Probes

Appendix N

Magic Trick

"Here's the trick. When you wrap the penny you only pretend to wrap it. It really falls in your lap like this."

MAGIC TRICK PROBES

1. "That's it. Those are my instructions."
2. "What do you think?"
3. "Do you have any questions?"
4. "Did I tell you everything you need to know to play the game?"
5. "Did I forget to tell you anything?"
6. "Can you tell me how to play?" (The experimenter prompts if necessary.)
7. "Did I tell you everything you need to know to play the game?"
8. "Do you think you can play? Let's play, you go first."
9. "Did I forget to tell you anything?"
10. "Are you sure? Did I tell you everything you need to know?"

Magic Trick - The experimenter first demonstrated the trick as follows: an ordinary plate, penny, and piece of paper were shown to the child. The cup, which was shown as empty, was placed on the table and the plate placed on top of the cup. The penny was then wrapped in a piece of paper, placed on top of the plate, and pushed through the plate into the cup. (The penny could be heard dropping into the cup.) Then the empty plate and cup which now contained the penny was presented for inspection. While the trick was being performed, the experimenter gave a commentary which simply described what she was doing. After the demonstration, the following instructions were given: Here's the trick. When you wrap the penny you only pretend to wrap it. It really falls in your lap like this." (The experimenter demonstrates.) The experimenter failed to mention how the penny, now in her lap, could end up in the cup. After the instructions were given, essentially the same 10 probes used in the game were asked. Once the child asked a question, the procedure was stopped, and the experimenter apologized and promised to return to the class to demonstrate the trick.

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Appendix O
Porteus Maze Test
(Porteus, 1952)
Sample of Stimulus

1:

id your way out.

Problem 2:

Find your way out.

Appendix P

Numbers Backwards (Wechsler, 1974)

Sample of Stimulus and Scoring System

Problem 5 and 6:

I am going to read some numbers and when I stop, I want you to say them backwards. Do you understand?

5. 5-7-4

6. 7-2-9-6

When the child has completed the task they are asked how they had remembered the numbers.

Numbers Backwards Scoring

Score 1

Listen well

Think about the numbers

Be aware of the numbers

Think of the numbers that are the same/different

Think of where the numbers are placed - the sequence

Hope there will be few numbers

Score 2

Go backwards through them

Rehearse forward

Concentrate on the sounds

Start with the last one

Use fingers to keep track of numbers

Score 3

Rehearse forward then reverse

Repeat in your head

Be aware of making mistakes

Make picture - your head in order then read backwards

Be aware of any pattern in the numbers

Appendix Q

Kemler Hypothesis Formation Task (Kemler, 1978)

Instructions

Sample of Stimulus

Scoring Sheet

Appendix Q

Kemler Hypothesis Formation Task

Instructions

This game revolves around a story about two identical twins, Amy and Betty. These identical twins wore different clothes so their friends could tell them apart. For instance, they had 2 different hats; necklaces, belts, hair ribbons, glasses, balloons, sweaters and wrist wear.

Some days they decided to play a trick on their classmates and switch some of the clothes they were wearing at mid-day. But each day the twins had a secret they told to their teacher.

It was a secret about the one thing the twins promised not to switch the whole day. Your job is to figure out what Amy always wears and never switches.

NAME: _____
 DATE: _____

Correctly Chosen
 Incorrect Choice

CHOICE I ☐
 CHOICE II ☐

KEMLER
 SCORING SHEET

Practise

Trial	Attributes	Time	Repeats
1	(c) b bu br	h m bo pr	
2	(c) b bo br	h m bu pr	
3	(c) m bo br	h b bu pr	
4	h m bo br	(c) b bu pr	
5	h m bu br	(c) b bo pr	
6	h b bu br	(c) m bo pr	
7	h b bu pr	(c) m bo br	
8	(c) b bu pr	h m bo br	

Sum: _____

X Time: _____

Trial to
 Criteria _____

Three Attributes

1	h (m) bu	(c) b bo		
2	h (m) bo	(c) b bu		
3	(c) (m) bo	h b bu		
4	(c) b bo	h (m) bu		
5	h b bo	(c) (m) bu		
6	(c) b bo	h (m) bu		
7	(c) b bu	h (m) bo		
8	h b bu	(c) (m) bo		

Sum: _____

X Time: _____

Trial to
 Criteria _____

NAME: _____
 DATE: _____

○ 1st choice
 □ = 2nd choice

KEMLER
 SCORING SHEET

ATTRIBUTES CHOSEN

Five
 Attributes
 (B)

					Time		Repeats
B1	C	M	bu	h b <u>bo</u>			
	(br)	pg		pr bg			
B2	C	M	<u>bo</u>	h b bu			
	(br)	pg		pr bg			
B3	h	m	<u>bo</u>	c b bu			
	(br)	pg		pr bg			
B4	h	m	<u>bo</u>	c b bu			
	pr	pg		(br) bg			
B5	h	b	<u>bo</u>	c m bu			
	pr	pg		(br) bg			
B6	c	b	<u>bo</u>	h m bu			
	pr	pg		(br) bg			
B7	c	b	bu	h m <u>bo</u>			
	pr	pg		(br) bg			
B8	c	b	bu	h m <u>bo</u>			
	(br)	pg		pr bg			
B9	h	b	bu	c m <u>bo</u>			
	(br)	pg		pr bg			
B10	h	m	bu	c b <u>bo</u>			
	(br)	pg		pr bg			
B11	c	m	bu	h b <u>bo</u>			
	(br)	bg		pr pg			
B12	c	m	<u>bo</u>	h b bu			
	(br)	bg		pr pg			
B13	c	b	<u>bo</u>	h m bu			
	(br)	bg		pr pg			
B14	c	b	<u>bo</u>	h m bu			
	(br)	pg		pr bg			

Sum: _____

$\bar{X}$ Time: _____

Trial to _____

Criteria _____

NAME: _____

DATE: _____

EIGHT ATTRIBUTES

KEMLER

ATTRIBUTES CHOSEN							Time	Repeats
C1	c br (rb)	m pg sj	bu w	h pr eb	b bg dj	bo bt		
C2	h br (rb)	m pg sj	bu w	c pr eb	b bg dj	bo bt		
C3	h br (rb)	m bg sj	bu w	c pr eb	b pg dj	bo bt		
C4	h br (rb)	b bg sj	bu w	c pr eb	m pg dj	bo bt		
C5	h br eb	b bg sj	bu w	c pr (rb)	m pg dj	bo bt		
C6	h br eb	b bg sj	bo w	c pr (rb)	m pg dj	bu bt		
C7	h br eb	b bg sj	bo bt	c pr (rb)	m pg dj	bu w		
C8	h br eb	b pg dj	bo bt	c pr (rb)	m bg sj	bu w		
C9	h br eb	m pg dj	bo bt	c pr (rb)	b bg sj	bu w		
C10	h pr eb	m pg dj	bo bt	c br (rb)	b bg sj	bu w		
C11	c pr eb	m pg dj	bo bt	h br (rb)	b bg sj	bu w		
C12	c pr eb	m pg dj	bu bt	h br (rb)	b bg sj	bo w		
C13	c pr (rb)	m pg dj	bu bt	h br eb	b bg sj	bo w		
C14	c pr (rb)	m bg dj	bu bt	h br eb	b pg sj	bo w		
C15	c pr (rb)	m bg sj	bu bt	h br eb	b pg dj	bo w		
C16	c pr (rb)	b bg sj	bu bt	h pr eb	m pg dj	bo w		

Sum: _____

X Time: _____

Trial to
Criteria

NAME: _____
 DATE: _____

MIXED
 KEMLER
 SCORING SHEET

ATTRIBUTES CHOSEN

Five
 Attributes
 (8)

						Time	Repeats
B1	C	M	bu	h	b	bo	
	br	pg		pr	bg		
B2	C	M	bo	h	b	bu	
	br	pg		pr	bg		
B3	h	m	bo	c	b	bu	
	br	pg		pr	bg		
B4	h	m	bo	c	b	bu	
	pr	pg		br	bg		
B5	h	b	bo	C	m	bu	
	pr	pg		br	bg		
B6	c	b	bo	h	m	bu	
	pr	pg		br	bg		
B7	c	b	bu	h	m	bo	
	pr	pg		br	bg		
B8	C	b	bu	h	m	bo	
	br	pg		pr	bg		
B9	h	b	bu	c	m	bo	
	br	pg		pr	bg		
B10	h	m	bu	C	b	bo	
	br	pg		pr	bg		
B11	c	m	bu	h	b	bo	
	br	bg		pr	pg		
B12	c	m	bo	h	b	bu	
	br	bg		pr	pg		
B13	c	b	bo	h	m	bu	
	br	bg		pr	pg		
B14	C	b	bo	h	m	bu	
	br	pg		pr	bg		

$\bar{x}$ _____

1. Are there any comments you would like to make about this task?

---

2. How did you find it?

Three Attribute Problem

Solution Alternatives

Five Attribute Problem

Solution Alternatives

Eight Attribute Problem

Solution Alternatives

Appendix R

Pattern Matching Task (Neimark & Lewis, 1967)

Instructions, Sample of Stimulus and Scoring Sheet

PATTERN-MATCHING TASK INSTRUCTIONS

These instructions are reprinted from Stober (1983)

1. Instructions

Specific instructions or words to be emphasized are underlined. Parentheses or standard margins indicate demonstrations that accompany verbal instructions

A. Training Problems:

Problem E-1: FOUR-DOT PATTERN IN FILE FOLDER/ FOUR-SOLUTION ALTERNATIVES

Now, I'm going to show you some patterns of dots like these. You see, here we have four patterns of dots with four dots in each pattern (pointing appropriately to the four-solution alternatives). Some of the dots are black; the rest are white. Behind the board, there is a pattern of dots exactly like one of the patterns you see here (pointing), with one dot behind each of these four windows (pointing). The top dot in the pattern (pointing) to the top dots in the solution alternatives is behind this top window (pointing to the top window of the problem board). This side dot (pointing to right side dot in pattern) is behind this side window. Which window would this bottom dot in the pattern (pointing to solution alternative) be behind? Right! Good! And which window would this (left) side dot be behind? Good!

If the child makes an error on one of these identifications, he is corrected and asked to point out windows corresponding to other positions until he can do this correctly.

O.K. Now for the important part. Your job is to figure out which one of these patterns (pointing) is behind this board. To do that, you open these windows one at a time. The idea is to figure out which pattern is behind the board opening as few windows as possible. It's important to remember that some moves are more helpful than others -- make the most helpful moves you can to figure it out opening as few windows as possible.

Let me show you how it goes. I could open this top window, for instance (opening top window). The dot behind the window is white. That means that the top dot in the pattern behind the board is white. Which of these patterns (pointing) might be behind the board? Remember, we know that the top dot in the pattern must be white. Good! (Or correcting him if wrong). O.K., which ones are wrong -- which ones have the wrong colour dots? Good!

(or correcting). O.K. We can forget about the ones that are wrong -- we'll just turn them over so we can really forget about them. (The experimenter demonstrates for the child how eliminated alternatives are to be turned over.) Now, we know that it must be one of these two. Our job is to figure out which one of these two patterns is behind the board. Which window would be most helpful to open next to figure that out?

If an informative window is opened, the experimenter opens a non-informative window as well and asks, "Was this window as helpful as the one you opened? No, it wasn't we couldn't turn any patterns over, so it wasn't helpful at all".

If a non-informative window is opened, the experimenter points out that this window is not helpful at all because no patterns can be turned over, and he then asks the child to select another window. When the child eventually opens the informative window, it is pointed out that this was helpful move since a pattern could be turned over. (Note that this coaching serves to 'operationally define' helpfulness by indicating that a helpful move is one that leads to the elimination of alternatives. However, the way one decides in advance which moves will be helpful is never outlined -- ie., the subject is not given a specific strategy for deciding which windows to open.)

Problem E-2: FOUR-DOT PATTERN INFILE FOLDER/
FOUR SOLUTION ALTERNATIVES

A second training trial, with four solution patterns of four dots each, is now presented and the child is asked to do this problem himself. The trial is introduced by the following instructions:

Now try this one yourself. Remember, you are to figure out which of those patterns is behind this board (pointing) by opening the windows one at a time and turning over the patterns that are wrong. It's important to remember that the idea is to figure it out opening as few windows as possible and that some moves are more helpful than others.

Occasionally a child eliminates alternatives inappropriately (for instance, after opening the top window and exposing a white dot, some subjects will turn over patterns with a white dot at the top, rather than those with a black dot at the top). These errors are corrected immediately and subjects are reminded that they are to eliminate (ie., turn over) the patterns with the wrong coloured dots at the top (or wherever).

Again, when a subject makes a non-informative move, the experimenter points out that that wasn't at all helpful because no patterns could be turned over. If no non-informative moves are made, the experimenter says "good", then "undoes" the subject's last move and makes a non-informative move, pointing out that the move the subject made was helpful because he could turn some over, but if he had made this move (ie., the non-informative move made by the experimenter), it would not have been at all helpful since no patterns could be eliminated.

Problem E-3: FOUR-DOT PATTERN IN FILE FOLDER/
SIX-SOLUTION ALTERNATIVES

Next, children are given a practice trial with a problem which has six four-dot pattern alternatives. This trial is introduced by the instructions used to introduce the previous training trial. After a subject opens a window, before he turns over any patterns, the experimenter says "Okay, be careful which patterns you turn over". If the subject makes an elimination error (i.e., if he unjustifiably turns over patterns or fails to turn over patterns which could properly be eliminated), he is corrected immediately.

PROBLEM E-4: EIGHT-DOT PATTERN IN WOODEN BOARD/
EIGHT-SOLUTION ALTERNATIVES

After a child has solved a six-pattern problem, a problem with eight patterns, each problem having eight dots, is placed before him along with the corresponding eight-dot problem board. The child is then oriented to this more complex problem with the following instructions:

This game is just like the one you've been playing except there are more patterns and more dots in each pattern. This makes the game more interesting, but you still play the same way. Just to make sure you get off to a good start, I want you to show me which window you'd open if you wanted to see about this dot (pointing to a dot in the pattern alternatives) -- just point to the window you'd open to check on this dot. Good! (or, no, look carefully -- Good!)

Materials for the Pattern-matching Task

Pattern-matching Board

Solution Alternatives

PATTERN-MATCHINGTRIAL EXERCISES

SCHOOL: _____

NAME: _____

GRADE: _____

SUBJECT NUMBER: _____

TASK ORDER PM/K K/PM

TAPE NUMBER: _____

DATE: _____

TOTAL TIME: _____ X TIME: _____

RATIO INCORRECT/CORRECT: _____ SELF CORRECTS: _____ I.E. _____ O.M. _____

Comments

Item: E1

Item: E2

Item: E3

Item: E4

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>
1	_____	1 2 3 4 5 6 7 8	_____
2	_____	1 2 3 4 5 6 7 8	_____
3	_____	1 2 3 4 5 6 7 8	_____
4	_____	1 2 3 4 5 6 7 8	_____
5	_____	1 2 3 4 5 6 7 8	_____
6	_____	1 2 3 4 5 6 7 8	_____
7	_____	1 2 3 4 5 6 7 8	_____
8	_____	1 2 3 4 5 6 7 8	_____

Name: _____ Grade: _____ Date: _____

PATTERN-MATCHING SERIES A

Item: A1

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S. Corr.</u>	<u>Bits</u>	
1	—	1 <u>2</u> <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	
2	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	
3	—	1 <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> 7 8	—	—	—	—	
4	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	
5	—	1 <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> 8	—	—	—	—	
6	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	% Focusing: _____
7	—	1 <u>2</u> <u>3</u> 4 5 <u>6</u> <u>7</u> <u>8</u>	—	—	—	—	% Gambling: _____
8	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	% NonInfor: _____
Sum: _____			_____	_____	_____	_____	
* : _____			_____	_____	_____	_____	Item A1 - Average: _____
Focusing: _____			Gambling: _____	NI Moves: _____	_____	_____	

Item: A2

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S. Corr.</u>	<u>Bits</u>	
1	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	
2	—	1 <u>2</u> <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	
3	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	
4	—	1 <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> 7 8	—	—	—	—	
5	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	
6	—	<u>1</u> 2 3 <u>4</u> <u>5</u> <u>6</u> 7 <u>8</u>	—	—	—	—	% Focusing: _____
7	—	1 2 3 4 5 6 7 <u>8</u>	—	—	—	—	% Gambling: _____
8	—	1 <u>2</u> <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	% NonInfor: _____
Sum: _____			_____	_____	_____	_____	
* : _____			_____	_____	_____	_____	Item A2 - Average: _____

Name: _____ Grade: _____ Date: _____

Series A, cont'd.

Item: A3

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S.Corr.</u>	<u>Bits</u>	
1	—	1 2 3 4 5 6 7 8	—	—	—	—	
2	—	1 2 3 4 5 6 7 8	—	—	—	—	
3	—	1 2 3 4 5 6 7 8	—	—	—	—	
4	---	1 2 3 4 5 6 7 8	----	----	----	----	
5	—	1 2 3 4 5 6 7 8	—	—	—	—	
6	—	1 2 3 4 5 6 7 8	—	—	—	—	% Focusing: _____
7	—	1 2 3 4 5 6 7 8	—	—	—	—	% Gambling: _____
8	---	1 2 3 4 5 6 7 8	----	----	----	----	% NonInfor: _____
Sum: _____			_____	_____	_____	_____	Item A3-Average: _____
Focusing: _____			Gambling: _____	NI Moves: _____			

Item: A4

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S.Corr.</u>	<u>Bits</u>	
1	—	1 2 3 4 5 6 7 8	—	—	—	—	
2	—	1 2 3 4 5 6 7 8	—	—	—	—	
3	—	1 2 3 4 5 6 7 8	—	—	—	—	
4	---	1 2 3 4 5 6 7 8	----	----	----	----	
5	—	1 2 3 4 5 6 7 8	—	—	—	—	
6	—	1 2 3 4 5 6 7 8	—	—	—	—	% Focusing: _____
7	—	1 2 3 4 5 6 7 8	—	—	—	—	% Gambling: _____
8	---	1 2 3 4 5 6 7 8	----	----	----	----	% NonInfor: _____
Sum: _____			_____	_____	_____	_____	Item A4 - Average: _____
Focusing: _____			Gambling: _____	NI Moves: _____			

Name: _____ Grade: _____ Date: _____

Pattern Matching - Series B

Item: B1

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S. Corr.</u>	<u>Bits</u>	
1	—	1 2 3 4 5 6 7 8	—	—	—	—	
2	—	1 2 3 4 5 6 7 8	—	—	—	—	
3	—	1 2 3 4 5 6 7 8	—	—	—	—	
4	—	1 2 3 4 5 6 7 8	—	—	—	—	
5	—	1 2 3 4 5 6 7 8	—	—	—	—	
6	—	1 2 3 4 5 6 7 8	—	—	—	—	% Focusing: _____
7	—	1 2 3 4 5 6 7 8	—	—	—	—	% Gambling: _____
8	—	1 2 3 4 5 6 7 8	—	—	—	—	% NonInfor: _____
Sum: _____			_____	_____	_____	_____	
Focusing: _____			Gambling: _____	NI Moves: _____	Item B1 Average: _____		

Item: B2

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S. Corr.</u>	<u>Bits</u>	
1	—	1 2 3 4 5 6 7 8	—	—	—	—	
2	—	1 2 3 4 5 6 7 8	—	—	—	—	
3	—	1 2 3 4 5 6 7 8	—	—	—	—	
4	—	1 2 3 4 5 6 7 8	—	—	—	—	
5	—	1 2 3 4 5 6 7 8	—	—	—	—	
6	—	1 2 3 4 5 6 7 8	—	—	—	—	% Focusing: _____
7	—	1 2 3 4 5 6 7 8	—	—	—	—	% Gambling: _____
8	—	1 2 3 4 5 6 7 8	—	—	—	—	% NonInfor: _____
Sum: _____			_____	_____	_____	_____	
Focusing: _____			Gambling: _____	NI Moves: _____	Item B2-Average: _____		

Name: _____ Grade: _____ Date: _____

Pattern Matching Series B - cont'd

Item: B3

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S.Corr.</u>	<u>Bits</u>	
1	—	1 2 <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	
2	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	
3	—	1 2 <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	
4	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	
5	—	<u>1</u> 2 3 4 <u>5</u> <u>6</u> 7 <u>8</u>	—	—	—	—	
6	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	% Focusing: —
7	—	<u>1</u> 2 <u>3</u> 4 5 <u>6</u> 7 8	—	—	—	—	% Gambling: —
8	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	% NonInfor: —
Sum: —			—	—	—	—	
:			—	—	—	—	Item B3-Average: —
Focusing: —			Gambling: —	NI Moves: —			

Item: B4

<u>Window</u>	<u>Move</u>	<u>Eliminated</u>	<u>Time</u>	<u>NR/NE</u>	<u>S.Corr.</u>	<u>Bits</u>	
1	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	
2	—	1 2 <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	
3	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	
4	—	1 2 <u>3</u> 4 5 <u>6</u> 7 <u>8</u>	—	—	—	—	
5	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	
6	—	<u>1</u> 2 3 4 <u>5</u> <u>6</u> 7 <u>8</u>	—	—	—	—	% Focusing: —
7	—	1 2 <u>3</u> 4 5 6 7 8	—	—	—	—	% Gambling: —
8	—	1 2 <u>3</u> 4 <u>5</u> <u>6</u> 7 <u>8</u>	—	—	—	—	% NonInfor: —
Sum: —			—	—	—	—	
:			—	—	—	—	Item B4-Average: —
Focusing: —			Gambling: —	NI Moves: —			

Appendix S

Matching Familiar Figures (Kagan, 1966):

Instructions, Sample of Stimulus, and Scoring Sheet

Appendix S

Standard Administration Directions for MFF20 (Stober, 1984)

"I am going to show you a picture of something you know and then some pictures that look like it. You will have to point to the picture on this bottom page (point) that is just like the one on this top page (point). Let's do some for practice". The experimenter (E) shows practice items and helps the child to find the correct answer. "Now we are going to do some that are a little bit harder. You will see a picture on top and six pictures on the bottom. Find the one that is just like the one on the top and point to it."

E will record latency to first response to the half-second, total number of errors for each item and the order in which the errors are made. If the subject (S) is correct, E will praise. If wrong, E will say, "No, that is not the right one. Find the one that is just like this one (point)." Continue to code responses (not times) until child makes a maximum of six errors or gets the item correct. If incorrect, E will show the right answer.

It is necessary to have a stand to place the test booklet on so that both the stimulus and the alternatives are clearly visible to the S at the same time. The two pages should be practically at right angles to one another.

Note: It is desirable to enclose each page in clear plastic in order to keep the pages clean.

MATCHING FAMILIAR FIGURES TEST 20

Name: _____ Sex: _____

Age: _____ Grade: _____ Date: _____

Time Begun: _____ Time Ended: _____

1	2	3
4	5	6

child

Item	Correct Response	Latency	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice
Practise:								
a) Pitcher	4							
b) Ruler	6							
Test:								
1. Leaf	2							
2. Scissors	6							
3. Glasses	3							
4. Cowboy	4							
5. House	1							
6. Spaceship	2							
7. Leaf	6							
8. Giraffe	4							
9. Aeroplane	1							
10. Flower	5							
11. Ship	2							
12. Wigwam	6							
13. Cat	3							
14. Speedboat	4							
15. T.V.	1							
16. Duck	5							
17. Lamp II	6							
18. Dress I	3							
19. Bear	1							
20. Lamp I	5							

Total task time: _____

Mean Latency: _____

Errors: _____

Appendix T
Spielberger State-Trait Anxiety Scale for Children
(Spielberger, 1973)
Test Protocol

HOW-I-FEEL QUESTIONNAIRE

458

Developed by C. D. Spielberger, C. D. Edwards, J. Montuori and R. Lushene
STAIC FORM C-1

NAME _____ AGE _____ DATE _____

DIRECTIONS: A number of statements which boys and girls use to describe themselves are given below. Read each statement carefully and decide how you feel *right now*. Then put an X in the box in front of the word or phrase which best describes how you feel. There are no right or wrong answers. Do not spend too much time on any one statement. Remember, find the word or phrase which best describes how you feel right now, *at this very moment*.

1.	I feel	☐ very calm	☐ calm	☐ not calm
2.	I feel	☐ very upset	☐ upset	☐ not upset
3.	I feel	☐ very pleasant	☐ pleasant	☐ not pleasant
4.	I feel	☐ very nervous	☐ nervous	☐ not nervous
5.	I feel	☐ very jittery	☐ jittery	☐ not jittery
6.	I feel	☐ very rested	☐ rested	☐ not rested
7.	I feel	☐ very scared	☐ scared	☐ not scared
8.	I feel	☐ very relaxed	☐ relaxed	☐ not relaxed
9.	I feel	☐ very worried	☐ worried	☐ not worried
10.	I feel	☐ very satisfied	☐ satisfied	☐ not satisfied
11.	I feel	☐ very frightened	☐ frightened	☐ not frightened
12.	I feel	☐ very happy	☐ happy	☐ not happy
13.	I feel	☐ very sure	☐ sure	☐ not sure
14.	I feel	☐ very good	☐ good	☐ not good
15.	I feel	☐ very troubled	☐ troubled	☐ not troubled
16.	I feel	☐ very bothered	☐ bothered	☐ not bothered
17.	I feel	☐ very,nice	☐ nice	☐ not nice
18.	I feel	☐ very terrified	☐ terrified	☐ not terrified
19.	I feel	☐ very mixed-up	☐ mixed-up	☐ not mixed-up
20.	I feel	☐ very cheerful	☐ cheerful	☐ not cheerful

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HOW-I-FEEL QUESTIONNAIRE

STAIC FORM C-2

NAME _____ AGE _____ DATE _____

DIRECTIONS: A number of statements which boys and girls use to describe themselves are given below. Read each statement and decide if it is *hardly-ever*, or *sometimes*, or *often* true for you. Then for each statement, put an X in the box in front of the word that seems to describe you best. There are no right or wrong answers. Do not spend too much time on any one statement. Remember, choose the word which seems to describe how you usually feel.

1.	I worry about making mistakes	☐	hardly-ever	☐	sometimes	☐	often
2.	I feel like crying	☐	hardly-ever	☐	sometimes	☐	often
3.	I feel unhappy	☐	hardly-ever	☐	sometimes	☐	often
4.	I have trouble making up my mind . . .	☐	hardly-ever	☐	sometimes	☐	often
5.	It is difficult for me to face my problems .	☐	hardly-ever	☐	sometimes	☐	often
6.	I worry too much	☐	hardly-ever	☐	sometimes	☐	often
7.	I get upset at home	☐	hardly-ever	☐	sometimes	☐	often
8.	I am shy	☐	hardly-ever	☐	sometimes	☐	often
9.	I feel troubled	☐	hardly-ever	☐	sometimes	☐	often
10.	Unimportant thoughts run through my mind and bother me	☐	hardly-ever	☐	sometimes	☐	often
11.	I worry about school	☐	hardly-ever	☐	sometimes	☐	often
12.	I have trouble deciding what to do . . .	☐	hardly-ever	☐	sometimes	☐	often
13.	I notice my heart beats fast	☐	hardly-ever	☐	sometimes	☐	often
14.	I am secretly afraid	☐	hardly-ever	☐	sometimes	☐	often
15.	I worry about my parents	☐	hardly-ever	☐	sometimes	☐	often
16.	My hands get sweaty	☐	hardly-ever	☐	sometimes	☐	often
17.	I worry about things that may happen . .	☐	hardly-ever	☐	sometimes	☐	often
18.	It is hard for me to fall asleep at night .	☐	hardly-ever	☐	sometimes	☐	often
19.	I get a funny feeling in my stomach . . .	☐	hardly-ever	☐	sometimes	☐	often
20.	I worry about what others think of me .	☐	hardly-ever	☐	sometimes	☐	often

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Appendix U
Children's Social Desirability Scale
(Crandall et al., 1965)
Test Protocol

The CSD Scale

Name _____

Date _____

Grade _____

Birthdate _____

Sex (male or female) _____

This questionnaire lists a number of experiences that most children have at one time or another. Read each of these carefully. After you have read one, decide whether it does or does not fit you. If it does, put a T (for true) in front of the statement; if it doesn't put an F (for false) in front of the statement.

If you have any questions at any time raise your hand, and one of the persons who passed out these questionnaires will come and explain it to you.

- _____ 1. I always enjoy myself at a party.
- _____ 2. I tell a little lie sometimes.
- _____ 3. I never get angry if I have to stop in the middle of something I am doing to eat dinner, or go to school.
- _____ 4. Sometimes I don't like to share my things with my friends.
- _____ 5. I am always respectful of older people.
- _____ 6. I would never hit a boy or girl who was smaller than me.
- _____ 7. Sometimes I do not feel like doing what my teachers want me to do.
- _____ 8. I never act "fresh" or "talk back" to my mother or father.
- _____ 9. When I make a mistake, I always admit I am wrong.
- _____ 10. I feel my parents do not always show good judgment.
- _____ 11. I have never felt like saying unkind things to a person.
- _____ 12. I always finish all of my homework on time.
- _____ 13. Sometimes I have felt like throwing or breaking things.
- _____ 14. I never let someone else get blamed for what I did wrong.

- _____ 15. Sometimes I say something just to impress my friends.
- _____ 16. I am always careful about keeping my clothing neat, and my room picked up.
- _____ 17. I never shout when I feel angry.
- _____ 18. Sometimes I feel like staying home from school even if I am not sick.
- _____ 19. Sometimes I wish that my parents didn't check up on me so closely.
- _____ 20. I always help people who need help .
- _____ 21. Sometimes I argue with my mother to do something she doesn't want me to.
- _____ 22. I never say anything that would make a person feel bad.
- _____ 23. My teachers always know more about everything than I do.
- _____ 24. I am always polite, even to people who are not very nice.
- _____ 25. Sometimes I do things I've been told not to do.
- _____ 26. I never get angry.
- _____ 27. I sometimes want to own things just because my friends have them.
- _____ 28. I always listen to my parents.
- _____ 29. I never forget to say "please" and "thank you".
- _____ 30. Sometimes I wish I could just "mess around" instead of having to go to school.
- _____ 31. I always wash my hands before every meal.
- _____ 32. Sometimes I dislike helping my parents even though I know they need my help around the house.
- _____ 33. I never find it hard to make friends.
- _____ 34. I have never been tempted to break a rule or a law.
- _____ 35. Sometimes I try to get even when someone does something to me I don't like.
- _____ 36. I sometimes feel angry when I don't get my way.
- _____ 37. I always help an injured animal.

- _____ 38. Sometimes I want to do things my parents think I am too young to do.
- _____ 39. I sometimes feel like making fun of other people.
- _____ 40. I have never borrowed anything without asking permission first.
- _____ 41. Sometimes I get annoyed when someone disturbs something I've been working on.
- _____ 42. I am always glad to cooperate with others.
- _____ 43. I never get annoyed when my best friend wants to do something I don't want to do.
- _____ 44. Sometimes I wish that the other kids would pay more attention to what I say.
- _____ 45. I always do the right things.
- _____ 46. Sometimes I don't like to obey my parents.
- _____ 47. Sometimes I don't like it when another person asks me to do things for him.
- _____ 48. Sometimes I get mad when people don't do what I want.

Appendix V

Washington University Sentence Completion Test

(Loevinger, 1970)

Test Protocol: Girls, Boys, Sample of Scoring Criteria

SENTENCE COMPLETION

Instructions: Complete the following sentences.

1. Raising a family _____
2. A boy has a right to _____
3. When they avoided me _____
4. If my mother _____
5. Being with other people _____
6. The thing I like about
myself is _____
7. My mother and I _____
8. What gets me into trouble
is _____
9. Education _____
10. When people are helpless _____
11. Women are lucky because _____
12. My father _____
13. When my mother spanked
me, I _____
14. A husband should _____
15. I feel sorry _____
16. Rules are _____
17. When I get mad _____

-2-

18. When a child will not join in group activities _____
19. Men are lucky because _____
_____
21. At times he worried about _____
22. I am _____
23. A man feels good when _____
24. My main problem is _____
25. My wife and I will _____
26. The worst thing about _____.
_____ being a man _____
27. A good father _____
28. Sometimes he wished that _____
29. When I am with a girl _____
30. When he thought of her mother, he _____
31. If I can't get what I want _____
32. For a man a career is _____
33. My conscience bothers me if _____
34. A man should always _____

SENTENCE COMPLETION

Instructions: Complete the following sentences.

1. Raising a family _____
2. A girl has a right to _____
3. When they avoided me _____
4. If my mother _____
5. Being with other people _____
6. The thing I like about myself is _____
7. My mother and I _____
8. What gets me into trouble is _____
9. Education _____
10. When people are helpless _____
11. Women are lucky because _____
12. My father _____
13. When my mother spanked me, I _____
14. A wife should _____
15. I feel sorry _____
16. Rules are _____
17. When I get mad _____

-2-

18. When a child will not join in group activities _____
19. Men are lucky because _____
_____
21. At times she worried about _____
22. I am _____
23. A woman feels good when _____
24. My main problem is _____
25. My husband and I will _____
26. The worst thing about _____
_____ being a woman _____
27. A good mother _____
28. Sometimes she wished that _____
29. When I am with a man _____
30. When she thought of her mother, she _____
31. If I can't get what I want _____
32. For a woman a career is _____
33. My conscience bothers me if _____
34. A woman should always _____

Conscientious

True conceptual complexity is shown by the I-4 person, contrasting with conceptual simplicity at I-3 and multiplicity at I-3/4. The I-4 subject not only displays complex thinking but also perceives complexity.

My mother and I - have some things in common, but generally do not think alike

Education - is an ongoing, stressful but rewarding experience

A woman's body - is a very complex structure

A good mother - conceals the fact

When she thought of her mother, she - was confused

Usually she felt that sex - was nice but mysterious

For a woman a career is - not essential but very stimulating and fun

My father - is a sweet but immature man

A response by an I-4 person will often combine alternatives that are polar opposites, each separately rated at I-3 or I-3/4. These polarities are not so global, so stereotyped, nor usually so evaluative as the good-bad, clean-dirty, right-wrong polarities of lower levels. Above the I-4 level even these differentiated polarities decrease.

A woman should always - be a lady in the parlor and a whore in the bedroom

A woman's body - should be to please a man, in love, not disgust him, in lust

Most men think that women - are too mannish, yet try to be too sexy

A good mother - should give her children good discipline and lots of love

When I am with a man - along, I try to enjoy myself and yet still act like a lady

Usually she felt that sex - should be beautiful not dragged through the gutter
- was an obligation rather than pleasure

Raising a family - may be hectic, but never dull
- is an enjoyable responsibility

I am - eager to be friendly, but shy with new friends

Absolute statements and rules are often replaced by ones in comparative and contingent form; these comparisons and contingencies are not so global and banal as the ones seen at I-3/4

Women are lucky because - they can tolerate many emotional crises that men cannot bear so well

Men are lucky because - there are many avenues open for them to pursue occupations which are not open to women

My mother and I - share some unfortunate traits

When my mother spanked me, I - accepted it, but when she scolded me, I cried

When I am with a man - I feel normal, according to who the man is and what he means to me

Raising a family - can be a wonderful experience if all work together.

Appendix W

Rorschach: Structural Summary Blank

(Exner, 1989)

Description of the Scoring Criteria and Interpretations of the
Indices Used in the Principal Component Analysis

STRUCTURAL SUMMARY BLANK
Developed by John E. Exner, Jr. for use with
THE RORSCHACH: A COMPREHENSIVE SYSTEM

472

TEST DATE: ____/____/____

I. Subject Data

NAME: _____

AGE: _____

SEX: ☐ Male ☐ Female

RACE: _____

BIRTH DATE: ____/____/____

PLACE OF BIRTH: _____

EDUCATION: Years Completed: _____

                         Degree Achieved: _____

CURRENT
EMPLOYMENT: _____

                         How Long: _____

PRIOR
EMPLOYMENT(S): _____

II. Family Background

MARITAL STATUS:

☐ Single   ☐ Married: ____ Years
☐ Engaged   ☐ Divorced: ____ Years
                                 ☐ Widowed: ____ Years

FAMILY STRUCTURE:

	Sex	Age	Occupation	Deceased?

SPOUSE: _____
(From Current or previous marriage)

FATHER: _____
MOTHER: _____

SIBLINGS: _____
_____
_____
_____

CHILDREN:	Sex	Age	Sex	Age

1	____	____	5	____
2	____	____	6	____
3	____	____	7	____
4	____	____	8	____

III. Referral Data

PURPOSE: _____

IF PSYCHIATRIC: _____

☐ Psychiatric
☐ Forensic
☐ Educational
☐ Other

☐ Admission
☐ Progress
☐ Discharge
☐ Other

☐ Inpatient
☐ Outpatient
☐ Day Treatment

☐ Prior Hospitalization
☐ Suicide Attempt
☐ Assaultiveness
☐ Substance Abuse

REFERRAL QUESTION: _____

PRESENTING PROBLEMS OR SYMPTOMS: _____

IV. Testing Situation

COOPERATION

Other Tests Administered

☐ Excellent
☐ Adequate
☐ Reluctant
☐ Resistant

_____
_____
_____
_____

V. Remarks

_____
_____
_____
_____

SEQUENCE OF SCORES

473

[illegible]

Location Features

Zf =
ZSum =
ZEst =

W =
(Wv =)
D =
Dd =
S =

DQ

.....(FQ-)
+ = ( )
o = ( )
v/+ = ( )
v = ( )

FQx   Form Quality
FQf   MQual   SQx

+ = + = + = + =
o = o = o = o =
u = u = u = u =
- = - = - = - =
none = none = none =

Determinants

Blends

Single

M =
FM =
m =
FC =
CF =
C =
Cn =
FC' =
C'F =
C' =
FT =
TF =
T =
FV =
VF =
V =
FY =
YF =
Y =
Fr =
rF =
FD =
F =

(2) =

Contents

H =
(H) =
Hd =
(Hd) =
Hx =
A =
(A) =
Ad =
(Ad) =
An =
Art =
Ay =
Bl =
Bt =
Cg =
Cl =
Ex =
Fd =
Fi =
Ge =
Hh =
Ls =
Na =
Sc =
Sx =
Idio =

Approach Summary

Card:

Locations:

I :
II :
III :
IV :
V :
VI :
VII :
VIII :
IX :
X :

Special Scorings

	Lvl-1	Lvl-2
DV =	x1	x2
INC =	x2	x4
DR =	x3	x6
FAB =	x4	x7
ALOG =	x5	
CON =	x7	

Raw Sum6 =
Wgtd Sum6 =

AB = CP =
AG = MOR =
CFB = PER =
COP = PSV =

RATIOS, PERCENTAGES, AND DERIVATIONS

R = L =

EB = : EA = EBPer =
eb = : es = D =
Adj es = Adj D =

FM = C' = T =
m = V = Y =

AFFECT

FC:CF+C = :
Pure C =
Afr =
S =
Blends:R = :
CP =

INTERPERSONAL

COP = AG =
Food =
Isolate/R =
H : (H)+Hd+(Hd) = :
(H)+(Hd):(A)+(Ad) = :
H+A : Hd+Ad = :

IDEATION

a:p = : Sum6 =
M^a:M^p = : Lvl-2 =
2AB+(Art+Ay) = WSum6 =
M - = M none =

MEDIATION

P =
X+% =
F+% =
X-% =
S-% =
Xu% =

PROCESSING

Zf =
Zd =
W:D:Dd = : :
W:M = :
DQ+ =
DQv =

SELF PERCEPTION

3r+(2)/R =
Fr+rF =
FD =
An+Xy =
MOR =

☐ SCZI = ☐ DEPI = ☐ CDI = ☐ S-Con = ☐ HVI = ☐ OBS =

S-Constellation (Suicide Potential):

☐ Check Positive if 8 or more conditions are true:
NOTE: Applicable only for subjects over 14 years old.

- ☐ $FV+VF+V+FD > 2$
- ☐ Color-Shading Blends > 0
- ☐ $3r+(2)/R < .31$ or $> .44$
- ☐ $MOR > 3$
- ☐ $Zd > +3.5$ or $Zd < -3.5$
- ☐ $es > EA$
- ☐ $CF+C+Cn > FC$
- ☐ $X+\% < .70$
- ☐ $S > 3$
- ☐ $P < 3$ or $P > 8$
- ☐ Pure H < 2
- ☐ $R < 17$

SCZI (Schizophrenia Index):

☐ Check Positive if 4 or more conditions are true:

- ☐ EITHER: $(X+\% < .61)$ and $(S-\% < .40)$
OR: $(X+\% < .50)$
- ☐ $X-\% > .29$
- ☐ EITHER: $(FQ- \geq FQu)$
OR: $(FQ- > FQo + FQ+)$
- ☐ (Sum Level 2 Sp. Sc. > 1) and $(FAB2 > 0)$
- * ☐ EITHER: (Raw Sum of 6 Spec. Scores > 6)
OR: (Weighted Sum of 6 Sp. Sc. > 17)
- ☐ EITHER: $(M- > 1)$
OR: $(X-\% > .40)$

DEPI (Depression Index):

☐ Check Positive if 5 or more conditions are true:

- ☐ $(FV+VF+V > 0)$ OR $(FD > 2)$
- ☐ (Col-Shd Blends > 0) OR $(S > 2)$
- * ☐ $(3r+(2)/R > .44$ and $Fr+rF=0$)
OR $(3r+(2)/R < .33)$
- ☐ $(Afr < .46)$ OR $(Blends < 4)$
- ☐ $(SumShading > FM+m)$ OR $(SumC' > 2)$
- ☐ $(MOR > 2)$ OR $(2xAB+Art+Ay > 3)$
- ☐ $(COP < 2)$ OR
 $([Bt+2xCl+Ge+Ls+2xNa]/R > .24)$

CDI (Coping Deficit Index):

☐ Check Positive if 4 or 5 conditions are true:

- ☐ $(EA < 6)$ OR $(AdjD < 0)$
- ☐ $(COP < 2)$ and $(AG < 2)$
- ☐ $(Weighted\ Sum\ C < 2.5)$ OR $(Afr < .46)$
- ☐ $(Passive > Active)$ OR $(Pure\ H < 2)$
- ☐ $(Sum\ T > 1)$
OR $(Isolate/R > .24)$
OR $(Food > 0)$

HV (Hypervigilance Index):

☐ Check Positive if Condition 1 is true and at least 4 of the others are true.

☐ (1) $FT+TF+T = 0$

-
- ☐ (2) $Zf > 12$
  - ☐ (3) $Zd > +3.5$
  - ☐ (4) $S > 3$
  - ☐ (5) $H+(H)+Hd+(Hd) > 7$
  - ☐ (6) $(H)+(A)+(Hd)+(Ad) > 3$
  - ☐ (7) $H+A : Hd+Ad < 4:1$
  - ☐ (8) $Cg > 3$

OBS (Obsessive Style Index):

- ☐ (1) $Dd > 3$
- ☐ (2) $Zf > 12$
- ☐ (3) $Zd > +3.0$
- ☐ (4) $Populars > 7$
- ☐ (5) $FQ+ > 1$

☐ Check Positive if one or more is true:

- ☐ Conditions 1 to 5 Are All True
- ☐ 2 or more of 1 to 4 are true AND $FQ+ > 3$
- ☐ 3 or more of 1 to 5 are true AND $X+\% > .89$
- ☐ $FQ+ > 3$ AND $X+\% > .89$

*NOTE: The cutoffs for Raw Sum6, Wgtd Sum6, and $3r+(2)/R$ should be adjusted to exceed ± 1 SD for younger clients.

Calculation Note: S-% is calculated as $\frac{SQx-}{FQx-}$

Organizational (Z) Values for Each of the 10 Cards

CARD	Z-W	Z-Adj	Z-Dis	Z-Space	CARD	Z-W	Z-Adj	Z-Dis	Z-Space
I	1.0	4.0	6.0	3.5	VI	2.5	2.5	6.0	6.5
II	4.5	3.0	5.5	4.5	VII	2.5	1.0	3.0	4.0
III	5.5	3.0	4.0	4.5 *	VIII	4.5	3.0	3.0	4.0
IV	2.0	4.0	3.5	5.0	IX	5.5	2.5	4.5	5.0
V	1.0	2.5	5.0	4.0	X	5.5	4.0	4.5	6.0 *

* NOTE: ZS is not assigned for face responses on Cards III and X unless the use of white space is clearly articulated.

Best Weighted ZSum Prediction When Zf is known

Zf	ZEst	Zf	ZEst	Zf	ZEst	Zf	ZEst	Zf	ZEst
1	—	11	34.5	21	70.0	31	105.5	41	141.0
2	2.5	12	38.0	22	73.5	32	109.0	42	144.5
3	6.0	13	41.5	23	77.0	33	112.5	43	148.0
4	10.0	14	45.5	24	81.0	34	116.5	44	152.0
5	13.5	15	49.0	25	84.5	35	120.0	45	155.5
6	17.0	16	52.5	26	88.0	36	123.5	46	159.0
7	20.5	17	56.0	27	91.5	37	127.0	47	162.5
8	24.0	18	59.5	28	95.0	38	130.5	48	166.0
9	27.5	19	63.0	29	98.5	39	134.0	49	169.5
10	31.0	20	66.5	30	102.5	40	137.5	50	173.0

I

II

III

IV

V

VI

VII

VIII

X

W - Whole Percepts

The "W" is a location score. It is coded when the subject uses the entire blot. Any responses covering less than the whole blot receives one of the other location scores. Interpretively, the W response has been empirically linked with an indication of motivation to deal with the entire stimulus field. On its own the W yields meagre information. Clinically, in combination with DQ, Zf, M and D scores (see below) W frequency takes on greater meaning.

D - Common Details

"D" is another location score referring to the commonly perceived areas of the blot. The decision to score D is based on frequency and in the Exner system, tables are provided to determine which responses to designated blot areas may be considered to be a common detail. D answers represent the ability to perceive and to react to the obvious characteristics of the environment.

Dd - Unusual Details

The Dd coding is given to responses that cover areas of the blot that are used infrequently. The criterion established is that the response to the blot area is given by less than 5% of subjects. Tables are provided to describe the most commonly found unusual details. Size of the percept is not a factor. By definition, any response not found in the tables or that is not W or D is scored Dd. More than three Dd responses signals a markedly atypical and usually obsessive

approach to the world. Another possible interpretation is that the individual is attempting to create a more narrow environment that is easier to manage. A protocol with one to three Dd responses in it is considered by Exner (1986) to be a healthy indication that the individual can show initiative and the capacity to back away temporarily. In excess of three, the Dd score can indicate a form of perfectionism or a tendency to flee from routine coping demands.

DQ - Developmental Quality

The location component of each response always includes two symbols, the first for the area used and the second for developmental quality. The coding of developmental quality is an attempt to capture differences in cognitive processing with regards to the organization of the stimulus features in a meaningful way. Combinatory or superior responses (DQ+) require a much higher level of cognitive action in contrast to an unorganized response that does not require specification of features (DQv). The developmental quality code provides information concerning the specification involved in the response. Interpretively, the DQ score appears to be related to the willingness and capacity to analyze and synthesize the stimulus field in a meaningful way. In general, a higher frequency of DQ+ answers is found among brighter and psychologically more complex subjects, whereas the lower-level DQv responses occur most frequently and intellectually limited or neurologically impaired subjects.

M - Human Movement

Three kinds of movement responses may occur in the Rorschach: (1) those involving humans or human-like behaviours; (2) those involving animals; (3) those involving inanimate or inorganic objects or forces. The M or human movement score is scored for human activity. The movement may be active or passive (see below). All movement responses, both human and non human, involve some form of projection, since the blots do not move. Therefore, the formation of a movement answer must include features that are mentally created by the subject and attributed to the stimulus field. Interpretively, Exner notes that "any attempt to summarize the full psychological meaning of M responses will probably fall short of describing the extremely complex activities to which they relate" (Exner, 1986, p. 329). Having said that, he summarizes the elements of M responses as relating to reasoning, imagination, and a higher form of conceptualization. He also writes that the M response is contingent on a form of delay from yielding to more spontaneous translation of, or responses to a stimulus field, during which time an active and deliberate form of ideation occurs. Finally, M-related activity does not appear to be a conscious process, although some of the reasoning involved probably does include a conscious focusing of attention.

M- - Human Movement Minus

Human movement minus coding indicates a response

including human or human-like movement, and a minus form quality designation (see below). The presence of even one M-response is sufficient to raise concerns about peculiarity in ideation. If the frequency is greater than one, the likelihood of a marked problem in thinking is considerably increased. More than two M- responses increases the probability of active, disoriented, psychotic-like thinking.

Ma: Mp - The ratio of Human Movement, active: Human Movement, passive

An important coding that must be added to all movement responses is a superscript which denotes whether the movement was active (a) or passive (p). There are two ratios which are derived and used in interpretation: (a) Ma:Mp - that is, human movement active to human movement passive, and (b) a:p - that is, that ratio of the sum of all active movement scores to all passive movement scores. Empirically, when Mp is greater than Ma, the ratio has been linked to a tendency to take flight into passive forms of fantasy as a defensive maneuver, and to a tendency to be less likely to initiate decisions or behaviours if the alternative that others will do so is available. This is called the "Simon White" feature.

a:p - The Ratio of all Active Movement Scores to all Passive Movement Scores

Summarizing the empirical data, Exner (1986) states that as the numbers in the ratio become more discrepant from each other ideational sets tend to be more well fixed. Conversely,

as the numbers in the ratio tend to approximate each other, greater flexibility in ideational or cognitive approach to issues seems to exist. Where inflexibility is found, it tends to inhibit a full processing and/or integration of previous material. It should be noted that a high frequency of active movement responses does not correspond to an unusual frequency of active behaviours or with any special class of behaviours because most people tend to give more active than passive responses.

S - Space responses, minus

S is scored whenever the white sections of the blot are included in the response as a part of the percept. S-, space minus indicates a space response with a minus form quality (see below). The empirical data on S responses is somewhat sparse however from the available data, Exner (1986) concludes that one or two S responses in a record of average length is probably a positive sign in which oppositional features are provoked by the need to remain somewhat independent in relation to task demands. However if S is elevated, especially if it exceeds three, the oppositionality is probably more pervasive as a trait-like feature of the personality. As such it can reflect a serious impediment to other operations and relations. S responses indicate a marked problem in thinking in relation to the oppositionality.

L - Lambda

Form (F) responses denote answers based solely on form of

the blot. Lambda is a ratio that compares the frequency of pure F responses with all other answers in the record. Interpretively, it is related to issues of economizing the use of resources. When L is disproportionately high, it signals that most of the responses which have been selected to deliver are generally simplistic, pure F responses. These responses ignore or neglect the complexities of the stimulus field. A low L indicates that the individual is having difficulty identifying the most economical ways of handling the demands of the task or that they are attempting to avoid error or failure. A more positive interpretation suggests an achievement-oriented person who is flexible and adapts easily to situations. If this individual views the test as a challenge to their coping skills, they will often sacrifice economy to gain a greater sense of achievement. The differentiation is made based on the pattern in the rest of the Rorschach record.

FD - Form Dimension

FD (form dimension) is scored whenever the response includes dimensionality or perspective based exclusively on form, interpreted by size or in relation to other blot areas. Most adults give at least one FD response and the frequency and mean gradually increase with age among children. The FD response is connected empirically with a self-inspecting process. An elevation in FD may signal an exaggerated involvement with self-examination. On the other hand, an

absence of FD responses may indicate an avoidance of self-awareness and/or self examination.

If - Organizing activity-frequency

A Z score is assigned to any response that includes form (see below) and meets at least one of the following criteria: (1) it is a W response with a DQ coding of + or v?+ or O, (2) it is a response that meaningfully integrates two or more adjacent detail areas, (3) it is a response that meaningfully integrates two more non-adjacent details areas, or (4) it is a response in which white space is meaningfully integrated with other areas of the blot. Form must always be involved to score Z. The actual value of Z is determined from a table. Two values are derived from the Z score. The first is Zf or frequency of Z scores, the second is Zd or organizational efficiency. Interpretively, Zf provides an indication of the extent to which the subject has approached the task using cognitive tactics that typically are more demanding than some other mediational approaches. An elevated Zf may be the product of intellectual striving or a need to deal with the stimulus field in a more careful and precise manner. A low Zf may indicate an intellectual limitation but more likely denotes a reluctance to tackle the complexity of the stimulus field.

Zd - Organizational efficiency

The Zd or organizational efficiency score is the difference obtained by subtracting the sum of the assigned Z

scores from the estimated sum of the Z scores given the number of responses (obtained from a table). The appropriate sign is also recorded. Whereas Zf relates to the effort to organize the stimulus field, the Zd provides information related to the efficiency involved in processing the stimuli. A score between ± 3.0 is considered to be within the normal range. A score greater than three is indicative of overincorporation; a score less than three is indicative of underincorporation.

P - Popular Responses

P or popular is scored for very conventional answers - those occurring in at least one in three records. Thirteen classes of popular responses have been identified and these are described in a table. The popular response has a finite limit of 13 and therefore it is relatively easy to identify deviant frequencies. Four or less Popular responses in the record of an adult reflects either an inability or an unwillingness to deliver that which may be the most obvious possible answer. It does not necessarily signify poor reality testing. Any elevation in the number of P responses is examined in the light of the value of Lambda (see above) for an interpretation for clinical purposes. If L is not high, an overabundance of Popular answers probably indicates an orientation towards the more simplistic and correct. It can hint of a commitment to conventionality well beyond that which might be expected. If L is high, this may simply reflect the effort to economize. If P is low, and is absent in those

cards to which a high percentage of Popular responses is given, the presence of severe pathology or an intense form of nonconforming may be indicated.

F + % - Conventional Pure form

Form Quality denotes the "good of fit" of the response to the area of the blot that is being used. The subscript for Form Quality is entered immediately after the coding for determinant. There are four possible subscripts, (a) + or superior or over-elaborated, (2) 0 or ordinary, (3) u unusual, or (4) - minus. Determination of Form Quality begins with examination of an actuarial table which lists W, D, and Dd percepts along with sample responses which have been coded o, u, or -. If a response is not listed in the table it is generally scored u or -, but only after a determination of the goodness of fit has been made by the examiner. Responses that are listed as o but which include an unusually precise articulation of the use of form in a manner that tends to enrich the quality of the response without sacrificing the appropriateness of the use of form are given a subscript of +. $F+\%$ (the number of F responses divided by the total number of F responses) concerns perceptual accuracy among the pure F responses. It is generally low for very young children but typically exceeds 80% by the sixth year. Whenever $F+\%$ is 60% or lower, severe pathology or marked intellectual limitations or brain dysfunction must be suspected.

X+% - Extended Form Quality

X+% is derived by dividing the Form Quality ordinary and plus for all responses, by the total number of responses. This variable concerns perceptual accuracy for the total record. The mean for nonpatient children and adults tends to be around 80%, with a standard deviation of 10%. Interpretively, the X+% provides information concerning perceptual accuracy for the total record. It relates to the use of form features of the blob in a commonplace, reality-oriented manner. It is considered to be a measure of perceptual or mediational conventionality. If X+% is greater than 90% it suggests that the individual may be overly conventional in translating stimulus inputs, and possibly sacrificing individuality to do so. If X+% is low, that is less than 70% it indicates that the subject tends to translate the stimulus field in ways that are more atypical.

X-% - Perceptual Mediational Distortion

The X-% is calculated by dividing the sum of all Form Quality minus divided by the total number of responses. This variable concerns the proportion of perceptual distortion that has occurred in the record. It represents the proportion of uncommon responses in the record that disregard the appropriate use of contours of the blot. Where the X-% is elevated, that is greater than 15% it indicates that the subject is having some difficulty translating perceptual input appropriately or accurately. When X-% exceeds 20% the likelihood of major impairment is substantial.

Appendix X

Letters of Consent

January, 1987

Dear Parent,

The Carleton Board of Education has given permission to doctoral students of Dr. H. B. Ferguson (Psychology Department, Carleton University) to conduct a study on the development of thinking processes in children.

It is expected that such research ultimately will provide teachers with curriculum guidelines and ways to enhance teaching methods.

This investigation will involve two one hour sessions to be arranged during school hours at the child's convenience.

Tasks to be completed include a knowledge questionnaire, personality measures and two "thinking" games. Past experience with these measures suggest most children have found them enjoyable and challenging.

In order to maintain the confidentiality of students identified as exceptional, the CBE cannot release the names of students without parental consent. Given the above condition, we would appreciate your signing the form below indicating approval or disapproval of your child's participation in this study. Please have your child return the form in the envelope to the school office.

If you would like more information or a summary of the research findings, please contact the researchers directly (Sandra Nandi, Office 820-1820, ext. 498, Home 828-7943 or Sue Baxt 727-0846).

Thank you for your interest in this project.

Yours sincerely,

John M. Beatty
Superintendent, Educational Services

Please Return to School Office

I agree _____ to the participation of my child (name of child _____) in the research
do not agree _____ project conducted by S. Nandi/S. Baxt under the supervision of Dr. H. B.
Ferguson (Psychology Dept. Carleton University).

Parents Signature _____

Date _____

January, 1987

Dear (Parent),

Mr.(s) (Principal) has approved our request to conduct a study on the development of children's problem-solving skills. This study is part of our doctoral research in educational psychology at Carleton University. The goal of this research is ultimately to provide teachers with curriculum guidelines and ways to enhance instructional methods.

Your child has been randomly selected for this study. Students so selected will not be identified by name or by school in the final analysis of the results.

During the study students will be requested to complete two "thinking" games, a knowledge questionnaire and several personality measures. We estimate two 1 hour sessions will be required. Testing sessions will be scheduled during school hours. Past experience with these measures suggests most children have found them enjoyable and challenging. Of course, your child's participation will be voluntary. If at any time your child wishes to discontinue, testing will be terminated.

We would appreciate your signing the form below indicating approval or disapproval of your child's participation in this study. Please have your child return the form in the envelope to the school office.

If you would like more information or a summary of the research findings, please contact us directly (Sandra Nandi, Office 820-1820 ext. 498, Home 828-7943 or Sue Baxt 727-0846).

Thank you for your interest in this project.

Yours sincerely,

Sandra Nandi

Please return to School Office

I agree _____ to the participation of my child (name of child _____) in the research
do not agree _____ project conducted by S. Nandi/S. Baxt under the supervision of Dr.
H.B. Ferguson (Psychology Dept. Carleton University).

Parent's Signature _____

Date _____

Susan Baxt, Ph.D. Candidate
Carleton University
(Home) 727-0846
(Work) 770-0042

Dear Parents:

A project aimed at increasing our understanding about how children learn to solve problems is being conducted by doctoral students from Carleton University. The Research Committee of the Carleton Board of Education has granted permission to one of the researchers to request your cooperation in part of this study.

The larger study, of which this present investigation is a small part, is aimed at understanding what factors contribute to making a child a good problem solver. In order to gather the needed information, two questionnaires were developed to assess an individual child's understanding of the general issues involved in problem solving (such as individual differences, etc.) and of their understanding of their own preferred problem solving style. The present investigation is being undertaken to ensure that these two questionnaires meet acceptable standards, that is, that scores remain relatively stable over short periods of time.

To that end, your child's participation in this study would entail two sessions of approximately 45 minutes each, spaced 6 weeks apart. The sessions will be arranged during school hours at the convenience of the school and the child. During each session your child would be asked to complete one of the two questionnaires, as determined by random selection from the group of students who have agreed to participate in the study. The first questionnaire is a three part, 35-item questionnaire related to general issues in problem solving. The second questionnaire is administered after a game-like problem solving task, and consists of six items questioning the child's awareness of his/her own activities while playing the game.

All information will be kept strictly confidential. This information will not appear in any school records, will be seen only by the researchers involved in this study, and will be used solely for research purposes. Those children who are selected to participate will not be identified ^{by name}. In order to select the students, it will be necessary to access the O.S.R.'s. Your co-operation and permission is requested in this matter. If you have any questions, please call the researcher at the number(s) given at the top of this letter.

We would be grateful for your cooperation. Whether or not you wish to participate, please complete the attached form and return it to the school within a week. If you indicate that you are interested, your child's name will be placed with the names of those children who have agreed to participate, and may be

- 2 -

selected for inclusion in the study (whether or not they are called will depend on the numbers who agree to be a part of the study in relation to the number of children required). The researcher will then contact your child through the school principal. An information session will be organized when the data has been analyzed and results are available. If your child has participated in the study, you will be contacted at that time.

Yours truly,

Sue Baxt

I hereby _____ give permission

_____ do not give permission

for my child _____ to participate in the
study "Evaluation of Two Metacognition Assessment
Questionnaires", described above, and for the researcher, Susan
Baxt, to have access to the information in my child's O.S.R.

_____
Signature of Parent or Guardian

_____
Date

Appendix Y

Testing Sessions

Appendix Y

Data Collection Testing Sessions

Session 1 (or 3)	Session 2 (or 1)	Session 3 (or 2)
Kemler Hypothesis Formation Task	Matching Familiar Figures	Children's Social Desirability Scale
Concurrent Interview Sentence		Loevinger's Completion Test
Pattern-Matching Task Completion	Rorschach	P a r a g r a p h Test
Concurrent Interview	Spielberger State-Trait Anxiety Scale for Children	Metacognitive K n o w l e d g e Questionnaire
Assessment		

(half the students were administered the tasks in this order, half the students were administered the tasks in the reverse order)