INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

Neuropsychological Correlates of Social Skills

in Clinically-Referred Children

by

Elisabeth Mary Suzanne Sherman

B.A., University of Ottawa, 1991

M.Sc., University of Victoria, 1995

A Dissertation Submitted in Partial Fulfilment of the

Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Department of Psychology

We accept this dissertation as conforming to the required standard.

Dr. M. Joschko, Supervisor (Department of Psychology)

Dr. E. Strauss, Supervisor (Department of Psychology)

Dr. H. Kadlec, Departmental Member (Department of Psychology)

Dr. M. Uhlemann, Outside Member (Department of Education)

Dr. J. MacDonald, External Examiner (B.C. Rehabilitation - G. F. Strong Centre)

© Elisabeth Mary Suzanne Sherman, 1997

University of Victoria

All rights reserved. This dissertation may not be reproduced in whole or in part, by photocopying or other means, without the permission of the author.

Supervisors: Drs. Michael Joschko and Esther H. Strauss

ABSTRACT

Case studies and a small number of group studies in the neuropsychological literature on adults and children with brain dysfunction suggest that certain cognitive skills are important determinants of social skills. However, standardised measures of social skills designed expressly to measure this construct have not been used previously in the neuropsychological field. The goal of this study was to determine neuropsychological correlates of social skills in children referred for neuropsychological assessment, and compare the findings to the cognitive skills identified in social information processing models from developmental and clinical psychology. In younger children (6 to 9 years), only a measure of conceptual ability was related to social skills. However, from a clinical standpoint, differences in conceptual skills between socially impaired and socially skilled children were minimal. In older children (10 to 13 years), sustained attention and verbal reasoning were strong, unique predictors of social skills. However, only differences in sustained attention between socially skilled and unskilled children were clinically significant. Results were discussed with regards to 1) social information processing models, 2) the effect of age on the cognitive correlates of social skills; and 3) the relationship between insight and social skills.

Examiners:

Dr. M. Joschko, Supervisor (Department of Psychology)

Dr. E. Strauss, Supervisor (Department of Psychology)

Dr. H. Kadlec, Departmental Member (Department of Psychology)

Dr. M. Uhlemann, Outside Member (Department of Education)

Dr. J. MacDonald, External Examiner (B.C. Rehabilitation - G. F. Strong Centre)

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGMENTS

I wish to thank Esther Strauss and Michael Joschko for their support, encouragement, and example throughout graduate school. I would also like to thank Dr. Helena Kadlec for methodological and statistical advice.

INTRODUCTION

Definitions and Models of Executive Functioning

Neuropsychology as a field has a rich tradition of attempting to characterise higher cognitive functions such as those that underlie judgement, problem solving, goal attainment, and the modulation of behaviour. In particular, early neuropsychologists and neurologists were struck by the severe behavioural deficits of certain patients with frontal lobe damage who were unable to carry out daily activities and sustain social interactions despite seemingly normal intelligence, memory and sensory-perceptual functions (e.g., Feuchtwanger, 1923, and Welt, 1888, as cited by Benton, 1991b; Ackerly, 1937; Brickner, 1934; 1936; Hebb & Penfield, 1940; Hebb, 1945). In the 1920s, Goldstein introduced the notion of "abstract attitude" (1936a; 1936b; 1944), a cognitive skill that encompassed the neuropsychological functions of abstract reasoning, initiative, foresight, self-awareness, behavioural flexibility, and complex problem analysis (Benton, 1991b). The loss of "abstract attitude" in certain brain-damaged individuals was thought to explain their behavioural impairments in the absence of deficits in other cognitive abilities. More recently, the term "executive functions" has replaced earlier terms to describe those cognitive operations that modulate and control more primary cognitive skills such as language, memory, perceptual skills, and motor behaviour,

in order to attain pre-set goals. Several models that further subdivide executive functioning into component processes have also emerged in the last decade. A review of the better known models follows.

Welsh, Pennington, and Groisser (1991) defined executive functions as consisting of planning, the ability to shift set, impulse control, and the organised search and retrieval of items from memory (Weyandt & Willis, 1994). Under the executive function rubric, Lezak (1995) included volition (the ability to form an intention and formulate a goal), planning (the ability to identify and organise the steps needed to reach a goal and identify alternative solutions), purposive action (the ability to initiate, maintain, switch and stop behaviour sequences in an orderly, organised manner), and effective performance (the ability to monitor, self-correct, and regulate performance). According to her model, deficits in executive functions are most evident in planned, intentional activities and most evident in situations demanding appropriate and socially responsible conduct. Lezak noted that the ability to initiate behaviour and the capacity for self-awareness are preconditions to volitional behaviour. In particular, Lezak posited that self-awareness could be broken down into the awareness of one's physical self within the immediate environment, awareness of self as distinct from the environment and from other individuals, and awareness of the self as part of social interactions.

Mateer and Williams (1991) viewed executive functions in terms of three general classifications: (1) self-regulatory abilities, (2) the allocation of attentional

resources, and (3) the ability to act on knowledge. More specifically, Mateer and Williams posited that executive functions include the direction of attention (orientation to a specific target and resistance to interference), the recognition of patterns of priority, the formulation of intentions, the development of plans for attainment, the execution of plans, and the recognition of goal attainment. According to this model, disruptions in executive functioning processes cause stimulus-bound behaviour, perseveration, lack of initiation, difficulty sustaining attention and motivation over time, failure to recognise and use feedback, failure to regulate behaviour independently, and lack of awareness of deficits (Mateer & Williams, 1991).

Measuring Executive Functions

In clinical neuropsychological investigations, the measurement of executive functioning skills poses an inherent challenge. Neuropsychological testing is a highly structured situation where the examiner formulates goals, determines projected outcomes, and provides the subject with specific instructions so that the subject performs a task within defined parameters and given materials, while the examiner monitors performance. According to Lezak (1995), the problem with assessing executive functioning in the context of a neuropsychological assessment is to "transfer goal-setting, structuring, and decision making from the clinician to

the subject within the structured examination" (p. 651). Fortunately, a number of paradigms have been developed that allow the measurement of executive functions within the structured context of neuropsychological testing.

Because they allow the subject to independently select a chosen path from a set of possible alternatives according to a self-initiated plan, maze tracing tasks have been used frequently in research on executive functions (e.g., Grodzinsky & Diamond, 1992; Porteus, 1959; Segalowitz, Unsal, & Dywan, 1992; Weyandt & Willis, 1994) as measures of planning and foresight (Lezak, 1995). Other well-known tests that are purported to measure planning are the tower tests (i.e., Tower of London, Tower of Hanoi, and Tower of Toronto). Briefly, these tests involve problem solving paradigms that allow a subject to select responses in order to attain a pre-set goal, according to given rules, such as having to move coloured disks from their initial position on a peg to a different peg, one disk at a time, in the least number of moves possible (Lezak, 1995). An effectively planned strategy is one that uses the least number of moves and does not include any rule violations. In addition to measurement of visual-spatial skills, complex design copy task are also thought to depend on planning ability (e.g., Rey-Osterrieth Complex figure test; Grodzinsky and Diamond, 1992; Lezak, 1995). The cognitive process of interest targeted by design copying tasks is the approach the subject takes in executing the design, rather than accuracy itself. However, because of the complexity of the design, poor planning may be accompanied by inaccurate

copying. Poor performance on design copy tasks may therefore reflect an unorganised, unplanned, piece-meal approach to problem solving.

Response inhibition (i.e., control of impulsivity and perseverative tendencies) has traditionally been assessed with Go-No-Go tasks and card-sorting tasks requiring set shifting in response to examiner feedback. The Wisconsin Card Sorting Test (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993) is currently the most widely used measure of executive functioning (Stuss & Benson, 1984). Poor performance on certain measures of the WCST such as the perseverative errors score reflects difficulty inhibiting a previously learned response set. Word generation tasks have also been used to measure initiation and strategic memory search. The subject is presented with either a letter or category, and then instructed to provide as many words beginning with the particular letter or exemplars from a category as possible within a given time limit. Lezak (1995) reports that performance on word generation tasks involves the use of strategy to guide the search of memory stores, such as the use of conceptual clustering along phonological or semantic categories, in addition to initiation and self-monitoring skills.

The Development of Executive Functions in Children

Like most cognitive skills, the development of executive functions in children appears to follow an age-dependent pattern (Becker, Isaac & Hynd, 1987; McKay, Halperin, Schwartz, & Sharma, 1994; Passler, Isaac, & Hynd, 1985; Stuss, 1992; Welsh, Pennington, & Groisser, 1991; Weyandt & Willis, 1994). The development of executive functions in children has been investigated primarily by assessing children on various paradigms known to detect executive functioning deficits in brain injured adults. The age at which children reach adult performance on any given executive functioning test is therefore thought to reflect the age at which the particular executive function becomes fully developed. Although this approach has been criticised because of the underlying assumption that children's cognitive skills are in a sense "partially formed" versions of adult skills instead of distinct cognitive skills that are appropriate, complete, and well suited to each developmental stage, these types of investigations have contributed to the understanding of neurocognitive development in children. The following is a brief review of this research emphasising the developmental progression of performance on executive functioning tests.

Adult-level performance on executive functioning measures reflecting set shifting, resisting perseverative tendencies, and self-monitoring appear to be reached by age 10 to 12 (Chelune & Baer, 1986; Chelune & Thompson, 1987; Levin et al., 1991; Passler at al., 1985) or older (Weyandt & Willis, 1994) on such tasks as

the WCST and Go-No-Go tasks (Drewe, 1975). Other research suggests that response inhibition develops most rapidly between 7 and 9 years of age, reaching adult levels at age 11 (McKay et al., 1994). Planning and strategy use increase substantially from 12 years to later adolescence (Levin et al., 1991; Welsh, Pennington & Groisser, 1991) as reflected by performance on the Tower of London (Shallice, 1982) and Twenty Questions procedure (Denny & Denny, 1973). Temporal ordering, a memory organisation skill, attains a peak by age 12 (Becker, Isaac, & Hynd, 1987). Other memory organization skills such as clustering responses into semantic categories to facilitate retrieval on word list learning tasks increase from age 7 to adolescence (Levin et al., 1991) on such tasks as the California Verbal Learning Test - Children's Version (Delis, Kramer, Kaplan, & Ober, 1986). Performance on word fluency tasks, a skill that depends on the use of rapid memory retrieval strategies, attains a plateau between the fifth and seventh grade (i.e., between approximately ages 11 and 13; Halperin, Healy, Zeitchik, Ludman, & Weinstein, 1989).

Based on the research of Welsh, Groissier, and Pennington (1988) and other researchers, Stuss (1992, p. 17) proposed a developmental progression in executive functions which follows three stages: (1) simple planning and organised visual search by age 6; (2) set maintenance, hypothesis testing, and impulse control by age 10; and (3) complex planning, motor sequencing, and verbal fluency during adolescence. The development of self-awareness, insight and self-reflectiveness,

presumably maturing later than other more basic executive functions, is not yet well charted, but presumably take a more protracted course.

Executive Functioning and Social Skills

Because executive functions modulate, organise, and integrate other cognitive processes and behavioural responses, the implications of deficits in this area are far reaching. In particular, Pennington and Welsh (1985) reported that social behaviour requires the integration of multiple sources of information, the ability to make inferences regarding others' mental states, the inhibition of inappropriate responding, and the rapid shifting of attentional resources. Because of these requirements, Pennington and Welsh posited that social skills would be expected to be highly dependent on executive functioning skills. Other researchers have reached similar conclusions. For example, in his examination of factors important after head injury, Ylvisaker et al. (1987) listed a number of cognitive deficits that have adverse effects on social skill. These included limited awareness of social and communicative events, inadequate retrieval of the rules of social interaction, reduced ability to take alternative perspectives, organisational problems leading to problems introducing, maintaining, and terminating conversational topics, and disinhibition and self-monitoring deficits in verbal and non-verbal behaviour causing the brain injured individual to repeat information,

make inappropriate remarks, have difficulty comprehending others, and to appear uninterested or unmotivated. All these difficulties, to some extent, appear to reflect deficits in executive functioning.

Although similar deficits occur with injury to other parts of the brain, executive deficits are commonly reported after frontal lobe damage in children (Ackerly, 1964; Dennis, 1991; Dennis & Barnes, 1990; Eslinger, Grattan, Damasio, & Damasio, 1990; Grattan & Eslinger, 1991; Mateer & Williams, 1991). Ylvisaker summarised the social deficits that are commonly reported after frontal lobe injury in children, highlighting the association between executive functioning deficits and problems in the social realm. These include "disinhibition, socially inappropriate behaviour and language, lack of initiation, difficulty reading social cues and interpreting social situations, difficulty organising complex responses, rigid social behaviour, and others" (p. 373).

Interestingly, Tranel, Anderson, and Benton (1994) include social conduct as a subset of executive functions. However, Bennett (1989) counters the view that social consciousness is an independent cognitive process; he states that the loss of social consciousness in brain injured patients such as those with frontal lobe damage "reflects the general difficulties that a frontal patient exhibits in interacting with the environment. He or she is impulsive, perseverative, monitors, his or her own behavior poorly, and is slow to self-correct" (p. 20). In Bennett's view, social deficits are not caused by damage to a separate "social module", but are instead

the behavioural manifestations of a more pervasive loss of executive functioning skills. Presumably, social situations, because of their complexity, and by virtue of their requirements for initiation, flexibility, and self-monitoring, unmask executive functioning problems.

Cognitive Determinants of Social Skill from Neuropsychology

Neuropsychological explorations of the relationship between cognitive skills and social difficulties are of two main types: case studies and clinicians' reports of social impairment following neurological disorders or damage to specific areas of the brain, and empirical group studies. Both types of approaches have contributed to our understanding of the cognitive determinants of social skills.

Neuropsychological Case Studies and Clinicians' Reports

Undoubtedly one of the most famous cases in neuropsychology, Phineas Gage was a young worker who sustained extensive frontal lobe damage when a large iron bar was accidentally propelled through his left frontal lobe, exiting at the posterior right frontal lobe (Benton, 1991; Harlow, 1848; MacMillan, 1986;

Steegman, 1962). Remarkably, despite the extensive size of the lesion, Gage showed preservation of intellect and memory. However, although previously an honest and reliable man, impulsivity, profanity, and poor judgement lead to interpersonal difficulties and disruption in his social and occupational functioning. Thus, despite selective preservation of certain cognitive skills, Gage was incapacitated, from a social standpoint, by his acquired deficits in impulse control and judgement.

The classic reports of patient JP by Brickner (1936), patient DT (Grattan & Eslinger, 1992; Eslinger, Grattan, Damasio, & Damasio, 1990), and patient EVR by Eslinger and Damasio (1985) have also contributed to clarifying the relationship between cognitive functions and social behaviour. JP had congenital, bilateral frontal lobe atrophy (Ackerly, 1950, 1964; Ackerly & Benton, 1947). JP's scores on tests of general intellectual ability were within the average range, yet he had impaired performance on tests measuring cognitive flexibility, planning, and abstraction. From a young age, his everyday behaviour was characterised by impulsivity, poor decision-making, and social problems described as the inability to sustain friendships, and superficiality in interpersonal relationship (Grattan & Eslinger, 1991). Grattan and Eslinger (1991) concluded that JP had deficiencies in decision making that were especially salient in his everyday social behaviour. They proposed that his social difficulties were influenced by his deficits in

cognitive flexibility. Based on their observations of JP, Ackerly and Benton (1947) characterised his dysfunction as a "primary social defect".

Grattan and Eslinger's (1992; Eslinger et al., 1990) patient DT sustained a subarachnoid haemorrhage at age 7 that caused bilateral frontal lobe damage. She had executive function impairments that included impaired cognitive flexibility, planning, self-monitoring, and organisation skills. Although she initially functioned socially within age expectations, as she grew older, she began to exhibit progressive social and emotional dysfunction. The researchers concluded that DT's deficits in executive functions interacted with increasing demand on social skills as she entered adolescence and adulthood, leading to pervasive social difficulties.

In the case of EVR (Eslinger & Damasio, 1985), an accountant who underwent bilateral orbital frontal lobe resection due to a tumour at age 35, Saver and Damasio (1991) demonstrated a dissociation between knowledge of socially-appropriate behaviour and the ability to deploy these behaviours in everyday life. Despite normal-range scores on tests of the ability to generate hypothetical behavioural alternatives to given social situations, EVR was unable to select and deploy appropriate social behaviours in real-life interpersonal situations, suggesting pervasive executive functioning deficits.

Price, Daffner, Stowe, and Mesulam (1990) provided two case reports of adults who sustained early bifrontal lobe damage, one at birth and the other at age

4. Both had chronic and pervasive behavioural difficulties, abnormal social conduct and lack of empathy. Standard neuropsychological assessment revealed deficits in the areas of attention, organisation, and mental flexibility despite adequate memory, visual-spatial, and language functioning. Developmental psychology paradigms measuring Piagetian cognitive stages (i.e., sensorimotor, preoperational, concrete operational and formal operations stage), perspective taking, and moral development (i.e., the Heinz dilemma) were administered to these patients. Consistent with their impaired executive functioning on neuropsychological tasks, both patients' performance on the developmental psychology paradigms was deficient. Their performance suggested that they had not developed past the concrete operational stage and had difficulty inferring the perspective of others. In one case, immature moral development was found. In the other, inconsistencies between knowledge of moral behaviour and deployment of moral behaviour in real life were evidenced. These results suggest that bilateral frontal lesions in childhood may lead to deficits in maturation of judgement, insight, foresight, abstract reasoning, perspective taking, empathy and moral development that are translated into aberrant social conduct despite the intactness of other cognitive skills such as memory, language, and visual-spatial skills.

Marlowe's (1992) patient PL sustained a right prefrontal penetrating injury at age 3 due to a lawn dart. He had executive functioning deficits including marked self-regulation deficits despite above average scores on conventional

intelligence tests. He also had marked difficulty adapting his behaviour after feedback (i.e., learning from experience), and he showed consistent difficulty in social situations.

Biddle and Eslinger's (1996) case of an 11 year old boy who sustained right frontal damage after an arterio-venous malformation at age 7 highlights the role of executive functioning and language in mediating social behaviour. Despite normal elementary language and verbal cognitive abilities, patient JC had severe expressive language problems that consisted of difficulty managing discourse production, especially the planning, organisation, flexibility and monitoring of discourse. The researchers argued that such impairments cause "significant 'listener burden' with potentially disruptive effects on social interaction and academic achievement". Ylvisaker (1993) noted that other language problems in children with brain dysfunction such as impaired word retrieval, and reading/auditory comprehension problems may actually be related to executive functioning deficits which preclude effective search of the semantic network and failure to use organising schemes to benefit comprehension. In addition, Ylvisaker emphasised that children with traumatic brain injury may have conceptual difficulties that interfere with their comprehension of verbal abstraction (e.g., metaphors and figures of speech), and understanding implied and indirect meanings (e.g., irony), problems that have significant impact on their ability to interact in interpersonal situations.

Clinicians working with neurological populations have often observed that impairments in executive functioning skills, abstraction, and reasoning skills appear to be accompanied by social and occupational difficulties (Hart & Jacobs, 1993; Sohlberg & Mateer, 1989; Varney & Menefee, 1993). In particular, impulsivity and poor judgement are thought to contribute to interpersonal difficulties in children with traumatic brain injury (McGuire & Rothenberg, 1986). Clinical impressions also suggest that head-injured persons with executive functioning deficits have reduced empathy (Cicerone, 1989; Lezak, 1993; Restak, 1984).

In summary, case studies and clinical observations suggest that executive functions (i.e., impulsivity inhibition, cognitive flexibility, planning) as well as other cognitive skills such as judgement, reasoning, conceptual ability and abstraction, are important variables in mediating social behaviour. Other difficulties such as executive-related language problems and attention deficits also appear to be implicated.

Neuropsychological Empirical Group Studies

There exist few controlled, empirical studies of social skills in the neuropsychological literature. Existing studies cover a range of clinical syndromes such as alcoholism, head injury, Tourette syndrome, and other conditions. A

unitary definition of social skills has not been used across studies, a fact that complicates interpretation of existing findings. In addition, the ways in which social skills are operationalized vary across studies. Specifically, heterogeneous methods have been used in previous research, including reports of clinical impressions, sociometric measures of likability, observational methods, and social skill scales from measures designed to measure general psychopathology. Despite these limitations, the contribution of these studies to our understanding of social behaviour complements case studies and clinical reports that provide a preliminary delineation of the relationship between cognitive and social skills.

Perrott, Taylor, and Montes (1991) found that performance on measures of auditory attention (WISC-R Digit Span) and inhibition/set shifting differentiated between head-injured children who were socially or behaviourally disordered and those whose social behaviour was within the normal range. In one study on normal children, conceptual ability and flexible strategy use (i.e., number of categories and perseverative errors on the WCST) were related to social adjustment (Social Problems subscale of the Teacher version of the Child Behaviour Checklist) in children aged 9 to 11. However, the variables were not significantly related for children younger than 9 years or older than 11 years (Riccio, Hall, Morgan, et al., 1994).

In another study on mild to moderate head injury in children, Papero, Prigatano, Snyder and Johnson (1993) found that boys but not girls had borderline

to low average social skills on the Socialization subscale of the parent-rated Vineland Adaptive Behaviour Scale. Exploratory item analysis suggested that social problems in boys stemmed from not following the rules of social convention and peer interaction. The researchers posited that dysfunction in the executive control of behaviour such as problems with impulse control and self-monitoring might lead to failures in exhibiting appropriate social behaviour in children with brain injury.

Stokes, Bawden, Camfield, Backman, and Dooley (1991) examined the question of neuropsychological test predictors of social adjustment in children with Tourette syndrome. Using a well-known peer nomination/sociometric measure, the Peer Evaluation Inventory, they found that several verbal tests were positively correlated with a peer-rated measure of likability, a construct thought to reflect social skills. These included the Wechsler Intelligence Scale for Children Verbal IQ, as well as a measure of fund of general information (Information subtest) and a verbal practical reasoning test (Comprehension subtest). A measure of expressive vocabulary (Peabody Picture Vocabulary Test-Revised) was also related to the sociometric measure. In addition, a measure of verbal memory and two subtests from the Performance scale of the Wechsler test (Picture Completion and Picture Arrangement) were also moderately correlated with the likability measure. Achievement, visual-motor integration, attention/impulsivity, and motor tests were not significantly correlated with likability measures. Consistent

with the view that non-verbal perceptual abilities may be related to social skills, Peterson (1988) found a strong correlation between social interactive competence and the ability to detect meaning in facial expressions.

In adults with head injury, Levine, Van Horn, and Curtis (1993) examined the ability to problem solve effectively and interpret interpersonal conflict situations presented in the form of stories. Head injured subjects showed a more concrete and less socially mature conceptualisation of the interpersonal situations compared to controls. In a similar vein, Marsh and Knight (1991) found that head injured adults' level of social skill in a real-life interaction was related to a verbal fluency task, suggesting that inflexibility in processing contributed to difficulties during social interactions. In contrast, level of social skill was not related to memory skills. In an earlier study, the researchers found similar results in that level of skill during social interaction was not related to memory, intellectual, or speed of information processing in very severely head injured adults (Marsh, Knight, & Godfrey, 1990). Newton and Johnson (1985) also found that intellectual ability was not related to level of skill in a videotaped social interaction in adults with severe head injury.

McKay and Ramsey (1984) examined the relationship between a peer nomination measure in adult alcoholics seen for group therapy and neuropsychological test performance (i.e., Luria Nebraska Neuropsychological Battery). The researchers concluded that sociometric ratings reflecting group

members' ratings of competence during therapy were related to communication skills such as verbal comprehension and fluency, non-verbal perceptual skills, and general intelligence. Perceptual skills were hypothesised to facilitate awareness of self and of others' affective state. McKay and Ramsey (1984) also emphasise that social behaviour requires a variety of perceptual, motor, and intellectual skills. In particular, they posited that "right-hemisphere" non-verbal skills such as prosody and appreciation of humour might also play an important part in mediating social skills.

Theories of Social Behaviour and Social Competence

To date, existing theories aimed at explicating social skills in children have been developed by clinical, developmental, and educational psychologists. Current conceptualisations consist of social information processing or social-cognitive problem solving models (e.g., Dodge, 1980, 1986; McFall, 1982; Pettit, 1992; Spivack, Platt & Shure, 1976). A review of three of the more influential models, namely those proposed by Spivack and Shure (1974), Rubin and Krasnor (1986), and Dodge (1986), highlights the importance of cognitive variables in mediating social skills. More specifically, review of these models demonstrates

their similarities to definitions of executive functioning such as those proposed by Mateer and Williams (1991), Lezak (1995), and Welsh et al. (1991).

Spivack and Shure (1974) proposed that children's social competence depends on specific cognitive operations consisting of (1) the recognition that an interpersonal problem needs to be solved; (2) the ability to generate alternative solutions to the problem; (3) means-end thinking, including the ability to sequentially consider the steps required to reach the goal; (4) causal thinking or the ability to foresee the consequences of future actions; and (5) the ability to identify the future behaviour and current motives of others (Rubin & Rose-Krasnor, 1992). This model emphasises that perspective taking and the ability to appreciate consequences are essential components of effective social functioning. In line with the model, Shure (1981) found that although four-year-olds could not spontaneously plan the sequential means to a goal, they could produce alternative solutions when asked (i.e., tell what might happen next). Children who were poor at providing alternate solutions were less liked by their peers than children who were able to generate solutions when prompted (for a case example of successful alternate solution generation from Shure, 1981, see Appendix A). Shure (1981) also successfully demonstrated that problem-solving skills were related to social competence by training these skills in children and then assessing social skills post-training.

Rubin and Krasnor (1986; cited in Rubin & Rose-Krasnor, 1992) introduced the idea of automatic scripts consisting of overlearned actions used in social interactions (for instance, greeting and leave-taking behaviour). Script-driven behaviour, however, is precluded when unexpected changes occur in the environment, or when the enactment of the script is prevented in some way. In this case, flexible strategy use is needed in order to function effectively in the social situation. Rubin and Krasnor posit that social functioning requires several cognitive operations: (1) selection of a goal, including forming a representation of the projected end-state of the problem-solving process; (2) examination of the task environment; (3) assessment and selection of strategies, including the retrieval of previously stored strategies, dependent in part on the automaticity of retrieval and the size of the strategy repertoire; (4) strategy outcome assessment requiring a feedback system that enables comparison of the initially formulated goal to the end result, with re-initiation of the problem-solving sequence if required. Appendix A, Case 2, illustrates the use of scripts in children's social interactions.

The models put forth by Dodge are some of the most influential and empirically-tested in their field (Pettit, 1992). For example, Dodge (1986) first proposed a five-stage model of social information processing that involves successive steps: (1) encoding (sensation, perception, and attention), (2) representation (integration of cues to memory stores, application of decision rules, feedback to encoding system, and interpretation), (3) response search (generation

of potential responses, application of response rules), (4) response decision (representation of consequences, evaluation of outcomes, feedback to response generation, and selection of response), and (6) enactment (use of scripts, monitoring of enactment, and self-regulation).

More recently, Dodge and colleagues revised their model to reflect an emerging view that social cognition does not necessarily reflect a sequential, linear process but a more plastic, on-line process where components interact in a dynamic fashion (Crick & Dodge, 1994). They proposed a six-component system composed of feedback loops and a cyclical path. Their model attempted to incorporate the view that processing occurs in simultaneous parallel paths instead of a rigid sequential structure. The six cognitive processes interact in an ongoing fashion with a proposed "data base" consisting of acquired rules, social schemas, and social knowledge, stored in long-term memory. These stored mental representations are retrieved in order to guide the processing of new social cues. The cognitive components are (1) encoding of cues, (2) interpretation of cues (including evaluation of goal attainment and self-evaluation, (3) clarification of goals (including arousal regulation), (4) response access or construction, (5) response decision (including self-efficacy evaluation and response selection), and (6) behavioral enactment. Crick and Dodge posit that individuals are continually and simultaneously engaged in multiple information processing activities, instead of sequentially employing each cognitive component in a step-by-step manner

until a behavioural goal is reached. For example, a person might engage in interpretation while encoding cues, and continue to evaluate the meaning of another person's behaviour while simultaneously accessing a behavioural response (p. 77). Nevertheless, Crick and Dodge emphasise that a sequential model is a useful heuristic in understanding the path from cue to response. In other words, the path from one stimulus to a behavioural response may generally follow a time-related linear structure, even though feedback loops connect components in a non-linear manner.

As illustrated by these models, the developmental literature suggests that elements of the executive functioning skills, identified in a parallel by neuropsychologists, are important determinants of social skills. Common to developmental approaches is the view that social problem solving consists of a sequence of cognitive processes that includes attention to cues, consideration of alternatives, decision-making, and enactment (Pettit, 1992). Several of these skills, in particular, the ability to resist impulsive responding, engage in strategic memory search and retrieval, and demonstrate flexible thinking while considering alternative courses of action, easily fall under the neuropsychological label of executive functions. Executive function models developed by neuropsychologists, most notably those by Stuss (1992), Mateer and Williams (1991), and Sohlberg and Mateer (1989) are remarkably similar to social information processing models such as that of Crick and Dodge (1994). The difference is the type of behavioural

outcome specified (i.e., restricted to the social realm in social information processing models, or applicable to all behaviour in the case of executive functioning models). Other non-executive cognitive operations are outlined in social information processing models, such as the ability to engage in effective problem solving using logical and conceptual abilities. The similarities between neuropsychological models of executive functioning and social information processing models suggest that neuropsychological measures may be useful tools in mapping the relationship between cognitive skills and social skills.

Measuring Social Skills

The selection of tests to measure particular facets of behaviour is always complex. In social skills research, three questions are particularly relevant: (1) what is the accepted definition of socially skilled behaviour?; (2) how are social skills operationalized?, and (3) who is the rater?

Gresham (1986) notes that an adequate conceptual definition of social skills has not yet been derived, perhaps because the field has been more concerned with treating social skill deficits than with deriving adequate assessment tools. Dodge noted that there might be as many definitions of social competence as there are researchers studying the phenomenon in this field (1985, as cited in Rubin & Rose-

Krasnor, 1992). Gresham (1986) notes that definitions of social skills have ranged from the abstract and vague (e.g., "the ability to interact [...] in specific ways that are socially acceptable and valued and at the same time are personally beneficial, mutually beneficial, or beneficial primarily to others"; Combs & Slaby, 1977, p. 162) to the concrete and vague (e.g., "the complex ability to both emit behaviors that are [...] reinforced and not to emit behaviors that are punished or extinguished by others"; Libet & Lewinsohn, 1973, p. 304). Despite these disparities, certain identifiable viewpoints on the conceptual nature of social skills have evolved.

Gresham (1986) emphasises the distinction between social skill as a *behavioural construct* and as a *trait*. The behavioural construct model (also known as the molecular model) operationalizes social skills as a category of discrete, situation-specific, observable behaviours. In contrast, trait theorists define social skills as a hypothetical, global personality trait or predisposition that is cross-situational. Although the trait model has received limited empirical support (McFall, 1982), the behavioural model, in its quest to reduce the construct of social skill into observable behaviours, has also incurred some problems. McFall (1982) outlines these difficulties. First, the question of which specific behaviours should be included in the category of social skill behaviours has not been adequately resolved. Second, the characteristics of a social skill situation have not been clarified (e.g., is it the physical characteristics of the situation or the persons

involved). Third, the definition of outcome for defining social efficacy (i.e., success vs. failure, long- vs. short-term outcome) is not clear.

In the developmental and educational field, social skills have been operationalized in a variety of ways, including sociometric indices, rating scales, and naturalistic observations of social interactions. A well-known technique, the sociometric measure, involves instructing groups of children (typically an entire class) to nominate other children for certain tasks or roles, or to rank their classmates on different dimensions of likability. In this conceptualisation of social skills, popularity is equated with social skill. Specifically, those children nominated on the highest number of positive dimensions, or nominated most often by other children as being a friend, are defined as socially skilled. Although sociometric measures are considered by some as the gold standard of social measurement (La Greca, 1981; Vosk, Forehand, Parker, & Rickard, 1982), sociometric ratings do not provide an understanding of the specific behaviours that lead to peer acceptance or rejection (Gresham, 1986; Van Hasselt, Hersen, Whitehill, & Bellack, 1979), an insight that is crucial from an intervention standpoint. Additionally, it is not clear that popularity is always synonymous with good social skills, or that social rejection invariably indicates social skill deficit. Evidently, not all rejected children are necessarily socially unskilled. Other factors such as illness, disability, socioeconomic status, or other factors may also impact acceptance and popularity among children. Importantly, peer nomination

measures that provide indices of popularity and rejection have been criticised because of the risk of disclosure of nominations by children to each other (La Greca, 1981).

Another way to measure social skills is by purely behavioural means. According to this definition, social skills are those behaviours that are reinforced in specific interpersonal situations. In this method, trained observers in naturalistic or role-play paradigms record behaviour in vivo. Deficits or excesses of specific behaviours are deemed to be indicative of social skill problems. Gresham (1986) notes that the advantage of this approach is that the antecedents and outcomes of specific behaviours can be identified. The disadvantage, of course, is that there is no guarantee that the specified behaviours are actually relevant in other contexts.

A third method is to use questionnaires using items that reflect specific behaviours that have demonstrated validity as indices of social competence, using raters that habitually see children interacting with their peers in several contexts. Observer-rated questionnaires have advantages over sociometric ratings and naturalistic observation in that risk of rating disclosure is minimised, data collection time is much reduced, and cross-situational stability is relatively ensured. Clearly, questionnaires designed specifically to measure social skills provide more specific information on actual social skill behaviour than do broad-band questionnaires (e.g., Child Behavior Checklist, Personality Inventory for

Children) which were developed as screening measures for general behavioural problems and as aids in diagnosing clinical psychopathology.

Lastly, the type of rater used in a psychometric measure of social skills influences the validity of that measure. Teacher-rated indices of social skill have demonstrated strong relationships to other social skill measures such as sociometric status and are considered valid and reliable ways of measuring social skills in children (Gresham, 1986). Parent-rated measures of social skills have received less attention in the social skills field; the validity of these measures is therefore currently unknown. Self-report measures of social skill or social competence in children are not recommended (Gresham, 1986). Self-rated measures derived to date show little relationship to peer acceptance, popularity, teacher ratings, role-play performance, or naturalistic observation (Gresham, 1986).

Summary of the Literature on Cognitive Correlates of Social Skills

Developmental psychology models of social information processing emphasise attention, executive functioning, and problem solving (logical reasoning and judgement) as important social skill determinants. In a similar vein, the neuropsychological literature suggests that several different cognitive skills may be related to social skills. These include (1) executive functioning, particularly self-

monitoring, the ability to inhibit impulsivity, and language-based manifestations of executive function, as well as executive skills enabling the proper deployment of social knowledge; (2) judgement, reasoning, and problem solving; and (3) non-verbal perceptual skills. Some researchers and clinicians have also implicated memory, language, and sensory/motor skills.

Although the contribution of neuropsychology to our understanding of social behaviour is important, some important limitations deserve to be noted. First, a unitary definition of social skills has not been used across studies, a fact that complicates interpretation of existing findings. In a related point, the ways in which social skills are operationalized vary across studies. Specifically, heterogeneous methods have been used in previous research, including reports of clinical impressions, sociometric measures of likability, and social skill scales from measures designed to measure general psychopathology. Care in choosing a definition and a way of measuring social skills in neuropsychological investigations is important, given that clinical, educational, and developmental psychologists are still debating the merits and limitations of existing measures of social skill. Indeed, no study to date has used a psychometrically robust measure that was developed specifically for measuring social skills. In addition to case studies and clinical reports, few empirical studies have been conducted on the cognitive correlates of social skills in the neuropsychological literature. There is

thus a need to verify previous findings using well-validated measures of social skill in groups of interest.

As measured by neuropsychological tests, executive skills appear to develop in an age-dependent manner, as do many other cognitive skills. Although the literature is not definitive as to which executive skills may be more important in mediating socials skills at different ages, the neuropsychological literature suggests that there is an age-dependent pattern of development, with more basic functions such as response inhibition developing early, and more complex functions such as set shifting, planning and strategy use developing later. Nonetheless, it is clear that the ability to take part in successful social interactions does not begin exclusively once a child has developed adult performance on neuropsychological measures of executive skills. Despite poor performance on certain executive functioning tests relative to older children, the majority of younger children exhibit age-appropriate social behaviour when interacting with their peers. If social skills are indeed dependent on specific cognitive skills at all age levels, then different cognitive skills may be more critical for social interactions at different ages. For example, attention skills may be better predictors of social skills than executive skills in 6 year olds. Conversely, attention skills may no longer be sufficient to maintain social interactions at age 10, if the social interactions of older children also require higher-level cognitive skills such as logical reasoning. For these reasons, the impact of age on the cognitive correlates of social skills may

be a crucial factor in determining appropriate models. With regard to the issue of age-related differences in social skill correlates, previous researchers have noted the importance of accounting for age in social information processing models (Crick & Dodge, 1994). Other limitations of existing models are a failure to account for changing social-environmental demands with age (Gottman, 1986).

Crick and Dodge (1994) have proposed some working hypotheses regarding the issue of age and social skill development. Specifically, they posit that the data base of social knowledge, including the stored representation of an increasingly skilful strategy repertoire, expands and changes as children are exposed to new experiences with age. In addition, children's attentional ability increases, providing greater accuracy (e.g., attention is focused more often on relevant vs. irrelevant cues) and speed of information processing. With age, children also develop more efficient ways of representing, organising, and interpreting social information.

GOALS AND HYPOTHESES

This study had two main goals: (1) to identify specific tests that might serve as useful measures for predicting social skill problems in clinically referred children, and (2) to answer theoretical questions on the relationship between neuropsychological functioning and social skills using standardized instruments designed expressly to measure social skills. From a statistical perspective, two general approaches were therefore taken to data analysis. Both approaches had their strengths and limitations. In the first approach, analyses were test-driven (i.e., dependent variables consisted of the neuropsychological test scores), so as to enable a test-based interpretation of results. Limitations included the large number of tests involved, and the resulting risk of increased Type I error. The second approach involved forming linear combinations of test scores that measured similar constructs, and assessing the relationship of these composite factors to measures of social skills. The interpretability of the results from the perspective of particular tests was therefore less direct; however, Type I error was minimized by reducing the large number of individual dependent variables to a smaller number of factors. In addition, this approach allowed for testing theoretical assumptions regarding the relationship between tests purported to measure similar abilities. Although perfect correspondence was not expected, it

was hypothesised that separate factors for verbal, visual-spatial, memory, executive, and motor skills would emerge from data reduction techniques.

The role of maturation on the cognitive correlates of social skills was of major interest in this study. Thus, an important hypothesis was that social skill predictors would differ according to age, with more basic skills predicting social efficacy at younger ages (e.g., such as attention, verbal ability, non-verbal ability, motor skills), and more complex, high-level abilities predicting social skills in older children (e.g., executive skills, conceptual ability, problem solving). For this reason, the group was divided into two age groups: (1) children 6 to 9 years of age, and (2) children 10 to 13 years of age. Age groupings were based on the neuropsychological literature on the development of executive functions reviewed above, which seemed to suggest rapid development of executive after middle childhood.

Previous studies reporting a lack of association between cognitive skills and psycho-emotional functioning in the learning disabilities field have been criticised for ignoring the heterogeneous nature of clinical samples, and treating patient groups as if they consisted exclusively of children with similar characteristics (Fuerst & Rourke, 1995), thus ignoring potentially important information on subtype-specific associations between cognitive skills and psycho-emotional functioning. Therefore, a more exploratory goal of this study was to derive social skill subtypes using cluster analysis techniques, and relate these to (1)

neuropsychological functioning, (2) age, and (3) other behavioural correlates of social behaviour. A related goal was to carry out a replicability check of the cluster solution obtained. Fuerst and Rourke (1995) emphasise that multivariate subtyping techniques such as cluster analysis will always produce data groupings, even if random data are employed. Further, they note that the clustering analysis literature provides limited evidence of the superiority of some clustering methods over others. A replicability check, by deriving different cluster solutions through different subtyping techniques is therefore useful in determining the robustness a particular clustering solution. Cluster solution replicability has been used successfully in deriving neuropsychological subtypes in other patient groups, such as learning disability and head injury (e.g., Fuerst & Rourke, 1993; Deshpande, Millis, Reeder, Fuerst, & Ricker, 1996).

Given the assumed development of self-awareness with age, another goal was to conduct exploratory analyses involving the relationship between insight and cognitive functions as measured by neuropsychological tests. Insight was operationalized as the absolute value of the discrepancy between teacher- and self-rated social skills. Thus, larger discrepancies between teacher- and self-rated social skills were interpreted as reflecting lower insight. It was hypothesised that teacher-self discrepancies would decrease with age, reflecting the development of self-awareness with age.

METHOD

PARTICIPANTS AND PROCEDURE

In order to obtain data for this study, files for all neuropsychological assessments conducted between 1991 and 1996 were surveyed at the Queen Alexandra Centre for Children's Health, a children's treatment and rehabilitation centre in Victoria, B.C. The list of confidential identification numbers of children having had neuropsychological assessments at this facility was generated, in order to identify children for possible inclusion in the study.

Each of these children had been referred for neuropsychological assessment by their physician, school psychologist, social worker, occupational therapist, or parent. Each assessment was conducted by a Ph.D. level child neuropsychologist, and included a full neuropsychological battery assessing general cognitive ability, achievement, executive functions, attention, conceptual/reasoning ability, language, motor skills, visual-spatial skills, and memory. Although a standardised battery was used in most cases, individual patients needs sometimes necessitated abbreviation or alteration of the standard battery. As part of the neuropsychological assessment, parents, teachers, and children completed questionnaires on the child's behaviour and psychosocial functioning. Each

assessment also included parent and child interview, detailed teacher questionnaires and administration of a one- to two-day neuropsychological test battery by a trained psychometrist, clinical neuropsychology graduate student, or intern. The assessment also included generation of a four to six page report with recommendations for parents, physicians, and teachers, feedback session with the neuropsychologist and parents to discuss test findings, and school conferences to discuss the implications of the findings for the child's academic functioning. Other feedback sessions were arranged depending on the individual needs of each child. Neuropsychological assessment reports were sent to referring physicians and to other sources with parental consent. All neuropsychological and psychosocial tests were scored using standardised normative data from test manuals or other published and unpublished sources, either by hand or using computerised scoring packages. Derivation of norm-based standardised scores, percentiles, and clinical classifications was checked at least once for accuracy prior to report writing. All parents and children were given the option of signing a consent form to allow use of their data in research, prior to initiation of the assessment.

From the initial list, approximately 130 patient files were considered for inclusion in the study. Criteria for inclusion in the study included (1) signed consent for participation in research, (2) age between 6 and 17, (3) administration of the standard neuropsychological test battery, and (4) presence of a completed parent or teacher social skill rating form. Each file was surveyed for inclusion

criteria, and entered in a computerised relational database. Data entry was conducted by the author, by another graduate student, and by a practicum student at the Queen Alexandra Centre for Children's Health. Because data entry was extensive and time consuming (i.e., including over 270 variables per case entered), each data point was triple-checked for accuracy. After transfer of the data to a standard spreadsheet program, and again after subsequent transfer to a statistical program, selected cases were also verified. Because data for this study were restricted to children whose files included complete data on the social skills measure, whose ages fell between 6 and 13 (for consistency of neuropsychological measures used), and who had few missing neuropsychological variables, only the data from 55 children (12 girls and 43 boys) between the ages of 6 and 13 ($M = 9.99$, $SD = 1.44$) were retained.

Diagnoses were available for 51 of the 55 children. Diagnoses were as follows: 9 (18%) were head injured, 15 (29%) had Attention Deficit Hyperactivity Disorder, 3 (6%) had a tic disorder, 3 (6%) had a psychiatric disorder, 13 (24%) had learning disabilities of unknown etiology, and 7 (13%) had other psychological, neurological or medical conditions (e.g., congenital malformations of unknown etiology, anoxic encephalopathy, low birth weight, epilepsy, severe abuse/neglect). Diagnoses were determined retrospectively by consulting medical (neurology or psychiatry) or psychology (psychology or neuropsychology) reports at the time of the assessment. When different diagnoses were mentioned in

different reports, final diagnoses were confirmed by consultation with the Queen Alexandra Centre for Children's Health staff neuropsychologists.

Socioeconomic status was calculated according to an occupation index developed by Blishen, Carroll, and Moore (1981). The average score on the Blishen scale was 45.26 (*SD* = 13.38). Sample occupations and socioeconomic scores are presented in Appendix B.

MATERIALS

The following tests, each part of the larger standardized test battery, were selected for inclusion in the study.

Social Skills

The Social Skills Rating Scale (SSRS; Gresham & Elliott, 1990) is a questionnaire designed to measure social skills in children and adolescents. The SSRS includes parent-, teacher-, and student-rated questionnaires for children in kindergarten to grade 6. The rater completes the SSRS using a Likert-type scale that reflects the frequency of a particular behaviour (i.e., Never, Sometimes, and

Very Often). Norm-based standard scores are derived based on sex, a variable consistently found to influence social behaviour (Gresham & Elliott, 1990).

All three SSRS scales include subscales for three main behaviours: (1) Cooperation, (2) Assertion, and (3) Self-Control. According to Gresham and Elliott (1990), the Cooperation subscale includes behaviours such as helping others, sharing materials, and complying with rules. The Assertion subscale includes initiation of behaviours, such as asking others for information, introducing oneself, and responding to the actions of others. In addition, the SSRS-Parent includes a Responsibility subscale, the SSRS-Student includes an Empathy scale, and the SSRS-Teacher includes a scale reflecting academic competence.

The SSRS also measures three kinds of Problem Behaviors (Externalizing, Internalizing, and Hyperactivity). The Externalizing scale measures verbal or physical aggression, poor temper control, and arguing with others. The Internalizing scale reflects behaviours indicative of anxiety, sadness, and poor self-esteem. The Hyperactivity scale measures behaviours that involve overactivity, fidgeting, and impulsivity.

In the development of this scale, individual items were derived on theoretical grounds based on the social skills literature. Subsequent factor analyses retained items with loadings of .30 or more on a single factor. Good test-retest reliability, internal consistency and construct validity have been demonstrated for the SSRS teacher and parent versions (for a review, see Gresham & Elliott, 1990).

However, given the paucity of research on the validity of parent-rated social skill measures compared to the extensive research on the validity of teacher-rated scales, only the latter was used as a measure of social skills in this study. For most analyses in this study, the total social skills score was used as a measure of social skill. The subscales were used in the derivation of social skill subtypes.

Despite the authors' assertion that all forms show adequate psychometric properties given the limitations of existing criterion-related studies (specifically, determining an appropriate criterion), reliability and construct validity is clearly less strong for the student-rated form of the SSRS. This finding, in concert with several studies suggesting that self-ratings of social skills do not correlate very well with criterion measures of social skill such as sociometric or teacher ratings (Gresham, 1986), raised some question as to the validity of the self-rated SSRS as a measure of social skills. For the purpose of this study, the self-rated SSRS was therefore used as a measure of a child's self-perception of social efficacy, not as a measure of social skills per se. The absolute value of teacher-self SSRS discrepancy was used as a measure of self-awareness and insight.

Intellectual Ability and Achievement Level

The Wechsler Intelligence Scale for Children, Third Edition (WISC-III; Wechsler, 1991) Full Scale Intelligence Quotient (FSIQ) was used as an estimate of

psychometric intelligence. The WISC-III consists of 13 subtests purported to measure different aspects of general intellectual ability. Each subtest takes approximately 10 minutes to administer. The Full-Scale score from the WISC-III is a norm-derived standard score (i.e., mean of 100, *SD* of 15) reflecting the average score across 10 subtests (3 subtests are supplemental subtests). Based on theoretical grounds, the subtests are used to form composite subscales based on whether the subtests reflect verbal (Verbal IQ) or non-verbal (Performance IQ) processes.

The Wechsler Individual Achievement Test (WIAT; Psychological Corporation, 1992) is comprised of several subtests, each reflecting an area of academic skill. Like the WISC-III, each subtest takes approximately 10 minutes to administer. It is a well-known test that is often used in conjunction with the WISC-III to provide information on discrepancies between intellectual ability and achievement, one method for determining learning disabilities. Two subtests from the WIAT were used for descriptive purposes as estimates of academic levels. These were the Reading subtest, a measure of single-word reading, and Numerical Operations, a subtest reflecting knowledge of computational mathematics.

Executive Functions

In clinical neuropsychological investigations, executive functioning skills have been evaluated in several ways. Examples include maze tracing tasks, design copy tasks, word generation tasks, and tests measuring impulse control. Several of these paradigms were included in this study.

The Mazes test is a subtest of the WISC-III. It consists of a series of pencil and paper maze tasks. For each maze, the child is told to find his or her way out without lifting the pencil from the paper, crossing grid lines, or going into any blind alleys. The child is not penalised for slow performance, as long as performance is within a certain time cut-off for each item. Errors are defined as entries into blind alleys, or crossing the maze grid lines. The total score is the number of errors. More errors than is typical for a given age group suggest poor planning and impulsivity.

Verbal Fluency (McCarthy, 1970) measures the ease with which words can be produced for given semantic and phonological categories (i.e., animals, foods, and words beginning with the sound "sh"). The child is given one minute to respond to each of the categories. Norms for Verbal Fluency were derived from data presented by Halperin, Healey, Zeitchik, Ludman, and Weinstein (1989).

For the purposes of this study, impulse control was measured using the Seidel Continuous Attention Task (SCAT; Seidel, 1988). The SCAT is a locally

normed continuous performance test. It consists of two 15-min tasks. In the first task, letters are presented one by one on an Apple II-c computer in random sequence, at a rate of 1.5 s and for a duration of 0.2 s. In total, 600 letters are presented, of which 90 (15%) are targets. The child is instructed to press the space bar as quickly as possible when the letter X is presented. In the second condition, the child is instructed to press the space bar only when the X has been preceded by the letter A. Thus the child must inhibit responding to the A itself, to other letters following the A, and to the X when it is not preceded by an A. This A-X condition was used in the analyses because it is the most well known CPT paradigm, and, like other Go-No-Go paradigms, has been used frequently in research on attention and impulse control in children and adults.

The SCAT is a computerised vigilance paradigm; number of targets responded to (i.e., hits) is purported to measure sustained attention, and errors of commission are thought to reflect impulsivity (Halperin, Wolf, Greenblatt & Young, 1991; Matier-Sharma, Perachio, Newcorn et al., 1995). Commission errors have been found to be related to other tests of executive functioning (Leavell & Entwistle, 1996). Z-scores were derived from normative data presented in Seidel (1988) and from unpublished norms (Joschko, 1997). All normative data were obtained from normal school children in the Victoria area.

The ability to inhibit a response set was also measured using the perseverative errors score of the Wisconsin Card Sorting Test (WCST). The WCST

(Heaton et al., 1993) consists of 128 cards on which are portrayed simple coloured geometric shapes, each one of which can be sorted according to at least three simple categories. The examinee is told to sort the cards one-by-one according to four key cards, and then is only told whether the sorted card is correctly or incorrectly sorted, not why the response was correct or incorrect. The examinee must thus deduce the sorting principle based on examiner feedback, plan future moves, and shift strategies when the sorting principle is changed. Perseverative errors are instances where the examinee continues to incorrectly sort to a particular category despite feedback that the category is incorrect. Perseverative errors therefore reflect difficulty shifting cognitive set. Z-scores for the WCST were derived from published norms (Heaton, Chelune, Talley, Kay, & Curtiss, 1993).

In addition to measurement of visual-spatial skills, the Rey Complex Figure Test (RCFT), a design copy task, is also thought to depend on planning ability (Grodzinsky and Diamond, 1992; Lezak, 1995). Administration of the RCFT involves the presentation of a complex geometric figure; the subject is instructed to copy the figure as carefully and as accurately as possible. Because of the complexity of the design, poor performance on this copying task is thought to reflect in part an unorganised, piece-meal approach to copying. Norm-based z-scores for the RCFT were derived from published norms of Canadian schoolchildren (Kolb & Wishaw, 1985).

Reasoning and Conceptual Ability

Reasoning skills and conceptual ability were measured using the WISC-III Comprehension and Similarities subtests, measures that Lezak (1995) and Sattler (1992) contend reflect these constructs. In particular, Lezak (1995) notes that the Comprehension test primarily measures common sense judgement and practical reasoning, while Similarities measures conceptual skills and the ability to produce abstract generalisations.

The Comprehension subtest consists of a series of questions on everyday knowledge, moral reasoning, and logic. Responses are scored from 0 to 2, based on the sophistication of the response. Higher scores are thought to reflect better reasoning skills. The Similarities subtest consists of a series of questions that ask how two things are alike (e.g., "How are a house and an apartment building alike?"). Responses are scored from 0 to 3, based on the degree of conceptual reasoning involved (e.g., "One's big and one's small", "They both have windows", and "Places where people live" would score 0, 1, and 2, respectively).

Because these tests are administered verbally and require a verbal response, a non-verbal measure of conceptual ability was also included. This was the Matrices subtest of the Stanford-Binet (Thorndike, Hagen, & Sattler, 1986). The Matrices subtest is a multiple-choice test, and is thus not affected by memory or word finding problems. The child is presented with an array of pictures or designs

that are presented according to a logical sequence or conceptual relationship, with one sector of the matrix of pictures or designs missing. The child chooses a response from a group of items at the bottom of the page.

Attention and Memory

Other neuropsychological tests administered were measures of sustained attention (SCAT Hits), and measures of verbal memory (Story Memory) and visual memory (Picture Memory) from the Wide Range Assessment of Memory and Learning test (Sheslow & Adams, 1990). The Story Memory subtest is comprised of two aurally presented stories, which the child is instructed to listen to, and then repeat as accurately as possible. The Picture Memory subtest is comprised of four line drawings that are presented to the child for 10 seconds each. After each presentation, the child is provided with a similar line drawing that includes additional elements or where original elements have been altered. The child is instructed to draw a line across all the elements that differ from the original picture presented.

Visual-Spatial and Verbal Skills

Visual-spatial skills were measured using the Block Design subtest from the WISC-III. The Block Design subtest is a timed block assembly task. After a practice trial, the child is provided with a two-dimensional drawing of a block construction and instructed to reproduce the drawing with real blocks, under time constraints. Younger children begin by reproducing the designs from a model.

Measures of verbal skills included the Listening Comprehension subtest and the Oral Expression subtest from the WIAT. These WIAT subtests measure receptive and expressive language, respectively. Listening Comprehension consists of the following: a short paragraph is read to the child, as s/he looks at a line drawing that depicts portions of the story. The child is then asked questions about the information that was read aloud. In the administration of Oral Expression, a picture or set of pictures is presented to the child. The child is then asked to describe aloud what is happening in the pictures. Content is scored along several dimensions according to the complexity, thoroughness, and organization of the child's response.

Motor Skills

All children were administered the Grooved Pegboard (Klove, 1963) and the hand dynamometer (Spreen & Strauss, 1991). The Grooved Pegboard measures manual dexterity. The child is provided with a small pegboard and matching pegs, and instructed to place the pegs as quickly as possible in the holes in the pegboard. The hand dynamometer is a device that measures grip strength in each hand. Norm-based z-cores for the Grooved Pegboard and dynamometer were based on data from Trites (1977) and Finlayson and Reitan (1976). Although both dominant and non-dominant hands are tested, only dominant hand scores were used in this study. Table 1 presents a summary of the neuropsychological measures, along with the neuropsychological functions purported to be measured by each test.

Table 1.

List of Neuropsychological Tests and Neuropsychological Functions Purported to be measured by Each Test

Neuropsychological Function		*Measure*
General Intellectual Ability		WISC-III Full Scale IQ
Academic Achievement	*Reading*	WIAT Reading
	Mathematics	WIAT Numerical Operations
Executive Functions	*Planning*	WISC-III Mazes
		Rey Complex Figure Test (RCFT)
	Initiation	Verbal Fluency
	Impulse Control	SCAT False Alarms
	Set Shifting	WCST Perseverative Errors
Reasoning/Conceptual	*Practical Reasoning*	WISC-III Comprehension
	Conceptual Skills	WISC-III Similarities
		Stanford-Binet Matrices
Attention and Memory	*Sustained Attention*	SCAT Hits
	Verbal Memory	WRAML Story Memory
	Visual Memory	WRAML Picture Memory
Visual-Spatial Skills		WISC-III Block Design
Verbal Skills	*Receptive Skills*	WIAT Listening Comprehension
	Expressive Skills	WIAT Oral Expression
Motor Skills	*Manual Dexterity*	Grooved Pegboard
	Grip Strength	Dynamometer

Impairment Classifications

In describing norm-referenced performance on neuropsychological tests or scores on psychosocial measures, impairment classifications are often used. The following table presents a synopsis of various scores and impairment classifications that are typically used in neuropsychology, taken from several sources (e.g., Spreen and Strauss, 1991; Lezak, 1995; Sattler, 1992). These impairment classifications will be used in this study to describe the sample's scores on various measures. For the purposes of this study, standard scores referred to norm-referenced scores with a mean of 100 and a standard deviation of 15; scaled scores referred to norm-referenced scores with a mean of 10 and standard deviation of 3. T-scores consist of scores with a mean of 50 and standard deviation of 10. In certain cases, all scores were converted to norm-referenced z-scores in order to allow visual comparison across test scores. In all cases (including tests where high raw scores indicate poor performance, such as the SCAT False Alarm score), scores were converted so that positive z-scores indicated average to above average performance compared to the normative group, and negative z-scores indicated lower performance compared to the normative group.

Table 2

Classification Table for Norm-Based Test Scores

Classification	*Standard Score*	*Scaled Score*	*Z-Score*
Very Superior	> 130	> 16	> 2.00
Superior	120 to 129	14 to 15	1.33 to 1.99
High Average	110 to 119	13	0.67 to 1.32
Average	90 to 109	8 to 12	-0.67 to 0.66
Low Average	80 to 89	7	-1.33 to -0.66
Mildly Impaired	70 to 79	5 to 6	-1.99 to -1.32
Moderately to Severely Impaired	< 69	< 4	< -2.00

RESULTS

Experiment-Wise Error and Statistical Considerations

To adjust for experiment-wise error (i.e., adjustment for multiple comparisons), the *p* value for determining statistical significance was set at .01. The significance for post-hoc tests, specifically, Tukey's Honestly Significant Difference (HSD) test, was maintained at the conventional level of .05. In addition, correlational effect size was defined according to Cohen's (1988) criteria (i.e., r = .10, r = .30, and r = .50, are defined as small, medium, and large correlations respectively). Statistics were conducted using SPSS for Windows Version 6.0 (Norusis, 1993).

Descriptive Data for the Entire Sample

To better identify the neuropsychological deficits exhibited by the sample, the percentage of scores falling 1.5 standard deviations or more below the normative mean was calculated for each measure. This percentage served as a clinically relevant metric reflecting the number of children with impairments in

specific areas of functioning. A score falling 1.5 standard deviations from the normative mean reflects mild impairment.

Social Skills

Table 3 shows the means and standard deviations for the teacher-rated SSRS scale. Total Social Skills, Total Problem Behaviors and Academic Competence are presented in the form of standard scores. The average total social skills score was approximately one standard deviation below the normative mean. One quarter of the sample had social skill problems defined as scores falling 1.5 standard deviations or more below the normative mean. The mean teacher rating of academic competence was in the low average range. Severity of problem behaviours as perceived by teachers was rated as above average.

Table 3 also presents parent ratings of social skills for descriptive purposes. Like teachers, parents rated their children's social skills as falling in the low average range. Parents also rated the severity of problem behaviours as above average.

Thirty of the 55 children completed the self-rated social skills scale. On average, in contrast to teacher and parent ratings, children perceived their social skills as falling within normal limits. Only 13% of the children's self-ratings were

in the impaired range, lending support to the notion that children's self-perceptions of social skill deviate from those of other raters.

Table 3

Means and Standard Deviations for the SSRS Scales

	Mean	*SD*	*% Impaired*
Teacher Rated SSRS			
Total Social Skills	86.42	14.73	24%
Total Problem Behaviors	115.23	11.08	24%
Academic Competence	85.41	11.22	21%
Parent-Rated SRSS			
Total Social Skills	89.12	16.10	34%
Total Problem Behaviors	115.31	18.20	37%
Self-Rated SSRS			
Total Social Skills	97.20	17.76	13%

Note. Means are in standard score format.

The SSRS manual provides cut-off scores for below average, average, and above average scores for the SSRS subscales and Problem Behaviors. According to these cut-offs, all subscales and Problem Behavior mean scores were in the average range. Raw scores for these scales are presented in Table 4.

Table 4

Raw Scores for the Teacher-Rated SSRS

SSRS - Teacher	*M*	*SD*
Cooperation	10.51	4.78
Assertion	8.96	3.97
Self-Control	10.95	4.11
Internalizing	5.77	2.63
Externalizing	3.86	2.79
Hyperactivity	5.77	2.63

Intellectual Ability and Achievement Level for All Children

For sample description purposes, Table 5 presents standard score means for the intellectual and achievement measures for the sample as a whole. Mean Full-Scale IQ and WIAT Reading scores were in the average range. The mean score for

the Numerical Operations scores was within the low average range. Almost one quarter of the sample had scores that were indicative of deficits in mathematical skills.

Table 5

Means and Standard Deviations for Intellectual Ability and Achievement Tests for the Entire Sample

Measure	*M*	*SD*	*< 1.5 SD*
WISC-III Full Scale Score	91.75	13.71	12%
WIAT Reading	95.94	17.31	9%
WIAT Numerical Operations	87.10	12.94	23%

Note. Scores are presented in the form of standard scores (M = 100, SD = 15).

Executive Functions

Means and standard deviations of executive functioning tests for the entire sample are presented in Table 6. The impulsivity measure from the SCAT was, on average, in the impaired range. Specifically, over 50% of children had clinically significant impulsivity problems. The rest of the executive functioning measures were within the average range. However, over one quarter of the sample had

deficits in the areas of planning (RCFT Copy), and over one third had deficits in set shifting (WCST). The executive functioning tests are presented in order of decreasing percent impaired for the sample.

Table 6

Means and Standard Deviations for Executive Functioning Tests

Executive Functioning Test	*M*	*SD*	*< 1.5 SD*
SCAT False Alarms	-2.36	2.95	51%
WCST	-0.17	1.17	38%
RCFT	-0.73	1.01	26%
Mazes	-0.03	1.44	13%
Fluency	-0.19	1.30	12%

Note. All scores are in norm-derived z-score format.

Other Neuropsychological Tests

Means and standard deviations for the neuropsychological tests from other domains are presented in Table 7. Mean scores were within the average range for all measures except sustained attention (SCAT Hits) and dexterity (Grooved Pegboard), which were in the low average range. One quarter of the group had

sustained attention problems and almost one third of the sample had deficits in motor dexterity. Descriptive information on the neuropsychological tests is presented in Table 7 in order of decreasing percent impaired for the sample.

Table 7

Means and Standard Deviations for the Other Neuropsychological Tests

Neuropsychological Test	*M*	*SD*	*< 1.5 SD*
Grooved Pegboard	-0.94	2.21	28%
SCAT Hits	-1.01	1.55	26%
Matrices	-0.10	0.78	20%
Comprehension	-0.50	1.01	19%
Story Memory	-0.16	1.24	15%
Block Design	-0.22	1.33	14%
Similarities	-0.32	1.12	13%
Dynamometer	1.02	2.20	13%
Picture Memory	0.09	1.06	9%
Listening Comprehension	0.01	0.90	4%
Oral Expression	0.64	0.85	0%

Note. All scores are presented in norm-derived z-score format.

Intercorrelations between Tests

For descriptive purposes, the intercorrelations between SSRS subscales are presented in tables 8 to 10. Intercorrelations for the neuropsychological tests are presented in table 11).

Table 8

Teacher SSRS Subtest Intercorrelations

	Cooperation	*Assertion*	*Self-Control*	*Internalizing*	*Externalizing*
Assertion	.40 [1]				
Self-Control	.46 [1]	.35 [1]			
Internalizing	.03	-.42 [1]	-.09		
Externalizing	-.16	-.13	-.70 [1]	.13	
Hyperactivity	-.62 [1]	-.17	-.60 [1]	-.10	.45 [1]

[1] $p < .001$

Table 9

Parent SSRS Subtest Intercorrelations

	Cooperation	*Assertion*	*Self-Control*	*Internalizing*	*Externalizing*
Assertion	.34 [3]				
Self-Control	.49 [1]	.52 [1]			
Internalizing	-.23	-.45 [1]	-.50 [1]		
Externalizing	-.31 [3]	-.37 [2]	-.82 [1]	.64 [1]	
Hyperactivity	-.37 [2]	-.40 [2]	-.67 [1]	.59 [1]	.68 [1]

[1] $p < .001$

[2] $p < .01$

[3] $p < .05$

Table 10

Self SSRS Subtest Intercorrelations

	Cooperation	*Assertion*	*Self-Control*
Assertion	.60		
Self-Control	.77	.71	
Empathy	.58	.68	.64

Note. All correlations were significant at $p < .001$

Table 11

Intercorrelations between Neuropsychological Tests

	FA	*Fluency*	*Mazes*	*RCFT*	*WCST*	*BD*	*Comp*	*Hits*	*Mat*	*Pegs*	*Dyn*	*Listen*	*Oral*	*Sim*	*Pic*
Fluency	.03														
Mazes	.03	.21													
RCFT	.24	-.06	.37 [2]												
WCST	.06	.13	.22	.28											
BD	.07	.13	.63 [1]	.62 [1]	.26										
Comp	.16	.39 [2]	.05	.20	.14	.21									
Hits	.59 [1]	.11	.17	.20	.17	.28	.35 [3]								
Mat	.22	.05	-.09	.30 [3]	.11	.14	.21	.13							
Pegs	.17	.11	.32 [3]	.29 [3]	.17	.27	.02	.22	.09						
Dyn	.04	.11	.30 [3]	.17	.22	.19	.06	.25	-.05	.22					
Listen	-.05	.38 [2]	.03	-.02	.27	.09	.21	.06	.15	.13	.07				
Oral	-.09	.30	-.09	.11	.34 [3]	.12	.40 [2]	.35 [3]	.34 [3]	.22	.21	.37 [3]			
Sim	.20	.34 [3]	.21	.43 [2]	.40 [2]	.36 [2]	.57 [1]	.34 [3]	.21	.29 [3]	.12	.46 [1]	.52 [1]		
Pic	.13	.02	-.09	.01	.30 [3]	-.02	.19	.28	.14	.04	-.04	.27	.35 [3]	.26	
Stor	.04	.27	-.11	.01	.17	-.16	.35 [2]	.04	.23	-.06	-.08	.69 [1]	.29	.32 [3]	.33 [3]

[1] $p < .001$

[2] $p < .01$

[3] $p < .05$

Note. FA (SCAT False Alarms), Fluency (Verbal Fluency), Comp (Comprehension), Hits (SCAT Hits), Mat (Matrices), BD (Block Design), Dyn (Dynamometer), Listen (Listening Comprehension), Oral (Oral Expression), Sim (Similarities), Pic (Picture Memory), Sto (Story Memory)

Social Skill Levels and Age

Children were divided into two groups based on age. Younger children included children aged 6 to 9 years (n = 28) and older children included children aged 10 to 13 years (n = 27). Mean teacher-rated total social skill score was in the low average to average range for both groups [younger children = 86.11 (16.39); older children = 86.74 (13.10)] on the total score of the teacher-rated SSRS. An independent samples t-test (2-tailed) indicated no significant differences in average teacher-rated total social skills between groups.

In terms of impairment classifications, 29% of the children aged 6 to 9 had social skill deficits defined as standard scores 1.5 standard deviations or more below the normative mean on the teacher SSRS; 19% of the older children had similar scores.

Correlational Analyses

Adjustment for Reliability

The effect of error of measurement on r is of consideration in the behavioral sciences, due to the nature of the measures used, which are typically inexact approximations of true scores. Because of this problem, a technique for

attenuating the effect of error of measurement which takes into account the reliability of the measures used was developed by Spearman (Peatman, 1963). This formula, known as the formula for correction for attenuation (Ferguson, 1981; Peatman, 1963), was used in calculating correlations between neuropsychological measures and social skill scores. This formula is presented in Appendix C. Test-retest reliability was used as a measure of reliability in calculating the adjusted correlation coefficients. The test-retest reliability coefficients for each measure is presented in Tables 12 to 15.

Of note was the fact that not all reliability coefficients were equivalent across neuropsychological tests. Specifically, re-test intervals varied and different populations were used across measures. In addition, some test-retest coefficients were not available. In these cases, other indices of reliability were used (see Table 15).

Table 12

Test-Retest Reliability Coefficients for the Teacher SSRS

SSRS - Teacher	*r*
Cooperation	.88
Assertion	.75
Self-Control	.80
Total Social Skills	.85
Internalizing	.76
Externalizing	.82
Hyperactivity	.83
Total Problem Behaviours	.84
Academic Competence	.93

Note. SSRS data from four week test-retest intervals (from Gresham & Elliott, 1990)

Table 13

Test-Retest Reliability Coefficients for the Parent SSRS

SSRS - Parent	*r*
Cooperation	.81
Assertion	.77
Self-Control	.77
Responsibility	.84
Total Social Skills	.87
Internalizing	.48
Externalizing	.58
Hyperactivity	.72
Total Problem Behaviours	.65

Note. SSRS data from four week test-retest intervals (from Gresham & Elliott, 1990)

Table 14

Test-Retest Reliability Coefficients for the Self-Rated SSRS

SSRS - Self	*r*
Cooperation	.54
Assertion	.52
Self-Control	.52
Empathy	.66
Total Social Skills	.68

Note. SSRS data from four week test-retest intervals (from Gresham & Elliott, 1990)

Table 15

Test-Retest Reliability Coefficients for the Neuropsychological Tests

	r	*Interval*	*Reference*
Full-Scale IQ	.90	6 wks	Wechsler (1991)
Fluency	.82	4 wks	McCarthy (1970)
Story Memory	.82	108 days	Sheslow & Adams (1990)
Grooved Pegboard	.82	n/a	Kelland, Lewis, & Gurevitch (1992)
SCAT Hits	.79	4 wks	Seidel & Joschko (1991)
Listening Comprehension	.79	17 days	Psychological Corp., (1992)
Oral Expression	.79	17 days	Psychological Corp., (1992)
Similarities	.77	6 wks	Wechsler (1991)
Block Design	.74	6 wks	Wechsler (1991)
Dynamometer	.70	2 years	Brown, Rourke, & Cicchetti (1989)
Comprehension	.68	6 wks	Wechsler (1991)
RCFT	.65	n/a	Lezak (1995)
Matrices	.63	16 wks	Thorndike, Hagen, & Sattler (1986)
Mazes	.61	6 wks	Wechsler (1991)
Picture Memory	.61	108 days	Sheslow & Adams (1990)
SCAT False Alarms	.54	4 wks	Seidel & Joschko (1991)
WCST	.52	4 wks	Heaton et al. (1993)

In Table 15, Story Memory and Picture Memory coefficients represent coefficients provided for composite indices (Verbal Memory and Visual Memory) because separate coefficients are not provided by the test publisher. RCFT Copy coefficient represents the mean of test-retest coefficients presented by Lezak (1995). WCST data represent generalizability coefficient; the Verbal Fluency coefficient represents the test-retest coefficient for the Verbal Scale of the McCarthy Scales, a composite measure consisting of Verbal Fluency and other verbal tests because separate information on Verbal Fluency test-retest stability is not provided by the publisher.

General Intellectual Ability

For the younger children, intellectual ability was not significantly related to teacher-rated social skills (r = .27, p = ns). In contrast, in older children, general intellectual ability was significantly related to teacher-rated social skills (r = .56, p < .01.)

Executive Functioning

Pearson product-moment correlations corrected for attenuation, between teacher-rated social skills and executive functioning for the two age groups are presented in Table 16. None of the correlations attained the statistical significance level of .01. However, in the younger children, trends were observed for the Mazes subtest. In both age groups, the correlation between teacher-rated social skills and the WCST perseverative errors approached significance. In sum, within the constraints resulting from the small sample size used in this study, the correlational analyses did not support the hypothesis that executive functioning skills are good predictors of social skills.

Table 16

Intercorrelations between Teacher-Rated Social Skills and Tests of Executive Functioning

Executive Functioning Tests	*Younger Children* $N = 28$	*Older Children* $N = 27$
SCAT False Alarms	-.12	.43 [1]
Mazes	.37 [2]	.36
RCFT	-.01	.16
WCST	.39 [2]	.42 [2]
Verbal Fluency	.06	.18

[1] $p < .02$

[2] $p < .05$

Other Neuropsychological Tests

Pearson product-moment correlations, corrected for attenuation, between teacher-rated social skills and scores for the other neuropsychological tests are presented in Table 17. In the case of the younger children, Similarities emerged as a significant correlate of social skills. Teacher-rated social skills were not related to other cognitive skills in younger children.

In the case of the older children, sustained attention (SCAT Hits), practical reasoning (Comprehension), and visual-spatial skills (Block Design) were significantly related to teacher-rated social skills. Correlational effect size for these associations was large (Cohen, 1988). Non-significant trends of moderate magnitude were observed in the case of conceptual ability (Similarities), visual memory (Picture Memory) and manual dexterity (Grooved Pegboard).

Table 17

Intercorrelations between Teacher-Rated Social Skills and Other Neuropsychological Tests

Neuropsychological Tests	*Younger Children* *N = 28*	*Older Children* *N = 27*
SCAT Hits	.02	.72 [1]
Comprehension	.25	.83 [1]
Similarities	.47 [1]	.29 [3]
Matrices	.01	-.16
Story Memory	.18	.18
Picture Memory	-.04	.46 [2]
Block Design	.13	.63 [1]
Listening Comprehension	.27	.09
Oral Expression	.11	.10
Grooved Pegboard	.25	.44 [2]
Dynamometer	.21	-.10

[1] $p < .01$

[2] $p < .02$

[3] $p < .05$

Testing for Statistical Differences between Correlations

To determine whether the correlations were significantly different in size, the correlations with teacher-rated social skills involving sustained attention (SCAT Hits), practical reasoning (Comprehension), and visual-spatial skills (Block Design) were compared, using the formula developed by Hotelling (1940, as cited in Peatman, 1963). This formula is presented in Appendix D. None of the differences between correlations were significant. However, the difference in correlational magnitude between practical reasoning (Comprehension) and visual-spatial skills (Block Design) approached significance ($p < .02$). These analyses suggested that sustained attention, practical reasoning, and visual-spatial skills were comparable correlates of teacher-rated social skills in older children.

Determining Unique Predictors of Social Skills with Regression Analysis

In the case of the younger children, only Similarities, a measure of conceptual ability, was a significant predictor of teacher-rated social skills. It was thus the best predictor of social skills in this age group. Because more than one neuropsychological measure was related to social skills in older children, a

regression analysis was performed to identify the "best" predictor of social skills–those measures contributing unique variance to the prediction of teacher-rated social skills. Only variables with significant correlations with social skills were considered for inclusion in the model (see Table 17). Thus, sustained attention (SCAT Hits), practical reasoning (Comprehension), and visual-spatial skills (Block Design) were regressed simultaneously on the total score of the teacher-rated social skills scale. The resulting model was significant ($R^2 = .65$, $p = .0001$), explaining 65% percent of the variance in the teacher-rated total social skills score. Only sustained attention as measured by SCAT Hits ($sr = .41$, $p = .007$) and practical reasoning as measured by Comprehension ($sr = .38$, $p = .01$) contributed uniquely and significantly to the prediction of teacher-rated social skills (see Table 18). Together, these variables contributed unique explanations of 31.3% percent of the variance in social skills. The remaining 31% of the variance represented shared or overlapping variability in the independent variables.

Table 18

Summary of Simultaneous Regression Analysis for Neuropsychological Measures Predicting Teacher-Rated Social Skills for Older Children

Variable	*B*	*SE B*	*Beta*	*Tolerance*	*sr*	*p*
SCAT Hits	3.38	0.82	.44	.85	.41	.007
Comprehension	2.29	0.81	.52	.53	.38	.01
Block Design	.06	1.11	.01	.55	.01	ns

Note. Regression terms are as follows: regression coefficients (B), standard error of B (SE B), standardised regression coefficient (Beta), tolerance values (Tolerance), and semipartial correlations (sr).

Data Reduction and Testing of Theoretical Associations between Measures

Several measures were identified as correlates of social skills in the previous analyses. Although the measures used were posited to measure distinct aspects of neuropsychological functioning, substantial correlations between measures were apparent (see Table 11). The neuropsychological variable matrix was therefore reduced into factors measuring similar constructs. A principle component analysis was conducted, with the goal of reducing the

number of variables involved in subsequent analyses. Although this limited the interpretation of results from the standpoint of individual tests, this approach allowed for reduction of Type I error, and for testing theoretical assumptions regarding construct similarity between tests. After removing subjects who had missing scores on one or more of the neuropsychological measures, 34 subjects remained.

Neuropsychological Factor Derivation

Bartlett's test of sphericity indicated the suitability of the data for analysis. A principle components solution with five factors was extracted and subjected to Varimax rotation. The five-factor factor solution obtained accounted for 65% of the variance. The rotated factor matrix was converged in 9 iterations. Table 19 presents the resulting factors and their associated eigenvalues, as well as the proportion of variance accounted for by each factor. Five factors of similar magnitude were extracted, accounting for 16.8, 15.3, 13.3, 11.3, and 8.4 of the variance, respectively.

Table 19

Factor Loadings and Rotated Factor Matrix

Measure	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	*Factor 5*
Block Design		.10	-.01	.07	05
RCFT Copy		-.06	.11	.15	.37
Mazes		.11	-.12	-.02	-.32
Grooved Pegboard		-.00	.26	.17	-.21
Verbal Fluency	.08		-.07	.04	-.25
Comprehension	.14		.05	.35	.20
Listening Comprehension	-.01		.45	-.21	.02
Story Memory	-.22		.37	-.10	.28
Similarities	.41		.38	.21	.15
Picture Memory	-.17	.06		.21	.11
Oral Expression	.07	.39		.11	.02
WCST	.36	.06		-.06	-.07
SCAT False Alarms	.06	-.01	-.02		.14
SCAT Hits	.17	.14	.24		-.14
Matrices	.16	.10	.25	.17	
Dynamometer	.32	.00	.26	.14	
Eigenvalues	2.69	2.44	2.12	1.8	1.35

Factor Interpretation

Loadings of approximately .45 or more were considered in the interpretation of factors [loadings of .45 considered "fair" and loadings of .55 considered "good", according to Comrey (1973), as cited in Tabachnick and Fidell (p. 640, 1989)]. The first factor appeared to represent a general non-verbal factor involving visual-constructional skills, visual planning, and dexterity. The RCFT, a design-copying task, and Mazes, a maze tracking task, both thought to involve visual planning and visual-spatial skills, loaded on this factor. In addition, a visual-constructional skill involving block assembly (Block Design) had substantial loadings on this factor, as did the Grooved Pegboard, a measure of manual dexterity and speed.

The second factor appeared to represent a general verbal ability factor. Measures of oral fluency (Verbal Fluency), aural comprehension (Listening Comprehension) loaded on this factor. In addition, measures of practical reasoning and conceptual ability from the WISC-III (Comprehension and Similarities), both measures with a significant verbal component, loaded on this factor, as did a measure of verbal recall (Story Memory).

The third factor was comprised of the Wisconsin Card Sorting Task perseverative errors, a measure of visual memory (Picture Memory), and a measure of oral expression, the Oral Expression subtest. Common elements

between these tests include the reliance on working memory; both Oral Expression and the WCST also require flexible thinking and initiation. Thus, this factor was interpreted as a working memory/flexibility factor.

The remaining two factors were comprised of two variables each. The fourth factor was an attention factor comprised of the SCAT measures of response inhibition and sustained attention. The smallest, fifth factor was comprised almost exclusively by a measure of non-verbal conceptual ability (Matrices) and grip strength. According to Tabachnick and Fidell (1989), factors comprised of two variables should be interpreted with caution, and depend to some extent on the correlations of the variables to each other and to other variables in the data set. Although the attention factor was only comprised of two variables, it was considered reliable because of the high correlation of the measures to each other ($r = .59$, $p < .001$, as shown in Table 11), and because these variables were only weakly correlated to most of the other variables in the matrix. In comparison, the measures making up Factor 5 were only correlated -.05 to each other, indicating a poorly defined or unreliable factor.

In sum, the factor analysis did not support the notion that the well-known executive functioning measures used in this study measured a distinct facet of neuropsychological performance not tapped by other neuropsychological tests.

AGE, HIGH/LOW SOCIAL SKILLS, AND NEUROPSYCHOLOGICAL FACTORS

To enable comparison of the neuropsychological factor scores for high and low social skill children for the two age groups, participants were divided into two groups based on whether their score on the teacher-rated social skill total scale fell below or above a cut-off of 1.5 z-score equivalents below the normative mean (Low SSRS scorers vs. High SSRS scorers). The factor scores for the five factors derived by principle components analysis were compared for cells formed by the factors of Age (Younger = ages 6-9, Older = ages 10-13) and SSRS Impairment (Low vs. High scorers) for the 34 subjects with factor scores. Cell sizes were as follows: Younger/High SSRS = 14, Younger/Low SSRS = 3, Older/High SSRS = 14, and Older/Low SSRS = 3.

Because factors scores from orthogonal factors were used as dependent variables, univariate analyses were conducted. The results of the ANOVA for the attention factor (factor 4) indicated a significant interaction effect (Age by High/Low Social Skills; F (3, 33) = 12.22, $p < .0001$). Results for the other factors were non-significant. Evaluation of group differences for the attention factor was conducted using Tukey's Honestly Significant Difference (HSD) Test. Mean scores on the attention factor are presented in Table 20.

Table 20

Means on the Attention Factor for Younger and Older Children With Low and High SSRS

	Low SSRS	*High SSRS*
Younger	0.20 (0.92)	0.16 (0.61)
Older	-1.85 (0.44)	0.42 (0.52)

Pairwise comparisons using Tukey's HSD indicated that older children with social skills deficits had significantly poorer scores on the attention factor than all other children, as shown in Table 20. Younger children with and without social problems did not differ in attention scores, nor did they differ from older children without social skill deficits. These results indicated that social deficits were associated with lower attention skills, but only for children aged 10 to 13.

In order to facilitate interpretation of these differences from a clinical standpoint, means on the neuropsychological tests were also examined. Means for all the neuropsychological tests for the younger children are presented in Table 21, with the mean difference between groups calculated in z-score units from each test's normative mean. Items in the tables are sorted according to the magnitude of the mean difference between groups. None of the group

differences were larger than one z-score unit, confirming the ANOVA results from a clinical standpoint.

Table 21

High and Low Scorers on the Teacher SSRS (Ages 6 to 9): Neuropsychological Performance

Variable	*Low SSRS*		*High SSRS*		*Absolute*
	Mean	*SD*	*Mean*	*SD*	*M Diff.*
SCAT False Alarms	-1.15	(2.26)			0.94
Mazes	-0.33	(1.2)	0.37	(1.56)	0.70
Dynamometer	0.76	(2.26)	1.42	(1.58)	0.66
WCST	-0.71	(1.82)	-.015	(1.11)	0.57
RCFT	-1.15	(1.00)	-0.59	(1.16)	0.56
Block Design	-0.48	(1.30)	0.09	(1.68)	0.56
Picture Memory	0.21	(1.10)	-0.30	(1.08)	0.50
SCAT Hits	-0.42	(0.76)	-0.86	(1.22)	0.43
Grooved Pegboard	-0.75	(1.96)	-0.37	(2.22)	0.38
Similarities	-0.76	(1.58)	-0.40	(1.05)	0.36
Listening Comprehension	-0.25	(1.25)	-0.001	(0.01)	0.25
Story Memory	-0.71	(0.79)	-0.48	(1.06)	0.23
Matrices	0.03	(0.45)	0.24	(0.71)	0.21
Comprehension	-0.76	(1.07)	-0.65	(0.91)	0.11
Verbal Fluency	-0.24	(1.16)	-0.32	(1.71)	0.09
Oral Expression	0.64	(0.70)	0.60	(0.87)	0.04

Note. All scores are presented in the form of norm-based z-scores; shaded scores indicate scores in the impaired range.

Results for the older children are presented in Table 22. In older children, group differences for the measures making up the attention factor were larger than two z-score units, a significant group difference from a clinical standpoint. However, both socially skilled and socially unskilled groups had mean scores that fell in the impaired range on the false alarms measure. In comparison to false alarm results, the group difference for the sustained attention measure (hits) was over 3 z-score units. The mean for the socially skilled group was in the average range; in comparison, the mean for the socially impaired group was in the impaired range. This difference in clinical classification, in addition to the large, clinically significant difference between groups, suggested that sustained attention had potential as a clinical marker of social skill difficulties.

Table 22

High and Low Scorers on the Teacher SSRS (Ages 10 to 13): Neuropsychological Performance

Variable	*Low SSRS*		*High SSRS*		
	Mean	*SD*	*Mean*	*SD*	*M Diff.*
SCAT Hits			-0.60	(1.07)	3.06
SCAT False Alarms					2.02
Picture Memory	-.087	(0.96)	0.58	(0.83)	1.45
Block Design	-0.73	(1.36)	-0.30	(0.95)	1.30
Grooved Pegboard			-1.17	(2.23)	1.21
Comprehension	-1.07	(0.80)	-0.12	(1.07)	0.95
Similarities	-0.67	(1.08)	-0.02	(1.03)	0.65
WCST	-0.33	(0.47)	0.04	(0.10)	0.37
Dynamometer	1.03	(3.97)	0.73	(2.29)	0.30
Oral Expression	0.45	(1.21)	0.71	(0.87)	0.26
Mazes	-0.40	(1.09)	-0.18	(1.47)	0.22
Story Memory	0.07	(1.17)	0.26	(1.45)	0.19
RCFT	-0.86	(1.25)	-0.71	(0.85)	0.16
Listening Comprehension	-0.03	(0.82)	0.13	(0.95)	0.16
Matrices	-0.45	(0.71)	-0.40	(0.84)	0.05
Verbal Fluency	-0.09	(0.87)	-0.08	(1.01)	0.01

Note. All scores are presented in the form of norm-based z-scores; shaded scores indicate scores in the impaired range.

Derivation of Social Skill Subtypes

An initial cluster solution for the teacher-rated social skill subscales (Assertion, Cooperation, and Self-Control) was performed using agglomerative hierarchical cluster analysis. The specific method used was the average linkage between groups method (UPGMA), a method that defines the distance between clusters as the mean distance between all pairs of cases which contain one pair member from a cluster. The advantage of this approach over other cluster analysis methods is that it uses information from all distance pairs instead of information from nearest or furthest pairs only (Norusis, 1992b).

Examination of squared Euclidean distances for the agglomeration schedule suggested that a 5-cluster solution might be appropriate. Although the difference in Euclidean distances between the 4- and 5-cluster solutions and the 6- and 7-cluster solutions were similar, a decision was made to use the 5-cluster solution to represent the data, given the small sample size and resulting risk of very small cluster size. In addition to squared Euclidean distances, visual inspection of the icicle plot and dendogram suggested that the 5-cluster solution might be a suitable representation of the data. Scores were not transformed prior to clustering because

all three subscales had similar maximum and minimum values. Specifically, each scale is comprised of 10 items with a possible score of 0 to 2, yielding subscale scores ranging from 0 to 20.

Mean social skill subscale scores for the five clusters appear in Table 23. The shaded area indicates scores that represent below average performance compared to the normative group (Gresham & Elliott, 1990).

Table 23

Mean SSRS Subscale Scores for the Five Subtypes

	N	*Assertion*	*Cooperation*	*Self-Control*
Subtype 1	12		13.6 (2.46)	11.8 (1.33)
Subtype 2	15	12.8 (1.32)	10.0 (2.98)	10.0 (3.05)
Subtype 3	17			
Subtype 4	9	12.4 (3.36)	16.6 (2.78)	17.2 (2.39)
Subtype 5	2			15.5 (2.12)

Note. The shaded area indicates scores that represent below average performance compared to the normative group; standard deviations are presented in parentheses.

Examination of the means for the social skill subscales across the five social skill subtypes suggests that Subtype 1 consisted of a group of children characterised by low scores on Assertion, but moderate Cooperation and Self-Control scores. This grouping was interpreted as reflecting a withdrawn, passive style in social interactions, where few social behaviours are initiated, but social behaviours from others are responded to in an appropriate way (Withdrawn Subtype). Subtype 2 was characterised by comparatively high scores on Assertion, and moderate scores in Cooperation and Self-Control (Assertive Subtype). Children in Subtype 3 appeared to have lower scores on all the social skill subscales; this group was interpreted as reflecting a globally unskilled group (Globally Unskilled Subtype). In contrast, Subtype 4 appeared to consist of children who had high scores on all three social skill subscales (Globally Skilled Subtype). Subtype 5 consisted of members with low scores on Assertion and Cooperation, but high Self-Control scores, suggesting a withdrawn subtype with additional problems cooperating with others; however, the validity of interpreting this cluster was questionable, as it was comprised of only two members.

Cluster Solution Replicability

Additional cluster solutions were derived using other well-known clustering approaches in order to examine the replicability of the initial cluster solution derived by the UPGMA method. Replication analyses included (1) k-means solution, (2) Ward's method, and (3) the complete linkage between groups method. A five-cluster solution was set a priori in each case.

Table 24 presents the k-means solution with the means for each SSRS subscale obtained by each cluster grouping. Examination of this table shows marked similarities to the solution provided by the UPGMA initial solution. Specifically, Subtype 1 appeared to reflect the Assertive subtype; Subtype 2 was similar to the Globally Skilled subtype. Subtype 3 resembled the fifth cluster identified in the initial solution, both by its restricted membership and its pattern of means. Subtype 4 was similar to the Globally Unskilled subtype of the initial solution, while Subtype 5 resembled the Withdrawn subtype.

Table 24

SSRS Subscale Means for the K-means Cluster Replication

	N	*Assertion*	*Cooperation*	*Self-Control*
Subtype 1	14	12.9 (1.35)	9.50 (2.35)	10.36 (2.82)
Subtype 2	10	12.4 (3.17)	16.40 (2.68)	16.8 (2.62)
Subtype 3	2			15.5 (2.12)
Subtype 4	17			
Subtype 5	12		13.8 (2.63)	11.2 (2.33)

Note. The shaded area indicates scores that represent below average performance compared to the normative group; standard deviations are presented in parentheses.

Using the k-means solution cluster method, 53 of the 55 cases (96%) were correctly classified into the same clusters they had been assigned to in the initial solution. The kappa statistic (Lorr, 1983) that allows adjustment for chance agreement, was .95, indicating excellent replicability of the cluster solution. In the case of a five-cluster solution, chance agreement is equivalent to values between 0 and .20. A value of 1.00 indicates perfect agreement between cluster solutions. The formula for calculating this statistic is presented in Appendix E.

Agreement using Ward's method and the complete linkage method were somewhat lower; both kappa values were .78. However, although better agreement was obtained with k-means clustering, these solutions also indicated good replicability of the initial cluster solution. Values of .70 or larger obtained for replicability statistics typically indicate good cluster recovery (Fuerst & Rourke, 1993). Means on the different social skill subscales for the cluster solutions derived using Ward's method and the complete linkage method are presented in Tables 25 and 26. Examination of the pattern of scores across subscales suggests that, of the five subtypes initially identified, the Withdrawn, Globally Unskilled, and Globally Skilled subtypes emerged consistently across cluster solutions.

Table 25

SSRS Subscale Scores for Ward's Method Cluster Replication

	N	*Assertion*	*Cooperation*	*Self-Control*
Subtype 1	15		12.3 (3.48)	12.0 (1.89)
Subtype 2	9	13.1 (1.27)		11.9 (0.93)
Subtype 3	10	12.7 (3.27)	16.1 (3.00)	16.8 (2.62)
Subtype 4	5	11.8 (0.45)	11.8 (2.95)	
Subtype 5	16			

Note. The shaded area indicates scores that represent below average performance compared to the normative group; standard deviations are in parentheses.

Table 26

SSRS Subscale Means for the Complete Linkage Method Cluster Replication

	N	*Assertion*	*Cooperation*	*Self-Control*
Subtype 1	17		12.2 (2.77)	9.94 (2.88)
Subtype 2	10	13.3 (1.34)		12.0 (0.94)
Subtype 3	16			
Subtype 4	11	12.2 (3.09)	16.45 (2.54)	16.3 (3.04)
Subtype 5	1			17.0

Note. The shaded area indicates scores that represent below average performance compared to the normative group; standard deviations are in parentheses.

Social Skill Subtypes, Age, and General Intellectual Skills

A One-Way ANOVA was conducted to determine the effect of subtype on age for the subtypes identified by the initial cluster solution derived by means of UPGMA. It was non-significant, indicating no significant age differences across the five clusters. The mean ages for the subtypes are presented in Table 27.

Table 27

Ages for the Five Social Skill Subtypes

	Age
Subtype 1	10.44 (1.36)
Subtype 2	9.97 (1.51)
Subtype 3	10.0 (1.50)
Subtype 4	9.72 (1.34)
Subtype 5	8.44 (0.98)

Note. Standard deviations are in parentheses.

A One-Way ANOVA examining the effect of subtype on general intellectual ability was also conducted. The analysis indicated a trend for differences in FSIQ across groups (f (4, 50) = 2.44, $p < .06$). As an exploratory analysis, group means were compared with Tukey's HSD, indicating significantly lower FSIQ for the Globally Unskilled group compared to the Globally Skilled group. Group means are presented in Table 28.

Table 28

Full-Scale IQ for the Five Social Skill Subtypes

	FSIQ
Withdrawn	90.33 (14.56)
Assertive	91.36 (12.14)
Globally Unskilled	87.56 (12.59)
Globally Skilled	104.38 (12.84)
Subtype 5	86.00 (12.73)

Note. Standard deviations are in parentheses.

Social Skill Subtypes and Neuropsychological Factors

To examine the effect of subtype membership on neuropsychological functioning, One-Way ANOVAs were performed for each neuropsychological factor (i.e., cluster membership x neuropsychological factor score). No significant effects were found. Group differences in verbal ability (factor 2) approached significance [F (4, 50) = 3.24, $p < .02$], with Subtype 5 having significantly lower performance than the Globally Skilled subtype (Tukey's HSD).

Social Skill Subtypes and Behaviour

The SSRS Problem Behaviours were examined as behavioural correlates of the social skill subtypes. These scales were of interest in determining the nature of the subtypes and in validating the interpretation of the subtypes because they provide information on behavioural dimensions that seemed similar to the interpretation of subtypes identified by the cluster solution. Specifically, the SSRS Problem Behaviours consist of three scales that assess Internalizing behaviours, Externalizing behaviours, and Hyperactivity.

Means for the Problem Behaviour subscales for the five subtypes are presented in Table 29. Perusal of the means in this table shows that the Globally Skilled group was the only group with scores in the normal range across Problem Behavior scales.

Table 29

Means and Standard Deviations for Problem Behaviour Subscales for the Social Skill Subtypes

	Hyperactivity	*Internalizing*	*Externalizing*
Withdrawn	4.33 (2.14)		3.58 (2.39)
Assertive		4.53 (2.39)	4.33 (2.77)
Globally Unskilled		5.88 (1.90)	5.18 (2.77)
Globally Skilled	2.44 (1.51)	3.67 (2.00)	1.22 (1.48)
Subtype 5	7.50 (0.71)		1.50 (2.12)

Note. Shaded areas indicate scores in the above average range, indicating more problem behaviours than the average child; standard deviations are in parentheses.

Given the collinearity of the Problem Behavior variables (see Table 7), a Multivariate Analysis of Variance (MANOVA) was conducted, with Cluster Membership (5 levels) as independent variables, and Problem Behaviours as dependent variables (3 levels).

The overall multivariate analysis was significant, suggesting an effect of cluster type on problem behaviours [F (12, 140) = 2.53, $p < .0001$; Power = 1.00].

Significant univariate effects were observed for Hyperactivity [F (4, 50) = 20.54, p < .0001; Power = 1.00], Internalizing [F (4, 50) = 9.42, p < .0001, Power = .1.00], and Externalizing [F (4, 50) = 4.27, p < .005, Power = .90].

Tukey's HSD test was applied in order to determine significant subtype differences in problem behaviours. In the case of Hyperactivity, the Globally Skilled subtype (Subtype 4) had significantly lower scores on the Hyperactivity scale (M = 2.44, SD = 1.51) than all other subtypes. The Withdrawn subtype (Subtype 1; M = 4.33, SD = 2.14) was significantly less hyperactive than the Assertive subtype (Subtype 2; M = 8.93, SD = 2.31) and the Globally Unskilled subtype (Subtype 3; M = 9.24, SD = 2.59). No significant differences between the Assertive and Globally Unskilled subtypes were found.

Tukey's HSD post-hoc test was also applied to Internalizing and Externalizing variables. Results of these analyses suggested that the Withdrawn subtype had higher Internalizing scores (M = 8.42, SD = 2.02) than the Globally Skilled (M = 3.67, SD = 2.00), Globally Unskilled (M = 5.88, SD = 1.90), and Assertive Subtypes (M = 4.53, SD = 2.39). In addition, the Globally Skilled subtype was found to have lower Externalizing scores (M = 1.22, SD = 1.48) than the Globally Unskilled (M = 5.18, SD = 2.77) and the Assertive subtypes (M = 4.33, SD = 2.77).

Overall, the analyses of the SSRS Problem Behaviours provided support for the interpretation of the Globally Skilled subtype as consisting of socially skilled

children with few problem behaviours. In addition, the interpretation of the Withdrawn subtype reflecting social withdrawal was consistent with this cluster's higher scores on the Internalizing measure. The Globally Unskilled and Assertive subtypes were both associated with hyperactive and externalising behaviour.

Measuring Insight: Teacher-Self Discrepancies and Neuropsychological Factors

Twenty-seven children had ratings on both teacher- and self-report SSRS measures. In order to determine insight, self-rated SSRS total scores were subtracted from teacher-rated SSRS total scores for these children. As noted above, the absolute value of this metric was used as a measure of insight.

Given the purported developmental progression of insight, age was examined as a predictor of insight. Pearson-product moment correlations suggested a trend for decreased teacher-self rating discrepancies with increasing age (r = -.41, p = .03). An independent samples t-test (2-tailed) comparing the magnitude of teacher-self discrepancies of younger and older children also suggested a trend for decreasing discrepancy with increasing age [for younger children, M = 20.24, SD = 10.6; for older children, M = 11.6, SD = 10.4; t (28) = 2.27, $p < .03$].

The association between insight and neuropsychological functioning was also explored. Correlational analyses suggested moderate statistical trends involving associations of insight with the verbal factor (factor 2) and the working memory/initiation factor (factor 3) for the sample as a whole. Correlations and associated significance levels are presented in Table 31.

Table 31

Intercorrelations between Insight and Neuropsychological Factors

	r	*p*
Visual/Planning Factor	.27	ns
Verbal Factor	-.45	.05
Working Memory/Initiation Factor	-.47	.04
Attention Factor	.17	ns
Factor 5	.03	ns

DISCUSSION

Summary and Discussion of Findings

Sample Characteristics and Prevalence of Social Problems

Developing successful peer relationships is one of the most crucial accomplishments of childhood (Guralnick, 1986). The neuropsychological literature on adults and children with brain injury suggests that certain cognitive functions, particularly executive functions, problem solving/abstraction, and non-verbal perceptual skills are related to social skills. However, inherent methodological limitations in this literature limit the strength of these findings, despite a substantial body of knowledge on the cognitive antecedents of social skill problems in the realm of developmental psychology, which seem to implicate similar cognitive processes.

This study investigated the relationship between teacher-rated social skills and neuropsychological performance in children seen for neuropsychological assessment at a children's treatment and rehabilitation centre. The sample consisted of a heterogeneous group of children with various diagnoses such as head injury, ADHD, learning disability, tic disorder, psychiatric problem,

abuse/neglect, or other neurological/medical condition. On average, social skills as assessed by the teacher-rated Social Skills Rating Scale were in the low average range in this sample. One quarter of the sample had social skill deficits defined as scores 1.5 standard deviations or more below the normative mean. In terms of clinical samples, this may be considered a mildly affected group. Consistent with this view is the fact that only one quarter of the children had behavioural problems as indicated by their teachers. On average, the children were also of normal intellectual ability. Language skills, verbal memory, and motor strength were within normal limits for the majority of the children. Impulsivity problems were most prevalent; approximately half of the children had impairments on the SCAT false alarms measure. Other executive functioning problems, present in one quarter to one third of children included deficits in planning and set shifting. Sustained attention and motor dexterity problems were found in approximately one fourth to one third of the sample. The neuropsychological performance of the group suggested that they had relatively circumscribed deficits, not global impairments across neuropsychological domains, as might be expected in other more severely affected patient groups.

Age-Related Cognitive Correlates of Social Skills

As hypothesised, the results indicated that the cognitive correlates of social skills in younger and older children differed. However, the type of predictors in each group was unexpected. In addition, the extent to which cognitive variables were related to social skills differed for each age group, with cognitive variables playing a larger role in older children than in younger children.

In younger children aged 6 to 9 years, a measure of conceptual ability, the Similarities subtest, was a moderate predictor of teacher-rated social skills. Although the relationship between conceptual ability and social skills was interesting from a theoretical viewpoint, for practical purposes such as helping identify children at risk for social skills, it was of lesser usefulness since performance differences on Similarities between high and low scorers on the teacher-rated social skill measure were negligible. In addition, when all neuropsychological test scores were reduced to five factors measuring similar dimensions of cognitive ability, no differences in cognitive skills were noted between children with high and low social skill scores. Visual examination of the specific test scores from which were derived the neuropsychological factors confirmed the lack of relationship between high/low scores on the social skill measure and neuropsychological performance.

In older children between the ages of 10 and 13, several cognitive skills were statistically related to teacher-rated social skills. Strong neuropsychological correlates of social skill in older children were (1) sustained attention; (2) practical reasoning; and (3) visual-spatial skills. Of these, only sustained attention and practical reasoning contributed unique variance to the prediction of social skills in older children. Further, when neuropsychological factors were used as dependent variables, only the attention factor was significantly lower in older children with social deficits. Examination of group means for high and low social skill children on tests making up the attention/impulsivity factor revealed clinically-significant differences between groups for sustained attention as well as impulsivity on the SCAT. Examination of clinical classifications for high/low social skill scorers using these measures suggested that sustained attention had potential as a clinical marker of social skill difficulties.

One hypothesis was that more basic skills, such as attention, verbal ability, visual-spatial skills, and motor skills would predict social efficacy at younger ages, whereas more complex, high-level abilities such as executive skills, reasoning, conceptual ability, and problem solving would predict social skills in older children. Contrary to expectations, the single cognitive correlate of teacher-rated social skills in young children consisted of a measure reflecting a rather sophisticated ability, namely the ability to make abstractions and deduce concepts. Conversely, the strongest predictor of social skills in older children, which

emerged consistently across statistical analyses and methodological approaches (including clinically significant analyses examining clinical classification and group differences), was sustained attention. Consistent with previous research, practical reasoning was also a strong predictor of social skills in older children. Visual-spatial skills, although also a strong predictor in correlational analyses, did not contribute unique variance to the prediction of social skills, unlike sustained attention and practical reasoning.

That attention skills emerged as a strong social skill determinant was an interesting finding which was incongruous with hypothesised age-related relationships. The reason for this pattern of results is unclear. Possible explanations include a lesser importance of sustained attention skills in the social interactions of young children compared to those of older children, so that attention deficits, when present in younger children, have little impact on social outcome. According to this line of reasoning, if the social interactions of older children require good attentional skills, children who reach ages 10 to 13 with attention deficits may no longer be able to negotiate social exchanges appropriately. Other possibilities include the cumulative effects of difficulties focusing on and encoding social cues over time, leading to a delayed social deficit due to inadequate learned knowledge about appropriate social behaviour, compounded by reduced opportunities to practice social skills with other children because of increasing exclusion by peers. Research on children with ADHD, a

syndrome where attention and impulsivity problems predominate, is somewhat informative in this regard. Up to 50% of ADHD children have problems in their peer interactions (Pelham & Bender, 1982) and are more often socially rejected (Johnson, Pelham, & Murphy, 1985; Pope, Bierman, & Mumma, 1989). However, the social skill problems of children with ADHD may not be restricted to a performance/execution deficit related to impaired attention to social cues or to problems inhibiting impulsivity. Some studies have found that these children have less knowledge about appropriate social behaviour than other children do (e.g., Grenell, Glass, & Katz, 1987).

The interpretation that attention deficits may only lead to social problems in late childhood raises questions concerning young children who have low scores on the measure of sustained attention. Are these children harbouring a "masked deficit" that becomes manifest with age as sustained attention gains importance in mediating social skills? It appears from classic case studies in the neuropsychological literature that social problems can emerge for the first time late in development, as evidenced by Grattan and Eslinger's patient DT. Unfortunately, the cross-sectional nature of the study design was not geared towards determining whether a "masked" social skill deficit becomes manifest later in childhood in young children with early attention problems. Further research, particularly in the form of longitudinal studies of neuropsychological populations, is needed in order to clarify this question. Should early neuropsychological deficits prove predictive

of later social problems, identification of children with certain cognitive deficits such as sustained attention deficits, and initiation of potentially important interventions such as social skills training may play a role in preventing later social deficits. More research is needed on the specific ways in which age impacts the development, behavioural manifestations, and environmental contingencies that mediate social skills in children.

Executive Skills and Social Skills

The lack of statistically-significant association between executive functioning skills and teacher-rated social skills for both age groups did not support the prominent role that executive functioning plays in existing social information processing models. These discrepancies may reflect population differences (normal vs. clinically referred children), social skill measurement differences (sociometric vs. observational vs. standardised questionnaires; observer vs. teacher ratings), or methodological differences in terms of the measurement of cognitive skills. In the latter case, neuropsychological instruments typically consist of standardised, norm-referenced tests that effectively remove the effect of age on performance. In contrast, many developmental paradigms in the social skills field are naturalistic observations or structured situations that were designed expressly to capture age-related changes in behaviour. Consequently, developmental

measures are seldom adjusted for age. What the lack of association between neuropsychological measures of executive functioning and teacher-rated social skills found in this study implies is that the age-related development of executive functions and of social skills, although occurring in parallel, might be independent processes. Alternatively, neuropsychological measures of executive skills may not tap the particular executive skills that are needed for social efficacy. As with all neuropsychological research, the validity of findings is only as strong as the neuropsychological instruments' ability to measure the constructs of interest. Existing executive functioning tasks, although normed on children and used frequently in investigations of executive functioning in children, essentially consist of downward extensions of adult-derived tasks. Thus, Tranel et al. (1994) emphasise that the measurement of executive functions in children should take into account potential limitations on the validity of adult-derived tasks, especially in younger children.

Neuropsychological Factors

Overall, the principle components analysis did not support the assumption that executive functioning tests measure a distinct dimension of cognitive ability. Executive functioning measures did not load on a common factor, but were instead divided among factors measuring various abilities. The

planning tasks (Mazes, RCFT), along with Block Design, loaded on a factor interpreted as measuring visual-constructional, visual planning, and manual dexterity skills. The Verbal Fluency test emerged on a factor composed exclusively of tests with a significant verbal component. The WCST, a measure of cognitive flexibility, loaded on a factor comprised of a measure of oral expression and a measure of visual memory. Common features of these three tests may have included working memory and initiation. The somewhat arbitrary assignment of the impulsivity measure (SCAT false alarms) as an executive functioning measure--conceptually separate from the sustained attention measure (SCAT hits)--was likely artificial, given the high correlations of these measures to each other (r = .59; see Table 10), and their emergence in isolation on a single factor. Although attention per se is not usually considered an executive functioning skill, the control of attention, evidenced by the ability to focus on relevant cues and ignore irrelevant ones, are included in executive functioning models such as those of Mateer and Williams (1991). Lezak (1995) has also noted that executive skills such as planning require the ability to sustain attention, along with the ability to resist impulsive responding and retrieve items from memory.

Social Skill Subtypes

Five social skill subtypes were identified in the sample using the SSRS teacher-rated subscales. Three of these subtypes were clearly replicated in additional cluster analyses to ensure the validity of the initial cluster solution. These were (1) a Globally Skilled subgroup, (2) a Globally Unskilled subgroup, and (3) a Withdrawn subgroup. A primarily Assertive group was also identified, although replication with other cluster analysis techniques was less consistent. Although age and performance on each of the neuropsychological factors derived by principle components analysis did not discriminate between subgroups, important differences in the areas of general intellectual ability and problem behaviour were identified. Specifically, a non-significant trend indicated that Globally Skilled children had higher IQ scores (M = 104, SD = 12.8) than the Globally Unskilled children (M = 87.6, SD = 12.6). The Globally Skilled group was also the only group without elevations on any of the Problem Behaviour subscales. The Assertive and Globally Unskilled subtypes had the highest scores on a scale reflecting hyperactivity. There was also a trend indicating that the Withdrawn subgroup had the highest Internalizing scores of all the subtypes.

Although a cross-validation of these subtypes is needed with other samples, the results provided preliminary evidence for distinct subtypes within a heterogeneous sample of children with neuropsychological impairments. This

study did not permit causative analyses of the etiology of social deficits for each subtype; consequently, interpretation of the results from an etiological framework is quite tentative. Given this caveat, the results suggest the possibility that the etiology of social difficulties may be different for different children, and include non-cognitive factors. For example, intellectual impairments may be associated with social deficits in children with global social problems, whereas internalizing behaviour may be associated with social problems in withdrawn children. In line with this interpretation is research suggesting that emotional adjustment appears to affect social competence. Although aggression is a strong predictor of peer rejection, withdrawal and anxiety influence patterns of peer acceptance (French, 1990; Hartup, 1992). In addition, unpopular children are more depressed than popular children (Vosk et al., 1982). Some research suggests that socially withdrawn children are at risk for later psychopathology (Rubin, 1985). In sum, the subtype analyses provide preliminary evidence for the multifactorial nature of social problems in children.

Insight, self-awareness and Social Skills

For the group as a whole, SSRS self-ratings indicated that children had different views on their own social abilities compared to that of other raters. Specifically, in comparison to teacher and parent ratings, children did not perceive

their social skills as falling outside the average range, lending support to the notion that children's self-perceptions of social skill deviate from those of other raters. Only a small minority of children (13%) perceived their own social skills as below that of other children.

In her definition of executive functioning skills, Lezak (1995) includes self-awareness. Self-awareness and insight are posited to develop with age, a hypothesis inherent to certain formulations of the development of executive functions such as that outlined by Stuss (1992). In this study, it was hypothesised that teacher-self discrepancies would decrease with age, reflecting the age-related development of self-awareness. A non-significant trend supported this hypothesis. Specifically, age was inversely related to teacher-self rating discrepancies on the social skill scale, with older children having lesser teacher-self rating discrepancies. Further, non-significant trends suggested that insight as operationalized in this manner was related to neuropsychological factors measuring verbal ability as well as components of executive functioning (i.e., the working memory/cognitive flexibility factor).

In theory, because both teacher and self-ratings are standardised using normative data, the prototypical normal child would obtain a teacher-self discrepancy of 0. In this sample of clinically referred children, the average discrepancy ranged from 20 in younger children to 11 in older children. Whether the teacher-self discrepancies obtained with this sample was larger than expected

compared to that of non-referred children could not be determined in this study because the variability of teacher-self discrepancies in normal populations was not available. Comparison to normative groups is especially pertinent in the study of neuropsychological populations because of suggestions that patient self-reports are typically less accurate and less consistent than those of controls (Allen & Ruff, 1990; Priddy, Mattes, & Lam, 1988). Indeed, the discrepancy between ratings of patients' own behaviour and the same behaviour as rated by a relative (such as a spouse or parent) forms the basis of several measures purported to measure insight after brain injury (for a review, see Fleming, Strong, & Ashton, 1996). Persons with cognitive deficits typically show much larger discrepancies than controls, indicating low insight. In addition, studies with adults suggest that patients with severe neuropsychological deficits show the least awareness of their deficits (Chelune, Heaton, & Lehman, 1986; Fordyce & Roueche, 1986). This study was the first attempt to use the SSRS as a measure of insight and self-awareness. Preliminary results indicated that insight was related to other cognitive skills in this population.

General Limitations of the Study

Design and Sample Characteristics

The extent to which the findings can be generalised to other populations is limited by the study's relatively small sample size. Thus, the findings require replication in larger groups. In addition, the small sample size allowed statistical detection of only moderate to large effects in most cases; more subtle effects could not be detected because of limited power in some analyses. Also important is the issue of experiment-wise error. Although limited to some extent by adopting an alpha level of .01, some significant findings may have been due to chance effect arising from the large number of analyses conducted in this study.

The heterogeneity of the sample makes the generalisation of findings to more homogenous populations somewhat problematic. The sample represented primarily children of normal intelligence, with mild or circumscribed cognitive deficits. As such, the results may not be applicable to other patient groups where cognitive deficits may be severe or global, such as acute care centres or inpatient rehabilitation centres for severely impaired children. However, the findings are applicable to other heterogeneous referral groups such as those found in most clinics that perform outpatient neuropsychological assessments.

Measurement

In terms of measuring social skill, limitations inherent in the use of teacher-rated instruments also deserve mention. For example, Milburn (as cited in Stumme, Gresham, & Scott, 1982) reported that teachers value order, cooperation, accepting consequences, following rules, avoiding conflict, and self-help behaviour more than they do initiating contact with others, conversational skills, and assertion in personal relationships. In addition, teachers are less likely to rate internalising behaviours such as social withdrawal as problematic (Achenbach, 1991, Gresham, 1986). Teacher-rated measures of social skill therefore measure a specific dimension of social skill that may not be equivalent with that of other raters.

Social skills are multiply determined; both internal and external factors interplay to produce social behaviour. In particular, social patterns result from an organized system that comprised biophysical, cognitive, social network, and ecological components (Cairns, 1986; Taylor & Cadet, 1989). Evidently, not all factors that potentially affect social skills could be included in this study.

Although the literature on the association between cognitive skills and social skills is compelling, a number of non-cognitive factors have also been implicated. Evidently, neuropsychological populations are not equivalent to normal populations; obvious differences exist in terms of cognitive functioning.

Less obvious differences, that arise secondary to cognitive limitations, may also come into play. Research in peer relationships suggests that child-child interactions are crucial in the development of social skills in children. Although adult-child interactions are also important, a child's exposure to child-child interactions confers a unique advantage to the development of social skills, and is a better predictor of later social competence (Guralnick, 1986). In adult-child interactions, adults are the primary initiators and verbal exchanges are salient features. In contrast, child-child interactions depend on the equal contribution and initiation of both partners; linguistic and communicative factors are less important, and interactions are less predictable (Guralnick, 1986). Flexibility and adaptability may therefore be assets in child-child interactions. Evidence from studies of developmentally delayed and hearing-impaired children suggest that these populations spend less time in child-child interactions. In addition, the child-child interactions they participate in are actually more similar to adult-child interactions because the non-handicapped child tends to take a directive, "adult" role with the handicapped child. The effects of reduced child-child interactions, along with other factors, may have cumulative effects on social competency that are not linearly related to a child's cognitive limitations. Guralnick (1986) reviewed research demonstrating that the social competence of developmentally delayed children lagged behind their cognitive levels, suggesting a cumulative adverse effect of reduced social interaction on social development. Similar results were obtained

with children who had sensory deficits involving hearing. Hearing impaired children lagged behind normal children in social development and took part in fewer child-child interactions. These results suggest that factors other than cognitive impairments affect the development of social skills in populations with deficits that interfere with the normal progression of peer interactions.

Given the variety of clinical disorders exhibited by the sample, it is likely that a number of children had physical and/or sensory handicaps. Along with executive functions, Lezak (1989) emphasises that the contribution of disorders of the sensory system, such as hearing and visual problems, may also adversely affect interpersonal skills in persons with brain dysfunction. Guralnick's (1986) review of studies on the social development of deaf children underline the fact that this phenomena may not be restricted to persons with cognitive limitations. As well, disruptions in social interactions in neuropsychological populations such as persons with head injury may also be related to non-cognitive factors, such as systemic injuries and orthopedic problems (Dikmen, McLean, & Temkin, 1986) that limit exposure to social situations. Other factors, such as attractiveness and the presence of physical anomalies have also been implicated in the development of peer relations (Guralnick, 1986). McConnell and Odom (1986) reviewed the literature on this issue and concluded that handicapping conditions, including learning disabilities, were associated with findings of lower sociometric ratings

in children. These and other factors may need to be accounted for in models that delineate predictors of social skills in neuropsychological populations.

Other influences on social functioning also deserve mention. Factors as seemingly trivial as a child's name have also been implicated in children's sociometric ratings (reviewed in McConnell & Odom, 1986). Attachment has also emerged in the developmental literature as an important predictor of social skills in children; children with handicaps may be at greater risk of insecure attachment to their caretakers (Guralnick, 1986), which presumably increases their risk of social deficits over and above other limitations imposed by their handicap. Some research suggests that non-specific factors related to chronic illness may also adversely impact psychological adjustment in children (Stein & Jessop, 1982) and have ramifications in the social realm; the impact of physical illness or handicap on the development of social skill may be considerable. On the other hand, illness has been isolated as a beneficial influence on the development of empathy in children (Nelms, 1989; Parmelee, 1986). Ill children are often asked how they feel, and this has been interpreted as facilitating the acquisition of self-awareness which in turn may generalise to increased awareness of the feeling states of others (Zahn-Waxler & Smith, 1992). However, evidence exists that children with neurological illnesses have more difficulty initiating social interactions than same-age peers with non-neurological illnesses, suggesting that cognitive factors play a role in predicting social competence over and above non-specific factors related to chronic illness

(Howe, Feinstein, Reiss, Molock, & Berger, 1993). In addition, the purported beneficial effects of illness on self-awareness may be limited in populations with cognitive deficits, as noted above. For instance, Jacobs (1993) found that children with brain injuries had limited self-awareness, defined as understanding the impact of brain injury on their cognitive processes and social interactions. In general, the children believed that their impairments were mainly physical.

Conclusion

In sum, the analyses highlighted the interaction of cognitive functioning, age, and social skills in children referred for neuropsychological assessment. Further, this study attempted to provide an important link between the developmental and the neuropsychological literature on social skill deficits. Keeping in mind the potential limitations of the measures used and the restrictions imposed by a small sample size, the findings suggest that social information processing models based on research with normal populations may need modification when applied to neuropsychological populations. Although the results showed that the relationship between some aspects of cognitive functioning and social problems found in the developmental literature also applied to this

neuropsychological population, important differences also emerged which, given further research, will help in the formation of future models of social skill correlates for neuropsychological populations.

BIBLIOGRAPHY

Achenbach, T. M. (1991). *Integrative guide for the 1991 CBCL/4-18, YSR, and TRF profiles.* Burlington, VT: University of Vermont Department of Psychiatry.

Ackerly, S. S. (1937). Instinctive, emotional, and mental changes following prefrontal lobe extirpation. *American Journal of Psychiatry, 92,* 717-729.

Ackerly, S. S. (1950). Prefrontal lobes and social development. *Yale Journal of Biological Medicine, 22,* 471-482.

Ackerly, S. S. (1964). A case of paranatal bilateral frontal lobe defect observed for thirty years. In J. M. Warren & K. Ackert (Eds.), *The frontal granular cortex and behavior* (pp. 192-218). New York: McGraw-Hill.

Ackerly, S. S., & Benton, A. L. (1947). Report of a case of bilateral frontal lobe defect. *Research Publication Association of Research on Nervous Mental Disorders, 27,* 479-504.

Allen, C., & Ruff, R. M. (1990). Self rating versus neuropsychological performance of moderate versus severe head injured patients. *Brain Injury, 4,* 7-17.

Barkley, R. A. (1991). The ecological validity of laboratory and analogue assessment methods of ADHD symptoms. *Journal of Abnormal Child Psychology, 19,* 149-178.

Becker, M. G., Isaac. W., & Hynd, G. (1987). Neuropsychological development of non-verbal behaviors attributed to "frontal lobe" functioning. *Developmental Neuropsychology, 3,* 275-298.

Bennett, T. L. (1989). Individual psychotherapy and minor head injuries. *Cognitive Rehabilitation, 7,* 20-25.

Benton, A. (1991a). Prefrontal injury and behavior in children. *Developmental Neuropsychology, 7,* 275-281.

Benton, A. (1991b). The prefrontal region: Its early history. In H. S. Levin, H. M. Eisenberg, & A. L. Benton (Eds.), *Frontal lobe function and dysfunction.* New York: Oxford University Press.

Blishen, B. R., Carroll, W. R., & Moore, C. (1981). The 1981 socioeconomic index for occupations in Canada. *Review of Sociology and Anthropology, 24,* 465-488.

Biddle, K. R., & Eslinger, P. J. (1996). *Normal Language with Impaired Discourse after Early Right Frontal Lobe Lesion.* Poster presented at the Twenty-Fourth Meeting of the International Neuropsychological Society, Chicago, Illinois.

Brickner, R. M. (1934). An interpretation of frontal lobe function based upon the study of a case of partial bilateral frontal lobectomy. In S. T. Orton, J. F. Fulton, & K. Davis (Eds.), *Localization of function in the cerebral cortex* (pp. 259-351). Baltimore: Williams & Wilkins.

Brickner, R. M. (1936). *The intellectual functions of the frontal lobes.* New York: Macmillan.

Brown, S. J., Rourke, B. P., & Cicchetti, D. V. (1989). Reliability of tests and measures used in the neuropsychological assessment of children. *The Clinical Neuropsychologist, 3,* 353-368.

Cairns, R. B. (1986). A contemporary perspective on social development. In P. S. Strain, M. J. Guralnick, & H. M. Walker (Eds.), *Children's social behavior: Development, assessment, and modification* (pp. 3-47). Toronto: Academic Press, Inc.

Case, R. (1992). The role of the frontal lobes in the regulation of cognitive development. *Brain and Cognition, 20,* 51-73.

Chelune, G. J., & Baer, R. A. (1986). Developmental norms for the Wisconsin Card Sorting Test. *Journal of Clinical and Experimental Neuropsychology, 8,* 219-228.

Chelune, G. J., Heaton, R. K., & Lehman, R. A. (1986). Relation of neuropsychological and personality test results to patients' complaints of disability. In G. Goldstein & R. Rarter (Eds.), *Advances in clinical neuropsychology* (Vol. 3). New York: Plenum Press.

Chelune, G. J., & Thompson, L. L. (1987). Evaluation of the general sensitivity of the Wisconsin Card Sorting Test among younger and older children. *Developmental Neuropsychology, 3,* 81-90.

Cicerone, K. D. (1989). Psychotherapeutic interventions with traumatically brain-injured patients. *Rehabilitation Psychology, 34,* 105-114.

Clare, I., & Clements, J. (1990). Social cognition and impaired social interaction in people with severe learning difficulties. *Journal of Mental Deficiency Research, 34,* 309-324.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* Hillsdale, NJ: Lawrence Welbaum Associates.

Combs, S. L., & Slaby, D. A. (1977). Social skills training with children. In B. B. Lahey & A. E. Kazdin (Eds.), *Advances in Clinical Child Psychology (Vol. 1).* New York: Plenum.

Costeff, H., Groswasser, Z., Landman, Y., & Brenner, T. (1985). Survivors of severe traumatic brain injury in childhood: I. Late residual disability. *Scandinavian Journal of Rehabilitation Medicine Supplement, 12,* 10-15.

Craft, S., Schatz, J., Glauser, T., Lee, B., & DeBaun, M. (1994). The effects of bifrontal stroke during childhood on visual attention: Evidence from children with sickle cell anemia. *Developmental Neuropsychology, 10,* 285-297.

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115,* 74-101.

Daigneault, S., Braun, C. M. J., & Whitaker, H. A. (1992). Early effects of normal aging in perseverative and nonperseverative prefrontal measures. *Developmental Neuropsychology, 8,* 99-114.

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (1986). *The California Verbal Learning Test - Research edition.* New York: Psychological Corporation.

Dennis, M. (1991). Frontal lobe function in childhood and adolescence: A heuristic for assessing attention regulation, executive control, and the intentional states important for social discourse. *Developmental Neuropsychology, 7,* 327-358.

Dennis, M., & Barnes, M. A. (1990). Knowing the meaning, getting the point, bridging the gap, and carrying the message: Aspects of discourse following closed head injury in childhood and adolescence. *Brain and Language, 39,* 428-446.

Denny, D. R., & Denny, N. W. (1973). The use of classification for problem-solving: A comparison of middle and old age. *Developmental Psychology, 9,* 275-278.

Derr, A. M. (1986). How learning disabled adolescent boys make moral judgements. *Journal of Learning Disabilities, 19,* 160-164.

Deshpande, S. A., Millis, S. R., Reeder, K. P., Fuerst, D., & Ricker, J. H. (1996). Verbal learning subtypes in traumatic brain injury: A replication. *Journal of Clinical and Experimental Neuropsychology, 18,* 836-842.

Dikmen, S., McLean, A., & Temkin, N. (1986). Neuropsychological and psychosocial consequences of minor head injury. *Journal of Neurology, Neurosurgery, and Psychiatry, 49,* 1227-1232.

Dishion, T. (1990). The family ecology of boys' peer relations in middle childhood. *Child Development, 61,* 874-892.

Dodge, K. A. (1980). Social cognition and children's aggressive behavior. *Child Development, 51,* 162-170.

Dodge, K. A. (1986). A social information processing model of social competence in children: In M. Perlmutter (Ed.), *Cognitive perspectives on children's social and behavioral development. The Minnesota Symposia on Child Psychology* (Vol. 18; pp. 77-126). Hillsdale, NJ: Erlbaum.

Drewe, E. A. (1975). Go-no go learning after frontal lobe lesions in humans. *Cortex, 11,* 8-16.

Eslinger, P. J., & Damasio, A. R. (1985). Severe disturbance of higher cognition after bilateral frontal ablation: Patient EVR. *Neurology, 35,* 1731-1741.

Eslinger, P. J., Grattan, L. M., Damasio, A. R., & Damasio, H. (1990). Childhood frontal lobe lesion and psychosocial development: Patient DT. *Journal of Clinical and Experimental Psychology, 12,* 94-95.

Finlayson, M. A., & Reitan, R. M. (1976). Handedness in relation to measures of motor and tactile-perceptual functions in normal children. *Perceptual and Motor Skills, 43,* 475-481.

Fleming, J. M., Strong, J., & Ashton, R. (1996). Self-awareness of deficits in adults with traumatic brain injury: how best to measure? *Brain Injury, 10,* 1-15.

Fordyce, D. J., & Roueche, J. R. (1986). Changes in perspectives of disability among patients, staff, and relatives during rehabilitation of brain injury. *Rehabilitation Psychology, 31,* 217-229.

French, D. C. (1990). Heterogeneity of peer rejected girls. *Child Development, 61,* 2028-2031.

Frederick, B. P., & Olmi, D. J. (1994). Children with attention-deficit/hyperactivity disorder: A review of the literature on social skills deficits. *Psychology in the Schools, 31,* 288-296.

Fuerst, D. R., & Rourke, B. P. (1993). Psychosocial functioning of children: Relations between personality subtypes and academic achievement. *Journal of Abnormal Child Psychology, 21,* 597-607.

Fuerst, D. R., & Rourke, B. P. (1995). Psychosocial functioning of children with learning disabilities at three age levels. *Child Neuropsychology, 1,* 38-55.

Ferguson, G. A. (1981). *Statistical analysis in psychology and education* (5th ed.). Montreal: McGraw-Hill Book Company.

Gallo, D. (1989). Educating for empathy, reason, and imagination. *The Journal of Creative Behavior, 23,* 98-115.

Goldstein, K. (1936a). The significance of the frontal lobes for mental performance. *Journal of Neurology and Psychopathology, 17,* 27-40.

Goldstein, K. (1936b). The modifications of behaviour consequent to cerebral lesions. *Psychiatric Quarterly, 10,* 586-610.

Goldstein, K. (1944). The mental changes due to frontal lobe damage. *Journal of Psychology, 17,* 187-204.

Gottlieb, J., Semmel, M. I., & Veldman, D. J. (1978). Correlates of social status among mainstreamed mentally retarded children. *Journal of Educational Psychology, 70,* 396-405.

Grattan, L. M., & Eslinger, P. J. (1991). Frontal lobe damage in children and adults: A comparative review. *Developmental Neuropsychology, 7,* 283-326.

Grattan, L. M., & Eslinger, P. J. (1992). Long-term psychological consequences of childhood frontal lobe lesion in patient DT. *Brain and Cognition, 20,* 185-195.

Grenell, M., Glass, C. R., & Katz, K. S. (1987). Hyperactive children and peer interaction: Knowledge and performance of social skills. *Journal of Abnormal Child Psychology, 15,* 1-13.

Gresham, F. M. (1981). Social skills training with handicapped children: A review. *Review of Educational Research, 51,* 139-176.

Gresham, F. M. (1986). Conceptual issues in the assessment of social competence in children. In P. S. Strain, M. J. Guralnick, & H. M. Walker (Eds.), *Children's social behavior: Development, assessment, and modification* (pp 143-179). Toronto: Academic Press, Inc.

Gresham, F. M., & Elliott, S. N. (1987). The relationship between adaptive behavior and social skills: Issues in definition and assessment. *The Journal of Special Education, 21,* 167-181.

Gresham, F. M., & Elliott, S. N. (1990). *Social Skills Rating System.* Circle Pines, MN: American Guidance Services.

Grodzinsky, G. M., & Diamond, R. (1992). Frontal lobe functioning in boys with attention-deficit hyperactivity disorder. *Developmental Neuropsychology, 8,* 427-445.

Guralnick, M. J. (1986). The peer relations of young handicapped and nonhandicapped children. In P. S. Strain, M. J. Guralnick, & H. M. Walker (Eds.), *Children's social behavior: Development, assessment, and modification* (pp. 93-140). Toronto: Academic Press, Inc.

Halperin, J. M., Healy, J. M., Zeitchik, E., Ludman, W. L., & Weinstein, L. (1989). Developmental aspects of linguistic and mnestic abilities in normal children. *Journal of Clinical and Experimental Neuropsychology, 11,* 518-528.

Halperin, J. M., Wolf, l. E., Greenblatt, E. R., & Young, J. G. (1991). Subtype analysis of commission errors on the continuous performance test in children. *Developmental Neuropsychology, 7,* 207-217.

Harlow, J. M. (1848). Passage of an iron bar through the head. *Boston Medical and Surgical Journal, 39,* 389-393.

Hart, T., & Jacobs, H. E. (1993). Rehabilitation and management of behavioral disturbances following frontal lobe injury. *Journal of Head Trauma Rehabilitation, 8,* 1-12.

Hartup, W. W. (1992). Peer relations in early and middle childhood. In V. B. Van Hasselt & M. Hersen (Eds.), *Handbook of social development: A lifespan perspective* (pp. 257-281). New York: Plenum Press.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G., & Curtiss, G. (1993). *Wisconsin Card Sorting Test manual: Revised and expanded.* Odessa, FL: Psychological Assessment Resources, Inc.

Hebb, D. O. (1945). Man's frontal lobes: A critical review. *Archives of Neurology and Psychiatry, 54,* 10-24.

Hebb, D. O., & W. (1940). Human behavior after extensive bilateral removal from the frontal lobes. *Archives of Neurology and Psychiatry, 44,* 421-438.

Hermann, B. P., Whitman, S., & Anton, M. (1992). A multietiological model of psychological and social dysfunction in epilepsy. In T. L. Bennett (Ed.), *The Neuropsychology of epilepsy* (pp. 39-57). New York: Plenum Press.

Howe, G. W., Feinstein, C., Reiss, D., Molock, S., & Berger, K. (1993). Adolescent adjustment to chronic physical disorders—I. Comparing neurological and non-neurological conditions. *Journal of Child Psychology and Psychiatry, 34,* 1153-1171.

Jacobs, M. P. (1993). Limited understanding of deficit in children with brain dysfunction. *Neuropsychological Rehabilitation, 3,* 341-365.

Johnston, C., Pelham, W. E., & Murphy, H. (1985). Peer relationships in ADDH and normal children: A developmental analysis of peer and teacher ratings. *Journal of Abnormal Child Psychology, 13,* 89-100.

Joschko, M. (1997). *Normative data for the Seidel Continuous Attention Test.* Unpublished manuscript, University of Victoria, Victoria, Canada.

Kelland, D. Z., Lewis, R., & Gurevitch, D. (1992). Evaluation of the Repeatable Cognitive-Perceptual-Motor Battery: Reliability, validity, and sensitivity to Diazepam. *Journal of Clinical and Experimental Neuropsychology, 14,* 65 (abstract).

Klöve, H. (1963). Clinical neuropsychology. In F. M. Forster (Ed.), *The medical clinics of North America.* New York: Saunders.

Kolb, B. (1990). Animal models for human PFC-related disorders. *Progress in Brain Research, 85,* 501-519.

Kolb, B., & Wishaw, J. (1985). *Fundamentals of human neuropsychology* (2nd ed.). New York: WH Freeman.

Kozeki, B., & Berghammer, R. (1992). The role of empathy in the motivational structure of school children. *Personality and Individual Differences, 13,* 191-203.

La Greca, A. M. (1981). Peer acceptance: The correspondence between children's sociometric scores and teacher ratings of peer interactions. *Journal of Abnormal Child Psychology, 9,* 167-178.

La Greca, A. M., & Stark, P. (1986). Naturalistic observations of children's social behavior. In P. S. Strain, M. J. Guralnick, & H. M. Walker (Eds.), *Children's social behavior: Development, assessment, and modification* (pp. 181-213). Toronto: Academic Press, Inc.

Leavell, C. A., & Entwistle, P. (1996). *The relationship between sustained attention, response inhibition and verbal learning in children with learning/attention problems.* Poster presented at the Twenty-Fourth Meeting of the International Neuropsychological Society, Chicago, Illinois.

Levine, M. J., Van Horn, K. R., & Curtis, A. B. (1993). Developmental models of social cognition in assessing psychosocial adjustments in head injury. *Brain Injury, 7,* 153-167.

Lezak, M. D. (1989). Assessment of psychosocial dysfunctions resulting from head trauma. In M. D. Lezak (Ed.), *Assessment of behavioral consequences of head trauma* (pp. 113-143). New York: Alan R. Liss, Inc.

Lezak, M. D. (1993). Newer contributions to the neuropsychological assessment of executive functions. *Journal of Head Trauma Rehabilitation, 8,* 25-33.

Lezak, M. D. (1995). *Neuropsychological assessment (3rd Ed.).* New York: Oxford.

Levin, H. S., Culhane, K. A., Hartmann, J., Evankovich, K.., Mattson, A. J., Harward, H., Ringholz, G., Ewing-Cobbs, L., & Fletcher, J. M. (1991). Developmental changes in performance on tests of purported frontal lobe functioning. *Developmental Neuropsychology, 7,* 377-395.

Levine, M. J., Van Horn, K. R., & Curtis, A. B. (1993). Developmental models of social cognition in assessing psychosocial adjustments in head injury. *Brain Injury, 7,* 153-167.

Libet, J. M., & Lewinsohn, P. M. (1973). Concept of social skills with special reference to the behavior of depressed persons. *Journal of Consulting and Clinical Psychology, 40,* 304-312.

Lorr, M. (1983). *Cluster analysis for social scientists: Techniques for analysing and simplifying complex blocks of data.* San Francisco: Jossey-Bass Publishers.

Macmillan, M. B. (1986). A wonderful journey through skull and brains: The travels of Mr. Gage's tamping iron. *Brain and Cognition, 5,* 67-102.

Marlowe, W. B. (1992). The impact of a right prefrontal lesion on the developing brain. *Brain and Cognition, 20,* 205-213.

Marsh, N. V., & Knight, R. G. (1991). Relationship between cognitive deficits and social skill after head injury. *Neuropsychology, 5,* 107-117.

Marsh, N. V., Knight, R. G., & Godfrey, H. P. D. (1990). Long-term psychosocial adjustment following very severe closed head injury. *Neuropsychology, 4,* 13-27.

Mateer, C. A., & Williams, D. (1991). Effects of frontal lobe injury in childhood. *Developmental Neuropsychology, 7,* 359-376.

Matier-Sharma, K., Perachio, N., Newcorn, J., Sharma, V., & Halperin, J. (1995). Differential diagnosis of ADHD: Are objective measures of attention, impulsivity, and activity level helpful? *Child Neuropsychology, 1,* 118-127.

McCarthy, D. (1970). *McCarthy Scales of Children's Abilities.* New York: Psychological Corporation.

McConnell, S. R., & Odom, S. L. (1986). Sociometrics: Peer-referenced measures and the assessment of social competence. In P. S. Strain, M. J. Guralnick, & H. M. Walker (Eds.), *Children's social behavior: Development, assessment, and modification* (pp. 215-284). Toronto: Academic Press, Inc.

McFall, R. M. (1982). A review and reformulation of the concept of social skills. *Behavioral Assessment, 4,* 1-33.

McGuire, T. L., & Rothenberg, M. B. (1986). Behavioral and psychosocial sequelae of pediatric head injury. *Journal of Head Trauma Rehabilitation,* 1-6.

McKay, K. E., Halperin, J. M., Schwartz, S. T., & Sharma, V. (1994). Developmental analysis of three aspects of information processing: Sustained attention, selective attention, and response organization. *Developmental Neuropsychology, 10,* 121-132.

McKay, S., & Ramsey, R. (1984). Neuropsychological correlates of sociometric status in alcoholics. *The International Journal of Clinical Neuropsychology, 6,* 191-197.

Minde, K. (1992). Aggression in preschoolers: Its relation to socialization. *Journal of the American Academy of Child and Adolescent Psychiatry, 31,* 853-862.

Morey, L. C., & Agresti, A. (1984). The measurement of classification agreement: An adjustment to the Rand statistic for chance agreement. *Educational and Psychological Measurement, 44,* 33-37.

Nelms, B. C. (1989). Emotional behavior of chronically ill children. *Journal of Abnormal Child Psychology, 17,* 657-668.

Newton, A., & Johnson, D. A. (1985). Social adjustment and interaction after severe head injury. *British Journal of Clinical Psychology, 24,* 225-234.

Norusis, M. J. (1992a). *SPSS/PC+ advanced statistics: Version 5.0.* Chicago: SPSS Inc.

Norusis, M. J. (1992b). *SPSS/PC+ professional statistics: Version 5.0.* Chicago: SPSS Inc.

Norusis, M. J. (1993). *SPSS for Windows base system user's guide: Release 6.0.* Chicago: SPSS Inc.

Papero, P. H., Prigatano, G. P., Snyder, H. M., & Johnson, D. L. (1993). Children's adaptive behavioural competence after head injury. *Neuropsychological Rehabilitation, 3,* 321-340.

Parker, J. G., & Asher, S. R. (1987). Peer relations and later personal adjustment: Are low-accepted children at risk? *Psychological Bulletin, 102,* 357-389.

Parmelee, A. (1986). Children's illnesses: Their beneficial effect on behavioral development. *Child Development, 57,* 1-10.

Passler, M. A., Isaac, W., & Hynd, G. (1985). Neuropsychological development of behavior attributed to frontal lobe functioning in children. *Developmental Neuropsychology, 1,* 349-370.

Paul, A. L., & Brown, W. S. (1996). Psychosocial deficits in agenesis of corpus callosum. Poster presented at the Twenty-Third Meeting of the International Neuropsychological Society, Chicago, Illinois.

Peatman, J. G. (1963). *Introduction to applied statistics.* New York: Harper & Row, Publishers.

Pelham, W. E., & Bender, M. E. (1982). Peer relationships in hyperactive children: Description and treatment. In K. D. Gadow & I. Bialer (Eds.), *Advances in learning and behavioral disabilities: A research annual* (Vol. 1, pp. 346-436). Greenwich, CT: JAI Press.

Pennington, B. E., & Welsh, M. (1995). Neuropsychology and developmental psychopathology. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental Psychopathology, Volume 1: Theory and methods* (pp. 254-290). Toronto: John Wiley & Sons.

Perrott, S. B., Taylor, H. G., & Montes, J. L. (1991). Neuropsychological sequelae, familial stress, and environmental adaptation following pediatric head injury. *Developmental Neuropsychology, 7,* 69-86.

Petterson, L. (1988). *Sensitivity to emotional cues and social behavior in children and adolescents after head injury.* Ph.D. dissertation, University of Minnesota.

Pettit, G. S. (1992). Developmental theories. In V. B. Van Hasselt & M. Hersen (Eds.), *Handbook of social development: A lifespan perspective* (pp. 3-28). New York: Plenum Press.

Pope, A. W., Bierman, K. L., & Mumma, G. H. (1989). Relations between hyperactive and aggressive behavior and peer relations at three elementary grade levels. *Journal of Abnormal Child Psychology, 17,* 253-267.

Porteus, S. D. (1959). *The Maze Test and clinical psychology.* Palo Alto, CA: Pacific Books.

Priddy, D. A., Mattes, D., & Lam, C. S. (1988). Reliability of self-report among non-oriented head-injured adults. *Brain Injury, 2,* 249-253.

Price, B. H., Daffner, K. R., Stowe, R. M., & Mesulam, M. M. (1990). The comportmental learning disabilities of early frontal lobe damage. *Brain, 113,* 1383-1393.

Prigatano, G. P., & Schacter, D. (1991). *Awareness of deficit after brain injury: Clinical and theoretical issues.* New York: Oxford University Press.

Psychological Corporation. (1992). *Wechsler Individual Achievement Test.* New York: Author.

Putallaz, M. (1983). Predicting children's social status from their behavior. *Child Development, 54,* 1417-1426.

Rand, W. M. (1971). Objective criteria for the evaluation of clustering methods. *Journal of the American Statistical Association, 66,* 846-850.

Renshaw, P. D., & Asher, S. R. (1983). Children's goals and strategies for social interaction. *Merrill-Palmer Quarterly, 29,* 353-374.

Restak, R. (1984). Possible neurophysiological correlates of empathy. In J. Lichtenberg, M. Bornstein, & D. Silver (Eds.), *Empathy I* (pp. 63-75). Hillsdale, N.J.: Lawrence Erlbaum.

Riccio, C. A., Hall, J., Morgan, A., Hynd, G. W., & Gonzalez, J. J. (1994). Executive function and the Wisconsin Card Sorting Test: Relationship with behavioral ratings and cognitive ability. *Developmental Neuropsychology, 10,* 215-229.

Rubin, K. H. (1985). Socially withdrawn children: An "at risk" population? In B. H. Schneider, K. H. Rubin, & J. E. Ledingham (Eds.), *Children's peer relations: Issues in assessment and intervention.* New York: Springer-Verlag.

Rubin, K. H., & Krasnor, L. R. (1986). Social-cognitive and social behavioral perspectives on problem solving. In M. Perlmutter (Ed.), *Cognitive perspectives on children's social and behavioral development. The Minnesota Symposia on Child Psychology* (Vol. 18; pp. 1-68). Hillsdale, NJ: Erlbaum.

Rubin, K. H., & Rose-Krasnor, L. (1992). Interpersonal problem-solving and social competence in children. In V. B. Van Hasselt & M. Hersen (Eds.), *Handbook of social development: A lifespan perspective* (pp. 283-323). New York: Plenum Press.

Sattler, J. M. (1992). *Assessment of children.* San Diego: Jerome M. Sattler, Publisher.

Saver, H., & Damasio, A. R. (1991). Preserved access and processing of social knowledge in a patient with acquired sociopathy due to ventromedial frontal damage. *Neuropsychologia, 29,* 1241-1249.

Segalowitz, S. J., Unsal, A., & Dywan, J. (1992). Cleverness and wisdom in 12-year-olds: Electrophysiological evidence for late maturation of the frontal lobe. *Developmental Neuropsychology, 8,* 279-298.

Seidel, W. T. (1988). *Assessment of attention in children.* Unpublished doctoral dissertation, University of Victoria, Victoria, B.C.

Seidel, W. T., & Joschko, M. (1991). Assessment of attention in children. *The Clinical Neuropsychologist, 5,* 53-66.

Selman, R. L. (1971). Taking another's perspective: Role-taking development in early childhood. *Child Development, 42,* 1721-1734.

Shallice, T. (1982). Specific impairments in planning. *Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences (London), 298,* 199-209.

Sheslow, D., & Adams, W. (1990). *Wide Range Assessment of Memory and Learning: Administration manual.* Wilmington, DE: Authors.

Shure, M. B. (1981). Social competence as a problem-solving skill. In J. D. Wine & M D. Smye (Eds.), *Social Competence* (pp. 158-185).

Sohlberg, M. , & Mateer, C. A. (1989). *Introduction to cognitive rehabilitation theory and practice.* New York: The Guilford Press.

Spivack, G. (1973). Problem-solving thinking and mental health. *The Forum, 2,* 58-73.

Spivack, G., Platt, J., & Shure, M. B. (1976). *The problem-solving approach to adjustment.* San Francisco: Jossey-Bass.

Spivack, G., & Shure, M. B. (1974). *Social adjustment of young children: A cognitive approach to solving real-life problems.* San Francisco: Jossey-Bass.

Spreen, O., & Strauss, E. (1991). *A compendium of neuropsychological tests: Administration, norms, and commentary.* New York: Oxford.

Steegman, A. T. (1962). Dr. Harlow's famous case: The "impossible" accident of Phineas P. Gage. *Surgery, 52,* 952-958.

Stein, R. E. K., & Jessop, D. I. (1982). What diagnosis does not tell: The case for a non-categorical approach to chronic physical illness. *Pediatric Research, 16,* 188A.

Stodden, V. S., Gresham, F. M., & Scott, N. A. (1982). Validity of Social Behavior Assessment in discriminating emotionally disabled from nonhandicapped students. *Journal of Behavioral Assessment, 4,* 327-341.

Stokes, A., Bawden, H, N, Camfield, P. R., Backman, J. E., & Dooley, J. M. (1991). Peer problems in Tourette's disorder. *Pediatrics, 87,* 936-942.

Stumme, V. S., Gresham, F. M., & Scott, N. A. (1982). Validity of Social Behavior Assessment in discriminating emotionally disabled from nonhandicapped students. *Journal of Behavioral Assessment, 4,* 327-342.

Stuss, D. T. (1991). Self, awareness, and the frontal lobes: A neuropsychological perspective. In J. Strauss & G. R. Goethals (Eds.), *The self: Interdisciplinary approaches* (pp. 255-278). New York: Springer-Verlag.

Stuss, D. T. (1992). Biological and psychological development of executive functions. *Brain and Cognition, 20,* 8-23.

Stuss, D. T., & Benson, D. F. (1984). *Neuropsychological studies of the frontal lobes. Psychological Bulletin, 95,* 3-28.

Tabachnick, B. G., & Fidell, L. S. (1989). *Using multivariate statistics (2nd ed.)* New York: Harper-Collins.

Taylor, E. H., & Cadet, J. L. (1989). Social intelligence, a neurological system? *Psychological Reports, 64,* 423-444.

Thorndike, R. L., Hagen, E. P., & Sattler, J. M. (1986). *Stanford-Binet Intelligence Scale: Fourth Edition Technical Manual.* Chicago, IL: The Riverside Publishing Company.

Tranel, D., Anderson, S. W., & Benton, A. (1994). Development of the concept of 'executive function' and its relationship to the frontal lobes. In F. Boller & J. Grafman (Eds.), *Handbook of neuropsychology* (pp. 125-147).

Trites, R. L. (1977). *Neuropsychological Test Manual.* Ottawa, Ontario: Royal Ottawa Hospital.

Tyron, R. C., & Bailey, D. E. (1970). *Cluster analysis.* Toronto: McGraw-Hill Book Company.

Van Hasselt, V. B., Hersen, M., Whitehill, M. B., & Bellack, A. S. (1979). Social skill assessment and training for children: An evaluative review. *Behaviour Research and Therapy, 17,* 413-437.

Varney, N. R., & Menefee, L. (1993). Psychosocial and executive deficits following closed head injury: Implications for orbital frontal cortex. *Journal of Head Trauma Rehabilitation, 8,* 32-41.

Vosk, B., Forehand, R., Parker, J. B., & Rickard, K. (1982). A multimethod comparison of popular and unpopular children. *Developmental Psychology, 18,* 571-575.

Walker, H., & McConnell, S. (1988). *Walker-McConnell scale of social competence and school adjustment.* Austin, TX: PRO-ED.

Wechsler, D. (1991). Wechsler Intelligence Scale for Children - Third Edition. New York: Psychological Corporation.

Welsh, M. C., Pennington, B. F., & Groisser, D. B. (1991). A normative-developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology, 7,* 131-149.

Weyandt, L., & Willis, W. G. (1994). Executive functions in school-aged children: Potential efficacy of tasks in discriminating clinical groups. *Developmental Neuropsychology, 10,* 27-38.

Williams, D., & Mateer, C. A. (1992). Developmental impact of frontal lobe injury in middle childhood. *Brain and Cognition, 20,* 196-204.

Wirt, R. D., Lachar, D., Klinedinst, J. K., & Seat, P. D. (1984). *Multidimensional description of child personality: A manual for the Personality Inventory for Children, Revised.* Los Angeles, CA: Western Psychological Services.

Ylvisaker, M. (1993). Communication outcome in children and adolescents with traumatic brain injury. *Neuropsychological Rehabilitation, 3,* 367-387.

Ylvisaker, M. , & Szekeres, S. F. (1989). Metacognitive and executive impairments in head injured children and adults. *Topics in Language Disorders, 9,* 34-49.

Zahn-Waxler, C., & Smith, K. D. (1992). The development of prosocial behavior. In V. B. Van Hasselt & M. Hersen (Eds.), *Handbook of social development: A lifespan perspective* (pp. 229-256). New York: Plenum Press.

APPENDIX A

CASE EXAMPLES

CASE 1

Robin, a good problem-solver and well-adjusted child, was seen exercising her skills. She wanted Melissa to give her the water cup (containing plant seeds). When Melissa said, "No, I need them" (the seeds), Robin did not create a new problem by reacting impulsively. Her ability to think of other options led her to another tactic. "When I get the big bike, I'll let you ride it." Defiantly, Melissa shouted, "I said NO!" Robin then asked, "What are you going to do with those seeds?" and Melissa answered, "Grow them". A few minutes later, Robin returned with a sand shovel, and offered, "I'll bury some and you bury some. Two of the flowers can be yours and two can be mine. How's that?" Melissa and Robin began to count the seeds, each burying "their own" in the dirt.

From Shure, M. B. (1981). Social competence as a problem-solving skill. In J. D. Wine & M. D. Smye (Eds.), *Social competence* (158-185).

CASE 2

Joshua and Nathan are fifth-grade children who are the best of friends. Most of the time, their interactions lead the parents of both children to assume that both partners operate on some type of "cooperative automatic pilot".

JOSH: (as Nathan comes through the front door). Hi Nathan, how're you doin'?

NATHAN: O.k., how're you? (not waiting for an answer) Wanna go upstairs and play Nintendo hockey?

JOSH: Sure, I'll be Team Canada...o.k.? You can be Team USA.

NATHAN: O.k., but I'll be Team Sweden, not USA.

This episode was entirely predictable–from standard greeting behavior, to the request to play ice hockey, to the choice of teams. The behavior of both children appeared to be script driven. After the first 15-minute game, however, script-driven behavior was precluded.

NATHAN: This time I'll be Team Canada...you always get to be them.

JOSH: No way! In my house, I'm Canada, and in your house, you're always Canada. (Canadian children rarely show nationalistic behavior

unless it is in the context of an ice-hockey match). You can be Russia this time.

NATHAN: Nope. Canada's the best team; we need to take turns. So tomorrow, at my place, we'll take turns too.

JOSH: I'll be Team Sweden, you can be Team Canada. But remember, at your house I'll get to be Canada, right?

In this sequence, Nathan had a particular social *goal* that precluded the children's following their usual "Nintendo script". He wanted to gain access to his favourite hockey team. Nathan used the *strategy* of employing the imperative to let Josh know what he wanted. The *outcome* of his initial attempt, however, was a failure. Nathan then produced a *flexible* move to achieve his goal [...] and it proved successful (p. 289).

From Rubin, K. H., & Rose-Krasnor, L. (1992). Interpersonal problem-solving and social competence in children. In V. B. Van Hasselt & M. Hersen (Eds.), *Handbook of social development: A lifespan perspective* (pp. 283-323). New York: Plenum Press.

APPENDIX B

SELECTED EXAMPLES FROM THE BLISHEN SCALES

OCCUPATION	SES INDEX
Government Administrators	66.84
Economists	69.18
Physicians	101.32
Lawyers	75.60
Geologists	71.01
Psychologists	62.26
University Teachers	75.87
Elementary Teachers	63.64
Registered Nurses	55.26
Secretaries	41.82
General Office Clerks	37.93
Real Estates Salespersons	49.99
Security Guards	31.95

Janitors	26.36
Bakers	30.55
Sawmill Sawyers	33.71
Welders	41.42
Shoemakers	25.37
Construction Electricians	47.94
Bus Drivers	34.93

APPENDIX C

FORMULA FOR THE CORRECTION FOR ATTENUATION

The formula for adjusting correlations according to the reliability of the measures used is as follows:

$$r_{T_xT_y} = \frac{r_{xy}}{\sqrt{r_{xx}r_{yy}}}$$

Where

r_{TxTy} = correlation between Test x and Test y

r_{xx} = reliability of Test x

r_{yy} = reliability of Test y

Note. From Ferguson, G. A. (1981). *Statistical analysis in psychology and education* (5th ed.). Montreal: McGraw-Hill Book Company, and Peatman, J. G. (1963). *Introduction to applied statistics.* New York: Harper & Row, Publishers.

APPENDIX D

FORMULA FOR DETERMINING STATISTICAL SIGNIFICANCE BETWEEN CORRELATIONS

The test of significance for correlations of related samples is as follows.

$$t = \frac{(r_{2g} - r_{1g})\sqrt{(n-3)(1+r_{12})}}{\sqrt{2(1-r_{1g}^2 - r_{2g}^2 - r_{12}^2 + 2r_{1g}r_{2g}r_{12})}}$$

Where

r_{12} = correlation between variable 1 and variable 2

r_{1g} = correlation for variable 1

r_{2g} = correlation for variable 2

n = sample size

Note. From: Peatman, J. G. (1963). *Introduction to applied statistics.* New York: Harper & Row, Publishers.

APPENDIX E

FORMULA FOR DETERMINING THE KAPPA STATISTIC

The formula for determining agreement between clusters is as follows.

$$kappa = \frac{P_o - P_c}{1 - P_c}$$

Where

P_o = observed proportion of agreement

P_c = proportion of chance agreement

Note. From: Lorr, M. (1983). *Cluster analysis for social scientists: Techniques for analysing and simplifying complex blocks of data.* San Francisco: Jossey-Bass Publishers.