CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The transition from preschool into formal school has been described as one of the major challenges and turning points young children in the western world are required to face in their early childhood years (Trudge, et al, 2003). School readiness is the term commonly used to describe a young child’s preparedness for formal schooling (Deitzmann, Watters & Fox, 2001; Janus & Offord, 2007; McBryde, Ziviani & Cuskelly, 2004; NSW Parenting Centre, 2003; Public Education NSW, 2008; Sherry, 2003). Occupational therapists are playing an increasing role in the transition of preschool children into formal schooling (Children’s Hospital at Westmead, Occupational Therapy Department, 2010; McBryde, Ziviani & Cuskelly, 2006).

There are currently no clear school readiness markers or comprehensive assessments that can be used to provide a definitive decision about readiness for school. Instead generalised checklists describing behaviours or levels of skill in developmental tasks exist that can be used to guide decisions about readiness (Aiossa, 2005; Cochran, 2003). Many children who are thought to be developing typically are found to display difficulties with the transition into formal schooling in the first year at school and beyond. The literature indicates that the ability to process information in situations of social and academic learning as well as task mastery impact on an individual’s readiness for school (Scrimsher, College & Tudge, 2003).

Information processing is conceptualized as a cycle of learning (Chapparo & Ranka, 2003; Law, Miisiuna, Pollock & Stewart, 2001). Children gather information from
people, things, and events in their environment. They organize this information in their minds and code it in ways that keep it usable and easily understood (Bohannon & Bonvillian, 2005). Children develop a large repertoire of automatic thinking skills, making performance quick and easy. These automatic skills are used to solve problems and contribute to new learning, allowing children to become ‘independent learners’ (Chapparo, 2010), the very skills generally regarded as essential for success at school. Central to information processing theory is that learning requires deliberate application of information processing strategies, and that disordered learning emerges when there are persistent processing errors at any point in this process (Chapparo & Ranka, 2003; Law, Missiuna, Pollock & Stewart, 2001).

1.2 RESEARCH NEED

There is a range of formal ‘school readiness’ measures and assessments, as well as many informal school readiness checklists, currently in use to determine the readiness of Australian preschool children to begin formal schooling (Aiossa, 2005; Cochran, 2003; Janus & Offord, 2007; McBryde, Ziviani & Cuskelly, 2006; Meisels, 1999). The majority of these are screening assessments that are used to identify children at risk of failure rather than reflecting on actual readiness for school (Meisels, 1999) and most do not identify particular areas of difficulty in individual children (Jannus & Offord, 2007). There is a clear requirement to establish more objective measures of school readiness as preschool aged children move through the preschool years and into formal schooling. No published data are available regarding numbers of Australian children who experience difficulty with transition into their first year at school, although data from Canada and the United States indicates that around 25% of children in the first years of
school experience cognitive and behavioural problems that prevent them taking full advantage of school education (Janus & Offord, 2007). Informal data, from currently practicing Australian teachers in NSW primary schools, indicates that as many as one in five Kindergarten children experience difficulties transitioning into formal school (Aspin, 2009; Burling, 2004; Carrol, 2009; Cowley, 2006; Thorne, 2004).

School readiness has been broadly regarded as an outcome of the preschool years (Dockett & Perry, 2001; Kagan & Rigby, 2003; McBryde, Ziviani & Cuskelly, 2006; NSW Parenting Centre, 2003). As such, the readiness of preschool children for the commencement of formal school can also be classified as a measurable health outcome in the paediatric population. Better measures are required to determine this actual readiness and guide interventions aimed at those children deemed ‘unready’. This view is supported by the numerous discussion papers and reports commissioned by government bodies in many western nations (CCCH, 2008a; CCCH, 2008b; CCCH & Telethon Institute for Child Health Research, 2007; Kagan & Rigby, 2003; NSW Parenting Centre, 2003). Readiness for school and successful assumption of the school student role in the early school years can potentially have long-term consequences for academic achievement, impacting school drop-out rates and participation in future work force.

The unique domain of occupational therapy is occupational performance (AOTA, 2002) and occupational therapists have expertise in both the assessment and remediation of areas of occupational dysfunction. Occupational therapists are in a unique position to assess school readiness as one of these domains of childhood occupational performance. From a developmental perspective, preschool and early school aged children are expanding and developing their ability to apply information processing strategies in...
situations of formal and informal learning (Berk, 2003; Berger, 2003; Boulton-Lewis, 1994; Halford, 1989; Klahr & MacWhinny, 1998). It is widely accepted that learning in the early childhood years is largely done through the medium of play (Bundy, 1997; Parham & Primeau, 1997; Vygotsky, 1976) and play skills, particularly pretend play skills, provide insight into cognitive development (Rutherford & Rodgers, 2003; Stagnetti, 2003; Stagnetti, Unsworth & Rodger, 2000).

As a person’s ability to apply effective information processing strategies impacts on successful task performance and completion (Chapparo & Ranka, 1997; Chapparo, 2010), the assessment of a preschool child’s capacity to apply information processing strategies during performance of school tasks may provide insight into aspects of readiness for school and the occupational roles that school demands. This research focuses on the information processing strategy use of typically developing preschool and school aged children as well as their preschool and school performance from the perspectives of their preschool and school teachers.

This study followed a small cohort of 32 typically developing children from their final years in preschool through until the end of Kindergarten, the first year in formal schooling in New South Wales, Australia. At approximately six monthly intervals the children’s information processing strategy application abilities were assessed using an occupational therapy information processing strategy application assessment, the Perceive, Recall, Plan and Perform Assessment of Task Analysis (Chapparo & Ranka, 1997).

The study aimed to investigate information processing strategy application in typically developing preschool and school aged children, as measured by the Perceive, Recall, Plan and Perform System of Task Analysis (PRPP), an occupational therapy assessment
specifically developed to measure cognitive strategy use. The purpose of the study was to explore the concept of information processing strategy application as a predictor of later school performance and thus an indicator of school readiness in preschool aged children.

1.3 RESEARCH QUESTIONS

The primary aim of this research was to examine information processing strategy application in typically developing preschool and school aged children and determine its impact on ongoing school performance and school readiness. The following questions guided the study:

1.3.1 Research Question One

What is the range of information processing strategy application ability found in a sample of typically developing preschool and school aged children without prior diagnosis of any learning or motor disorder, as assessed by the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis (Chapparo & Ranka, 1997)?

1.3.2 Research Question Two

Which areas of information processing strategy application are more or less efficient than other strategy application areas in typically developing preschool and school aged children, as assessed by the PRPP System of Task Analysis?

1.3.3 Research Question Three

How does strategy application change in children as they move through preschool and into the first year of formal schooling?
1.3.4 Research Question Four

What was the agreement between a specifically designed questionnaire completed by a preschool or school teacher, based on PRPP information processing behaviours and the information processing strategies as scored by a trained therapist using the PRPP System of Task Analysis?

1.3.5 Research Question Five

What correlation exists between the results of an information processing strategy application assessment, the PRPP System of Task Analysis and teacher assessment of class performance at the end of preschool and in the final term of Kindergarten as children near the move into Year 1, the second year of formal schooling in NSW?

1.3.6 Research Question Six

What is the relationship between information processing strategy application as assessed by the PRPP System and reading and handwriting ability as typically developing children move into formal schooling?

1.3.7 Research Question Seven

What is the congruence between the PRPP System of Task Analysis, an information processing strategy application assessment and pretend play as measured by the Child Initiated Pretend Play Assessment (ChIPPA), an assessment of children’s pretend play?
1.4 DEFINITION OF TERMS

1.4.1 Typical development

Typically developing children are defined as those children who are following the sequential changes in function and ability that occur with maturation, as seen in the majority of the population. The children in this study have been referred to as typically developing as they had no prior identified learning or motor delay at the time of their recruitment to the study nor during the course of the study.

1.4.2 Preschool

In Australia, preschool is a non compulsory period of planned education for children before the commencement of statutory education, usually attended between the ages of three and five. Preschool education is child focused and directed primarily at pre academic education and child development (Australian Education Union, 2007). Preschool may also be known or referred to as long day care in New South Wales, Australia where this study was conducted. In this study children are referred to as of preschool age between the ages of approximately three and five and a half, before they commenced formal schooling.

1.4.3 School or Formal School

School is defined as a period of compulsory education, attended between the ages of approximately 5 years and 16 years. In New South Wales, Australia, children may commence their first year of formal school, known as Kindergarten, if they turn five before the 31st July of that year and by law must have commenced school by their sixth birthday. In this study children have been referred to as school age once they have
commenced Kindergarten at formal school. School, by its very nature, is a place of continual academic learning.

1.4.4 School Readiness

School readiness is a widely used phrase that generally describes a child’s readiness to commence formal schooling. It encompasses such aspects as chronological age, fine and gross motor skills, social and emotional characteristics, pre-academic performance, physical well being, language skills and cognitive development. In this study school readiness is investigated from a cognitive information processing strategy application perspective and the term school readiness is used to reflect only this aspect of readiness for school and not necessarily as an overall indicator of an individual’s readiness for school.

1.4.5 Cognition

Cognition has been defined as the processes of the mind by which people become aware of the object of thought and perception, including all aspects of perceiving, remembering, thinking and planning (Berger, 2002). Cognition is one of the domains of concern of the occupational therapy profession (AOTA, 2002). In relation to preschool and school children, cognition refers to the student’s capacity to gather and use relevant information to perform the tasks required for or directed by the relevant curriculum. This study focuses on the information processing perspective of cognition and the application of information processing strategies as seen in the targeted preschool and early school age population.
1.4.6 Information processing strategies

Information processing is comprised of many individual areas, all of which interact to receive, store, retrieve and use knowledge (Law, Missiuna, Pollock & Stewart, 2001). It encompasses such areas as attention, memory, problem solving and thinking skills (Berk, 2003). Information processing strategies are small internally generated segments of behaviour that as an entire unit work together to guide information processing during task performance. Information processing strategies develop rapidly in the preschool and early school years (Berk, 2003; Berger, 2002; Boulton-Lewis, 1994), impacting on the developing child’s ability to manage and succeed in the academic and social environment that comprises formal schooling in Australia.

1.4.7 Information processing strategy use

Information processing strategy use refers to the ability to select segments of behaviour and generate an approach that will effectively enable completion of a task. In this study, information processing strategy application will be referred to as strategy application. Strategy application processes are sequential (Huitt, 2003) and deficits in information processing occur when strategy application breaks down at any point during the process. Efficient strategy application occurs when a child applies effective information processing strategies, as demanded by the task and context, and is able to complete tasks to a level expected in an efficient and timely manner. This is demonstrated by efficient strategy application in the areas of attention, searching for and locating required information and tools, recalling task steps and outcomes, and systematic planning of the task resulting in efficient task performance.

Inefficient information processing strategy application occurs when there is an ineffective application of information processing strategies resulting in poor task
performance. This is demonstrated by poor attention skills, a limited ability to remember and follow instructions, poor ongoing monitoring of performance and a resultant task outcome below a level expected of a child of that age.

1.4.8 Occupational performance

Occupational performance is the ability to carry out and accomplish selected activities of daily life including, education, work, play, leisure and social participation (AOTA, 2002). Occupational performance refers to “The ability to perceive, desire, recall, plan and carry out roles, routines, tasks and sub-tasks for the purpose of self-maintenance, productivity, leisure and rest in response to demands of the internal and/or external environment” (Chapparo & Ranka, 1992, p.56).

1.4.9 Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis

The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis is a criterion referenced occupational therapy assessment that investigates how information processing strategies are applied during occupational performance (Chapparo & Ranka, 1997b; 2003). This assessment will be referred to as The PRPP System throughout this document. The PRPP System uses a two stage assessment approach: Stage 1 is a task analysis approach identifying errors in performance and Stage 2 is a cognitive task analysis that evaluates information processing strategies applied during task performance. This study has focused on Stage 2 analysis and unless otherwise stated all references to the PRPP System refer to Stage 2 analysis using this assessment tool.

1.4.10 Child Initiated Pretend Play Assessment (ChIPPA)

The Child Initiated pretend Play Assessment (ChIPPA) a norm referenced, standardised assessment designed to quantify a child’s self-initiated pretend play ability (Stagnitti,
2000). The ChIPPA was designed, based on cognitive developmental theory, to measure cognitive play skills and a child’s ability to initiate play.

1.4.11 Pretend Play

Pretend play includes the ability to spontaneously use symbols in play, to substitute objects, refer to absent objects and to attribute properties to objects (Bergen, 2002; Doe, 1997; Stagnitti & Unsworth, 2000). These abilities seen in pretend play highlight the unique cognitive input pretend play requires. Pretend play is the result of a child’s creativity and gives the child a sense of control, promotes self-esteem and new ideas and provides the child with a chance to learn new things (Doe, 1997).

1.5 SCOPE AND SIGNIFICANCE OF THE STUDY

This study used a standardised, criterion based information processing assessment to follow the information processing skills of 32 preschool aged children as they moved into formal schooling. This study provides a clinical research model that investigates the impact of information processing strategy application on preschool and later, school performance. There is little or no longitudinal research in the field of occupational therapy into school readiness, yet this is one of the main focuses of paediatric occupational therapy. This study, although limited by a small cohort, contributes to the field of information processing strategy application development in children as well as to the impact of information processing strategy application on school readiness in children transitioning from preschool into formal school. Caution is warranted in applying the results of this study to the general population of children.
1.6 DESIGN AND OVERVIEW OF THE STUDY

This study was a longitudinal study following a cohort of 32 typically developing children from preschool into formal school. Participants were seen five times at approximately six monthly intervals from 18 months prior to school entry until the end of their first year at formal school. Information processing strategy application abilities were assessed at each data collection time. In addition to strategy application, data from a variety of other assessments and questionnaires were collected. Table 1.1 outlines the format of this thesis.
Table 1.1: Thesis outline

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<thead>
<tr>
<th>Section</th>
<th>Reported Chapter</th>
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<td>Background</td>
<td>Two</td>
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| The literature review provides a review of the main themes of the study. Concepts examined include occupational performance, child development, cognition, information processing, information processing theories, pretend play, school readiness and assessments utilised including the PRPP and ChIPPA.

<table>
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<tr>
<th>Methods</th>
<th>Three</th>
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| A summary of the methodology is provided. This includes the study design, participant recruitment, data collection instruments, details of the phases of data collection and an overview of statistical analyses utilised.

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<th>Results</th>
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| This section reports the research findings. Each of the research questions are addressed individually. A Rasch analysis is also discussed.

<table>
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<th>Case Studies</th>
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| Three case studies are presented to illustrate the differing information processing profiles of three typically developing children across the time span of the study.

<table>
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<th>Discussion and Conclusion</th>
<th>Six</th>
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| A discussion of the main research findings, the significance and limitations of the research, recommendations and conclusion are presented in this chapter.

1.7 OUTCOME OF RESEARCH

This study provides a model for research into information processing strategy application development in typically developing children and the impact information processing strategies can have on school readiness and the transition into formal school. Differences in information processing capacities can be clearly identified during task performance in typically developing preschool children and the application of efficient
and inefficient information processing strategies continue as children moved into formal schooling. Assessment of strategy application abilities could be used as one indicator of a preschool child’s readiness for formal schooling and in particular as an indicator of their readiness to learn. The results of this study provide preliminary evidence that the assessment of information processing strategy application abilities in preschool children can be used as an indicator of school readiness as children approach the move to formal school at the end of their preschool years.
CHAPTER TWO
LITERATURE REVIEW

The purpose of this chapter is to provide a comprehensive review of the concepts addressed in this study. The themes examined include occupational performance, child development, cognition, information processing, play, preschool and school curriculums in Australia, and school readiness. There are three broad sections to the chapter. The first section will explore occupational performance, one of the theoretical perspectives that support the study and the domain of practice of occupational therapy for children. The occupational performance roles and capacities of typically developing children will be presented as well as an overview of typical childhood development during the preschool and early school years. The second section will present an overview of cognition and specifically, an information processing view of cognition. Various developmental theories of cognition will be presented as well as typical cognitive development during the preschool and early school years. Play and its importance to and impact on typical childhood development will be discussed and the link between cognition and pretend play will also be presented. The third section of this chapter will review current preschool curriculum in Australia and present views on factors that contribute to school readiness in typically developing Australian children. A review of current checklists and school readiness assessments will be presented.

2.1 OCCUPATIONAL PERFORMANCE

Occupational therapy is concerned with people and their ability to function within their own environment (AOTA, 2002). As occupational therapy (OT) has evolved as a
profession, theorists have developed theories of occupation and occupational performance, integrating elements of theories that are aligned with particular perspectives of occupation (Brown, Rodger, Brown & Roever, 2005; Fearing, Law & Clark, 1997; Ikiugu, Smallfield & Condit, 2009; Kielhofner, 2004; Reed & Sanderson, 1992). The past few decades have seen the emergence of many conceptual models in occupational therapy practice and education (Reed, 1984). The development over the past 30 years of one concept, termed occupational performance, is one that is able to explain and define occupational therapy theory and practice (AOTA, 2002; Chapparo & Ranka, 1997; Llorens, 1982; Reed & Saunderson, 1992; and Whiteford & Fossey, 2002). More recently this concept has evolved into specific frameworks that guide client intervention and provide outcome measures (Canadian Occupational Performance Measure, Law et al. 1994; Occupational Performance Model: Australia, Chapparo & Ranka, 1997a) and also provide terminology classification systems (Chapparo & Ranka, 1997a).

Many of the more recent occupational therapy models focus on occupation and its relationship to client centred practice (Canadian Association of Occupational Therapy, 1997; Chapparo & Ranka, 1997; Keilhofner, 2004). For the purposes of this research the Occupational Performance Model (Australia) OPM(Aus), (Chapparo & Ranka, 1997a) will be used as a frame of reference to consider all the aspects of children’s preschool and school performance.

The Occupational Performance Model (Australia) (Chapparo & Ranka, 1997a) represents and illustrates the domain of concern that is occupational therapy. Its basic premise is that all people carry out roles by engaging in routines, tasks and sub-tasks in a way that supports their roles related to self-maintenance, productivity, leisure and rest.
Performance of everyday routines, tasks and sub-tasks is thought to be influenced by the various performance components in the biomechanical, sensory-motor, cognitive, interpersonal and intrapersonal domains, as well as by the physical, social, cultural and sensory environments that surround each person (Chapparo & Ranka, 1997a). This model highlights the importance of the core elements of a person, being the body, mind and spirit, which “represent the essence of that person” (Ranka, 2003, p.4) as well as consideration of a person’s sense of place and fit in the time and space continuum.

Performance deficits in any domain may influence occupational performance by limiting a person’s ability to perform necessary and valued occupational performance roles. All aspects of this model are of equal importance and are interrelated (as shown in the OPM (Aus) Model diagram, Figure 2.1), indicating that all aspects of occupational performance be considered for each individual's situation.
Information processing strategy application, the focus of this study, falls largely under the area of cognition, one of the occupational performance components. The cognitive component of the OPM (Aus) refers to the “operation and interaction of and between mental processes used during task performance” (Chapparo & Ranka, 1997a, p10). Information processing ability is also influenced by the biomechanical and sensory-motor components of occupational performance. Cognition is directly linked to the other occupational performance components as well as the occupational performance areas, impacting on occupational role and being influenced by the environments that surround the person. These links and influences are graphically demonstrated on the Occupational Performance Model (Australia) diagram (Figure 2.1).
2.1.1 Occupational performance roles of the preschool and school aged child

Roles are defined in the occupational therapy literature as “a set of behaviours that have some socially agreed upon function and for which there is an accepted code of norms” (Christianson & Baum, 1997, p.56). Occupational performance roles are made up of patterns of behaviour and action determined by each individual’s daily routine requirements in the areas of self-maintenance, productivity, leisure and rest in response to internal and/or external environmental demands (AOTA, 2002; Chapparo & Ranka, 1997a). Roles are founded through need and/or choice and are influenced by many factors, including age, ability and circumstance and they change throughout the lifespan (Chapparo & Ranka, 1997; Rodger & Ziviani, 2006). The ability to satisfactorily carry out valued roles results in feelings of competence and efficaciousness (Fidler & Fidler, 1978; Llorens, 1991). Successful role attainment leads to strong social approval while unsuccessful role attainment and failure to meet role expectations may result in strong social disapproval (Rodger & Ziviani, 2006).

This research focuses on children in the final years of preschool and the first years of compulsory schooling. The occupational performance roles of all children are the result of their environmental expectations, supports and constraints (Case-Smith, 2001; Rodger & Ziviani, 2006). The occupational therapy literature suggests that the two main occupational performance roles of the preschool child are those of player and self maintainer (Bundy, 1997; Case-Smith, 2001; Chapparo & Ranka, 1997a; Knox, 1997; Primeau, 2008; Stagnitti & Unsworth, 2000). Play is seen as a primary domain of concern for occupational therapists (AOTA, 2002; Rigby & Rodger, 2006; Primeau, 2008).
Play is typically classified as a leisure occupation and consists of “routines, tasks and
sub-tasks, done for the purposes of entertainment, creativity and celebration” (Chapparo
& Ranka, 1997, p.7). Play has been assumed to be the way children learn (Parham &
Primeau, 1997) and consists of “any spontaneous or organised activity that provides
enjoyment, entertainment, amusement or diversion” (Parham & Fazio, 1997, p.252).
Play has long been known to contribute to the physical, cognitive, emotional and social
development of children (Anselmo & Franz, 1995; Fisher, 1992; Neville-Jan, Fazio,
Kennedy & Snyder, 1997; Vygotsky, 1976). It can also be argued that play not only
serves a recreational function but for children it also fulfils an educational function.
When considered from this perspective, play is also an expression of an emerging
productivity occupational role for children, particularly preschool aged children who are
yet to begin formal schooling. The concept of play having an educational, and therefore
a dual leisure/productivity role, is supported by the fact that for more than 100 years
play has been the focus of the early intervention and preschool curriculum in most
developed countries (Glover, 1999; Harley, 1999; & Spodek, 1974). Play has been
described as the first independent occupational performance role that young children
develop (Bundy, 1997; Case-Smith, 2001; Primeau, 2008; Parham & Fazio, 1997;
Stagnitti & Unsworth, 2000).

The other primary occupational performance role of young children is the emerging role
of self-maintainer. This role encompasses those routines, tasks and sub-tasks performed
to maintain health and well-being (AOTA, 2002). The self-maintenance role of young
children includes such routines and tasks as: dressing and undressing; eating and
drinking; bathing and toileting (AOTA, 2002). Emerging independent self maintenance
and an understanding of personal responsibility develop in the late preschool years
(Gartland, 1997). Once children reach school age there is an expectation, particularly
from the school system, that they be independent in most basic self-maintenance activities (Bool, 2006; Burling, 2004; Cowley, 2006; NSW Department of Education and Training, 2005; Public Education NSW, 2008; Thorne, 2004). These self-maintenance activities include: toileting independence; managing recess and lunch, including possibly the purchase of food from a school canteen; managing and drinking from various drink bottles and bubblers; looking after all personal items; and being able to independently dress and undress as required (Shephard, 1997).

Another emerging role found in preschool and school aged children is that of student (Ziviani & Muhlenhaupt, 2006). This role targets productivity, play and self maintenance, while in adults the work role includes routines, tasks and sub-tasks carried out for the purpose of ultimately providing support for self, family or community through goods production or service provision (Chapparo & Ranka, 1997), the student role is determined by the routine activities expected of and performed by children at each successive schooling level. The role of the preschool student and school student and the routines, tasks and sub-tasks that define these roles varies enormously and reflect cultural, social and environmental expectations (Case-Smith, 2001; McBryde, Ziviani & Cuskelly, 2006).

The preschool student role is generally one of active participation in a variety of play and pre-academic based group and individual activities. The preschool daily routine is reasonably structured, with specific indoor and outdoor activity times and a high teacher to child ratio, which enables each individual child to attract individual adult attention during all parts of the preschool day (Aiossa, 2005; Harrington, 2008; NSW Department of Community Services, no date-a & no date-b; Stacy, 2009). The student tasks commonly forming part of the preschool routine include: directed and undirected indoor
and outdoor play; pre-writing activities, such as drawing, colouring and pencil work; pre-maths activities, such as matching and counting; many fine and gross motor activities and listening to and participating in story time and group discussion activities (Aiossa, 2005; Sam, 2006; Sheeba, 2006). There are also many self-maintenance tasks that are a daily part of the preschool routine. These may include: toileting, washing hands, managing at mealtimes and putting on and removing jackets/tops and shoes and socks. Some independence is expected of most children although childcare staff are always on hand to assist children (Aiossa, 2005; Sam, 2006; Sheeba, 2006).

There are many attributes that children should ideally have before they begin school (Harrington, 2008; Kronemann, 1999; NSW Department of Community Services, nd–b; NSW Department of Education and Training 2005b). Preschool is often considered as the place that children learn many of the skills necessary for beginning school at the Kindergarten level (NSW Department of Education and Training, 2005b; Walker, 2004). The transition from preschool to school is seen by many as the “most critical transition children in the industrialised world undergo” (Trudge, et al, 2003, p.43). This transition is characterised by the role of the student changing from one of nurtured participant to independent student. This transition can be potentially demanding and difficult due to the differences between the early childhood environment and the school environment into which the child transitions (McBryde, Ziviani & Cuskelly, 2006).

The role of the school student requires greater amounts of self-sufficiency, self-organization and responsibility. Children are required to learn a whole new set of ‘rules’ associated with the new role of school student. These include completion of tasks within set time frames, responding appropriately to directions and attending to self care tasks such as toileting at appropriate times (McBryde, Ziviani & Cuskelly, 2006). The role is
also further defined by the expectation placed on students to concentrate and independently complete tasks set by others and begin to develop good work habits (Wing, 1995).

2.2 TYPICAL CHILD DEVELOPMENT DURING THE PRESCHOOL AND EARLY SCHOOL YEARS

The participants in this study are typically developing children aged between 3 ½ to 6 ½ years and child development over this time frame will be broadly presented. Cognitive development, the main focus of this study, will be described later in greater detail. Significant development occurs in children between the ages of 2 and 6 years, largely the result of increased myelination enabling the growing child to use more coordinated thought and memory and react faster (Berger, 2003). Maturation of the frontal cortex also occurs during this stage of child development, although full maturation does not occur until mid-adolescence (Bergen, 2002). The frontal cortex is responsible for planning, analysing, selecting and coordinating thoughts as well as assisting in self control and self regulation (Risberg & Grafman, 2006). Maturation of the frontal cortex makes formal education attainable as children move through the preschool and early school years.

It is well documented that gross motor skills progress rapidly during the preschool years with children developing greater speed and co-ordination and generally learning and refining skills by learning from other children or teaching themselves rather than via adult instruction (Berger, 2002; Berk, 2003). Gross motor skills include running, climbing, jumping, hopping, rolling and throwing. Fine motor skills, requiring small body movements particularly of the hand and fingers, are harder to master and require
greater concentration and effort. Fine motor skill development relies on muscular control and practice and between the ages of 3 and 6 typically developing children are expected to master accurate scissor use, fastenings such as buttons and zips, a mature tripod pencil grasp, colouring within the lines, tying shoe laces and an ability to accurately copy letters and numbers (Exner, 2001; Mulligan, 2003).

2.3 COGNITIVE INFORMATION PROCESSING

The improvement of occupational performance is the domain of occupational therapy (AOTA, 2002). Occupational performance is comprised of many parameters, one of which is cognition. Many occupational therapy models of practice recognise the importance of cognition and its impact on occupational performance (Chapparo & Ranka, 1997). Cognitive information processing refers to the process of gathering relevant information from the environment, interpretation of that information and then production of a behavioural response (Law, Missiuna, Pollock & Stewart, 2001). Information processing is an ongoing dynamic interaction between the task, the person and the task environment (Chapparo & Ranka, 2003).

Cognition is defined as ‘the act or process of knowing’ (Macquarie Dictionary, 1982) and ‘the faculty of knowing or perceiving things’ (Oxford Dictionary, 1994). Cognition can be described as the activity of receiving, storing, retrieving and then using knowledge. Cognitive activity usually requires interest, demands some effort and depends on memory processes and leads to learning. Cognitive development refers to the development of the processes of learning, thinking and understanding, the use of memory and language and the ability to gather relevant information and use it to

The theories of information processing largely refer to the process as a system of sensory *input, throughput*, which is a process of problem solving and use of memory and *output*, which is the biomechanical result (Law, Missiuna, Pollock & Stewart, 2001). There can also be a feedback loop, which explains the laying down or acquisition of new knowledge for future use. Deficits in information processing ability can consequently occur at any stage in this four part process. Many information processing theorists view the mind as a complex system similar to a computer (Case, 1992; Shiffrin & Atkinson, 1969; Siegler, 1996). Information from the environment is taken in by the system and encoded. This encoded information is then recoded to make it more effective for use, then combined and compared to other information already in the system so it can be used to make sense of the person’s experiences and solve problems.

Information processing is a continuous process that results in learning and is influenced by ongoing experience (Berk, 2003; Berger, 2003; Vygotsky, 1933/1978).

From a developmental perspective information processing theory emphasizes the development of cognitive skills which include: attention, memory, problem solving and thinking skills. Literature on the development of children’s thinking from the past 40 years focuses on the mechanisms of how children process information (Berk, 2003; Berger, 2003; Boulton-Lewis, 1994; Halford, 1989; Klahr & MacWhinney, 1998). It is well established that children’s cognitive abilities mature with age. Cognitive development is complex and many theories of cognitive development have been proposed. The focus of this study is information processing strategy application and development during the preschool and early school years and it is important to reflect
on differing theories of cognitive development that span these childhood years. Four theories of cognitive development will be discussed and the impact of information processing development on the preschool and early school aged child presented. The first two theories discussed are generated by Piaget (1952) and Vygotsky (1933/1978) and both have heavily influenced developmental theory and therefore early childhood education over the past century. Other more recent developmental theories of information processing will be presented, the neo-Piagetian theories by Case (1988), Fisher (1980) and Halford (1989) and Siegler’s Model of Strategy Choice (1996, 2002 & 2005).

2.3.1 Piaget – Cognitive Development Theory

Jean Piaget (1896-1980), a Swiss cognitive theorist, has influenced and contributed to knowledge about child development over the past century. According to his ‘cognitive-developmental theory’, children actively build their knowledge as they participate in and explore their world (1952). He proposed that infants do not start out as cognitive beings but rather, by actively participating in daily activities, they develop and refine their psychological structures. Piaget proposed that as children develop they move through four broad stages, characterised by distinctive ways of thinking. These stages are the Sensorimotor stage from birth to 2 years; Preoperational stage from 2 to 7 years; the Concrete Operational stage from 7 to 11 years and the Formal Operational stage from 11 years on (1952). These four stages move from a baby’s use of senses and movement for exploration in the Sensorimotor stage to the ‘illogical thinking’ of the preschooler and early school child in the Preoperational stage. In the Concrete Operation stage a child’s reasoning becomes more logical and organised until finally in
the Formal Operational stage, adolescent and adult thought becomes complex and reasoning more abstract.

This study focuses on preschool and early school aged children, aged 3 to 7, Piaget’s Preoperational stage. Piaget presented children in this stage as rapidly developing their language abilities, their pretend play ability and their ability to represent things symbolically, i.e., drawing ability. He proposed that their thinking was still illogical and rigid, disorganised and limited to one aspect of a situation at a time and influenced only by the current situation. More recently Piaget’s theories have been challenged (Berk, 2003; Boulton-Lewis, 1994; Halford, 1989) and it has been found that preschool aged children do demonstrate logical understanding and that logical reasoning develops gradually in an interactive way, not at a specific age/stage of development as Piaget suggested (Berk, 2003).

### 2.3.2 Vygotsky – Sociocultural Theory

Lev Vygotsky (1896-1934) a Russian psychologist proposed that higher cognitive processes develop in children as a result of social interactions. He viewed cognitive development as a ‘socially mediated process’ in which, as children participate in activities with older members of their society, they learn to think and master tasks relevant to their culture and society. Unlike Piaget’s theory which proposes universal cognitive change, Vygotsky’s theory explains why there are wide cultural variations in cognitive skill styles and development. Vygotsky (1933/1978) proposed that as children develop language they talk themselves through tasks and they use this self-guidance language for all higher cognitive processes such as: controlled attention, memory, recall, categorization, planning, problem solving, abstract reasoning and self-
reflection. This self-directed speech reduces as children get older and is internalised but used for the same purpose of processing information required for tasks.

Vygotsky used the term ‘zone of proximal development’ to describe the range of skills a person can achieve with assistance, but not yet perform independently. When learning occurs children are drawn into their zone of proximal development through the ‘teacher’ who guides in the transition from assisted to independent performance.

Vygotsky’s theory supports the importance of social integration in the preschool years in order to develop and master tasks relevant to a child’s culture and society (Berk, 2003). He proposed not just independent discovery both in and out of the classroom as did Piaget, but assisted discovery where adults assume the role of ‘mediator’ to guide a child’s learning. In the preschool years he emphasised the importance of providing many socially meaningful activities with opportunity for pretend play, literacy activities where emphasised once formal schooling began (Berk, 2003).

2.3.3 Neo-Piagetian Theory

A number of theorists have proposed alternative theories of cognitive development beyond those proposed by Piaget, commonly referred to as Neo-Piagetian theories (Case, 1988 & 1992; Fisher, 1980 & Halford, 1989). All the theories differ slightly but propose a shifting through stages at different ages and ability levels. Case (1988), one of many neo-Piagetian theorists, proposed a neo-Piagetian theory that reinterprets Piagetian theory, using an information processing framework. Case proposed that as information processing capacity increases children change within each of Piaget’s broad Stages as well as move from one stage to the next. He outlined distinct cognitive structures in each Piagetian Stage and proposed that as children’s cognitive processing
becomes more efficient, they hold more information and combine it within their working memory and move through the cognitive stages Piaget proposed (Case, 1988). Case (1992) used a staircase metaphor to reflect children’s thinking and cognitive development. This suggests children think in one way for a period of time (a tread on a staircase), then their thinking shifts upward (a riser on the staircase) and they think in a different, higher way, (the next tread on the staircase). This theory does not necessarily account for multiple strategy use and variability of performance, commonly seen in young children (Siegler, 2002).

2.3.4 Siegler – Model of Strategy Choice, Overlapping Waves Theory

Siegler (1996) emphasises the concepts of variation and selection and their role in children’s mental strategies and adaptive problem solving. He proposes that children don’t think in only one way, even when presented with the same task and will even use differing approaches for the same task. Faced with new tasks, children use a variety of strategies, eventually selecting on the basis of speed and accuracy (Siegler, 2005). He views cognitive development not as a series of steps or stages as proposed by Piaget (1952) and Case (1988 & 1992), but as changes in the frequency with which children use different strategies. Siegler proposed the overlapping waves theory where learning and development are both processes of variability, choice and change (2005). These findings and models culminated in the overlapping waves theory of cognitive development. This theory proposes that at any given time, children use a variety of approaches to solve problems and that more effective approaches become increasingly common with age and experience. Children frequently discover new approaches and choose adaptively among all the approaches they know. The overlapping waves theory also provides a framework for analysing cognitive change in terms of its path, rate,
The overlapping waves model is shown in Figure 2.2. This model demonstrates that as children age they use a variety of strategies with, for example, some strategies becoming less frequently used (strategy 1) and some more frequently used (strategy 5), some not used frequently at all (strategy 3).

**Figure 2.2:** Overlapping Waves Model (Siegler, 2002 & 2005).

Over time, children's problem solving strategies typically become more efficient and replace less effective strategies. Siegler found that older children use more effective strategies than younger children, but all children use multiple strategies (McGilly & Siegler, 1989 & 1990). Siegler (1996) proposed that variability, particularly for infants and young children, enhances learning and that children tend to experiment with different strategies, determining long term, the most effective for task performance. Siegler’s view of multiple thinking and sensing strategies moves cognition and cognitive development away from a structuralist view of intelligence towards a more flexible and adaptive view. This view supposes success in relation to the capacity to ‘apply’ what is known to task performance, rather than ‘how much’ is known and aligns
itself with the multiple types of processes defined in an information processing model of cognition.

Theories of cognitive information processing theory serve to inform and guide teaching and curriculum development (Boulton-Lewis, 1994; Berk, 2003; Stacy, 2009). They explain the developmental acquisition of knowledge as well as inform regarding broad developmental ages of learning ability expectation. Cognitive information processing theory development was used in this study to aid in the selection of developmentally appropriate preschool and school aged tasks as well as determine criterion levels of expected achievement.

2.4 INFORMATION PROCESSING DEVELOPMENT AND THE PRESCHOOL AND SCHOOL AGED CHILD

Information processing is comprised of many individual processes, all of which interact to receive, store, retrieve and use knowledge. These fundamental aspects of information processing will be discussed and used to illustrate how children encode important information, use it in their working memory, retrieve it and use it to solve problems as they develop during the preschool and school ages (Berk, 2003; Berger, 2003; Boulton-Lewis, 1994).

2.4.1 Attention

A child’s ability to gather information in an organised and efficient way is essential to the development of skilled information processing (Woody-Ramsey & Miller, 1988). The focus of a person’s attention influences motor performance. Attention determines fluidity of motion, consistency of movement and skill accuracy (Wulf, 2007). Attention
determines what information will be considered when faced with a task and is central to human thinking. Attention improves as children mature to become more adaptable, flexible and selective (Berk, 2003). As children develop and practice skills the degree of attention required for the planning and execution of a skilled task reduces and task performance becomes more automatic (Wulf, 2007).

Selective attention, sometimes referred to as attention management (Crandall, Klein & Hoffman, 2006), depends on a child’s cognitive inhibition, or the ability to filter out distracting or irrelevant stimuli. Cognitive inhibition improves with age and gains in this are particularly marked from early to middle childhood. Children are known to use a variety of attention strategies as they develop, eventually selecting consistent strategies that result in improved performance. Preschool children have been found to be able to spontaneously restrict their attention to relevant stimuli but only if the task is directly relevant to them (Woody-Ramsey & Miller, 1988). Generally children do not use organised selective attention until well into their formal schooling years (Woody-Ramsey & Miller, 1988).

Research has shown that children aged 3 to 4 have some understanding that both noise and interest hinder attention (Miller & Zalenski, 1982) but a reasonably poor understanding of attention and its impact on thinking (Flavell, Green & Flavell, 1995; Pillow, 1988). The development of children’s knowledge of attention increases with age between the preschool years and early school years. Children develop an understanding that attention is selective and limited and if one fully attends to one thing, one will not normally be aware of other things (Flavell, Green & Flavell, 1995). By the age of eight, children have a well developed understanding of the process of attention. They understand that they can shut out some information and successfully attend to other
information despite the levels of background noise (Flavell & Miller, 1998). This change in children’s knowledge about attention occurs as children become better able to monitor their own ongoing mental events and they develop a conception of the mind as being active and constructive. There is a realisation that attention is active and requires effort, is something they do purposefully rather than something that just happens (Flavell, Green & Flavell, 1995).

2.4.2 Memory

Memory is the “ability to keep things in one’s mind or to recall them at will” (Oxford Dictionary, 1994). Memory has three levels, that of sensory memory, short-term memory and long-term memory (Boulton-Lewis, 1994). Sensory memory receives information from the senses and stores it only very briefly. Short-term memory, sometimes referred to as working memory, is where limited amounts of information are stored for brief periods of time and not necessarily preserved unless strategies are utilised to retain it (Boulton-Lewis, 1994). Long term memory involves the storage and retrieval of information and has an unlimited capacity and flexible timeframe from minutes to years (Eadie & Douglas, 2005; Huitt, 2003). Memory strategies emerge in the preschool child and develop rapidly during the early school years (Berk, 2003).

Memory strategies enable us to not only transfer knowledge to long-term memory but also hold information in our current working memory. Long term memory becomes the learning platform of knowledge from which children retrieve information they require for learning at school and gaps in this knowledge platform results in long term difficulties with academic performance at school (Lerner, 2000).

There are a variety of strategies that researchers have found are used to enhance
memory and store information. These include rehearsal, organisation and elaboration (Berk, 2003; Coyle & Bjorklund, 1997; Boulton-Lewis, 1994). Rehearsal is the act of repeating relevant information to oneself and organisation involves grouping or sorting related items. The beginnings of rehearsal and organisation are demonstrated by preschool aged children, although research indicates these strategies are not very efficient due to utilization deficiencies, a phase in strategy development where children use various strategies but gain little or no benefit in their performance (Bjorklund, Schneider, Cassel & Ashley, 1994). Elaboration, the third memory strategy, comes into use towards the end of middle childhood, around the age of 9 to 11 years. Elaboration involves the creating of a relationship between unrelated information and commonly requires the translation of information into images. Research has demonstrated that young children use only associative pairing to organise, remember and recall information, whereas older children demonstrate greater flexibility in their strategies, ie. the use of elaboration (Bjorklund, 1985; Schneider, 1986).

2.4.3 Recall

Once information has been remembered it needs to be recalled in order to use it again. Recognition, recall and reconstruction are the main ways in which information is retrieved from memory. Recognition, the simplest form of retrieval involves determining that an item is the same as or similar to an item previously experienced. Recall involves the generation of a mental representation of an absent stimulus and is present before the age of one year. Recall improves as children develop, as they begin to make use of a more effective range of retrieval cues and more developed semantic organisation (Schneider, 1986; Schneider & Bjorklund, 1998). Keniston & Flavell (1979) and later Flavell, Miller & Miller (1993), found that younger children often fail
to use external memory cues to aid in retrieval of information and fail to always spontaneously generate the most appropriate retrieval plan but are able to so very effectively once prompted. Reconstruction is the final retrieval mechanism and refers to the way people select and interpret information they are presented with and then transform it, rather than faithfully storing then reproducing it.

Metamemory, originally introduced by Falvell (1971) refers to knowledge about memory processes and contents. Metamemory explains the developmental increase in use of intentional memorizing and rapidly develops as children enter formal schooling (Berk, 2003; Schneider & Bjorklund, 1998). Preschool aged children are only occasionally required to use intentional memory, whereas school aged children are confronted daily with memory tasks and quickly discover the advantages of internal memorising and thus they develop metamemory (Berk, 2003). Metamemory is comprised of sensitivity, being the knowledge of when memory is necessary and variables. Variables include person characteristics, task characteristics and knowledge about memory strategies. Metamemory is one component of metacognition, explained further in Section 2.4.5.

2.4.4 Planning

A child’s ability to plan also changes as children develop. Planning is evident in preschool aged children, but generally only when tasks are familiar and not too complex (Fabricius, 1988). In order to complete a task with many steps a child must plan their actions before performing them. The planning encompasses consideration of alternatives, organising materials they may require, remembering the steps in their plan, sequencing the steps, and monitoring and revising if necessary as they perform the task (Chapparo & Ranka, 1997). The development of planning is coordinated with the
development of attention and other cognitive operations (Berk, 2003). As children develop it is evident they learn to solve complex problems or tasks by increasingly complex planning and strategy choice (Siegler, 2002). Task performance must be delayed as they consider alternatives, organise themselves and any required materials, remember the steps and sequence of their plan, then as they perform the task they must monitor their plan and make necessary changes to ensure success (Bergen, 2003).

As planning is so complex, preschool aged children frequently forget important steps in their plans as they perform tasks. Effective planning strategies can be reinforced through parents, preschool and school teachers and the expectations of independence these people place on developing children. Planning skills are refined and reinforced by planning collaboration with more mature planners, such as older children and adults (Berk, 2003). This supports Vygotsky’s theory of the importance of social interaction and its impact on development as well as his theory of the ‘zone of proximal development’ where developing children are aided in their planning processes as they gain independence in tasks. Well developed attention strategies and planning are essential to eventual success in formal schooling.

2.4.5 Metacognition

Metacognition refers to “the awareness and understanding of various aspects of thought” (Berk, 2003, p.294) or the knowing about knowing (Flavell, Green & Flavell, 1995). During the preschool and early school years metacognition develops as children begin to understand what it means to think (Berk, 2003). Children become aware of their cognitive capacities, they develop insight into strategies they can use to process information and gain knowledge about what will and will not aid them in task performance. Information processing thus works most effectively when the system is
aware of itself. Cognitive self-regulation, the ability to continuously self-monitor performance and change or alter the plan if performance appears to be unsuccessful, does not become an effective skill until the late primary, early high school years (Schneider & Pressley, 1997).

Research has found that both the environment and impact of school, influences the acquisition of memory strategies and affects the development of a child’s metacognitive knowledge base (Schneider & Bjorklund, 1998). Studies by Moely et al (1995) have shown that teachers vary markedly in the amount of strategy instruction they provide and that children exposed to high levels of strategy instruction benefit from subsequent strategy instruction more than those children from lower strategy instruction classrooms.

2.5 INFORMATION PROCESSING APPROACH TO LEARNING

The information processing approach is explicit and precise in breaking down complex cognitive performance into many individual components. In this way the cognitive processes responsible for strong or weak task performance can be analysed and individual skills worked on to improve overall task performance (Chapparo & Ranka, 1997). This can be equally applied to academic learning where differences in the cognitive skills of good and poor learners are analysed to design teaching methods that address critical learning deficits. In contrast, routine intelligence tests provide an overall picture of intelligence performance but do not provide insight into why some children do well and others poorly (Mulligan, 2003). Intelligence tests are norm referenced, offering only a comparison of individual performance to group performance (Stewart, 2001).
The information processing strategy application approach in relation to child development is viewed as one of continuous increase, without defined developmental stages as Piaget proposed (Berk, 2003). The thought processes of information processing such as perception, attention, categorization, recall of information, planning and evaluation that result in motor performance are present at all ages but less developed in young children (Halford, 1989).

2.5.1 Information Processing and Occupational Performance

As stated earlier in this Chapter, occupational performance refers to “The ability to perceive, desire, recall, plan and carry out roles, routines, tasks and sub-tasks for the purpose of self-maintenance, productivity, leisure and rest in response to demands of the internal and/or external environment” (Chapparo & Ranka, 1992, p.56). Efficient occupational performance relies on the ability to select the most appropriate information processing strategies. The literature supports that skilled information processing develops over time and with typical developmental maturation (Berk, 2003; Berger, 2003; Boulton-Lewis, 1994; Siegler, 2002, 2005; Vygotsky,1933/1978).

The ability to apply information processing strategies is thought to impact on a child’s ability to cope with changing task performance demands (Schunk, 2008). Information processing strategy application determines a child’s ability to engage and participate actively in the learning process and studies indicate there is a correlation between information processing capacity and school performance (Booth, MacWhinney & Harasaki, 2000; Friedman & Miyake, 2004; Kali, 2000). What is lacking in the literature is longitudinal research linking success in the application of information processing strategies to task performance in preschoolers to success in task performance in school students in the early years of formal schooling.
Chapter Two: Literature Review

2.6 ASSESSMENT OF INFORMATION PROCESSING

Information processing strategy application and cognition can be examined through the assessment of a person’s performance in needed routines and tasks that are relevant and related to their occupational performance roles, rather than by comparison to a ‘typical’ model of cognitive performance (Chapparo & Ranka, 1997b). In this way the impact of strategy application impairment can be determined as it relates to the person’s performance of everyday tasks (Chapparo & Ranka, 1997b; Nott, 2008). In relation to children at the preschool and early school level, inefficient strategy application can be determined by detailed observation and assessment of the performance of everyday classroom activities. As a result specific strategy application deficits in the input, throughput, output or feedback stages can be identified and specific treatment can be used to target these difficulties and improve overall strategy application ability, resulting in improved occupational performance (Chapparo & Ranka, 2007; Nott & Chapparo, 2007).

The information processing framework can be used to analyse and describe a child’s performance during cognitive tasks. Varying information processing demands are placed on a child during participation in everyday tasks and the capacity of the child to respond to these demands determines their ability to effectively complete the task (Swanson, 1987). Young preschool aged children are commonly seen to have difficulty with tasks when they are unable to alter their information processing strategies, cannot detect and then abandon ineffective strategies, or are unable to use a combination of information processing strategies to successfully complete a task (Boulton-Lewis, 1994).
2.6.1 The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis

The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis is a standardised, two stage, criterion referenced assessment that has been developed to specifically address the information processing strategy application assessment requirements for occupational therapists (Chapparo & Ranka, 1997a). The PRPP System can be applied to any task or activity, role and occupation and does not assess a pre-defined set of tasks (Chapparo & Ranka, 2003), making it an ecologically focussed occupational therapy assessment. Specific OT intervention can also be determined from the PRPP assessment (Chapparo & Ranka, 2007). This intervention is a combination of “sensory-motor, sensory-integrative, behavioural, expressive, experiential and physical guidance techniques used within a systematic instruction framework” (Chapparo & Ranka, 2003, p.8).

The PRPP System employs a process of procedural and process task analysis to identify strengths and weaknesses and quantitatively measure information processing strategy application during everyday occupational task performance. Specifically the PRPP System assesses occupational mastery in selected tasks, which is assessed through the Stage One Analysis and identifies the information processing reasons for disordered occupational performance, which is the Stage Two Analysis.

The PRPP System theoretical model (Figure 2.3) illustrates the critical information processing strategies measured. These include: attention and sensory processing in the Perceive Quadrant; memory and information retrieval in the Recall Quadrant; plan formation and evaluation in the Plan Quadrant and motor output and monitoring in the Perform Quadrant (Chapparo & Ranka, 2003).
2.6.1.1  

**Stage One Analysis**

The Stage One analysis of the PRPP System of Task Analysis employs procedural task analysis whereby tasks are systematically broken down into operationally defined steps and performance difficulties or mastery with each step are identified (Chapparo & Ranka, 2003). Performance of each step of the task is determined and errors are categorised and recorded. Errors fall into four types. First, errors of accuracy, where an attempt is made to perform a task step but performance is either inaccurate or incorrect. Second, errors of repetition occur when performance of a task step does not stop at a point required by the task. Third, when no attempt is made to perform a task step an error of omission is recorded and fourth, errors of timing are recoded when step performance is too slow or too fast. Analysis in Stage One provides data on actual levels of mastery against expected levels of mastery and scores are expressed as percentages, whereby 100% is the criterion score.

2.6.1.2  

**Stage Two Analysis**

The PRPP System Stage Two Analysis employs a process of task analysis to further analyse performance difficulties and the cognitive processes that underlie those difficulties (Chapparo & Ranka, 2003). Analysis of occupational performance tasks occurs in four main information processing quadrants. The first is the Perceive Quadrant. This assesses the ability to attend to and gather all the sensory information required for a task, while not being distracted by irrelevant sensory information. The focus of this quadrant is sensory processing. The Recall Quadrant assesses the ability to remember information from past experiences about aspects of tasks and use that information to make decisions about tasks being done in the present. It focuses on the establishment and use of knowledge.
The Plan Quadrant assesses the capacity to work out a plan, deal with new tasks and cope with novelty. The final quadrant is the Perform Quadrant. This quadrant assesses the ability to appropriately initiate, monitor and cease active participation in a task in a smooth and controlled manner, as demanded by the task. The focus of this quadrant is motor output.

Each PRPP quadrant is broken down into three sub-quadrants and each sub-quadrant into a number of descriptor behaviours, or observable behaviours that represent the information processing aspects of that sub-quadrant and quadrant. Quantitative data are obtained on each observable behaviour using a three point scale. For each behaviour descriptor a score of 3, 2 or 1 is determined based on the extent that each behaviour has supported overall task performance. A score of 3 is assigned when no prompting, assistance or errors are made in that descriptor behaviour. A score of 2 is given if there are no errors in that descriptor behaviour but minimal prompting was required or processing was slow. If significant deficits in the descriptor behaviour were observed, many prompts were required to gain engagement in the descriptor behaviour or if performance was too slow or fast causing major errors in task performance, then a score of 1 is assigned (Chapparo & Ranka, 2003).

2.6.1.3 The Perceive Quadrant

The Perceive or sensory processing quadrant assesses the effectiveness of the sensory gathering strategies a person has used during task performance. A description of the three sub-quadrants and their descriptors follows.

**Attending**: the ability to pay attention or notice relevant cues and prompts from the environment, spontaneously narrow and broaden attention, shift attention from one aspect of a task to another and maintain attention in order to complete
the task (Chapparo & Ranka, 2003). Difficulties in this sub-quadrant might be demonstrated by hyper or hypo arousal, distractibility, difficulty focusing or shifting focus, poor concentration or the requirement of multiple prompting to attend to the task.

**Sensing:** the ability to actively and systematically seek out relevant sensory information, locate objects required for the task and monitor aspects of the task as it progresses and the environment changes (Chapparo & Ranka, 2003). Poor performance in this sub-quadrant may include, difficulty scanning and searching for required information or items, requiring prompting to use body parts during a task and not responding to changes occurring during a task resulting in task deterioration.

**Discriminating:** is the ability to distinguish between the relevant and irrelevant stimuli in order to match or differentiate between body parts or objects required for the task (Chapparo & Ranka, 2003). Difficulties with discrimination may present as being unable to match attributes of objects such as size and shape, not being able to find objects in a cluttered environment or overuse of tactile or visual cues to compensate.

### 2.6.1.4 The Recall Quadrant

The Recall Quadrant focuses on the establishment and the use of knowledge. It assesses the strategy application ability of the person to retrieve acquired information and then use this information to aide in current task performance. The sub-quadrants include:

**Recalling Facts:** being able to recall relevant facts or information that would aide in the recognition, labelling and categorising of objects or body parts
required for task performance (Chapparo & Ranka, 2003). Poor performance in this sub-quadrant may be demonstrated by decreased recognition of objects, body parts, spoken or written language or an inability to group related things together to make up the whole.

**Recalling Schemes:** this is an understanding or recall of when and where a task should occur as well as how long it should take. These skills are important so that tasks occur in the appropriate context (Chapparo & Ranka, 2003). Poor recollection of schemes may result in performance of tasks at the wrong time or in the wrong place, with task duration not matching task requirements.

**Recalling Procedures:** the ability to recall information regarding object and body use as well as the sequence or steps in a task (Chapparo & Ranka, 2003). Difficulties with recalling procedures may be demonstrated by incorrect or poor use of task objects, poor body movement or positioning for the task and forgetting or fragmenting task sequence.

The Recall sub-quadrants of the PRPP System reflect the aspects of metamemory outlined in Section 2.4.3, those that investigate the knowledge about memory processes and contents (Schneider & Bjorklund, 1998).

### 2.6.1.5 *The Plan Quadrant*

The Plan Quadrant assesses the effectiveness of a person’s thinking skills. It focuses on the ability to develop a workable plan, cope with novelty and evaluate performance as the task progresses. The three sub-quadrants of the Plan Quadrant are:

**Mapping:** this is the ability to formulate a relevant task goal, identify any obstacles that may hinder task completion and organise and reorganise the task
environment as the task progresses (Chapparo & Ranka, 2003). Poor Mapping ability can be demonstrated by a lack of a goal, an unrealistic goal, changing of the directed goal, an inability to deal with obstacles or a perception of too many or no obstacles to goal completion and disorganisation.

**Programming**: is the ability to select, sequence and regulate the force required for task completion (Chapparo & Ranka, 2003). Difficulties in this sub-quadrant may be demonstrated by incorrect or incomplete choices and sequences and movements that are too forceful, awkward or not matched to the task and environment.

**Evaluating**: is the ability to question, analyse and judge aspects of the task during task performance (Chapparo & Ranka, 2003). Evaluation problems may include a lack of or over questioning task performance, poor analysis of the ongoing task or a specific constraint and a lack of judgement regarding physical capabilities or the limits of the task environment.

The Evaluating sub-quadrant of the PRPP Plan Quadrant investigates the metacognitive aspects of information processing, the understanding and awareness of aspects of thought (Berk, 2003).

### 2.6.1.6 The Perform Quadrant

The Perform Quadrant is focused on the motor output of the task. It assesses the initiation and completion of the task as well as the control demonstrated during task performance. It is made up of the following sub-quadrants:

**Initiation**: this is the ability to start and stop a task, with timing being appropriate to expected task performance (Chapparo & Ranka, 2003). Difficulties with
initiation include an inability to start without prompting, inability to stop, stopping too early or being unable to restart a task.

**Continuation:** is the ability to smoothly continue with a task until completion (Chapparo & Ranka, 2003). Poor continuation may involve a stop/start, uneven approach to the task, incompletion of the task or demonstration that performance is not consistent with ability.

**Controlling:** is the ability to correctly time, coordinate and adjust movements to enable smooth task performance (Chapparo & Ranka, 2003). Control difficulties may include being too fast or too slow, demonstrating weakness, clumsiness, tremors or poor muscle action to suit the task.

The PRPP quadrants are all interrelated, as is demonstrated on the PRPP System of Task Analysis: Stage Two Model (Figure 2.3) and address all the input, throughput, output and feedback stages of information processing theory.
Figure 2.3: The Perceive, Recall, Plan and Perform System of Task Analysis Model

The PRPP System of Task Analysis (Chapparo & Ranka, 1997a) is a criterion referenced assessment, which means that it provides a measure of performance that is interpreted in terms of a clearly defined and delimited learning task (Linn & Gronlund, 2000). The PRPP assessment score is interpreted and reported as a percentage, by comparing a person’s assessment performance to a pre determined performance standard. The PRPP assessment is unique in that it is suitable to use across all age
groups, genders, cultural groups and disabling conditions (Chapparo & Ranka, 1997b). The assessment is used to assess the performance of ‘real world’ tasks that are deemed important to the occupational performance roles of the client. The outcome of the assessment is not only a detailed analysis of the client’s cognitive information processing strategy application abilities but also provides information about how well selected occupations are performed and it can be used to guide occupational therapy intervention Chapparo & Ranka, 2007; Nott, 2008).

The PRPP System is utilised by occupational therapists to assess cognitive strategy application during occupational performance in a wide range of diagnostic groups. Recent research use of the PRPP System has included: the assessment of strategy application during everyday task performance in men with HIV-1 dementia (Ranka, 2010); measurement of cognitive information processing strategy application in clients with extreme agitation following traumatic brain injury (Nott, 2008); cognitive impairment in adults with schizophrenia (Aubin, et, al, 2008) and in adults following traumatic brain injury (Farquhar, 2010; Fry & O’Brien, 2002); strategy application in children with learning difficulties (Boland, 2004; Chapparo, 2010) and the assessment of strategy application in children with autism spectrum disorder (Lohri, 2005). No studies to date have investigated strategy application in typically developing children.

2.7 PLAY

The focus of this study is the information processing strategy application development of preschool and school aged children and the impact of information processing ability on individual school readiness. Play is assumed to be the way young children learn (Parham & Primeau, 1997) and play skills, particularly pretend play skills, provide
insight into children’s cognitive development (Rutherford & Rodgers, 2003, Stagnetti, 2003; Stagnetti, Unsworth & Rodger, 2000; Vygotsky, 1976). In this section play will be defined, theories of play discussed in relation to current occupational therapy assessment and practice and the link between pretend play and cognition presented. The Child Initiated Pretend Play Assessment (ChIPPA) (Stagnetti, 2003), an assessment that quantitatively measures the cognitive aspects of a child’s spontaneous pretend play, will also be presented.

Unlike other childhood occupational roles, such as that of self-maintainer, play is a role that is intrinsically motivated and self directed (Bundy, 1997; Walsh, 1997; Wing, 1995). Occupational therapists have long identified the importance of play and its role as the primary occupation of young children (Bundy, 1997; Knox, 1974; Morrison & Metzger, 2001; Parham & Fazio, 1997; Reilly, 1974; Stagnetti & Unsworth, 2000; Sturgess, 1997). The benefits of play are undisputed and are seen by occupational therapists and other health professionals as a major key to a child’s cognitive and physical development (Anselmo & Franz, 1995; Fisher, 1992; Neville-Jan, Fazio, Kennedy & Snyder, 1997; Vygotsky, 1976). Play is also viewed as an essential medium for child learning (Sponseller, 1974). Play influences the development of problem solving abilities, exploration skills, language, literacy skills, cognitive processing skills, adaptability, social and emotional development as well as gross and fine motor skills (Pellegrini, 1985; Stagnitti & Unsworth, 2000; Westby, 1980; Wyver & Spence, 1995). Thus it can be seen that through play, the crucial foundations of learning and skill acquisition occur across all domains in a child’s life. Play is central to the development of skills that will ultimately determine the calibre of a child’s occupational roles and work personality (Scaletti, 1995).
Play can be defined in many ways and each definition influences how play is understood and interpreted. Most literature on the area of play will provide some definition and most often will compare play to work and discuss the differences. The culmination of these definitions indicates that it is not the activity itself that determines whether an activity is viewed as play or work, but the reason for that activity (Rigby & Rodger, 2006). Children tend to view voluntary, self directed, internally controlled activity as play and children tend to categorise activities by the environment in which they are performed (Chapparo & Hooper, 2002; Hughes, 1991; Wing, 1995). Play, according to Rubin, Fein & Vandenberg (1983) is defined as having five essential characteristics. These are that play is intrinsically motivated, freely chosen, pleasurable, non-literal and actively engaged in. Other activities can have some of these characteristics, but play combines them all.

2.7.1 Theories of Play

Occupational therapists understanding of play has come not only from within the profession but has been influenced by the work of psychologists, educationalists and the other health sciences. Early theories on play tended to emphasise the biomechanical and physical nature of play and attempted to explain the purpose of play and what causes it. Early theories from the late 19th century to the early 20th century included the Surplus Energy Theory, developed largely by Spencer in 1878 (Parham & Fazio, 1997) where play was viewed as the medium through which children discharge additional natural body energy, thus children played because they had too much energy. A theory almost opposite of the Surplus Energy Theory was the Renewal of Energy Theory by Patrick (1916) (Mellou, 1994), where play was used to avoid boredom and relax whilst the body’s natural energy was restored.
The Recapitulation Theory regarded play development as reflecting the evolutionary history of the entire human species. Children’s play was thought to reflect the developmental evolution of the entire human species (Rubin et al, 1983). The final biogenetic play theory, The Pre-exercise theory, developed by Groos (1901, translation), considered play as a child’s medium for the development of skills and knowledge that would be required for adulthood. These four theories all contain some elements of the purpose of play but lack a full understanding of the role of play and its causes in development as well as the cognitive, emotional and social aspects of play. These areas are covered more concisely in the modern theories of play.

There are three major modern theories of play: the Psychoanalytic, the Arousal Modulation and the Cognitive Developmental theories. The Psychoanalytic Theory of play, which focuses on the emotional and social benefits of play, were developed largely by Freud and also reflected upon by Erikson (Hughes, 1991). This theory stated that the reason for play was to reduce a child’s anxiety by providing children with a sense of control over their world and also as an acceptable way to express impulses. The Arousal Modulation Theory of play is based on the premise that humans try to maintain an optimal level of central nervous system arousal by relieving boredom and reducing uncertainty. This theory, initially developed by Berlyne (1969) was later further developed by Ellis (1973) and Fein (1981) (Rubin et al, 1983) and has as its focus the emotional and physical benefits of play.

The Cognitive Developmental theories of play focus on play being a tool for the facilitation of cognitive development. Play is used to consolidate physical and cognitive learning that has previously taken place and to facilitate new learning. The main proponent of this theory was Piaget. Piaget (1951) interpreted play as a ‘manifestation
of cognitive processes’. He identified play as a cognitive process that contributes to a child’s overall cognitive development. It must be noted however, that Piaget’s work was not focused entirely on play but rather on the emergence of intelligence (Parham & Fazio, 1997). Piaget outlined stages of cognitive development that can be observed through play, an example of which is the preoperational stage of cognitive development that outlines the complexity of play behaviours that will be observable in normally developing children between the ages of two and seven (Piaget, no date).

Play, as an occupation, has always been acknowledged as an important area of focus for occupational therapy, although there is evidence that the profession, in an attempt to be seen as more scientific during the mid twentieth century, temporarily drifted away from its focus on play and occupations (Parham & Fazio, 1997). Current occupational therapy play theory, influenced to differing degrees by the major modern theories, has largely been developed by Reilly (1974). Reilly (1974) was among the first to focus on play as an area for serious research and theory. Her systems theory views play as a multidimensional phenomenon that attempts to explain how we acquire play and its purposes. Childhood play is viewed as the preparation area of skills, interests and abilities required in adulthood for work (Reilly, 1974). Many of the initial occupational therapy assessments that investigated play history and play development were developed by students working with Reilly in the 1960’s, 1970’s and 1980’s (Takata, 1969; Florey, 1971, 1981; & Knox, 1974).

A more recent occupational therapy theme is occupational science, which states that an occupation such as play should be studied directly rather than seeking greater understanding of it through studying its occupational performance components (Parham & Fazio, 1997). Bundy (1997) developed a model of playfulness and an assessment
based on this model, in response to what she perceived as a lack of available valid play assessments. The basis of this model is that OT’s can gain greater information regarding a child’s development from that child’s playfulness rather than from evaluating their play activities. Playfulness is determined by evaluating a child’s intrinsic motivation, internal control and their freedom to suspend reality (Bundy, 1997).

2.8 COGNITION AND PRETEND PLAY

Cognitive performance during play refers to the interactive mental processes used during play such as: problem solving, recognising, remembering, judging, learning, thinking and knowing (Chapparo & Ranka, 1997). The play task itself will determine the complexity of cognitive processing demanded. Cognition literally means ‘to know or perceive things’ and a child uses play as its medium for this process of getting to know about itself and the world around it. Piaget (1951), as previously mentioned, based his work of child development on cognitive development, naming four distinct stages.

The cognitive aspects of play can most readily be seen in a child’s imaginative or pretend play (Stagnetti, 2003). Cognitive development is reflected in the complexity of a child’s play themes, their sequences of imaginative play actions, their ability to role play and their use of object substitutions (Stagnetti, 2003). It is within the domain of cognitive information processing that this research is based.

There is evidence to indicate a link between the development of play behaviours in preschool aged children and their cognitive development (Cole & LaVoie, 1985; Difffy & Morrison, 2000; Lewis, Boucher & Astell, 1992; Pelligrini, 1993; Rutherford &
Rodgers, 2003; Westby, 1980). There is also some indication that cognitive processing difficulties as seen in preschool play behaviours could indicate future cognitive processing difficulties in the school aged child and impact on the role of academic student (Bergen, 2001 & 2002; Stagnitti, Unsworth & Rodger, 2000). Specifically, it is the area of pretend play in preschool aged children that reflects the cognitive skills of play. Pretend play, according to Piaget (1951) occurs between the ages of 18 months and 6 years, being at its peak in the preschool years and forms the foundation for literacy development and representational thought. Vygotsky (1976) considered pretend play to be the mature form of play for the preschool aged child and a major source of development.

Pretend play can be a solitary activity and can occur in parallel or within a group situation (Parham & Fazio, 1997). Solitary pretend play occurs when a child is engaged in make believe play with another toy or an imaginary companion. Parallel pretend play is seen when two or more children are seemingly playing together but are in fact involved in their own fantasy world. As children get older, group pretend play is seen, peaking between the ages of five and six (Fein, 1978). This type of advanced pretend play, sometime referred to as socio-dramatic play, involves each group member taking on different roles that complement not only each other but also the play theme, intricate plots and ingenious improvisations.

Pretend play, as seen in normally developing children includes the ability to spontaneously use symbols in play, to substitute objects, refer to absent objects and to attribute properties to objects (Bergen, 2002; Doe, 1997; Stagnitti & Unsworth, 2000). These abilities as seen in pretend play highlight the unique cognitive input pretend play requires. Pretend play is the result of a child’s creativity and gives the child a sense of
control, promotes self-esteem and new ideas and provides the child with a chance to learn new things (Doe, 1997). Pretend play competence has also been linked to pre-literacy skills and language development (Cole & LaVoie, 1985; Lewis, Boucher & Astell, 1992; Pelligrini, 1985; Westby, 1980) and is the emphasis of a number of papers and assessments in the areas of speech and language pathology, psychology and education.

As stated, play is not the main emphasis of paediatric OT assessment and to date play has largely been formally assessed by OT’s from a developmental point of view. Current literature indicates a trend towards the importance of the formal assessment of play and in particular pretend play, in addition to the more traditional paediatric assessments (Bundy, 1997; Stagnetti, 2003).

More recently, interesting research has been conducted into the perceptions and views of young school children on what constitutes work at school and consequently what constitutes play (Chapparo & Hooper, 2002; Wing, 1995). Wing’s qualitative study investigated children from Kindergarten, Year 1 and Year 2 on their views regarding play and work at school. The results indicated that the children had very definite ideas about what constitutes work and what constitutes play. Play was identified as an activity that was self directed, freely chosen, able to be abandoned at will, having no specific end product, not teacher directed and only allowed when ‘work’ was completed. Work on the other hand was directed and evaluated by the teacher, required concentration, studying and cognitive strain. The children in the study identified writing as the ultimate work activity, followed closely by reading, both of which required cognitive effort (Wing, 1995, p.239).
Although the purpose of Wing’s (1995) research was not to investigate a child’s preference for ‘work’ or ‘play’ based assessment, her findings support the fact that work and play are both equally important aspects of classroom academic routine. Children, although not disliking ‘work’ activities did identify a preference for ‘play’ activities. The research conducted by Chapparo & Hooper (2002) investigated Year one children’s perceptions of work in their school day. This research found that the children participating in the study had very individual ideas about what constituted work versus play and other activities at school. The children’s classification process was based on the activity environment, the task itself, the personal meaning they attributed to the task and their perceived level of control over the task (Chapparo & Hooper, 2002). This study also found that a task became work when it involved the child writing, sitting still or listening (Chapparo & Hooper, 2002).

The findings from Wing’s (1995) research might be considered by OT’s as it not only emphasises the importance of play in a child’s class routine but also highlights children’s preferences for play activity. Perhaps the child’s play as well as the more traditional ‘work’ assessments should be considered. Many of the traditional OT assessments include such aspects as hand writing, copying shapes and patterns, memory, reading, following instructions and performance of set gross and fine motor tasks (examples of which include: School Function Assessment, Coster et al. 1998; Bruininks-Oseretsky Test of Motor Proficiency, Bruininks, 1978; Test of Gross Motor Development, Ulrich, 2000 and Test of Visual-Motor Skills & Test of Visual-Perceptual Skills, Gardener, 1995 & 1997). Play assessment on the other hand tends to be an undirected observation of a child’s free play skills.
Assessment of play, using an assessment such as the ChIPPA (Stagnitti, Unsworth & Rodgers, 2000) could provide greater insight into the child’s school functioning (or potential school functioning) and in particular their cognitive functioning. Play tasks could also be assessed from an information processing perspective with the PRPP System of Task Analysis (Boland, 2004; Chapparo & Ranka, 2003).

2.8.1 Child Initiated Pretend Play Assessment (ChIPPA)

The Child Initiated Pretend Play Assessment (ChIPPA) is a recently published occupational therapy assessment by paediatric occupational therapist Karen Stagnitti, having undergoing extensive research and development (Stagnitti, 2003). The ChIPPA purports to quantitatively measure the cognitive aspects of a child’s spontaneous pretend play ability and determine information processing deficits. Stagnetti, Unsworth & Rodger (2000) developed the ChIPPA in order to “discriminate between the play of typically developing preschoolers and preschoolers with pre-academic problems” (p.291). Stagnetti, Unsworth & Rodger state that “play gives valuable information about the competence and function of a child” (2000) and that the formal assessment of play should be considered as a valuable source of information regarding a preschool child’s readiness for the occupational role of school student. The ChIPPA focuses on pretend play skills and the cognitive processing skills involved in pretend play. It investigates a child’s ability to initiate and organise their play.

The ChIPPA clearly defines a child’s actions as play or non-play behaviours and scoring reflects these actions. The ChIPPA assesses a number of features of pretend play. These include; the elaboration and imagination seen in a child’s play performance, which gives an indication of a child’s sequential thinking and planning skills; the number of imitative actions seen during a child’s play which is indicative of their ability
to self initiate play; and finally a child’s ability to substitute one object for another, reflective of imaginative play behaviour. An initial study using the ChIPPA (Stagnitti, Unsworth & Rodger, 2000) confirmed that it is, as an assessment, able to discriminate between preschool children with suspected pre-academic problems and typically developing children. Children with suspected pre-academic problems were found to demonstrate fewer elaborative imaginative play actions, fewer object substitutions and in most cases, a higher number of imitative actions, thus overall indicating poorer pretend play skills.

2.9 THE PRESCHOOL CURRICULUM IN AUSTRALIA

Preschool in Australia is defined as a planned educational program aimed largely at children in the year before the first year at formal school. This usually includes children aged between 4 and 5 years of age. In most states, this definition expands to include children two years before formal school, children aged 3 to 5 years. The preschool years were the major focus of this study. Preschool and preschool curriculum will be discussed to provide insight into the possible long term implications of various curriculum’s on the school readiness of Australian preschoolers.

There would appear to be a lack of clarity across all the states and territories in Australia regarding the actual numbers of children attending preschool programs. More recent reports and inquiries (Kronenmann, 1999; NSW DET, 2005; Walker, 2004) indicate that the majority of Australian preschool aged children do attend some form of organized childcare in their final year/s before entry to formal schooling and statistics from the Australian Bureau of Statistics (2009) indicates that as many as 88% of four
year olds and 74% of three year old children attended some form of child care facility in NSW during 2005.

From a national perspective Australian preschool education lacks a systematic and consistent approach. This is largely due to the lack of an overriding national body to coordinate curriculum, costs, access, funding and teacher/child ratios (Walker, 2004). In New South Wales, for example, 85% of preschool education is overseen by The Department of Community Service (DOCS) and to a lesser extent, 10%, by The Department of Education and Training (DET) (Harrington, 2008). DET preschools are usually attached to DET primary schools in less advantaged socio-economic areas. As of July 2008, these preschools now also require licensing from DOCS (Harrington, 2008). Preschools are also run by the private sector and are not necessarily answerable to either of these government organizations.

Organized childcare takes many forms, including long day care, preschool and family day care. As the focus of this study was on children attending childcare in their ‘preschool years’ the two types of childcare discussed will consist of Long Day Care, where extended hours of care as well as a preschool curriculum are offered and Preschool, which consists of a more structured curriculum and strict operational hours, usually 9am to 3pm.

With an ever expanding spot light and emphasis on child care policy and procedure both in Australia and internationally, child care services are becoming increasingly responsible for the learning outcomes and ultimate school readiness of the children accessing their services. Inquiries into Australian preschool education (NSW DET, 2005; Walker, 2004) have found enormous variations in preschool curriculum, learning
outcomes and thus the resulting school readiness of the children transitioning into formal schooling.

There are documented a number of different preschool curriculums in place within Australian preschools and childcare centres, with very little comment in the literature regarding their impact on the ‘school readiness’ of Australian children. As this study was based in New South Wales (NSW) the current curriculums operating within this state will be discussed. The NSW DOCS established the Office of Childcare in 1998 and in 2001 piloted and refined their preschool curriculum framework ‘The Practice of Relationships’ (NSW DOCS, nd - a). This curriculum provides only a framework for preschool staff to plan and evaluate the work they do with the children in their care as well as support the children’s learning and well-being but it does not prescribe context or activities nor does it provide any specific curriculum academic outcomes.

The Practice of Relationships (NSW DOCS, no date - a) is a curriculum framework rather than a curriculum. It acknowledges that current and past preschool curriculum practices in NSW and Australia are based on a diversity of pedagogy. A number of international early childhood curriculums have influenced and shaped The Practice of Relationships, including: Developmentally Appropriate Practice from the United States of America (National Association for the Education of Young Children, NAEYC, 1997); The Antibias Curriculum by the National Association for the Education of Young Children in the USA (NAEYC, 1989); The Reggio Emilia experience from Italy and Te Whariki from New Zealand (New Zealand Ministry of Education, 1996).

Developmentally Appropriate Practice (DAP) initially outlined by Bredekamp in 1987 and further refined by Bredekamp and Copple in 1997 (NAEYC, 1997) focuses on normative ages and stages, primarily from a Piagetian perspective. The DAP has many
critics but it can be argued that traditional developmental psychology has both informed and formed the foundation of early childhood teaching. The Antibias Curriculum, developed in the United States of America in 1989 emphasizes cultural awareness, the value of diversity and the promotion of equality.

Reggio Emilia, a town in Northern Italy, is broadly recognized as having an exemplary model of early childhood education (Ching, 2003; Hertzog, 2001; Pinnacle Presbyterian Church, 2005; Shireen Desouza, 1999). What is now termed the Reggio Emilia experience was established shortly after World War II and strongly emphasizes the child and adult learning with others and from each other, the influence of the child’s environment and community and has a focus on learning from the perspective of the child, building on topics the child finds interesting and stimulating. The Reggio Emilian programs do not evaluate against any predetermined outcomes. Te Whariki is the national curriculum framework in New Zealand, implemented in 1996. It emphasizes quality in social interactions and relationships and has an interrelated framework focusing on the Maori population. This curriculum also demonstrates links between early childhood outcomes and school learning.

The majority of directors and teachers from the participating preschools in this study stated they were following what they termed an emergent curriculum or The Practice of Relationships as directed by DOCS. The Emergent Curriculum is inspired by the children’s emerging interests and is stated to provide a captivating environment where children learn and discover by participation in activities they enjoy (Stacy, 2009). It was noted by the researcher that those preschools stating they followed an ‘emergent curriculum’ appeared to have less formal structure to the preschool day with a reduced
emphasis on completion of craft and desk top activities as well as less participation in group activities such as story time.

The other curriculums noted by the researcher were labeled the ‘traditional preschool curriculum’ and the ‘mixed curriculum’. The traditional curriculum has as its focus, the preparation of young children for school through the use of play, craft, pre-academic activities with an emphasis on independence and social interaction (Aiosa, 2005). These preschools focus on routine, encourage set periods that demand concentration, group work and encourage participation in every aspect of the preschool routine. The preschools claiming a mixed curriculum stated they borrow what they perceive to be the better aspects of the traditional and emergent curriculums. Teachers following what they termed the traditional and mixed curriculums also stated that at all time they followed and built upon the interests of the children in their programs.

2.10 SCHOOL READINESS

School readiness is the common phrase used to describe a child’s readiness for beginning formal schooling. It can be defined as the point at which a child is deemed ‘ready to learn’ and has mastered the ‘set of skills’ required to meet all the demands of school. There is little consensus among teachers, therapists, paediatricians and parents about exactly which specific tasks or personal characteristics represent school readiness, although there would appear to be agreement about the many broad facets of childhood capacities that contribute to readiness for school (Deitzmann, Watters & Fox, 2001; Janus & Offord, 2007). This section will present background and current literature regarding school readiness, the assessment of school readiness, perspectives on school
readiness and the role of the occupational therapist in the transition of young children into formal schooling in Australia.

It is widely accepted that there are many facets that contribute to school readiness in younger children with chronological age being the most commonly cited single criterion (McBryde, Ziviani & Cuskelly, 2004; NSW Parenting Centre, 2003). A child’s legal eligibility to start school is based on chronological age as it is easily defined, correlates with broad developmental levels and can be applied across a large disparate population. School entry age varies in the Australian states with starting ages from 4 ½ to 6 years with some states taking multiple entries across the school year (Taylor & Edwards, 2009). In NSW a child may start school if they turn five on or before the 31st July in that year and must have legally started school by their sixth birthday (Public Schools NSW, 2008).

Other continually emerging themes are those of social and emotional readiness, often expressed as some of the more important factors from the perspective of the preschool and kindergarten teacher (Aiossa, 2005; Bool, 2006; Burling, 2004; Cowley, 2006 & Thorne, 2004). The social and emotional characteristics that underlie academic competence and achievement include: a child’s understanding and demonstration of the social expectations of behaviour; an ability to appropriately regulate emotion and behavior; demonstrated compliance with rules and adult requests; cooperation; the ability to make meaningful friendships and a positive approach to learning situations and new experiences (Bowman, 1999; Janus & Offord, 2007). A child’s ability to manage their emotions and exhibit appropriate social behaviours is an important indicator of school readiness and predictor of academic success (Webster-Stratton & Reid, 2004).
Physical well-being and appropriate levels of motor development are another commonly cited theme of school readiness. This encompasses fine and gross motor skills, physical independence and energy levels throughout the day. The physical skills commonly cited as indicators of school readiness include being able to use scissors, use a pincer grasp to hold pencils, be independent in dressing and toileting and enjoy a variety of indoor and outdoor play experiences such as running, jumping, rolling and ball play (Sherry, 2003).

Age appropriate language skills, including an ability to use language correctly and communicate ones needs and thoughts is also a recurring theme of school readiness. It is important for children starting school that they are willing and able to communicate for themselves (Sherry, 2003). A basic understanding of numeracy is also important when considering readiness for school. Concepts such as more, less, up, down, in front, behind, over and under as well as the recognition that numbers are used to count (Public Education NSW, 2008). Additional cognitive indicators of readiness for school include recognition that symbols, such as letters, have meaning, an ability to follow two to three part instructions and recall basic information as well as a demonstrated ability to concentrate without continuous adult supervision (Sherry, 2003).

Various theories of school readiness exist and the two most influential have at their focus either maturation or early environmental experience (McBryde, Ziviani & Cuskelly, 2006). Maturation theory contends that development is biological and genetically determined and growth is viewed as a function of maturation with the environment having little influence (Gredler, 1992). This theory was the first model of school readiness and remains the most influential in educational practice (McBryde, Ziviani & Cuskelly, 2006). Maturation theory states that children develop at individual rates and advocates delaying school entry if requisite developmental abilities have not
emerged (Gredler, 1992). The maturation theory is heavily influenced by Piaget (1952) and the stages of childhood development he proposed.

The environmentalist theory approach to school readiness emphasises the importance of the early childhood learning environment and early stimulation resulting in intellectual development (Weber 1984). This view supports children always being ready to learn and school readiness assessment as unnecessary. This theory and approach to school readiness reflects the developmental approach proposed by Vygotsky (1933/1978).

It is acknowledged that preschool and the experiences it provides enhance a child’s cognitive development and social behaviour and provides them with the opportunity to strengthen their school readiness (Harrington, 2008; Kronemann, 1999; NSW Department of Community Services, no date–b; NSW Department of Education and Training 2005b). Findings from the Effective Provision of Preschool Education project (EPPE, 1997–2003), Europe’s largest longitudinal investigation into the effects of preschool education on children’s developmental, were that children who had attended preschool were better developed in the areas of independence, concentration, cooperation, conformity and sociability (Sylva et.al. 2003). Studies have also shown that children who receive a high quality preschool education tend to attain higher performance levels at both primary and secondary school (Ramey & Ramey, 2004) and greater numbers go on to enter skilled employment and higher education.

2.10.1 School Readiness Assessment

School readiness measures used for the identification of children ready or not ready to start formal schooling are well documented in the literature. They are largely used to identify children at risk of failure at school rather than reflecting readiness for school
The major failing of existing school readiness assessments is their lack of predictive validity. Most assessments are not able to predict future academic functioning (McBryde, Ziviani & Cuskelly, 2006). Some of the more widely known and utilised measures will be presented.

The Gesell School Readiness Test (Ilg et al. 1978) is one of the earlier measures of school readiness. It is described an observational, qualitative tool that assesses skills such as writing, drawing, visual and motor co-ordination from a maturation perspective. Two skill oriented measures are the Brigance Diagnostic Inventory of Early Development (Brigance, 1992) and the Developmental Indicators for the Assessment of Learning (Mardell-Czudnowski & Goldberg, 1998). These assess motor, cognitive and language areas as well as using parent questionnaires to investigate social skills and development. The Lollipop Test (Chew & Lang, 1990) assesses shape, colour, picture, letter and number recognition and identification. The Phelps Kindergarten Readiness Scale (Augustyniak, Cook-Cottone & Calabrese, 2004) which assesses verbal, perceptual and auditory processing, memory, language competence and shape was reproduction was developed to measure the academic readiness of children prior to Kindergarten entry.

These tests, as measures of potential school readiness, do not assess gross motor function or physical independence. They do provide some indication of fine motor performance and of cognitive and language development. Only a few provide insight into social competence (Janus & Offord, 2007). The Early Development Instrument (EDI) was developed by Janus and Offord (2007) as they determined there was a need to assess outcomes of early development as reflective of school readiness for the move into Year 1, the first recognised year of formal schooling in Canada. The EDI assesses
physical health, social competence, emotional maturity, language and communication, cognitive development and general knowledge. It is established as an adequate indicator of readiness of school (Janus & Offord, 2007) but provides data too broad to identify individual deficit areas in individual children.

While it is often assumed that tests exist to reliably determine which children are ‘ready’ to enter school, preschool children, by nature, are not good test-takers. This has prompted some to assert that there are no acceptable existing readiness measures (Janus & Offord, 2007; Meisels, 1999), and that therefore, the only legally and ethically defensible criterion for determining school entry is whether the child has reached the legal chronological age of school entry. Others, particularly parents and teachers, support the use of physical health, gender, social and emotional skills, language skills, concentration skills and independence as predictors of school readiness (Community Child Health, 2005; McBryde, Ziviani & Cuskelly, 2004; NSW Department of Education & Training, 2005; NSW Parenting Centre, 2003). There are, however, three substantive differences in perceptions of how these predictors relate to readiness.

The first perspective is ‘readiness for school’ (Kagan, 1992). This approach focuses on children demonstrating a particular developmental level of ‘readiness’ in physical, social or intellectual development that match the demands of school. Readiness from this perspective is determined by assessments that measure mastery of performance in school based tasks against set developmental criteria (e.g. naming colours, drawing a person, dressing, managing emotions) (Deitzmann, Watters & Fox, 2001). Many have argued this concept of readiness on developmental, social and emotional grounds (Kagan, 1992).
The second perspective is ‘readiness to learn’. Readiness to learn generally refers to the age at which children are assumed to be ready to learn particular material and supports the use of chronological age as the entry criteria for school. Reviews of entrance age studies as reported by Deitzmann, Watters and Fox (2001) and others (de Cos, 1997; Perry, Dockett & Howard, 2000; Taylor & Edwards, 2009) however, are equivocal. There is an increasing trend by some parents to delay their children’s school entry so that they may cope better, while some teachers claim that broadening the age range between the oldest and youngest children in a class may be problematic for both extremes (Perry, Dockett & Howard, 2000).

A third perspective is ‘individual readiness’. While ‘readiness for school’ and ‘readiness to learn’ suggest that development precedes learning, the concept of individual readiness suggests that learning precedes development. Founded in the work of Vygotsky (1933/1978), this perspective moves the emphasis of readiness away from what the child has learned toward the child’s capacity to engage in a process of learning, or the capacity to process information to learn about how new tasks can be done (Scrimsher, College & Tudge, 2003). This is consistent with teachers’ views of school readiness as a child’s individual readiness to learn coupled with ‘teachability’, which is marked by positive emotional expressiveness, enthusiasm, and the ability to problem solve (Denham, 2006). This concept of readiness provides support for the argument that assessment of task embedded information processing strategy application may offer a contribution to predicting school readiness, targeting specific processing behaviours that support transition to school, and to predicting children who may require additional support with learning. Presently there is a lack of information about the emergence of information processing functions throughout the span of school years.
Without such information, researchers into children’s cognition assert that decisions about the readiness of children for the instructional demands of schooling are, at best, inadequately informed estimates (Petersen, 1994).

### 2.10.2 Occupational therapy and school readiness

Occupational therapists are frequently involved in the transition of young children from preschool to formal schooling (Children’s Hospital at Westmead, Occupational Therapy Department, 2010; McBryde, Ziviani & Cuskelly, 2006). Occupational therapists continue to develop and administer individual and group therapy sessions aimed at improving skill deficit areas that are considered to be hampering children’s readiness for school (Children’s Hospital at Westmead, Occupational Therapy Department, 2010). From an occupational therapy perspective, school readiness has traditionally concentrated on a child’s developmental competence in motor, social and pre-academic task performance (McBryde, Ziviani & Cuskelly, 2004).

To a lesser degree has children’s ability to process information required for these skills been studied. Information processing and cognition can be examined through the assessment of a client’s performance of routines and tasks related to their occupational performance roles (Chapparo & Ranka, 1997). In this way the impact of information processing strategy application impairment can be determined as it relates to the clients performance of everyday tasks.

In relation to children at the preschool and early school level, the assessment of the information processing aspects of regular preschool and school tasks can provide a detailed profile on which to not only base possible OT referral and intervention, but on which to base school readiness recommendations. This may be as opposed to or in
addition to the more traditional assessment of pre-academic ability and determination of developmental age via a developmental checklist.

Information processing refers to the process of gathering relevant information from the environment, interpretation of that information and then production of a behavioural response (Law, Missiuna, Pollock & Stewart, 2001). From a developmental perspective information processing theory emphasizes the development of cognitive skills which include: attention, memory, problem solving and thinking skills. The theories of information processing largely refer to the process as a system of sensory input, throughput, which is a process of problem solving, and use of memory to generate responses. Feedback loops carry information from the response back into the system for further processing and is thought to contribute to the acquisition of new knowledge for future use. Deficits in information processing strategy application can consequently occur at any stage in this four-part process. Therefore information processing is a continuous process that results in learning and is influenced by ongoing experience.

Information processing is conceptualized as a cycle of learning. Children gather information from people, things, and events in their environment. They organize this information in their minds, and code it in ways that keep it usable and easily understood (Bohannon & Bonvillian, 2005). They develop a large repertoire of automatic thinking skills, making performance quick and easy. These automatic skills are used to solve problems and contribute to new learning, allowing children to become ‘independent learners’. Central to the theory is that learning requires deliberate information processing, and that disordered learning emerges when there are persistent processing errors at any point in this process. This processing system is controlled by an executive system (metacognition) that enables children to think about and evaluate their own
learning capacity (Huitt, 2003).

Detailed analysis of a child’s information processing strategy application abilities may thus provide insight into a child’s capacity to process information required for specific school tasks, or in other words provide insight into a child’s ‘teachability’ and ‘individual readiness’ to learn. This information could provide parents and teachers alike with a greater understanding of an individual child’s readiness for school.

There would appear to be an increasing trend for earlier referral of young children to occupational therapy services (Robotham, 2005a; Robotham, 2005b). In Australia these early referrals may well be the result of the ever-increasing competitive pressure children are under in their early years to perform well at school. Referral of young preschool and early primary school aged children to OT services appears to take two forms. First, children are referred after 1, 2 or even 3 years at formal school when it is seen, usually by their teacher, that they are experiencing great difficulty with their academic student role. By this stage in their schooling they are usually having difficulty in most areas of school participation and as a consequence present with poor self esteem. Second, there would appear to be an increasing trend for early referral of preschool children to OT services with poorly defined co-ordination or information processing problems (Robotham, 2005a; Robotham, 2005b).

More sophisticated assessment tools are required that precisely define this client groups areas of difficulty with occupational performance. Such assessment tools require some predictive validity and the need to link preschool performance with later school performance. This is necessary to enable children to make the most of their preschool education and be given the best possible start to formal schooling.
2.11 ASSESSMENT TOOLS

Standardised assessment tools are assessments that have specific procedures for both administration and scoring. Typically they include a test manual or instructional guide that details the purpose of the assessment, the targeted population for whom it was designed, administration and scoring procedures and usually the results of research that examines the validity and reliability of the assessment tool. Standardised assessment tools provide objective data about client performance and are used in occupational therapy not only for diagnostic purposes but for evaluation of performance over time, program planning and evaluation and for research. The two types of standardised assessments are norm referenced and criterion referenced.

2.11.1 Norm referenced assessments

Norm referenced assessment tools compare individual performance to the performance of a specific sample or group. An individual’s achievement is evaluated not in terms of what degree of proficiency they exhibit or what the individual can do but rather as a comparison between the individual’s performance and the performance of other members of the test group (Glaser, 1963). Scoring from a norm referenced assessment indicates which individual is more or less able than another but does not provide information about levels of actual task proficiency. Norm referenced assessments provide normative data and the characteristics of the normative group. The ChIPPA (Stagnitti, 2000) is a norm referenced assessment. Data from the ChIPPA provides insight into suspected pre-academic difficulties and can be used to guide intervention (Stagnitti, Unsworth & Ridger, 2000).
2.11.2 Criterion referenced assessments

Criterion referenced assessments measure a person’s performance in terms of what tasks the person is able to do and the behaviours they display rather than how their performance compares to others (Anastasi, 1988; Griffin, 1995). Interpretation focuses on individual performance rather than on membership to a norm referenced group. Glaser (1963) originally put forward the notion of criterion-referenced testing based on his perceived need to make test scores more informative about behaviour rather than about performance. He defined criterion referenced measurement as “being dependent on an understanding of the components of human performance’ (Glaser, 1981 p.935).

Criterion referenced assessment tools specifically describe an individual’s performance, in terms of what they can do and cannot do and compares performance to a predetermined performance level (Montgomery & Connolly, 1987). Performance level does not necessarily refer to a final behaviour but a point along an achievement continuum (Glaser, 1963) and is usually determined by the task itself and the expected developmental levels of the individuals performing the task/test.

Criterion referenced assessments have at their focus the task and its demands and the individual’s ability to perform the task (Griffin, 1995) as well as consideration of the context in which the task occurs. They typically use rating scales that produce an outcome score based on levels of mastery and provide information regarding how an individual performs a task. This information can then be utilised to guide individualised intervention plans. Occupational therapy theory and practice focuses on the individual and their ability to function within their own environment, thus the use of criterion referenced assessments, that measure and comment on real-life performance, are a valuable tool in occupational therapy assessment and intervention planning.
The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis is a criterion referenced assessment that measures cognitive information processing abilities during real-life task performance. The literature supports the increasing use of criterion referenced assessment as measures of occupational performance (Katz et al, 2007; Mulligan, 2003; Nott, Chapparo & Heard, 2009) and as a means of guiding future interventions.

2.12 LITERATURE SUMMARY

This chapter has presented a review of the main themes that underpin this study, those of occupational performance, typical child development in the preschool and early school years, cognition and information processing, pretend play and its link with cognition, Australian preschool curriculums and the concept of school readiness from an Australian perspective. The following is a summary of the findings:

2.12.1 Occupational Performance

Occupational performance, the unique domain of occupational therapy is represented by the Occupational Performance Model (Australia)(Chapparo & Ranka, 1997a). The area of interest of this study falls largely under the area of cognition, one of the interacting occupational performance components that comprises the OPM(Aus).

2.12.2 Occupational Performance Roles

The main occupational performance roles of the preschool and early school aged child are those of player, self maintainer and academic student. All areas of focus in this study.
1.12.3 Child Development

Significant motor, social and cognitive development occurs in children around the ages of 3 ½ to 6 ½. In particular the maturation of the frontal cortex, responsible for planning, analysis, selection and coordination of thought, self control and self regulation, makes formal education in this age group attainable.

2.12.4 Child Cognitive Development

Children’s cognitive abilities mature with age and many theories of cognitive development have been proposed. These theories have historically been used to inform and guide teaching and academic curriculum development. In particular the theories proposed by Vygotsky ((1933/1978) and Siegler (1998, 2002, 2004, 2005) reflect the development of information processing strategy application during the childhood years.

2.12.5 Play

Play, the primary occupation of young children, presents a key to children’s cognitive and physical development. In particular pretend play has been linked to cognitive development and cognitive processing difficulties seen in preschool play behaviours may indicate similar difficulties in the school aged child and impact on academic development.

2.12.6 Preschool

It is well established that non compulsory forms of education prior to school entry, ie preschool, have a positive impact on transition of young children into formal schooling. Preschool curriculum in Australia and in particular New South Wales, the setting for this study, is influenced by multiple internationally established curriculums. Currently
there is no single over riding body to administer or uphold learning outcomes of any sort in New South Wales preschools and long day care centres.

2.12.7 School Readiness

The concept of school readiness, used to describe a child’s readiness for formal schooling in Australia, lacks strict definition and consensus regarding the essential skills required. Perspectives on school readiness encompass ‘readiness for school’, ‘readiness to learn’ and ‘individual readiness’. Individual readiness, the focus of this study, focuses not on what the child has learned but rather on their capacity to engage in the learning process and learn how new tasks can be done, a concept consistent with information processing development.
CHAPTER THREE

METHODOLOGY

This chapter contains an outline of the methods used in the study. A description of the study design, recruitment and data collection methods is presented. The phases of data collection are described along with details and justification of assessment tasks. Finally an overview of data analysis methods is outlined.

The study focused on the information processing strategies used by typically developing preschool and school aged children during performance of regular preschool and school tasks, self-maintenance tasks and pretend play. The study was longitudinal in design and followed a cohort of children as they transitioned from preschool into formal schooling. The aim was to investigate the predictive value of an occupational therapy information processing assessment, the PRPP System, on aspects of school readiness of the study participants.

3.1 ETHICS APPROVAL PROCEDURES

The Human Research and Ethics Committee (HREC) at the University of Sydney reviewed this research. Approval documentation is provided in Appendix A. The State Education Research Approval Process (SERAP) for the New South Wales Department of Education and Training reviewed Phase 2, the School Phase, of this research. Approval documentation is provided in Appendix I. Written approval from the individual preschools and schools was also obtained as part of the University of Sydney ethics approval process.
3.2 RESEARCH DESIGN

A longitudinal study following a cohort of preschool children through until the end of their first year at formal school was employed. The study had a total sample size of 39 participants of which 32 were followed from preschool to the end of their first year at formal school. From the 32 participants followed from preschool into formal schooling 29 complete sets of data were collected over the period of active data collection. A complete set of data comprised a total of 5 separate data sets, collected at six monthly intervals. Time 1, Time 2 and Time 3 (the Preschool Phase) were collected during the participant’s years at preschool and Time 4 and Time 5 (the School Phase) collected in Kindergarten or the equivalent of the first year at formal school (see Figure 3.1).

In addition to 29 complete data sets, 4 of the possible 5 data sets were collected from three participants. Two of these participants were not able to be seen during term 2 in Kindergarten at Time 4 due to difficulties organising visits to the schools and the third participant did not attend preschool during the time of data collection at Time 2. In total 32 sets of data, comprising the 29 full sets and 3 almost complete sets were used for analysis in this study (see Table 3.1).

Table 3.1: Participant data included and excluded from analysis

<table>
<thead>
<tr>
<th>Participants – Study Data Included</th>
<th>Participants – Study Data Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Complete data sets (90%)  n = 29</td>
<td>Moved out of area  n = 4</td>
</tr>
<tr>
<td>Incomplete data sets (10%)  n = 3</td>
<td>Early move to Kindergarten  n = 2</td>
</tr>
<tr>
<td>(100%)  n = 32</td>
<td>Additional year at preschool  n = 1</td>
</tr>
</tbody>
</table>
Partial data were collected on the seven remaining participants. Four participants either moved during the course of the study or were not able to be followed into formal schooling, two participants moved into formal schooling a year earlier than expected by their preschools and one final participant was followed for the full length of the study but spent an extra year in preschool as they were deemed not ready to start school. These data were not included in the total data analysis.

The data were collected in two main phases of the study. These were the Preschool and the School Phases. Figure 3.1 outlines the sequence of data collection and assessments utilised. Assessments are described in detail later in this chapter.
**3.3 SAMPLE**

Cluster sampling and criterion based sampling were used in this study. Day Care Centres and Preschools were selected using cluster sampling, from a local telephone directory listing Early Childcare Centres, with an equal number of Long Day Care
Centres and Preschool Centres initially contacted (n=12) of which nine centres agreed to participate in the study. All participants attended Long Day Care or Preschool in the North-Western Suburbs of Sydney, New South Wales, Australia. This area was selected due to its local proximity to the researcher. The sample of participants in this study was a criterion based sample. The researcher was not directly involved in the sample selection.

The majority of participants attended Preschool (n=27) compared to Long Day care (n=11). A small number of participants changed Centres during the study making a total of 11 Long Day Care Centres and Preschools involved in the study. All participants were identified by their Long Day Care or Preschool teachers as typically developing preschoolers at the time of the study, with no identified learning or motor difficulties. All participants had been at long day care or preschool for at least 8 months prior to the commencement of the study and it was anticipated by the preschool teachers, that all would progress onto formal schooling approximately 16 months after the study had commenced.

There were a total of 20 female and 18 male participants in the study. The age range of the participants at the commencement of the study was from 3 years 5 months to 4 years 7 months, with a mean age of 4 years 1 month. At the conclusion of the study the age range was 5 years 6 months to 6 years 7 months, with a mean age of 6 years 1 month.

Each participant in the study had by association, a teacher at both preschool and school. As some data were collected via teacher questionnaires and informal teacher interviews, all preschool and school teachers were also considered participants in the study. A total of nine preschool teachers participated, with an approximate preschool teaching experience range from one year to over 20 years. It was observed that the Long Day
Care Centres had younger staff with less working experience compared to the preschools.

There were 25 Kindergarten teacher participants from twenty primary schools. Of the primary schools participating, 10% (n=2) were Independent schools, 20% (n=4) Catholic primary schools and 70% (n=14) NSW Department of Education and Training Public schools. All Kindergarten teachers had greater than two years teaching experience and many had over 15 years of teaching Kindergarten and other primary classes.

3.4 RECRUITMENT PROCEDURE

Twelve Day Care Centres and Preschools were contacted via telephone in the first instance and the study aims and objectives discussed with the Directors. A follow up letter was then sent summarising the research study and the proposed participation of the Centres 75% (n = 9) agreed to participate. A letter was then obtained from each Long Day Care or Preschool Centre outlining their willingness to participate in the research.

A visit was organised by the researcher to further discuss the study and distribute participant information packages (see Appendix II) for the Preschools and Long Day Care Centres to distribute to interested families. The Centre Directors were asked to only distribute information packages to the families of children from their Centre who were in their final two years of preschool, and who had no identified learning or motor difficulties. Information packages were distributed by the Centres and interested responses from families were collected. Initial information collected on participants
included only their name, date of birth, preschool centre and signed permission from
their parent/guardian to participate in the study.

The sampling method outlined above was utilised in this study both for convenience and
because one of the assumptions of this study was that in a group of ‘typically
developing’ preschool aged children, a small percentage of these children would present
with information processing difficulties that would impact on school readiness and
successful assumption of the school student role as the children moved into formal
schooling. The other assumption was that the majority of the children from a small
criterion based sample, would not present with any significant information processing
strategy application difficulties and that preschool, typical development and natural
maturation would suffice as a means for school readiness.

The participant sample was from a small area in the north western suburbs of Sydney in
the Hills Shire, “home to a relatively young population with a significant share of
overseas born residents. The socio-economic status of residents in the Hills is high in
comparison to Western Sydney, with average weekly individual income and
qualification levels the highest in the region” (NSW Department of Health, 2009).
Socioeconomic position measures include occupation, income, assets and education
(NSW Department of Health, 2009).

The Long Day Care Centres and Preschools participating in this study provided a range
of preschool curriculums. As part of their curriculum the centres provided a wide
variety of pre academic programming which would appear to be reflective of Centres
like these across Australia (Kronenmann, 1999; NSW DET, 2005; Walker, 2004). The
only preschool program/curriculum not represented in this study was a Steiner based
program.
3.5 DATA COLLECTION INSTRUMENTS

The principal assessment utilised in this study was the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis (Chapparo & Ranka, 2003). The focus of this study was the investigation of information processing strategy application and the strengths and weaknesses found in typically developing preschool and early school aged children as they moved from their preschool years into formal schooling.

With the literature providing a clear link between children’s play, in particular pretend play, and cognition (Bergen, 2001 & 2003; Stagnitti, 2003; Stagnitti, Unsworth & Rodger, 2000; Vygotsky, 1976), the Child Initiated Pretend Play Assessment (ChIPPA) (Stagnitti, 2003) was also utilised. The ChIPPA purports to quantitatively measure the cognitive aspects of a child’s spontaneous pretend play ability and recent research has found correlations between the ChIPPA and the PRPP scores when play (as differentiated from other preschool tasks) is assessed (Boland, 2004). This study employed a number of additional assessments, utilised by the researcher, to either compliment the PRPP System or provide additional data about the study participants. A description of the PRPP System of Task Analysis, the ChIPPA and additional assessments follows.

3.5.1 The Perceive, Recall, Plan, Perform (PRPP) System of Task Analysis

(Chapparo & Ranka, 1997b, 2003)

The PRPP System is an occupational therapy assessment currently being employed by occupational therapists to link cognitive function or impairment to occupational performance across many diagnostic groups. It has been utilised as a primary research tool in the areas of traumatic brain injury (Farquhar, 2010; Fry & O’Brien, 2002; Nott,
2008), schizophrenia (Aubin et.al., 2008), and in children with learning difficulties (Boland, 2004; Chapparo, 2010) and autism spectrum disorder (Lohri, 2005).

The PRPP System (Chapparo & Ranka, 1997b) was used at each data collection time in this study in order to gain data and insight into the information processing abilities of typically developing preschool children as this is an area identified in the literature as lacking comprehensive norms (Peterson, 1994; Robotham, 2005b). In this study, performance success was determined to be within the 90% to 100% range, as the tasks set had been identified as well within the performance abilities of typically developing preschool children.

3.5.1.1 **Reliability and Validity of the PRPP**

Reliability and validity studies conducted during the development of the PRPP System (Chapparo & Ranka, 1997b) established face and content validity in adult traumatic brain injury patients. Subsequent published and unpublished studies have demonstrated acceptable to high levels of inter-rater, intra-rater and test-retest agreement across a number of diagnostic groups (Aubin et al., 2008; Boland, 2003; Lohri, 2005; Nott, Chapparo & Heard, 2009; Nott, 2008; Pulis, 2002). The PRPP System has been shown to have good reliability across raters and within assessment procedures (Nott, Chapparo & Heard, 2009). The PRPP System also has demonstrated reliability and concurrent validity with accepted measures of elaborative pretend play (Boland, 2003).

Test and rater reliability have not been specifically examined in the typically developing preschool and early school aged population. Criterion related validity – predictive validity will demonstrate that information processing strategy application difficulties seen during the assessment of self-maintenance tasks and pretend play will predict
similar difficulties with tasks (academic and other) related to a school student’s role. Intra-rater and inter-rater reliability of the PRPP System will be also be demonstrated.

3.5.1.2 PRPP System Administration and Scoring

All participants were assessed during each stage of data collection using the PRPP System across a number of typical preschool or school aged tasks, as described in Section 3.6. Two main scores are derived from the PRPP, one from the Stage One Analysis and one from the Stage Two Analysis. Statistical analysis was performed using the Social Sciences statistical software program, SPSS Statistics Graduate Pack version 17.0 (2008) and Rasch analysis (winsteps and Facets).

In this study, Stage One scores, expressed as percentages, provided data on the levels of mastery against teacher expectations of mastery for each task attempted. Scores are based on error versus error free performance and scored in the areas of accuracy, repetition, omission and timing. A score of 100% was set as the criterion score for each task, as selected tasks were deemed within the capability of typically developing children (see Section 3.6). Criterion performance in Stage One of the PRPP System is measured against what is expected of the individual within a set environment (Chapparo & Ranka, 2003). The individual tasks for each stage of data collection were broken down into operationally defined steps, or steps that were expected for successful task completion. A percentage score was calculated for each separate task as well as a total percentage score across all the tasks completed during each data set. Figure 3.2 provides an example of a PRPP System score sheet, the left hand side detailing the Stage One analysis and the right hand side showing the Stage Two analysis. Operationally defined steps, found in the left hand column of Figure 3.2 are an example task steps from data collection at Time 1.
Figure 3.2: Sample PRPP System Scoring Sheet
In this study the Stage Two PRPP scores, calculated across the four information processing quadrants, were based on performance across all tasks completed during each data set. A single PRPP Stage Two score rather than a score for each separate task was obtained as strong or weak performance for individual descriptor behaviours was seen during each task attempted and a single score better reflected each participants total level of information processing strategy application ability.

The Stage Two analysis provides a total PRPP score comprised of quadrant, sub-quadrant scores and individual descriptor scores (see Appendix III for PRPP Stage Two Descriptor definitions). The total PRPP System score and the quadrant scores, Perceive, Recall, Plan and Perform, were used for analysis in this study as they reflect the broader areas of information processing strategy application that were the focus of this study.

The total PRPP System scores and the Quadrant scores were all converted to total percentages in order that analysis could be undertaken and comparisons made. All conversions to percentages were completed using the SPSS (2008). Percentages were calculated using the following formula:

\[
\% = \frac{\text{actual score} - \text{minimum score possible}}{\text{score range}} \times 100
\]

*Score range = highest possible score – lowest possible score
Table 3.2: Calculation values for Percentage conversion of PRPP System raw scores

<table>
<thead>
<tr>
<th></th>
<th>Highest possible score</th>
<th>Lowest possible score</th>
<th>Score range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total PRPP</td>
<td>102</td>
<td>34</td>
<td>68</td>
</tr>
<tr>
<td>Perceive</td>
<td>24</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Recall</td>
<td>27</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Plan</td>
<td>27</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Perform</td>
<td>24</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

For example, for a participant who scored 92 out of a possible 102 on the PRPP, their percentage score would be:

\[
\text{Total PRPP score \%} = \frac{92 - 34}{68} \times 100
\]

\[
\text{Total PRPP \%} = 85.29411
\]

3.5.1.3 PRPP System Inter-Rater and Intra-Rater Reliability

A total of eight participants were videotaped during the first data collection at Time 1. Scoring by the researcher, using the PRPP Stage Two Analysis, was completed a second time via video analysis following the data collection at Time 5, approximately 24 months later, to establish intra-rater reliability. Inter-rater reliability of scoring was established using an independent rater, familiar with the PRPP System, to analyse and score the same eight participant video tapes. Data were analysed using SPSS (2008). A description of the non-parametric statistical tests utilised is found in Section 3.8.6. The results of the intra-rater and inter-rater reliability are shown in Table 3.3 and Table 3.4.
Table 3.3: Spearman’s Rank Order Correlation Coefficient for Intra-rater reliability data for Quadrants and total PRPP score

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Spearman’s rho (r)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive</td>
<td>.994, p&lt;.001**</td>
<td></td>
</tr>
<tr>
<td>Recall</td>
<td>.410, p&gt;0.01*</td>
<td></td>
</tr>
<tr>
<td>Plan</td>
<td>.738, p&lt;0.023*</td>
<td></td>
</tr>
<tr>
<td>Perform</td>
<td>.872, p&lt;.002**</td>
<td></td>
</tr>
<tr>
<td>PRPP Total</td>
<td>.930, p&lt;.001**</td>
<td></td>
</tr>
</tbody>
</table>

* Correlation significant at the 0.05 level  ** Correlation significant at the 0.001 level

These scores indicate that scoring at Time 1 and re-scoring via video 24 months later produced mostly consistent results. There is a positive association between all the sets of scores, with significant agreement shown between the Perceive and Perform quadrants as well as for the total PRPP scores. Less positive agreement is demonstrated between the Plan and Recall quadrant scores. The Wilcoxon signed-rank test also demonstrated there were no significant differences between the two sets of scores for all quadrants and the Total PRPP scores.
Table 3.4: Spearman’s Rank Order Correlation Coefficient for Inter-rater reliability data for Quadrants and total PRPP score

<table>
<thead>
<tr>
<th></th>
<th>Spearman’s rho (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive</td>
<td>.884, p&lt;.004**</td>
</tr>
<tr>
<td>Recall</td>
<td>.883, p&lt;.01*</td>
</tr>
<tr>
<td>Plan</td>
<td>.935, p&lt;.001**</td>
</tr>
<tr>
<td>Perform</td>
<td>.882, p&lt;.004**</td>
</tr>
<tr>
<td>PRPP Total</td>
<td>.805, p&lt;.016*</td>
</tr>
</tbody>
</table>

* Correlation significant at the 0.05 level  ** Correlation significant at the 0.001 level

The inter-rater reliability data analysis also indicates positive agreement between sets of scores. There is significant agreement between the Plan quadrant scores, followed by the Perceive and Perform Quadrant scores and less significant agreement between the Recall quadrant and Total PRPP scores. The Wilcoxon signed-rank test demonstrated no significant differences between the two sets of scores. All inter-rater and intra-rater scores were significantly similar at the p<0.01 level or greater.

3.5.2 The Child-Initiated Pretend Play Assessment (ChIPPA) (Stagnitti, 2000)

The Child Initiated Pretend Play Assessment (ChIPPA) (Stagnitti, 2003), a recently published occupational therapy assessment which purports to quantitatively measure the cognitive aspects of children’s pretend play, was used to assess pretend play at Time 1 and Time 5 in this study. The ChIPPA was developed to discriminate between the play of typically developing children and those with pre-academic problems (Stagnitti, Unsworth & Rodger, 2000). All participants were assessed using the ChIPPA at Time 1 and purposeful sampling was used at Time 5, targeting eight participants.
3.5.2.1 *Reliability and Validity of the ChIPPA*

The ChIPPA, being a relatively newly developed assessment, has had limited clinical application beyond that of Stagnetti and her researchers. It has been developed as a standardised play assessment and raw scores can be used to compare children to their peer group (Stagnetti, 2003). In a study published by Stagnetti, Unsworth & Rodger, (2000) inter-rater reliability of the ChIPPA was found to be high. This study also supported the researches hypothesis that the ChIPPA would discriminate between normally developing children and those with suspected pre-academic difficulties. Thus preliminary studies indicate that the ChIPPA has good reliability and validity.

3.5.2.2 *ChIPPA Administration and Scoring*

The ChIPPA was administered to all participants during the first data collection at Time 1. Scoring was done both in situ and via video analysis for the first ten participants then as familiarity with scoring improved all scoring was done in situ as it was found some play behaviours could be missed via video analysis alone. Scoring for four participants was not completed due to stolen video footage occurring within days of data collection. Footage was contained on a tape in a video camera that was stolen from the researchers home before conversion to VHS video tape could be performed. Sydney University Ethics Committee were notified of this event.

The ChIPPA was administered to a purposeful sample of eight participants at Time 5. A smaller number of participants were selected due to time constraints and lack of a quiet play assessment area in some schools, once participants were at formal school. Only five complete ChIPPA scores were obtained as three participants were unwilling to participate. This reaction was discussed with the author of the assessment, Professor Karen Stagnitti, who had not found older children unwilling to complete the assessment.
The participants stated they did not want to play with the toys and although encouragement was given, the assessment was not completed on these participants.

The ChIPPA assesses pretend play during a conventional-imaginative play session, using conventional toys such as a truck, farm animals, people and cups and plates (examples of the conventional toys are shown in Figure 3.3), then again during a symbolic play session using ‘junk’ toys such as pebbles, cone, tin, stick, cardboard box, hand towel and cloth dolls with hand drawn faces (examples of the ‘junk’ toys are shown in Figure 3.4).

**Figure 3.3:** Examples of the ChIPPA Conventional play session toys

**Figure 3.4:** Examples of the ChIPPA Symbolic Play session toys
Each play session is structured by time and order or toy presentation and broken into two 9 minute (for children of 3 years) or 15 minute (for children aged 4 to 7 years) sessions. The ChIPPA assesses a variety of play behaviours during the 9 or 15 minute sessions. These play actions include:

- Behavioural play actions, single actions including reaching, picking up, asking questions
- Functional play actions, where toys are used in a functional manner such as feeding, naming, dressing
- Number of Object Substitutions (NOS) where one object is substituted for another
- Number of Imitative Actions (NIA) were child imitates the examiners modelled action
- Elaborative Pretend Play Actions (PEPA) which is a functional play action executed carefully in a play context with attention to detail (Stagnitti, 2003).

Raw scores were obtained for all three areas of pretend play, NOS, NIA and PEPA. Tables of normative data, generated by the ChIPPA were used to convert the raw scores for each child into normalised values. (Appendix IV contains ChIPPA score sheet examples). This conversion is performed to place each child’s performance score into a meaningful context of the range of performance for children in particular age brackets. Normative data has been generated for each component of the ChIPPA scores for conventional and symbolic play. Separate normative data tables have been generated for approximately every 6 month increase in age. In this study the ChIPPA normative data used matched the participant’s ages which ranged from 3 year 10 months to 4 years 7 months.
The NIA component scores were excluded from the data analysis, beyond simple descriptive statistics, as according to the ChIPPA these scores are not indicative of a child’s cognitive ability.

Data from the ChIPPA was used in this study to investigate congruence between information processing strategy application, as assessed using the PRPP System and pretend play ability. Data were also used to confirm that the participants were a sample of typically developing children presenting with a range of typically developing play profiles.

3.5.3 PRPP Questionnaires

In order to more effectively gain understanding of the information processing strategy application effectiveness of each participant in the study from the perspective of their preschool and school teachers, two questionnaires were developed by the researcher. These were the Preschool Performance Questionnaire (PPQ) completed at Time 1 and the School Performance Questionnaire (SPQ), completed at Time 5.

The questionnaires were based on and complemented the PRPP System of Task Analysis observations (Chapparo & Ranka, 2003). Teacher questionnaires based on the PRPP System have previously been used and found reliable (Lohri, 2005; Wight & Chapparo, 2008). The aim of the questionnaires was to gain insight into each child’s performance of regular preschool or school tasks from their teacher’s perspective. The questionnaires were also used to determine whether information processing strategy application strengths and weaknesses could be similarly determined by preschool or school teachers untrained in the PRPP System of Task Analysis, as compared to assessment of information processing strategy application using the PRPP System by a
trained occupational therapist. The questionnaires examine each of the PRPP descriptor behaviours. The questions required either a yes/no/sometimes response or a response on a 5 point or 3 point scale. The full versions of the PPQ and SPQ are included in Appendix V.

An example of a question from the Preschool Performance Questionnaire (PPQ) gaining information about the Plan quadrant of the PRPP System (ie. investigating a child’s thinking ability, whether a child is able to work out how to deal with new and different variables and cope with novelty) is:

\[
\begin{array}{|c|c|c|c|c|}
\hline
\text{Is the child able to organise themselves and their work space?} & 1 & 2 & 3 & 4 & 5 \\
\hline
\text{Does the child perform tasks in a logical sequence?} & 1 & 2 & 3 & 4 & 5 \\
\hline
\end{array}
\]

Scale: 1 = no, rarely, 2 = not without individual help/instruction, 3 = sometimes, often requires some help/instruction, 4 = usually, 5 = yes, always

Examples of questions from the School Performance Questionnaire (SPQ) gaining information about the Plan quadrant of the PRPP are:

\[
\begin{array}{|c|c|c|}
\hline
\text{During class work time} \ does \ the \ child:} & 1 & 2 & 3 \\
\text{periodically question their actions/work and make appropriate changes?} \\
\hline
\text{During social interactions} \ does \ the \ child:} & 1 & 2 & 3 \\
\text{make appropriate and safe judgments about their interaction? (eg. is it socially acceptable?, keep going?, change? or stop,?)} \\
\hline
\end{array}
\]

Scale: 1 = no, rarely, 2 = sometimes, often requires some help/instruction, 3 = yes, always
3.5.3.1 Development of the Questionnaires

The questionnaires were developed by the researcher using the PRPP System of Task Analysis (Chapparo & Ranka, 2003) as their basis. Initially, each descriptor behaviour from the PRPP was assigned a five-point scale to specify differing levels of task performance. Questions targeting each descriptor behaviour were then developed and a scoring system, using the five-point scale applied. This questionnaire was disseminated to a number of preschool and school teachers as well as peer reviewed by occupational therapists, familiar and unfamiliar with the PRPP assessment. Comments and suggestions were then used to refine the questionnaire. The second questionnaire, the SPQ, grouped many of the skill behaviours and focused on social interaction and class work performance. The SPQ used a three-point scoring scale that mimicked the scoring guidelines for the PRPP System of Task analysis.

3.5.4 Informal Interview

Following each assessment the participants preschool and school teachers were informally interviewed regarding the participants class progress. A general question such as “How is _____ going at preschool/school?” would be posed and followed up with more probing questions if required. The answers to these questions were used to obtain additional information about general class progress. Prior to school entry, at Data Time 3, the preschool teachers were asked whether, in their opinion, the participant was ready to start formal school. Responses were noted as either a “yes, they are ready” or “no, they are not ready” or, as in some cases, “they are only just ready”. At Data Time 5 teachers were asked if, in their opinion, the participants were coping well at formal school. The responses were noted as either a “yes”, “no” or “not well/variable performance”. Some teachers did elaborate on their answers and others, usually due to
time constraints, did not. As a questionnaire was also being requested at this data
collection time (Time 5), more in depth interviews did not occur. The majority of
teachers did not have time to discuss the participants in detail as data collection always
occurred during class time.

3.5.5 Drawing

The participants were instructed to draw a person as part of one of the tasks analysed
using the Stage 1 and Stage 2 analysis of the PRPP System of Task Analysis. The
children were asked who they had drawn and the drawings were additionally scored
using the detailed scoring requirements for either Draw-a-man or Draw-a-women
underpinning this assessment is that “drawing for the child is primarily a cognitive
process” (Harris, 1963, p.173) and detailed analysis of drawing can be a guide to not
only cognitive development but also the development of language and motor control.
The scoring system is based on the fact that children include greater detail in their
drawings as they get older. It must be noted that although the drawing score scales from
the Goodenough Draw-A-Man Test Manual (Harris, 1963) were used to determine
changes in representational drawing skill, the strict test guidelines of this assessment
where not adhered to.

All participants included greater detail in their drawings of people between Time 1 and
Time 5 but a consistent increase in body features and improvement in representational
drawing was not always demonstrated. Data from these drawings were not analysed
separately in this study but as part of the PRPP System Assessment score, the drawing
being one of the tasks requested for the overall PRPP assessment. Comment on
individual drawing skill and in particular representational drawing skill is contained within the Case Study Chapter, Chapter Five.

3.5.6 **Handwriting**

Handwriting forms the basis of the majority of school based tasks and as such required investigation in this study. A formal standardised assessment of handwriting was not completed during any stage of the data collection. Instead an informal handwriting task was included as part of both School Phase data collections, data sets at Time 4 and Time 5. The handwriting tasks were assessed using both Stage 1 and Stage 2 of the PRPP System of Task Analysis. In addition, the handwriting was analysed for word and letter legibility using the legibility guidelines published in the Evaluation Tool of Children’s Handwriting (ETCH) (Amundson, 1995). Legibility refers to the readability of the written text and is assessed in terms of letter formation, size, alignment and spacing (Amundson, 1995). A total letter legibility percentage was calculated as was a total word legibility percentage. A number of the children were unable to copy the required sentence on the line provided and did not leave spaces between words, produce capitals or full stops. These are skills expected of children nearing the completion of their first full year at formal school (Bool, 2006; Burling, 2004; Cowley, 2006 & Thorne, 2004) therefore for the final data collection at Time 5 a further percentage was calculated to reflect not only legibility but the presence of word spaces, a capital at the beginning of the sentence and a full stop at the end.

3.5.7 **Reading**

Reading is a skill developed during the final year of preschool first years of formal schooling. Formal assessment of reading levels was beyond the scope of this study and not completed as part of the data collection, but each participant’s reading level at data
collection Time 4 then data collection Time 5 was noted. As many differing systems of reading are in operation throughout NSW schools an idea of how well each participant was progressing with reading was obtained from each class teacher. Teachers were asked if the child was above, below or on par with the average reading level expected of a Kindergarten child at that school.

3.6 DESCRIPTION OF THE PRPP ASSESSMENT TASKS

The tasks selected for each stage of data collection were based on the main occupational performance domains of preschool and school aged children, those of play, self maintenance and productivity and were informed by cognitive information processing theory development. As the PRPP System is a criterion referenced assessment, all tasks were confirmed, by a selection of the participating Centres teachers, as representative of tasks that children of that age and preschool or school stage would be expected to successfully complete within their curriculum. The tasks comprised various age/developmentally appropriate skills consistent with preschool or school performance in typically developing children. Developmental skill levels were used to inform task selection for each stage of data collection. In general the participants were expected to complete a colour, cut and paste task, a dressing task, a drawing task and reading and writing tasks as they moved into formal schooling. The majority of participants were able to complete all the tasks within a 20 minute to 30 minute time frame.

3.6.1 Justification for Task Selection

The majority of tasks selected for assessment were table top activities and involved bilateral upper limb use and fine motor control. Research into the amount of time spent
on fine motor tasks in the first years at school found that as much as 55% of each day was spent in fine motor activity (McHale & Cermak, 1992). The development of hand function in children was considered when selecting the tasks for each successive data collection. In particular the use of scissors for cutting and pencils for drawing and writing are complex tasks involving grasp and manipulation of the tool as it acts on another object. Tool mastery is developmental and practice of the skill results in performance becoming faster, smoother and more accurate (Mulligan, 2003). Task expectation was generally based on the mean age of the participants for each data collection time.

The following tasks were selected as typical preschool and school age tasks. Developmental expectations are described below:

- **Colouring:** Children learn to colour within the lines between the ages of 3 and 4 years (Case-Smith, 2001). As with other fine motor skills, colouring accuracy increases with age as fine motor skills mature.

- **Scissor use:** Cutting with scissors is a bimanual task involving grasp and coordinated opening and closing of the scissors in one hand and stabilization or manipulation of the object being cut in the other hand. The Peabody Developmental Motor Scales (Folio & Fewell, 2000) indicate that by 3 ½ to 4 years a child can cut out a circle and by 4 ½ years can cut out a square. Mature use of scissors occurs around 5 to 6 years of age when eye-hand coordination is well developed and the child can achieve simultaneous hand control and isolated finger movement.

- **Drawing:** Drawing, whether representational or abstract, is a common feature in both preschool and school routines. Children use drawing to represent their view
of what they see around them. As they move into formal schooling they are expected to illustrate stories, recreate visual experiences and create drawn artwork using a variety of mediums. The literature on children’s drawing clearly demonstrates that drawing changes and when under instruction, becomes more representative as a child matures (Harris, 1963; Mulligan, 2003). The scoring guidelines and normative scores from the Goodenough Draw-A-Man Test (Harris, 1963) were used to inform expected performance criteria at each data collection time.

- **Dressing:** Independent dressing, another developmental task, involves fine motor control, balance, strength, visual monitoring and bilateral upper limb use. Klein (1983) determined that by the age of 3 ½ children can dress and undress with supervision. By the age of 4 children should be able to remove a pullover top independently and put socks and shoes on. By the age of 5 they should be able to lace up shoes independently (Case-Smith, 2001).

- **Handwriting:** Handwriting forms the basis of the majority of school subjects and is a means by which humans communicate ideas and information. It is an important academic occupation for all school children. At school children are required to use handwriting to create stories, take notes, complete mathematics and practice written spelling. By the end of their first year at school the expectation is that children will be able to reproduce all the letters of the alphabet, write simple words and understand the use of capitals and full stops, although not necessarily use these during free writing (Bool, 2006; Burling, 2004; Cowley, 2006 & Thorne, 2004). When copying sentences the expectation is that spaces and capitals and full stops are faithfully reproduced.
• **Reading**: Children are not necessarily expected to be able to read when transitioning into formal school (NSW Department of Education and Training, 2005; Public Education NSW, 2008). This is a skill taught and learnt in the first few years at school. The majority of children are able to read simple books by the end of their first year at school (Burling, 2004; Thorne, 2004). There appear to be many different reading programs in place in schools across NSW and Australia. All the schools in the study had home reading and class reading programs that encouraged improvement and progress in reading by attainment of reading levels over the year. The reading task in this study was minor, with participants asked to read short, developmentally appropriate sentences, for example, ‘I can jump’.

Outlined below are detailed explanations of all tasks utilised for Time 1 to Time 5. In addition, a table with details on exact task expectations is provided. Expectations were based on both developmental ability, as outlined in the literature, and preschool and school teacher expectation of proficiency levels for each task. Time limits indicated were a guide only and were not rigidly adhered.

### 3.6.2 Tasks at Time 1

Assessment at Time 1 occurred during Term 4 of preschool (October to December). The age range of participants was 3 years 5 months to 4 years 7 months, with an average age of 4 years 1 month. For this initial assessment greater emphasis was placed on chronological age and fine motor development as the majority of children had only attended preschool for 8 months at the time of data collection 1. For successive assessments participant mean age was used to set task expectations along with teacher expectation.
Time 1 data collection comprised a drawing, cutting and pasting task and a dressing task. The drawing, cut and paste task had six steps. The child had to cut out a pre-drawn 8cm diameter circle (drawn in 2mm black marker pen) from a 12.5cm² piece of coloured craft paper, then cut out a pre-drawn 8 x 6cm rectangle (drawn in 2mm black marker pen) from another piece of 12.5cm² coloured craft paper (Figure 3.5). Then both shapes had to be pasted, using a glue stick, onto one side of a standard brown paper bag. The child then had to draw a person (a boy for the male participants and a girl for the female participants) on a piece of A5 white paper and paste it onto the other side of the brown paper bag. The children were invited to write their names on their pictures, but this aspect of the task was not included in the assessment as it does not necessarily represent an age appropriate skill. This task represented an unfamiliar but typical, preschool level craft task.

![Figure 3.5: Time 1 cut and paste task - pre-drawn circle and rectangle](image)

The dressing task comprised eight steps and required the child to take their jumper top off, rearrange it ready to put back on then put the top back on. The majority of children had a jumper top with them at preschool, but a jumper top was borrowed from another child or provided if necessary. This dressing task is representative of the developmental
level children at this stage prior to school should be able to complete independently.

Task expectations for Time 1 are outlined in Table 3.5.

**Table 3.5: Expectations of tasks at Time 1**

<table>
<thead>
<tr>
<th>Tasks at Time 1</th>
<th>Expectation of Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drawing</strong></td>
<td>Able to draw a recognisable person with a head, some facial features, at least 2 limbs and possibly a body. No expectations placed on body part proportions or correct feature placement.</td>
</tr>
<tr>
<td><strong>Cut &amp; Paste</strong></td>
<td>Cut out both circle and square within 5mm either side of the 2mm thick drawn line, no ripping of paper. Shapes expected to resemble a square and a circle. Circle expected to be more accurately cut out than square (see developmental scissor use, Section 3.6.1). Square and circle to be pasted onto same side of paper bag, not overlapping. Time limit of 10 minutes.</td>
</tr>
<tr>
<td><strong>Dressing</strong></td>
<td>Independently remove then put back on a long sleeve top (jumper, track top) without any prompts. Top expected to be correct side out and correct way around once put back on. No time limit imposed.</td>
</tr>
</tbody>
</table>

### 3.6.3 Tasks at Time 2

The mean age of participants at data collection Time 2 was 4 years and 7 ½ months, with an overall range between 4 years and 5 years 2 months. Time 2 data collection comprised of 3 tasks, a colour, cut and paste task, drawing of a person and a dressing task. Task 1, the colour, cut and paste task required the participants to identify and name a randomly placed triangle, square and rectangle, in 2mm black lines on a white piece of A4 paper (Figure 3.6) and identify what the shapes might be able to make if cut out and
pasted together (the answer being a house). The participants were instructed to colour each shape in, cut them out and paste them onto an A4 coloured sheet of paper to make them into a house (a completed house was briefly shown to each child).

![House shapes](image)

**Figure 3.6:** Time 2 colour, cut and paste task - House shapes

The second task, comprising of 8 steps, was identical to the dressing task completed in Time 1. This task was selected as a number of the participants had difficulty with this task during the first data collection. In addition to these 2 tasks, the children were also asked to draw a person. The expectations placed on the tasks for Time 2 are outlined in Table 3.6.
Table 3.6: Expectations of tasks at Time 2

<table>
<thead>
<tr>
<th>Tasks at Time 2</th>
<th>Expectation of Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour, cut &amp; paste</td>
<td>1. Correctly identify a square, triangle and rectangle drawn on a piece of paper</td>
</tr>
<tr>
<td></td>
<td>2. Identify shapes could make a house. A space ship was also accepted (3 male participants).</td>
</tr>
<tr>
<td></td>
<td>3. Colour the 4 shapes, mostly keeping within the lines</td>
</tr>
<tr>
<td></td>
<td>4. Cut shapes out, staying within 5mm of the pre-drawn lines. All shapes expected to resemble drawn shape and be accurately cut out. No ripping of paper.</td>
</tr>
<tr>
<td></td>
<td>5. Shapes to be pasted onto separate sheet of paper to make a house, ie. triangle on top of large rectangle to form roof, window and door in approximately correct locations.</td>
</tr>
<tr>
<td></td>
<td>Task, along with drawing of person to be completed within 25 minutes</td>
</tr>
<tr>
<td>Drawing</td>
<td>Able to draw a recognisable person with a head, some facial features, 4 limbs and possibly a body. No expectations on body part proportions or correct feature placement.</td>
</tr>
<tr>
<td>Dressing</td>
<td>Independently remove then put back on a long sleeve top (jumper, track top) without any prompts. Top expected to be correct side out and correct way around once put back on. Time limit of &lt; 5 minutes.</td>
</tr>
</tbody>
</table>
3.6.4 Tasks at Time 3

The tasks selected for Time 3, the third data collection required greater attention and accuracy than the previous tasks and the task of writing was introduced, as the majority of preschool children are able to write their names in the six months leading up to the start of school (Aiossa, 2005). The mean age of participants at Time 3 was 5 years 1 month, with an age range of 4 years 5 months to 5 years 7 months.

The first task was presented to the child on a single sheet of A4 paper. There was a single black line at the top of the page and a dashed outline of a house at the bottom of the page (Figure 3.7). The task, of 3 steps, required the child to write their name on the pre-drawn line then carefully trace the dashed lines of the outline of the house. They then had to turn the paper over and draw a person. If the child had difficulty writing their name, it was either written for them to trace over or copy, depending on their preference.

![Figure 3.7: Time 3 task - outline of house and line to write name](image)

The second task, of 13 steps, was presented on another piece of A4 paper (Figure 3.8). On the paper were randomly presented, in dashed outline, two small circles with dots on their centre, a larger circle, a triangle, an oval with two small diamonds at the bottom and two semi circles. They were asked to identify the shapes and what they thought the
shapes could make if cut out and pasted together (the answer being a bird). The children then had to colour in all the shapes, cut them out and paste them onto a coloured piece of A4 paper to make a bird (a completed bird was briefly shown to them). Task expectations are outlined in Table 3.7.

Table 3.7: Expectations of tasks at Time 3

<table>
<thead>
<tr>
<th>Tasks at Time 3</th>
<th>Expectation of Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write Name</td>
<td>Any attempt to write, trace or copy name was accepted</td>
</tr>
<tr>
<td>Trace outline of house</td>
<td>All dotted lines to be traced. Tracing to be accurate to within 5mm either side on straight lines and within 7mm of all corner lines.</td>
</tr>
<tr>
<td>Drawing</td>
<td>Able to draw a recognisable person with a head, at least 4 correctly placed facial features, 4 limbs and a body. No expectations on body part proportions or correct limb placement.</td>
</tr>
<tr>
<td>Colour, cut &amp; paste</td>
<td>1. Correctly identify a triangle, circle and diamonds drawn on a piece of paper</td>
</tr>
<tr>
<td></td>
<td>2. Identify shapes could make a bird, if no response a prompt was given and</td>
</tr>
</tbody>
</table>
3.6.5 Tasks at Time 4

The mean age of participants at Time 4 was 5 years 8 months with an age range between 5 years and 6 years 4 months. Time 4 data collection, taking place after a full term at formal school, comprised of a reading and copying task and a colour, cut and paste task. The reading and copying task, of 3 steps, required the children to recognise the letters in a short sentence, the sentence being “I can jump”, read the sentence then copy it on a line underneath (Figure 3.9).

![Figure 3.9: Time 4 reading and copying task - “I can jump” sentence](image)

For the second task the children were presented with a piece of paper with a story and 3 pictures about Humpty Dumpty on it and a second piece of paper with the words

noted

3. Accurately colour, within the lines, all the shapes

4. Cut shapes out, staying within 3mm of the lines. All shapes expected to resemble drawn shape and be accurately cut out. No ripping of paper.

5. Shapes to be pasted onto separate sheet of paper to make a bird similar to completed bird shown at start of task. Range of bird varieties accepted, but had to resemble a bird. * time limit of 20 minutes
“Humpty Dumpty” written in dots at the top (Figures 3.10 & 3.11). The children had to identify the story from the pictures and/or words on the first piece of paper, trace the dotted words on the second piece of paper, colour in ONLY Humpty Dumpty and his hat, cut out the 3 squares that comprised the story and paste in the correct order of the story under their word tracing. In addition the children were also asked to draw a person on an A5 piece of paper. Task expectations for Time 4 are outlined in Table 3.8.

Figure 3.10: Time 4 task - Humpty Dumpty story page

Figure 3.11: Time 4 task - Humpty Dumpty tracing/pasting page
### Table 3.8: Expectations of tasks at Time 4

<table>
<thead>
<tr>
<th>Tasks at Time 4</th>
<th>Expectation of Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading</strong></td>
<td>Read the sentence “I can jump”. ‘I’ and ‘can’ were words Kindergarten children were expected to sight read and ‘jump’ a word they were expected to sound out if unable to read it.</td>
</tr>
<tr>
<td><strong>Writing</strong></td>
<td>Write the sentence “I can jump” horizontally, within 1cm of the line provided or preferably on the line provided. Capital letter expected, full stop not expected.</td>
</tr>
</tbody>
</table>
| **Humpty Dumpty task** | 1. Correctly identify the story was Humpty Dumpty from either the pictures or the words (story briefly talked about)  
2. Accurately colour in ONLY Humpty Dumpty and his hat in the 3 pictures, colouring to be all within the lines  
4. Accurately cut out the 3 squares that made up the story, staying within 2mm of all lines.  
5. Paste the 3 squares of the story in the correct order of the Humpty Dumpty story onto sheet of paper with Humpty Dumpty outlined in dotted letters  
6. Trace the dotted words ‘Humpty Dumpty’, staying with 2mm of all dotted lines  
* Time limit of 15 minutes |
| **Drawing**     | Draw a recognisable person with a head, at least 4 correctly placed facial features, 4 limbs and a body. Some expectation of correct body part proportions and correct limb placement. Some expectation of clothing to be represented |
3.6.6 Tasks at Time 5

The mean age of participants at Time 5 was 6 years and 1 month with a range between 5 years 6 months and 6 years 7 months. The final data collection had 3 tasks. The first, of 4 steps, involved reading, copying and drawing. The children were asked to read the sentence “The quick fox and the lazy dog” and copy it on the lines drawn below the sentence (Figure 3.12). The children were also asked to draw a person on the back of the page they had been working on.

![Image of reading task](image)

**Figure 3.12:** Time 5 reading, and writing task- “The quick fox and the lazy dog” sentence

The second task was a colour, cut and paste task. The children were presented with a piece of A4 paper with a series of shapes outlined on it (Figure 3.11). They had to identify what animal the shapes could make if cut out and pasted together. They were instructed to only colour the legs, head, tail and patches on the shell. Then cut the shapes out and make a ‘walking turtle’. A completed walking turtle was briefly shown to them.
The final task was a six step dressing task. The children were required to take off their shoes and socks and put them back on. This included either velcro or lace-up shoes. Task expectations are outlined in Table 3.7.

Table 3.9: Expectations of tasks at Time 5

<table>
<thead>
<tr>
<th>Tasks at Time 5</th>
<th>Expectation of Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading</strong></td>
<td>Read the sentence “The quick fox and the lazy dog”. All words, except ‘quick’ and ‘lazy’ were identified by teachers as words Kindergarten children were expected to sight read. Help was provided in sounding out ‘quick’ and ‘lazy’ if required.</td>
</tr>
<tr>
<td><strong>Writing</strong></td>
<td>Write the sentence “The quick fox and the lazy dog” horizontally, on the line provided or within 5mm of the line. Capital letter, spaces and full stop expected.</td>
</tr>
<tr>
<td><strong>Drawing</strong></td>
<td>Draw a recognisable person with a head, at least 4 correctly placed facial features, 4 limbs and a body. Expectation of correct body part proportions and correct limb placement. Clothing expected to be represented.</td>
</tr>
</tbody>
</table>
Colour, cut and paste

1. Correctly identify the shapes could make a turtle
2. Accurately colour in ONLY the legs, head, tail and patches on the shell. All colouring to be within the lines, neat and no scribble accepted
4. Accurately cut out the shapes staying within 1 to 2mm of all lines.
5. Paste the shapes to make a ‘walking’ turtle as per the picture shown at the start

Dressing

Remove and put back on shoes and socks. Shoes to be fastened either using the shoes velcro or shoe laces. Socks to be correctly oriented but no expectation of correct side out. Task to take < 5 minutes

3.7 ASSESSMENT SETTING

During the Preschool Phase all PRPP System assessment tasks were performed within the participant’s regular preschool room, usually in a small area not being used by the other preschool children. There was no effort to remove the children from their normal preschool classroom as this represented the typical preschool environment complete with the distractions and ongoing noise that preschool children are expected to deal with during routine preschool task performance. Where ever possible a quiet area was selected for the ChIPPA assessment, as directed in the ChIPPA assessment guidelines.

During the School Phase the tasks were usually completed in a room away from the participant’s regular class in order to reduce disruption to ongoing class routine. Where assessment occurred was left entirely up to the participants teachers.

The complete instructions for every new task were given prior to commencement of the task, conforming with PRPP System administration guidelines (Chapparo & Ranka,
2003). A least to most prompt hierarchy was used, meaning if prompting were required a minimal prompt was initially used then more prompting provided if this were indicated. Prompting was only given when the child asked for guidance or indicated they were unable to recall the next step.

### 3.8 DATA ANALYSIS

All data were entered into the Statistical Package for the Social Sciences, SPSS (2008) and this program was used to perform the majority of the data analysis. A descriptive analysis was performed to determine the nature, distribution and characteristics of the sample. Statistical analysis was then conducted to address the specific research questions posed.

#### 3.8.1 Descriptive Data Analysis

In this study descriptive data analysis was performed to make preliminary general assumptions about the data collected as well as the distribution of the data. This aspect of the data analysis consisted of the frequency distributions and measures of central tendency and variability.

*Frequency distributions* list all the possible scores from a data set for each variable and the number of times each score appears (Unsworth, 1999). It is useful to determine the most common scores and the normality of the distribution of the data. Frequency can be displayed graphically or numerically. The use of a frequency histogram clearly presents the shape of the distribution, enabling the researcher to determine the normality of the distribution (Unsworth, 1999). A normal distribution, ie one that has an equal number of
scores above and below the middle point, is prerequisite or an assumption of many statistical tests (SPSS, 2008).

**Measures of Central Tendency and Variability** are used to describe the average scores, middle score and most frequently occurring scores from a set of data as well as the score range, inter-quartile range, standard deviation and variance (Unsworth, 1999). The most frequently used measure of central tendency is the mean, the average score for a variable in a set of data. It is important to note that the mean can be distorted by outlying data, particularly when the distribution of the data is skewed.

### 3.8.2 Assessment of Normality

The assessment of normality of data is a prerequisite for many statistical analyses (Coakes, Steed & Dzidic, 2006; Unsworth, 1999). The assumption of the normality of data can be explored graphically and statistically via SPSS. Graphically, histograms, stem-and-leaf plots, boxplots, normal probability plots and detrended plots can be produced. Examination of the graphical representations of the final PRPP scores for each of the 5 data collection times (PRPP Time 1, PRPP Time 2, PRPP Time 3, PRPP Time 4 & PRPP Time 5) indicated that the results did not follow the assumption of normal distribution. Examination of the statistical normality tests, including Kolmogorov-Smirnov statistic with a Lilliefors Significance Correction, the Shapiro-Wilk statistic as well as skewness and kurtosis, also indicated the results did not meet the assumption of normality. The data was negatively skewed with a peaked distribution. The Kolmogorov-Smirnov statistics with Lilliefors Significance levels (p<0.05), indicate normality was not assumed (see Appendix VI). Kolmogorov-Smirnov and Shapiro-Wilk Statistics on each PRPP data set, Time 1 to Time 5.
The only aspects of the data that did represent normal distribution were the age range and gender of the participants. This finding was expected as the PRPP System, being a criterion referenced assessment investigating the information processing strategies used during specific task performance aimed at the individuals developmental level, will not tend to fit normal distribution patterns. Criterion referenced assessments measure performance ability rather than comparing performance to a normed group.

All data violated the normality distribution assumptions required for parametric statistical tests, with highly statistically differences from normal (p<.001) on all measures excepting age and gender. Non-parametric data analyses were therefore used in this study. Data did meet the generic assumptions of non-parametric techniques (Coakes, Steed & Dzidic, 2006; Unsworth, 1999). The sample used in this study was a small (n=32) convenience, criterion based sample and there was a similar shape and variability across the distributions.

### 3.8.3 Hierarchical Cluster Analysis

Cluster analysis is a procedure that attempts to identify relatively homogeneous groups of cases based on selected characteristics, after specifying the number of clusters. Distances are computed using simple Euclidean distance (the square root of the sum of the squared differences between values for the items and the default for interval data) (SPSS, 2008). Cluster analysis was performed via the hierarchical cluster procedure as this is the most appropriate method for data sets with less than 200 cases (Heard, 2010; Norusis, 2005). K-means clustering was selected as this enables a predetermined number of clusters to be formed. The algorithm iteratively estimates each cluster mean and assigns each participant to the cluster for which its score distance to the cluster mean is the smallest (Norusis, 2005). In this study hierarchical cluster analysis was
used to group the participants, based on their scores, into groupings or clusters for comparison to other data that had ranked the participants into either three or four groupings.

3.8.4 Sensitivity and Specificity of Data

Sensitivity and specificity are used to determine or summarise the relationship between a diagnostic test and the actual presence of disease (Fletcher, Fletcher & Wagner, 1998). The sensitivity and specificity of a test should be taken into account when a test is selected to determine the presence or absence of a disease (or problem). Sensitivity and specificity were calculated in this study looking at those children who, in their teachers opinion, were having difficulties at preschool/school and those children, as determined by the PRPP, as having difficulties at preschool/school. A sensitive test will rarely miss people with the disease (or problem) and a specific test will rarely misclassify people without the disease (or problem) as diseased (or problematic). Sensitivity and specificity tests were calculated using WinPepi, Pepi for Windows, version 9.9 (Abramson, 2009). WinPepi is a computer program for epidemiologists, designed for use in practice and research in the health field. It aims to complement other statistics packages.

In this study sensitivity and specificity of data were analysed to determine the relationship between strategy application abilities determined by the PRPP System as a ‘test’ of readiness for school and the Preschool and School teacher’s ‘opinions’ on readiness.
3.8.5 Rasch Analysis

Rasch analysis was applied to the data to examine the difficulty of the different test items and calibrate them on a single, common scale. Rasch analysis makes the assumption that each item measures an underlying common characteristic or trait. By analysing how participants perform on a range of test items it is possible to arrange the items on a scale that reflects their difficulty. The Rasch model scale is independent of the sample of participants doing the test items and it can be applied when the difficulty of the items being assessed are not equally spaced. This characteristic makes the Rasch model valid for criterion based assessments such as the Perceive, Recall, Plan and Perform System of Task Analysis (Chapparo & Ranka, 1997). Rasch also calculates a "fit statistic" for each item so that, it is possible to establish whether a test item is measuring a common underlying characteristic.

The Rasch model is an item-response latent-trait model. The use of a set of carefully selected survey items or questions produces an interval scale that determines item difficulties and person measures. The items are arranged on a scale according to how likely they are to be upheld (item difficulty). The scale is then used to show person measure, a quantitative measure of a person’s attitude on the unidimensional scale. This means the items are used to define the measure’s scale, and people or participants are then placed on the scale based on their responses to the items in the measure or test. The scale units are logits (log odds units), which are linear and thus suitable for use in simple statistical procedures.

In this study Rasch model analysis was performed to determine the degree to which the scoring and summing of the PRPP assessment are defensible for the data collected, reflecting measurement of a unidimensional construct, ie. information processing
strategy application ability. Rasch analysis was indicated as PRPP quadrant and total scores are produced by participants scoring either a 1, 2 or 3 on each item assessed, indicating increasing levels of response for each test item, or variable. PRPP quadrant scores and total scores summarise each participant’s responses to all the items, implying that the items are measuring a unidimensional variable, ie strategy application. The PPRR total score reflects strategy application a higher total score indicating more efficient strategy application than a lower score.

3.8.6 Non-Parametric Tests

3.8.6.1 Friedman's Test

The Friedman Test is a non-parametric test used to compare two or more related observations repeated on the same subjects. It is comparable to the parametric repeated measures ANOVA. A non-parametric test was used as the data did not meet the assumptions of the repeated measures ANOVA, these being the normal distribution of scores. This test, like many other non-parametric tests, uses the ranks of the data rather than their raw values to calculate the statistic. As this test does not make a distribution assumption, it is not as powerful as the ANOVA.

The hypotheses for the comparison across the repeated measures are:

H₀: The distributions are the same across repeated measures.

H₁: The distributions across repeated measures are different

The Freidman test indicates whether at least one of the observations differs from at least one other observation but does not indicate which one is different or how many are different from each other (Siegal & Castellan, 1988). The test statistic for the
Friedman's test is a Chi-square with ‘a’-1 degrees of freedom, where ‘a’ is the number of repeated measures. When the p-value for this test is small (usually <0.05) there is evidence to reject the null hypothesis.

In this study the Friedman Test was used during the data analysis to determine whether any one set of scores or observations differed from any other over the time period of data collection.

### 3.8.6.2 Wilcoxon’s Test

The Wilcoxon signed-rank test, often referred to as the Wilcoxon t-test, is the non-parametric equivalent of the paired samples t-test (Story, 1999). This non-parametric test is used when data does not meet the assumptions generic to all types of t-tests.

The Wilcoxon test calculates the difference between each set of pairs, and analyses that list of differences. It ranks the absolute values of the differences between the paired data in each sample and calculates a statistic on the number of negative and positive differences. If the null hypothesis is true then the sum of positive differences should be the same as the sum of negative differences. The Wilcoxon tests whether the distribution of two paired variables in two related samples is the same at the group level.

In this study the Wilcoxon signed rank test was used to determine where the differences lay in the distribution of a pair of variables after a Friedman Test had indicated significant differences existed. The Wilcoxon signed rank test was also employed to calculate any differences between the paired data from a teacher completed questionnaire and the researcher’s findings.
3.8.6.3 **Spearman’s Rank Order correlation coefficient**

Spearman’s rank order correlation is the non parametric equivalent to the parametric Pearson’s product moment correlation coefficient. The Spearman’s rank order correlation coefficient is used to examine the degree of association between two sets of scores. The result is an r value falling between -1 and +1 where -1 indicates a perfect negative relationship and +1 indicates a perfect positive relationship. A zero indicates that there is no relationship between the two variables (Bailey, 1991). Spearman’s rho examines two sets of scores to determine the extent of their relationship to each other. It examines at the individual level within the group.

In this study the Spearman’s rank order correlation coefficient was used to examine the degree of association between sets of scores. It was employed to help analyse data to answer the many of the research questions.

3.8.6.4 **Kendall coefficient of concordance**

Kendall coefficient of concordance is a non-parametric test used when there are 3 or more sets of rank orderings. It provides a value from 0 to +1, where 0 indicates no correlation between the scores and +1 indicates a positive correlation. Kendall’s coefficient of concordance was used in this study to investigate whether the individual participant’s information processing abilities remained consistent over the time frame of the study.
CHAPTER FOUR

RESULTS

The purpose of this chapter is to review the findings that emerged from the study. Descriptive data analysis is presented first. The seven research questions, outlined in Section 1.3, are answered sequentially. A summary of the results is contained at the end of the chapter.

4.1 INFORMATION PROCESSING PROFILES OF TYPICALLY DEVELOPING PRESCHOOL AND SCHOOL AGED CHILDREN

This section answers the first of the research questions. What is the range of information processing strategy application ability found in a sample of typically developing preschool and school aged children without prior diagnosis of any learning or motor disorder, as assessed by the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis (Chapparo & Ranka, 1997)?

The information processing strategy application abilities of a criterion based sample of 32 preschool aged children were assessed using the Perceive, Recall, Plan and Perform System of Task Analysis (Chapparo & Ranka, 1997). Strategy applications were assessed at approximately six monthly intervals on all study participants from 18 months prior to school entry in the preschool years until the end of Kindergarten at formal school. All PRPP System Stage 2 data were entered into SPSS (2008) and descriptive data analysis was performed to determine the nature, distribution and characteristics of the sample and of participant performance. In total, five completed data sets were entered into SPSS for analysis. These represented the data collected at
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Time 1, Time 2, Time 3, Time 4 and Time 5. These data sets consisted of a total percentage score from each completed Perceive, Recall, Plan and Perform (PRPP) System assessment as well as individual scores from the four quadrants that make up each total PRPP System score. All scores were converted to corrected percentages and expressed as these percentages for analysis (see Section 3.5.1.2 for formula). Data labels used and referred to throughout this chapter are detailed below:

PRPP Time 1, Perceive Time 1, Recall Time 1, Plan Time 1 and Perform Time 1 = in order are the total PRPP score, total Perceive score, total Recall score, total Plan score and total Perform score from data collected at Time 1

PRPP Time 2, Perceive Time 2, Recall Time 2, Plan Time 2 and Perform Time 2 = in order are the total PRPP score, total Perceive score, total Recall score, total Plan score and total Perform score from data collected at Time 2

PRPP Time 3, Perceive Time 3, Recall Time 3, Plan Time 3 and Perform Time 3 = in order are the total PRPP score, total Perceive score, total Recall score, total Plan score and total Perform score from data collected at Time 3

PRPP Time 4, Perceive Time 4, Recall Time 4, Plan Time 4 and Perform Time 4 = in order are the total PRPP score, total Perceive score, total Recall score, total Plan score and total Perform score from data collected at Time 4

PRPP Time 5, Perceive Time 5, Recall Time 5, Plan Time 5 and Perform Time 5 = in order are the total PRPP score, total Perceive score, total Recall score, total Plan score and total Perform score from data collected at Time 5

In addition a multi-faceted Rasch model was used and data were entered into Facets
(Linacre, 2007) to generate a Rasch modelled hierarchy of PRPP descriptors, item difficulty and person ability. A three facets analysis was performed investigating participants (n=32), data collection times (n=5) and items (n=34).

4.1.1 Descriptive Data Analysis – Total PRPP Scores

Descriptive data analysis was used to describe, summarise and make general observations about all the data collected. Total percentage scores for each PRPP data set from Time 1 to Time 5, (PRPP Time 1, PRPP Time 2, PRPP Time 3, PRPP Time 4, and PRPP Time 5) were entered into SPSS (2008) and frequency, measures of central tendency and variability were analysed. Table 4.1 displays the results numerically. Figures 4.1 to 4.5 display the frequency histograms for each data set, Time 1 to Time 5, with superimposed normal curve.

Table 4.1: Frequency Table for PRPP Time 1, PRPP Time 2, PRPP Time 3, PRPP Time 4 and PRPP Time 5 total percentage scores

<table>
<thead>
<tr>
<th></th>
<th>PRPP Time 1</th>
<th>PRPP Time 2</th>
<th>PRPP Time 3</th>
<th>PRPP Time 4</th>
<th>PRPP Time 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>N Missing</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>87.6838</td>
<td>88.4725</td>
<td>86.5809</td>
<td>89.4118</td>
<td>87.6838</td>
</tr>
<tr>
<td>Median</td>
<td>93.3824</td>
<td>92.6471</td>
<td>91.1765</td>
<td>92.6471</td>
<td>90.4412</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>11.9047</td>
<td>11.89933</td>
<td>16.27214</td>
<td>10.13275</td>
<td>11.54171</td>
</tr>
<tr>
<td>Minimum</td>
<td>54.41</td>
<td>47.06</td>
<td>19.12</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Figures 4.1 to 4.5 display frequency of scores for each set of data collected, Time 1 to Time 5. Potential score range is 0 to 100. A higher score indicates a higher level of strategy application performance as measured by the PRPP System of Task Analysis. Lower scores indicate less efficient strategy application. The PRPP System of Task Analysis is a criterion referenced assessment and as such when assessing a cohort of typically developing children, as was done in this study, the bell shaped curve is skewed to the right. Criterion performance was set at 100% with a range of 85% to 100% indicating typical performance (Chapparo & Ranka, 2003). All histograms are configured with identical ‘x’ axis score ranges and ‘y’ axis frequency ranges in order that figures can be compared against one another. Visual analysis of total PRPP scores from Time 1 to Time 5 indicates a greater frequency of higher scores than lower scores.

**Figure 4.1:** Frequency Histogram for PRPP Time 1 scores

**Figure 4.2:** Frequency Histogram for PRPP Time 2 Scores
Figure 4.3: Frequency Histogram for PRPP Time 3 scores

Figure 4.4: Frequency Histogram for PRPP Time 4 scores

Figure 4.5: Frequency Histogram for PRPP Time 5 scores
4.1.2 Descriptive Data Analysis – Individual PRPP Quadrant Scores

The four PRPP quadrants, named the Perceive, Recall, Plan and Perform quadrants assess differing aspects of information processing strategy application skill, as described in Section 3.5.1. This section presents the frequency of the individual quadrant scores from Time 1 to Time 5. For each quadrant the potential score range is 0 to 100. A higher score indicates a more efficient level of performance in the individual information processing quadrant. Lower scores indicate less efficient strategy application within that quadrant or specific area of strategy application ability. All histograms are configured with identical ‘x’ axis score ranges and ‘y’ axis frequency ranges in order that figures can be compared against one another. The frequency statistics tables for the PRPP individual quadrant percentage scores from Time 1 to Time 5 can be found in Appendix VII (Tables A2 to A6).

Figure 4.6 to Figure 4.9 display the frequency of scores for each quadrant, Perceive, Recall, Plan and Perform for Time 1. Visual analysis of the quadrant scores from Time 1 indicates a greater frequency of higher scores than lower scores and differences in the score spread for the different quadrants. Overall it can be seen that participants performed more strongly in the Perceive (range 70 – 100%, mean 94.9%) and Recall (72 – 100%, mean 90.3%) quadrants, whilst there was a greater range of scores found in the Plan (27 – 100% , mean 78.8%) and Perform (27 – 100% , mean 87.1%) quadrants. Scores were also consistently lower in the Plan quadrant.
Chapter Four: Results

Figure 4.6: Frequency Histogram for Perceive Time 1 scores

Figure 4.7: Frequency Histogram for Recall Time 1 scores

Figure 4.8: Frequency Histogram for Plan Time 1 scores

Figure 4.9: Frequency Histogram for Perform Time 1 scores

Figure 4.10 to Figure 4.13 display the frequency of scores for each quadrant, Perceive, Recall, Plan and Perform for Time 2. Again a peaked distribution in the higher score ranges is evident, demonstrating a greater number of participants with efficient strategy application.
Figure 4.10: Frequency Histogram for Perceive Time 2 scores

Figure 4.11: Frequency Histogram for Recall Time 2 scores

Figure 4.12: Frequency Histogram for Plan Time 2 scores

Figure 4.13: Frequency Histogram for Perform Time 2 scores

Figure 4.14 to Figure 4.17 present the frequency of scores for the Perceive, Recall, Plan and Perform quadrants for Time 3. This data collection time was at the end of the participant’s time at preschool, before moving into Kindergarten the following year. A percentage score range of 10 to 100% is shown on the ‘x’ axis for Time 3 as quadrant...
scores below 20 were obtained in the Plan and Perform quadrant from 1 participant. A peaked distribution, indicating the majority of participants gained a higher score is again demonstrated. The Plan scores demonstrate a flatter curve, indicating a greater spread of scores in this quadrant.

**Figure 4.15**: Frequency Histogram for Perceive Time 3 scores

**Figure 4.14**: Frequency Histogram for Recall Time 3 scores

**Figure 4.16**: Frequency Histogram for Plan Time 3 scores

**Figure 4.17**: Frequency Histogram for Perform Time 3 scores
The Perceive, Recall, Plan and Perform quadrant frequency scores for Time 4 are shown in Figures 4.18 to 4.21. Time 4 data was collected half way through the participants first year at school in Kindergarten.

**Figure 4.18**: Frequency Histogram for Perceive Time 4 scores

**Figure 4.19**: Frequency Histogram for Recall Time 4 scores

**Figure 4.20**: Frequency Histogram for Plan Time 4 scores

**Figure 4.21**: Frequency Histogram for Perform Time 4 scores
The Perceive, Recall, Plan and Perform quadrant frequency scores for Time 5 are shown in Figures 4.22 to 4.25. This data was collected at the end of the participants first year at formal school and was the final data set collected.

**Figure 4.22:** Frequency Histogram for Perceive Time 5 scores

**Figure 4.23:** Frequency Histogram for Recall Time 5 scores

**Figure 4.24:** Frequency Histogram for Plan Time 5 scores

**Figure 4.25:** Frequency Histogram for Perform Time 5 scores
A similar trend was found for all five data collection times. The Perceive and Recall quadrants demonstrated a consistent trend for more efficient strategy application indicated by higher scores, while the Plan and Perform quadrants demonstrated a greater spread of scores across the score range, although always presenting a peaked distribution at the higher end of the score range indicating a greater number of participants having efficient strategy application abilities in those quadrants. The flatter superimposed curve on all five Plan quadrant histograms indicates a greater spread of scores and thus larger range of planning strategy application ability across all five data collection times. Visual analysis highlights a small number of participants performed poorly compared to the overall cohort across all variables scored.

4.1.3 Hierarchical Cluster Analysis

A hierarchical cluster analysis was performed using SPSS (2008) to determine whether participants could be grouped into distinct groupings of information processing strategy application ability based on total PRPP System scores. Based on examination of visual data, it was hypothesised that the participants would fall into three clear groups. The first and largest group were those participants with effective overall strategy application abilities, able to easily complete presented tasks to an expected age appropriate level. The second, a smaller group, being those with some areas of inefficient or inconsistent strategy application ability but who were able to complete tasks presented, with the results often being a lesser standard than would be expected for their age. The final and smallest group being those participants with overall reduced strategy application, whose ability to complete age appropriate tasks was hampered by ineffective strategy application, resulting in incomplete or very poor task performance. Table 4.2 presents the cluster ranges and numbers of cases in each cluster from the SPSS hierarchical
cluster analysis.

**Table 4.2:** Hierarchical cluster analysis (SPSS, 2008), showing cluster ranges for PRPP Time 1 to Time 5 and number of cases in each cluster group.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Participants in</th>
<th>PRPP Time 1 n=32</th>
<th>PRPP Time 2 n=31</th>
<th>PRPP Time 3 n=32</th>
<th>PRPP Time 4 n=30</th>
<th>PRPP Time 5 n=32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>21</td>
<td>24</td>
<td>26</td>
<td>20</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>SPSS Cluster range (%)</td>
<td>86.7 - 100</td>
<td>86.7 - 100</td>
<td>83.8 - 100</td>
<td>91.2 - 100</td>
<td>89.7 - 100</td>
<td></td>
</tr>
<tr>
<td>Cluster 2</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>SPSS Cluster range (%)</td>
<td>70.6 - 85.3</td>
<td>73.5 - 85.3</td>
<td>51.5 - 79.4</td>
<td>76.4 - 86.7</td>
<td>76.4 - 88.2</td>
<td></td>
</tr>
<tr>
<td>Cluster 3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>SPSS Cluster range (%)</td>
<td>54.4 - 67.6</td>
<td>47.1 - 55.9</td>
<td>19.12</td>
<td>50</td>
<td>50 - 67.6</td>
<td></td>
</tr>
</tbody>
</table>

A mean of the five ranges was calculated for each of the 3 distinct clusters in order to group the participants into overall strategy application groups across the five data collection times. These mean ranges also represent the range of strategy application ability typically seen in any targeted population, i.e. effective strategy application ability, moderate and then inefficient strategy application ability (Chapparo & Ranka, 2003). It was expected that some participants would remain within the same group across each of the five data collection times, while others, particularly those in the middle group would move between groups across the five data collection times. The
mean cluster ranges are presented in Table 4.3.

**Table 4.3: Mean Cluster Ranges for Cluster Groups 1 to 3.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Cluster Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>87.6 – 100%</td>
</tr>
<tr>
<td>Group 2</td>
<td>71.2 – 87.5%</td>
</tr>
<tr>
<td>Group 3</td>
<td>&lt; 71.1%</td>
</tr>
</tbody>
</table>

The spread of score frequencies that contribute to the clustering into 3 distinct groups of strategy application ability is evident by the score spread shown on the frequency histograms from Time 1 to Time 5, Figure 4.1 to Figure 4.5. Across the five data collection times an average of 22 participants were in Group 1, indicating effective strategy application ability, 8 in Group 2, and 2 in Group 3, indicating reduced strategy application ability. The consistency of participant performance will be further analysed in Section 4.3.

### 4.1.4 Rasch Analysis

Rasch analysis was utilised to confirm the unidimensionality of the PRPP System items, to create a linear hierarchy of strategies used, confirm hierarchical cluster analysis and determine the reliability of the measure. In Rasch measurement, fit statistics are used to detect the discrepancies between the Rasch model and the data collected. Items that do not fit the unidimensional construct are those that diverge unacceptably from the expected ability/difficulty pattern. Rasch analysis programmes usually report fit statistics as two chi-square ratios: infit and outfit mean square statistics that have an expected value of +1 and range from 0 to infinity. Wright and Linacre (1994) suggest
the reasonable range for mean-square fit values should be based on the nature of the
testing situation rather than adopting a single standard fit range. For clinical
observations, a mean-square range of 0.5-1.7 is considered acceptable; however, a fit
range of $1 \pm 0.4$ is suggested for survey style data. The high misfit scores are more
problematic than the low ones (low scores mean too predictable).

Infit and Outfit statistics are also reported in interval-scale forms (e.g. $t$ or $z$) in which
their expected value is 0. Using the commonly accepted interpretation of $t$ values, infit
and outfit $t$-values greater than +2 or less than -2 are generally interpreted as having less
compatibility with the model than expected ($p<.05$). It is generally expected that 95% of
the persons and items should meet these criteria and that 5% may misfit by chance
(Wright & Masters, 1982; Wright & Mok, 2000).

Individual person scores outlined in Table 4.4 are all within the acceptable range for
Infit and Outfit. Participant 7 has higher than expected outfit mean square value & their
ZStd scores are borderline. As an entire group:

- Person mean infit (MnSq) = 0.99  Person mean infit (ZStd) = 0.0
- Person mean outfit (MnSq) = 0.93  Person mean outfit (ZStd) = 0.0

The Individual person Scores Table (Table 4.4) places the participants in order of
highest Rasch measure, or most able to the lowest Rasch measure or least able, across
all 5 times assessed. The measure value is the Rasch calibrated Measure, or ‘Ability’
score indicating each participants overall score across all times measured. Participant 6
was overall the most able and participant 4 overall the lease able, with the scores
ranging from 4.77 logits to -.29 logits.
Table 4.4: Rasch generated hierarchy of strategy application ability for study participants Time 1 to time 5 in logits

<table>
<thead>
<tr>
<th>Participant</th>
<th>Difficulty Measure</th>
<th>St Error</th>
<th>Infit Mn Sq</th>
<th>Zstd</th>
<th>Outfit Mn Sq</th>
<th>Zstd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most Able</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4.77</td>
<td>.33</td>
<td>1.06</td>
<td>.3</td>
<td>.96</td>
<td>.2</td>
</tr>
<tr>
<td>8</td>
<td>4.67</td>
<td>.32</td>
<td>.85</td>
<td>-.4</td>
<td>.43</td>
<td>-.7</td>
</tr>
<tr>
<td>16</td>
<td>4.67</td>
<td>.32</td>
<td>.97</td>
<td>.0</td>
<td>.70</td>
<td>-.2</td>
</tr>
<tr>
<td>9</td>
<td>4.57</td>
<td>.31</td>
<td>.97</td>
<td>.0</td>
<td>1.05</td>
<td>.3</td>
</tr>
<tr>
<td>32</td>
<td>4.48</td>
<td>.30</td>
<td>.95</td>
<td>-.1</td>
<td>.63</td>
<td>-.4</td>
</tr>
<tr>
<td>23</td>
<td>4.39</td>
<td>.29</td>
<td>.94</td>
<td>-.2</td>
<td>.63</td>
<td>-.4</td>
</tr>
<tr>
<td>15</td>
<td>4.31</td>
<td>.28</td>
<td>1.03</td>
<td>.2</td>
<td>.85</td>
<td>.0</td>
</tr>
<tr>
<td>29</td>
<td>4.17</td>
<td>.26</td>
<td>.89</td>
<td>-.4</td>
<td>.55</td>
<td>-.8</td>
</tr>
<tr>
<td>5</td>
<td>3.97</td>
<td>.25</td>
<td>.98</td>
<td>.0</td>
<td>.98</td>
<td>.1</td>
</tr>
<tr>
<td>18</td>
<td>3.97</td>
<td>.25</td>
<td>1.16</td>
<td>.8</td>
<td>.91</td>
<td>.0</td>
</tr>
<tr>
<td>12</td>
<td>3.91</td>
<td>.24</td>
<td>.88</td>
<td>-.6</td>
<td>.59</td>
<td>-.8</td>
</tr>
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Notes: SE = Standard Error; MnSq = Mean Square; ZStd = Standard Z Scores

Fit parameters: MnSq = 0.5 to 1.7; ZStd = 0±2

Person mean infit (MnSq) = 0.99  Person mean infit (ZStd) = 0.0
Person mean outfit (MnSq) = 0.93  Person mean outfit (zStd) = 0.0
Individual item or PRPP System descriptor scores shown in Table 4.5 shows most test items are within the acceptable range for Infit and Outfit. Matches & Labels have infit & outfit problems and Flows is overly fitted to the model.

Overall:

- Item mean infit (MnSq) = 1.02
- Item mean infit (ZStd) = 0.1
- Item mean outfit (MnSq) = 0.92
- Item mean outfit (ZStd) = -0.1
Table 4.5: Rasch generated hierarchy of difficulty of PRPP Stage Two descriptors in logits

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<th>Zstd</th>
<th>Outfit</th>
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Notes: SE = Standard Error; MnSq = Mean Square; ZStd = Standard Z Scores

Fit parameters: MnSq = 0.5 to 1.7; ZStd = 0±2

Item mean infit (MnSq) = 1.02
Item mean infit (ZStd) = 0.1
Item mean outfit (MnSq) = 0.92
Item mean outfit (ZStd) = 0.1
When examining each participant’s Rasch calibrated score on each testing occasion, the pattern is variable. This is demonstrated on the Bias/Interaction graphs (Appendix VIII, Figures A1 & A2). This could be explained by data only being collected once at each 6 monthly interval, thus an average performance score for each testing time was not gained, with greater variation in performance being seen. Also, children develop at differing rates and this may account for some children demonstrating stronger strategy application abilities at Time 1 compared to Time 5. For example participant 18 scored significantly higher at Time 1 (p>.05) than at all other testing Times. Participant 22 scored significantly lower at Time 1 compared to being significantly higher at Time 4, indicating improvement in their information processing strategy application abilities over time. This finding is supported by the literature which indicates that information processing development occurs throughout childhood and into adolescence, does not occur in set stages and is individual and influenced by an individual’s environment (Schneider & Pressley, 1997; Siegler 1996; Vygotsky 1933/1978; Woody-Ramsey & Miller, 1988).

The Individual Descriptor Scores Table (Table 4.5) places the descriptor items in order of highest Rasch measure, or most difficult descriptor item, to the lowest rasch measure, least difficult descriptor item, across all 5 times assessed. Therefore Calibrates is the hardest item at 2.11 logits and Discriminates the easiest item at -4.05 logits. This item hierarchy showing the empirical ordering of the descriptors (or test items) reflects the theoretical ordering of the descriptors (or test items) that you would expect to see in typically developing children. Developmental milestones would indicate that as a child moves through preschool and into formal school their ability to ‘Use Objects’ would improve, this is demonstrated on the Bias/Interaction graphs (Appendix VIII, Figures A3 & A4) showing ‘Use Objects’ to be significantly easier (p>.05) at Times 4 and 5.
than at Times 1 and 2. The opposite can be seen for ‘Matches’ which is significantly
easier (p>0.05) at Time 1 than at Times 4 and 5, indicating that task demands in the area
of matching increased as the children moved into formal schooling, which reflects
formal school curriculum demands. Thus differences in the difficulty levels of the
various descriptors over the 5 data Times can be attributed to developmental maturation
and increasing task difficulty levels reflecting school curriculum demands. The harder
descriptors, or test items, were from the Plan quadrant and the easier descriptors from
the Recall and Perceive quadrants. This finding is reflected in the statistical analysis
from Question Two, section 4.2.

4.1.4.1 Reliability

In traditional test theory, reliability is measured in terms of the internal consistency or
stability of scores over measurements (test-retest). Using Rasch analysis, instead of
Correlational analysis, which tends to be sample dependent, the reliability of a measure
is determined by the separation index, i.e. the number of distinct strata that can be
distinguished in the distribution of persons and items. High separation indicates
variation in the measure due to differing amounts of the actual attribute; low separation
indicates that so much error exists that we cannot tell if people or tasks truly differ in
regard to the attribute. Rasch also produces a separation reliability based on the
separation index which is interpreted in the same way as cronbachs alpha. A person
separation index of 1.50 and reliability of .70 is acceptable; separation index of 2.0 and
reliability of .80 is good; and a separation index of 3.0 and reliability of .90 is excellent
(Duncan, Bode, Min Lai, & Perera, 2003). Rasch person separation index analysis was:

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<td>Strata 6.11</td>
<td>Reliability .95</td>
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The data suggests excellent person and item reliability and separation.

The Vertical Ruler (Figure 4.26) shows the relative relationship between the logit measure, each participant, the relative difficulty at each time interval (Times 1 to 5), the difficulty of each test item and the 3 point rating scale used in the PRPP assessment. The ideal is to have a range of item difficulties that target the range of person abilities. In this sample, item abilities range from -4.05 to 2.11, while person abilities range from -.29 to 4.77.
Figure 4.26: Vertical ruler – Rasch calibrated hierarchy for each facet

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<th>PRPP Scale</th>
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<td>6</td>
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<tr>
<td>15 32 23</td>
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<tr>
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<td>7 1 19 21</td>
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</table>

**KEY:** (Perceive descriptors = Blue; Recall descriptors = Green; Plan descriptors = Red, Perform descriptors = Purple)
In general, the participants (subjects) appear to be not well targeted by the PRPP items (descriptor behaviours measured), as they are generally more able than the most difficult item. Only participants 4, 2, 20, 28 and 30 cross over with the PRPP items. The use of a criterion based assessment would predict that the majority of the typically developing participants would in fact be typically developing and able to complete most, if not all test items. The difficulty with interpreting this graph is that at the higher end of the participant’s abilities an accurate model of their abilities cannot be shown. This is the result expected of a cohort of typically developing children, demonstrating that the majority of the participants where more able than the test items.

4.2 ANALYSIS OF SPECIFIC AREAS OF INFORMATION PROCESSING

This section analysed data to answer the second stated research question: Which areas of information processing strategy application are more or less efficient than other strategy application areas in typically developing preschool and school aged children, as assessed by the PRPP System of Task Analysis?

Visual analysis of Figures 4.1 to 4.25 in Section 4.1 indicates that a group of typically developing children present with a range of strategy application ability. The Friedman Test, used to compare two or more related observations repeated on the same subjects, was employed to determine whether any one quadrant from the PRPP System of Task Analysis was scoring differently, either higher or lower, than the others for each of the five data sets, Time 1 to Time 5. Two series of Freidman tests were run, the first series compared the four quadrant scores at each Time against each other. The second series compared each quadrant to its equivalent quadrant across the five times to determine any significant differences between quadrant scores at each data collection time. Where
the Friedman test had shown that quadrant scores were significantly different from each other, a Wilcoxon signed-rank test, used to calculate the differences between sets of pairs, was employed to calculate which quadrants were significantly different from any others.

As each quadrant of the PRPP System of Task Analysis covers different areas of strategy application (as outlined in Section 2.6.1), analysis of quadrant scores determines which strategy application skills are the least efficient, as found in typically developing preschool and school aged children. Graphical representation, as shown in Figure 4.27 indicates that strategy application in the Plan Quadrant was the least efficient as indicated by consistently lower percentage scores.

Figure 4.27: Perceive, Recall, Plan and Perform (PRPP) Quadrant Scores for Time 1 to Time 5 (Perceive 1 = Perceive % scores from Time 1, Perceive 2 = Perceive % scores from Time 2 etc)
The results of the first series of Friedman Tests confirmed that there were differences between the quadrant scores. The descriptive statistics from the Friedman test showed that the Plan Quadrant was ranked as the lowest for each of the five data sets (Perceive > Recall > Perform > Plan). Friedman and Wilcoxon test results are contained in Appendix IX.

The Freidman Test for Time 1, Time 2, Time 3, Time 4 and Time 5 suggested the quadrants were not equal, as shown in Table 4.6. This was confirmed by the Wilcoxon tests for each data collection time, showing the strategy application behaviours from the Plan quadrant to be consistently the least effective (p<.001).

Table 4.6: Friedman Chi-square Statistic and Significance, Time 1, 2, 3, 4 & Time 5

<table>
<thead>
<tr>
<th>Time</th>
<th>Friedman Chi-square Statistic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 1</td>
<td>24.849,</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>Time 2</td>
<td>46.956,</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>Time 3</td>
<td>43.233,</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>Time 4</td>
<td>10.855,</td>
<td>p&lt;.01</td>
</tr>
<tr>
<td>Time 5</td>
<td>28.183,</td>
<td>p&lt;.001</td>
</tr>
</tbody>
</table>

The Freidman test for Time 4 also suggested the strategy application in each quadrant was not equal, Freidman Chi-square Time 4 = 10.855, p<.01. The Wilcoxon test confirmed this with Perceive 4 > Plan 4 (p<.001), Recall 4 > Plan 4 (p<.005) and Perform 4 > Plan 4 (p<.01).
4.2.1 In Depth Analysis of the Plan Quadrants and Sub-Quadrants

Each of the four PRPP quadrants is comprised of either eight or nine descriptor behaviours which are grouped into three sub-quadrants (see Figure 2.3). The Sub-quadrants in Plan measure the Mapping, Programming and Evaluation strategies used during planning. Further Freidman tests were conducted to determine whether any of the Plan Sub-Quadrants demonstrated less efficient strategy use that any other, in other words, was one sub-quadrant more difficult and causing lower total Plan scores than another. The first series of Freidman Tests, comparing each of the sub-quadrants of Mapping Time 1 to 5, Programming Time 1 to 5 and Evaluating from Time 1 to 5 showed that there were no significant differences between the scores on each of the three Plan sub-quadrants (p>.01 on all tests).

The second series of Freidman tests compared each of the Plan sub-quadrant scores at each data collection Time. The Friedman test results indicated that at Times 1, 4 and 5 there were no significant differences between the Mapping, Programming and Evaluating sub-quadrant scores. At Time 2 the Friedman results indicated some differences between the three sub-quadrant scores (Chi-square = 9.910, p<.007) and a further Wilcoxon Test showed Mapping to be significantly more problematic that Evaluating (p<.004). At Time 3 the Friedman test results also indicated some differences between the three Plan sub-quadrant scores (Chi-square = 7.072, p<.002). Wilcoxon test results showed Programming to be significantly more problematic that evaluating, (p<.002).

These results from the sub-quadrants of the Plan Quadrant indicate that not one specific Plan sub-quadrant consistently demonstrated less efficient strategy application than any
other across the five data collection times and thus did not consistently contribute to lower overall Plan Quadrant scores.

### 4.2.2 Task Mastery: PRPP Stage One Analysis

The PRPP System identifies the information processing strategy application reasons for disordered occupational performance, which is the Stage Two Analysis. Additionally, the PRPP System assesses occupational mastery in selected tasks, which is assessed through the Stage One analysis. Stage One analysis provides an accurate and objective measure of task step achievement. Each set of tasks from each data collection time were broken down into small steps and a judgment made regarding each participant’s level of mastery (Chapparo & Ranka, 2003). Errors in mastery were identified as errors of accuracy, repetition, omission and errors of timing. Table 4.7 details the error types made by the participants (as a group) at each data collection time, expressed as actual error numbers (No.) and percentages (%).

**Table 4.7: Stage One analysis - Error types during task performance**

<table>
<thead>
<tr>
<th>Data Collection Time</th>
<th>Errors of Accuracy</th>
<th>Errors of Repetition</th>
<th>Errors of Omission</th>
<th>Errors of Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Time 1</td>
<td>61</td>
<td>44%</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Time 2</td>
<td>95</td>
<td>74%</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Time 3</td>
<td>113</td>
<td>88%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time 4</td>
<td>62</td>
<td>98%</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Time 5</td>
<td>100</td>
<td>86%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Times 1 - 5</td>
<td>75%</td>
<td>1%</td>
<td>21%</td>
<td>3%</td>
</tr>
</tbody>
</table>
This data demonstrates that the majority of errors made by the participants during the PRPP assessment tasks, were errors of accuracy, 75% of the total errors. These errors included inaccurate cutting, colouring and pasting and decreased accuracy with the reading and writing tasks. Errors in accuracy did not always reflect overall inefficient strategy application, although the participants with greater numbers of accuracy errors were those with less efficient overall information processing strategy application. Errors of omission were high during Time 1, Time 2 and Time 5. This was due to some participants not wanting to complete the dressing tasks, contributing to 28% of the omission errors. As this was something that clearly made the participants uncomfortable, the completion of this task was never insisted upon but was recorded as an error of omission. This error was not necessarily reflected in the overall PRPP Stage 2 scores as strategy application required during the dressing task could not be assessed and scores were based on strategy application in the other selected tasks at those data collection times. Errors of repetition were few, as were errors in timing.

4.3 LONGITUDINAL ANALYSIS OF INFORMATION PROCESSING ABILITIES

This section answers the third research question: *How does strategy application change in children as they move through preschool and into the first year of formal schooling?*

4.3.1 Investigating the relationship between data sets

The Perceive, Recall, Plan and Perform System of Task Analysis was used to assess all participants information processing strategy application abilities at each of the five described data sets, Time 1 to Time 5. Data was collected over a 2 ½ year period and as
such it is important to determine the relationship between the data sets and establish whether the individual participants remained reasonably consistent in their performance relative to the entire sample. This analysis helps determine the information processing profiles of typically developing preschool and early school aged children, data not currently available in the literature. As the data violated the distribution assumptions for parametric statistical analysis, an Intra-Class Correlation Coefficient was not employed. The alternative non-parametric statistical analysis, Kendall’s Coefficient of concordance, was used.

Kendall’s coefficient of concordance was calculated for each quadrant across the 5 times. The following Kendall’s W calculations, shown in Table 4.8 were produced. These scores indicate that performance by each participant across the 5 data collection times was not necessarily consistent. A positive correlation was shown for all the quadrants and total scores with a greater correlation existing for Perform scores, followed by the participants Recall, Plan then Perceive scores. Total PRPP score correlation (W = .637) was also positive, where a Kendall’s W calculation of +1 equals perfect correlation and W = 0 indicates no correlation.

**Table 4.8: Kendall’s W Statistic for Perceive, Recall, Plan, Perform and Total PRPP scores**

<table>
<thead>
<tr>
<th>Kendall’s W statistic (W)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive</td>
<td>.541</td>
</tr>
<tr>
<td>Recall</td>
<td>.602</td>
</tr>
<tr>
<td>Plan</td>
<td>.592</td>
</tr>
<tr>
<td>Perform</td>
<td>.682</td>
</tr>
<tr>
<td>PRPP Total</td>
<td>.637</td>
</tr>
</tbody>
</table>
Spearman’s Rank Order correlation coefficient was also computed to examine the degree of association between each individual quadrant score as well as between the total PRPP scores for each of the 5 data sets. Spearman’s rho indicated that the pattern of agreement across times was reasonably consistent. Spearman’s rank order correlation computations are contained within Appendix X, Tables A15 to A19.

The Spearman’s rho statistics indicate the same trend as the Kendall’s statistic with greater agreement between the Perform quadrants across the five data sets, followed by the total PRPP scores, the Plan and Recall quadrant scores and the least agreement between the Perceive quadrant scores. While a stronger relationship might have been expected between adjacent data collection times, for example Times 4 and 5, as opposed to Times 1 and 5, this did not occur as the PRPP System of Task Analysis did not assess the same tasks at each data collection time but rather specifically selected age appropriate tasks, directly relevant to the participants age, at each data collection time.

A second series of analysis was completed to determine whether there was a significant difference between the participant’s quadrant scores across the five data sets. This was done to determine whether participants performed in a similar manner for each data set assessment. The Friedman Test, used to compare two or more related observations repeated on the same subjects, was again employed to determine if the distributions were the same across the repeated measures. This was followed by the Wilcoxon signed rank test only when the Freidman test indicated significant differences had occurred.
Table 4.9: Friedman Chi-square Statistic for Quadrant scores Time 1 to Time 5

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Friedman Chi-square Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive scores,</td>
<td>10.903, p&lt;.028</td>
</tr>
<tr>
<td>Time 1 to Time 5</td>
<td></td>
</tr>
<tr>
<td>Recall scores,</td>
<td>4.451, p&gt;.05</td>
</tr>
<tr>
<td>Time 1 to Time 5</td>
<td></td>
</tr>
<tr>
<td>Plan scores,</td>
<td>3.076, p&gt;.5</td>
</tr>
<tr>
<td>Time 1 to Time 5</td>
<td></td>
</tr>
<tr>
<td>Perform scores,</td>
<td>4.575, p&gt;.05</td>
</tr>
<tr>
<td>Time 1 to Time 5</td>
<td></td>
</tr>
</tbody>
</table>

The Freidman Test descriptive statistics, displayed in Table 4.9, suggested that there were minor differences in the scores for the different quadrants across the five data sets, with only the Perceive Quadrant from data set 5 showing a significant difference (Freidman Chi-square = 10.903, p<.028). Smaller Chi-square statistics also indicate the quadrant scores across the five data sets were more similar for the Recall, Plan and Perform Quadrants. This demonstrates similar performance in the individual Recall, Plan and Perform quadrants across the five data sets. A Wilcoxon Signed Rank Test was then performed on the Perceive Quadrants to gain the pattern of the score differences. The Wilcoxon Test indicated Perceive Time 5 to be significantly different to Perceive Time 1 (p<.012) and Perceive Time 2 (p<.006). This demonstrates that there was a difference in the performance of the individuals in the Perceive Quadrant at Time 5, particularly compared to the Perceive Quadrants at Times 1 and 2.
4.4 COMPARISON BETWEEN A TEACHER COMPLETED PRPP BASED QUESTIONNAIRE AND THERAPIST SCORED PRPP

This section addresses the fourth research question: What was the agreement between a specifically designed questionnaire completed by a preschool or school teacher, based on PRPP information processing behaviours and the information processing strategies as scored by a trained therapist using the PRPP System of Task Analysis?

Two questionnaires were completed during the data collection phase. The questionnaires, designed by the researcher, were based on the descriptor behaviours from PRPP System of Task Analysis (see Appendix III for PRPP Descriptor definitions and Appendix V for Questionnaires). The questionnaires, assessing participant’s strategy application abilities, were completed by the participant’s teachers at Time 1 and Time 5. The aim of the questionnaires was to determine whether information processing strategy application strengths and weaknesses could be accurately determined by preschool or school teachers untrained in the PRPP System of Task Analysis as compared to assessment of information processing strategy application skills using the PRPP System of Task Analysis by a trained occupational therapist, the researcher. The questionnaires also served to provide greater insight into each participant and their information processing behaviour from the perspective of the preschool and school teacher.

The Preschool Performance Questionnaire (PPQ) was completed at Time 1 and completed by the participant’s preschool teachers. This questionnaire had a 100% completion rate. The final questionnaire, made up of two parts that examined work and social interactions, was the School Performance Questionnaire (SPQ) and was completed at Time 5 by the participants Kindergarten teachers. This questionnaire had an 81.25% completion rate.
The scores for the questionnaires were determined by grouping the questions into their corresponding information processing quadrants and gaining a quadrant score for Perceive, Recall, Plan and Perform as well as an overall score. These scores were all converted to total percentages in order that analysis could be undertaken and comparisons made. All conversions to percentages were completed using the SPSS (2008). Percentages were calculated using the following formula:

\[
\% = \frac{\text{actual score} - \text{minimum score possible}}{\text{score range}} \times 100
\]

*Score range = highest possible score – lowest possible score

The PRPP Quadrant and PRPP Total percentage scores from each of the two questionnaires were then compared to the Quadrant and Total percentage scores from the PRPP System of Task Analysis from the corresponding data set.

4.4.1 Comparison of Preschool Performance Questionnaire (PPQ) and PRPP

Time 1 (PRPP 1): Total scores and Quadrant scores

The Preschool Performance Questionnaire (PPQ) was compared to the PRPP from Time 1. The Wilcoxon signed rank test was conducted to calculate any differences between each set of paired data (see Appendix XI, Table A20). Spearman’s Rank Order correlation coefficient was then conducted to examine the degree of association between the two sets of scores (see Appendix XI, Table A21).

The Wilcoxon output indicates that there was only a significant difference between the PRPP Perceive quadrant data and the PPQ Perceive quadrant data \(z = -3.443, p<.001\) showing that the teachers tended to rate the participants performance as poorer than the experience therapist. There was not a significant difference between the other PRPP
quadrants and total scores and the PPQ quadrants and total scores. This would indicate that on a group level the PRPP and the PPQ scores are largely in agreement. However, the Spearman’s output would indicate that Spearman’s rank-order correlation is not significant for any of the variables (at p<.01) so it can be concluded that on the individual level the PRPP scores and the PPQ scores are not in agreement. This is important in this study because the PRPP System of Task Analysis was employed to identify the information processing reasons for inefficient occupational performance in individuals and it can be concluded that when a questionnaire designed around the PRPP descriptor behaviours is completed by a preschool teacher, agreement on information processing strengths and weaknesses between the teachers and the trained therapist is not necessarily high for individual students.

4.4.2 **Comparison of School Performance Questionnaire (SPQ) and PRPP Time 5 (PRPP5): Total scores and Quadrant scores**

The School Performance Questionnaire, consisting of the ‘Social Interactions’ and ‘Class Work Performance and Habits’, was then compared to the PRPP from Time 5. The Wilcoxon signed rank test was conducted to calculate any differences between each set of paired data (see Appendix XI, Table A2). Spearman’s Rank Order correlation coefficient was then conducted to examine the degree of association between the two sets of scores (see Appendix XI, Table A23, A24 and A25).

The Wilcoxon output indicates that there was a significant difference between the PRPP Perceive quadrant data and the SPQ Social and Work Perceive and Perform quadrants, the PRPP Plan and the SPQ Social Plan quadrant, and between the PRPP Total score and the SPQ Social and Work and Social/Work Total scores. This would indicate that on a group level the PRPP and the SPQ scores were not in agreement. The Wilcoxon
data also indicates that on average the teachers rated the performance of their students as poorer than the researcher trained in PRPP administration.

The Spearman’s output indicates there is a positive relationship between the SPQ (Social and Work) quadrant and total scores and the PRPP quadrant and total scores. In the majority of cases this is significant, indicating that on the individual level there is some agreement between the scores from the teachers on the SPQ and the scores by the researcher on the PRPP during Time 5. This would indicate that a questionnaire based on the PRPP descriptors completed by a child’s Kindergarten teacher and PRPP assessment conducted by a trained occupational therapist are largely in agreement when considering an individual child’s information processing strategy application abilities. The pattern is consistent with the experienced rater (the researcher) and the teachers having moderate agreement but the teachers tending to rate at a lower level, indicating poorer child performance.

4.5 PARTICIPANT PERFORMANCE ON PRPP COMPARED TO TEACHER ASSESSMENT

This section addresses the fifth research question: What correlation exists between the results of an information processing strategy application assessment, the PRPP System of Task Analysis and teacher assessment of class performance at the end of preschool and in the final term of Kindergarten as children near the move into Year 1, the second year of formal schooling in NSW?

Informal interviews were conducted, as described in the Methodology, with each participant’s preschool and school teacher following each data collection time. At Time 3, just prior to school entry, participant’s preschool teachers were asked if, in their
opinion, the participant was ready to start school. Responses were noted and each participant given an ordinal ranking. These are described below.

1 = “Yes, in their opinion ready to start school, no concerns regarding school readiness”

2 = “ready for school, but some concerns regarding complete readiness for school”

3 = “concerns regarding school readiness, in their opinion, not ready for school”

Kindergarten teachers were again informally interviewed at Time 5. Teachers were asked how each participant was coping with formal school and did they have any concerns regarding the move into Year One, the second year of formal school that follows Kindergarten in New South Wales schools in Australia. Responses were again noted and given ordinal ranking as described below.

1 = “no concerns regarding performance at school, ready for Year One”

2 = “some concerns regarding some areas of school progress, but overall ready for Year One”

3 = “many concerns regarding school progress and the move into Year One”

In order to compare the ordinal rankings given by the participants teachers, these rankings were compared to the rankings of the PRPP data provided by the cluster analysis, outlined in Section 4.1.3. The 3 clusters, computed using SPSS (2008) placed participants according to the strength of their information processing skills, as assessed using the PRPP System of Task Analysis.

\[
\text{Cluster 1} = \quad \text{strong overall information processing skills, able to easily complete presented tasks to an expected age appropriate level.}
\]
Cluster 2 = some areas of disordered information processing ability but able to complete tasks presented, with the results often being a lesser standard than would be expected for their age

Cluster 3 = overall disordered information processing ability, whose ability to complete age appropriate tasks was hampered by poor information processing, resulting in incomplete or very poor task performance.

Spearman’s rank order correlation was employed to examine the degree of association between the preschool teacher’s participant rankings and PRPP scores from Time 3, the end of preschool and school teacher’s rankings and PRPP scores from Time 5, the end of Kindergarten.

4.5.1 Participant performance on PRPP compared to pre-school teacher assessment at Time 3

Spearman’s rank order correlation demonstrated significant but weak agreement between the preschool teacher’s opinion on school readiness and the results of the PRPP assessment taken at the same time, Time 3 (Spearman’s rho = .430, p<.05).

4.5.2 Participant performance on PRPP compared to teacher assessment at Time 5

Spearman’s rank order correlation demonstrated a strong significant agreement between the Kindergarten school teacher’s opinion on readiness to move through to Year 1 and the PRPP assessment taken at Time 5 (Spearman’s rho = .924, p<.0001).
4.5.3 Sensitivity and Specificity of data

Sensitivity and specificity were also calculated on data at Time 3 and Time 5 to determine the relationship between information processing strategy application abilities determined by the PRPP System of Task Analysis as a test of ‘readiness’ and the Preschool and School teacher’s opinions on child performance with regards to readiness for formal school or the move into Year 1, as the actual presence or absence of ‘readiness’. The term readiness refers to either readiness for school at the end of preschool or readiness to move into year 1 at the end of Kindergarten at school. The presence or the absence of ‘readiness’ in calculating sensitivity and specificity, was determined by the preschool or the school teachers. This was the best criterion available, if a somewhat flawed criterion.

The sensitivity of a test can be defined as the proportion of participants (children), determined to have information processing strategy application difficulties present who were deemed to be having difficulties at preschool or school, in the opinion of their preschool or school teachers. A sensitive test will rarely miss children with difficulties.

Specificity is the proportion of participants (children), who had an absence of information processing strategy application difficulties and who were deemed to be doing well, in the opinion of the preschool and school teachers, and who were ready to move into formal schooling or into Year 1. A specific test would rarely misclassify children who were doing well as having difficulties.

4.5.3.1 Sensitivity and Specificity for data at Time 3, end of Preschool

Sensitivity and specificity were calculated to determine the relationship between the PRPP System of Task Analysis as an indicator of school readiness investigating information processing strategy application strengths and weaknesses and the Preschool
teacher’s opinions on child performance as the diagnostic indicator of strengths and weaknesses with regard to school readiness. Preschool teachers are routinely asked to provide opinion on the school readiness of the children in their care as children approach the age they are deemed legally able to commence formal schooling in Australia.

A total number of 32 children were assessed in the final year of preschool and of these 5 were classified by their preschool teachers as having difficulties. The PRPP tested 6 as having information processing strategy application difficulties, but only confirming the opinion of the preschool teachers in 4 of those cases, giving a sensitivity of 80%. The preschool teachers identified 27 of the participants as not presenting with any difficulties and the PRPP identified 26 participants as not having information processing strategy application difficulties, but only agreeing with teacher opinion in 25 cases. This calculated a specificity of 92.59%. Sensitivity and specificity calculations are contained in Appendix XII.

4.5.3.2 Sensitivity and Specificity for data at Time 5, end of Kindergarten

Sensitivity and specificity were also calculated looking at the relationship between school teachers opinions on the participant’s readiness to move into Year 1 and the PRPP as an indicator of information processing strategy application strengths and weaknesses. Class teachers in all year groups at formal school are expected to make informed decisions regarding each child’s readiness to move into the next stage of schooling or whether a child should be held back for an additional year or requires additional teaching input with the aim of bringing them more in line with their peers.

Of the 32 children assessed at the end of Kindergarten at Time 5, eight were identified
by their school teachers as having difficulty and nine as having information processing strategy application difficulties as assessed using the PRPP, for a sensitivity of 100%. Of the remaining 23 participants who did not present with information processing difficulties, the school teachers identified 24 for a specificity of 95.83%. Sensitivity and specificity calculations are contained in Appendix XII.

4.6 COMPARISON OF PRPP SCORES TO READING AND WRITING LEGIBILITY SCORES

This section investigates Research Question Six: What is the relationship between information processing strategy application as assessed by the PRPP System and reading and handwriting ability as typically developing children move into formal schooling?

A handwriting sample was taken during data collections at Times 4 and 5. Each participant was asked to read a simple sentence then copy the sentence on a line provided below. A reading score was obtained by simply determining a percentage of words read correctly from the total number of words presented. A legibility writing score was calculated by adding up the total number of letters, capital letters required, spaces between words and if appropriate, full stops. Both reading and writing tasks were representative of typical reading and writing tasks for Kindergarten children at Time 4 and Time 5.

At Time 4 the sentence presented was “I can jump”. For Time 4 a total reading score was calculated out of 3 and a legibility score was calculated as a percentage out of 11. This included 8 letters, 2 spaces and 1 capital letter. The full stop was not scored as it is not expected that the majority of Kindergarten children would add a full stop at this
stage in their writing development, 6 months into Kindergarten (Bool, 2006; Burling, 2004; Cowley, 2006 & Thorne, 2004).

At Time 5 the sentence was “The quick fox and the lazy dog.” For Time 5 a total reading score was calculated out of 7 and a legibility score, calculated as a percentage was determined out of 31. This included 24 letters, 1 capital letter, 5 spaces and 1 full stop. Only five spaces were included as the sentence was copied over 2 lines, thus reducing the number of calculated spaces required.

The total percentage score from the two handwriting samples as well as reading scores were compared to the total percentage scores from the PRPP System of Task Analysis from the corresponding data set. Handwriting and reading from Time 4 was compared to the PRPP scores from Time 4 and handwriting and reading from Time 5 compared to the PRPP scores from Time 5. Additional reading rankings were also correlated with total PRPP rankings from Time 4 and Time 5.

Spearman’s Rank Order correlation coefficient was then conducted to examine the degree of association between the two sets of scores (see Appendix XIII, Table A26).

Data was labelled as follows:

\[
\begin{align*}
\text{PRPP 4} & = \text{PRPP assessment percentage score from Time 4} \\
\text{PRPP 5} & = \text{PRPP assessment percentage score from Time 5} \\
\text{Read 4} & = \text{Reading percentage score from Time 4 (I can jump)} \\
\text{Read 5} & = \text{Reading percentage score from Time 5 (The quick fox and the lazy dog)} \\
\text{Total 4} & = \text{Legibility percentage score from Time 4} \\
\text{Total 5} & = \text{Legibility percentage score from Time 5}
\end{align*}
\]
The Spearman’s rho statistic indicates that there was a trend towards a positive relationship between the total PRPP scores from Time 4 and 5 and the corresponding reading and legibility scores from those times, Read 4 and Read 5, Total 4 and Total 5. However, this positive relationship was not statistically significant at the p<.01 level. This indicates that in this study and cohort, PRPP scores are independent of reading and handwriting legibility scores and performance in one did not predict the performance in the other. Spearman’s rho statistic does indicate a significant correlation (p<.005) between the reading scores obtained at Time 4 and those at time 5 indicating that these two scores did agree with each other, or indicate similar performance levels.

The reading assessed in this PRPP assessment does not provide great insight into each participant’s overall reading ability. Further reading analysis was conducted by obtaining each participants current reading level at Time 5, as they neared the end of Kindergarten and ranking each participants reading level in collaboration with the participant’s teacher in relation to where that participant was reading compared to their class peers. Rankings were used rather than actual reading levels as it was found that schools do not necessarily use the same reading programs and one program, with its corresponding reading levels, was not comparable to another. The following reading rankings were guided by and agreed to by all the participants’ class teachers.

- **Reading rank 1** = well above average
- **Reading rank 2** = average to just above average
- **Reading rank 3** = below average
- **Reading rank 4** = well below average
These reading rankings, taken at Time 5 were then compared to PRPP total score and quadrant score rankings from Time 5. Spearman’s rho statistics are displayed in Appendix XIII, Table A27. Efficient and inefficient information processing strategy application, as measured by the Perceive, Recall, Plan and Perform System of Task Analysis in this study did not predict or correlate with reading ability in the Kindergarten children in this cohort.

A link between reading and writing legibility and information processing strategy application ability cannot be made from this limited data. A more rigorous research design, focusing on these areas of academic skill would need to be implemented to study the relationship between cognitive information processing development and reading and writing legibility.

4.7 COMPARISON OF STRATEGY APPLICATION AND PRETEND PLAY

This section answers research question seven: What is the congruence between the PRPP System of Task Analysis, an information processing strategy application assessment and pretend play as measured by the Child Initiated Pretend Play Assessment (ChIPPA), an assessment of children’s pretend play?

The ChIPPA and the PRPP System of Task Analysis assert to measure components of children’s cognitive functioning. The ChIPPA quantitatively measures the cognitive aspects of a child’s spontaneous, self initiated pretend play. The PRPP measures the information processing strategy application performance of a child as they perform any functional task and identifies the cognitive information processing reasons for disordered performance. The ChIPPA and the PRPP were both used during the initial Data set in this study at Time 1. ChIPPA results were gained on 28 participants and
compared to the PRPP results for those same participants. The PRPP assessment did not assess the participants pretend play but rather age appropriate preschool tasks involving cutting, drawing, pasting and dressing (as outlined in Section 3.6). The ChIPPA was administered to determine whether the assessment of a child’s pretend play could be used as an additional indicator of cognitive dysfunction and ultimate school readiness.

Time 1 data consisted of data collected on the PRPP System and the Child Initiated Pretend Play Assessment (ChIPPA). A total PRPP score was gained on each participant’s completion of age appropriate preschool tasks and a ChIPPA score was determined after completion of the ChIPPA. The PRPP, a criterion referenced assessment provides a final score based on participant levels of mastery, whereas the ChIPPA provides normative scores. As the two assessments provide very differing final scores, in order to analyse and compare the assessments all final scores were converted to rankings. A ranking of 1 for both assessments indicates higher scoring and performance whilst a ranking of 4 indicates significant difficulty in the area of play or strategy application. Four rankings were chosen as the ChIPPA presents four distinct ranking groups in its scoring manual, as opposed to the three rankings which would reflect the initial cluster analysis done on the PRPP.

Rankings for the ChIPPA were determined from the Scoring Manual. All raw scores for each section of the ChIPPA (ie. Percentage of Elaborative Play Actions - PEPA, Number of Object Substitutions – NOS and Number of Imitated Actions – NIA) were converted to standard scores, or a rescaled score where 100 is the mean and 15 is the standard deviation. Table 4.10 shows the four play ability levels as described by Stagnitti (2000) in the ChIPPA Standard Score Booklet and the rankings allocated to these play ability levels by the researcher.
Table 4.10: ChIPPA Play Ability Levels, corresponding re-scaled Scores and allocated Rankings

<table>
<thead>
<tr>
<th>Description of Play Ability (Stagnitti, 2006)</th>
<th>ChIPPA Re-Scaled Score ranges</th>
<th>Score Rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle to high range or normal play</td>
<td>100.50 – 137.50</td>
<td>1</td>
</tr>
<tr>
<td>Middle to lower range of normal play</td>
<td>85.50 – 99.50</td>
<td>2</td>
</tr>
<tr>
<td>Delayed play</td>
<td>70.50 – 84.50</td>
<td>3</td>
</tr>
<tr>
<td>Significantly delayed play</td>
<td>37.50 - 70.49</td>
<td>4</td>
</tr>
</tbody>
</table>

Scores for Number of Imitative Actions (NIA) were not converted to rankings nor analysed as this aspect of the ChIPPA does not assess a child’s cognition (Boland, 2004; Stagnitti, 2003). The normal range for Number of Object Substitutions in the conventional play session is 0-2 and while a small number of children scored greater than this, the overall ranking of 1 indicating normal play, did not change. As a consequence this variable was also not analysed.

The following ChIPPA variables were ranked and used in this analysis:

- PEPacon - Percentage of Elaborative Play Actions for conventional imaginative play
- PEPAsym - Percentage of Elaborative Play Actions for symbolic play session
- PEPAcomb - Percentage of Elaborative Play Actions for the conventional play session + the symbolic play session
- NOSsym - Number of Object Substitutions for the symbolic play session
• NOScomb - Number of Object Substitutions for the conventional play session + the symbolic play session

Rankings for the PRPP total score and the scores for the four PRPP quadrants were determined via a k-means cluster analysis. Cluster analysis was used to identify four relatively homogeneous groups of cases via SPSS (2008). Four clusters were selected as this corresponded to the four classifications of play ability outlined by the ChIPPA scoring manual. Cluster analysis was selected as data was quantitative and interval in nature. Distances between the cluster centres were computed using simple Euclidean distance in SPSS. Score ranges for the total PRPP scores and Quadrant scores are outlined in Table 4.11.

**Table 4.11: PRPP Total Score and PRPP Quadrant Score Rankings**

<table>
<thead>
<tr>
<th>Score Rankings</th>
<th>PRPP Total Score ranges (%)</th>
<th>Perceive Quadrant score ranges (%)</th>
<th>Recall Quadrant score ranges (%)</th>
<th>Plan Quadrant score ranges (%)</th>
<th>Perform Quadrant score ranges (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>92.65 - 100</td>
<td>100</td>
<td>94.44 - 100</td>
<td>83.34 – 100</td>
<td>93.75 - 100</td>
</tr>
<tr>
<td>2</td>
<td>79.40 – 91.17</td>
<td>93.75</td>
<td>83.34 – 88.89</td>
<td>61.11 – 77.78</td>
<td>68.75 – 87.55</td>
</tr>
<tr>
<td>3</td>
<td>64.70 – 76.47</td>
<td>87.5</td>
<td>77.78</td>
<td>38.89 – 44.44</td>
<td>56.25 – 62.5</td>
</tr>
<tr>
<td>4</td>
<td>54.41</td>
<td>75.0</td>
<td>72.22</td>
<td>27.78</td>
<td>25.00</td>
</tr>
</tbody>
</table>

The score rankings determined by the k-means cluster analysis reflected the groupings of information processing ability commonly found when using the PRPP System.

Rankings 1 and 2 reflect the range of strategy application ability expected to be found in typically developing children, with Rank 1 signifying higher range and Rank 2 the
lower range of efficient strategy application ability. This range fell approximately
between an overall percentage score of 78 to 100%. Rankings 3 and 4 indicate
inefficient strategy application, where 4 indicates significant strategy application
difficulties preventing typical task completion and 3 indicating strategy application
difficulties interfering with or hampering completion of typical age appropriate tasks.
This range covered those scores falling approximately between 50% and 77%.

The following PRPP variables were converted to rankings for analysis:

- PRPP total – total score from PRPP presented as a percentage
- Perceive – score from the Perceive quadrant, presented as a percentage
- Recall - score from the Recall quadrant, presented as a percentage
- Plan - score from the Plan quadrant, presented as a percentage
- Perform - score from the Perform quadrant, presented as a percentage

To examine the strength of association between the PRPP and the ChIPPA, Spearman’s
rank order correlation was used. As the assumptions for use of a parametric test were
not met, the non-parametric equivalent was employed. The PRPP rankings (total scores
and quadrant scores) and the ChIPPA rankings (PEPA – Con, PEPA – Sym, PEPA –
Comb, NIA – Sym and NIA – Comb) were examined (N = 28). The Spearman’s
statistics are displayed in Table A28 in Appendix XIV.

The results from the Spearman’s rank order correlation indicate a significant positive
correlation between the PRPP total rank and the PEPA symbolic rank, indicating
agreement. Significant negative correlations exist between the Recall and Plan ranks
and PEPA symbolic and combined ranks and between the Perform rank and the PEPA
symbolic rank. This indicates that the two assessment scales disagree with each other for these ranked constructs.

Further statistical analysis was performed on the raw scores of the ChIPPA and percentage scores of the PRPP to determine if conversion to rankings, as performed above, was not sensitive to smaller associations between the two tests. The results from the Spearman’s rank order correlation also indicate a significant positive correlation, p<.01, between the PRPP total score and the PEPA symbolic and combined scores, indicating the two test scales do agree with each other on these cognitive constructs. Significant correlations also existed between the Plan scores and PEPA symbolic and combined scores and between the Perform score and the PEPA symbolic score. Less significant correlations ( p<.05) were also found between the Recall and PEPA symbolic and combined scores, the Perform and PEPA combined scores and the Plan and NOS symbolic scores.

### 4.8 SUMMARY OF RESULTS

#### 4.8.1 Results from Research Question 1

*What is the range of information processing strategy application ability found in a sample of typically developing preschool and school aged children without prior diagnosis of any learning or motor disorder, as assessed by the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis (Chapparo & Ranka, 1997)?*

- The study sample of typically developing preschool and school aged children presented with a range of cognitive information processing strategy application ability, as assessed on five separate occasions using the PRPP System over a 30 month time period.
• The majority of participants demonstrated efficient strategy application abilities, gaining higher scores across all performance quadrants as well as in the total PRPP score.

• Inefficient strategy application was demonstrated by a small number of participants, with scores at the lower end of the range for each data collection time.

• There was a consistent trend for higher scores, indicating efficient strategy application, in the Perceive quadrants. Higher scores, demonstrated by the peaked distribution skewed to the right, where also found in the Recall quadrant. A greater spread of scores in the Plan and Perform quadrants indicated that a greater number of participants demonstrated less efficient strategy application in the descriptor behaviours of these quadrants. The Plan quadrant, in particular, showed a flatter superimposed curve with a great spread of scores.

• The participants were grouped into three distinct clusters. The largest group where those with efficient strategy application ability, gaining consistently higher scores at each data collection time. The second, smaller group demonstrated some disordered strategy application and the third, smallest group demonstrated consistent inefficient strategy application during task performance.

• Rasch analysis confirmed that Perceive and Recall quadrant descriptor behaviours were ranked the ‘easier items’ in the hierarchical order compared to the Perform and Plan descriptor behaviours (Table 4.5, Figure 4.26). Rasch analysis of the individual person scores supported the cluster analysis, providing a hierarchical order of ‘most able’ to ‘least able’ (Table 4.4, Figure 4.26).
4.8.2 Results from Research Question 2

Which areas of information processing strategy application are more or less efficient than other strategy application areas in typically developing preschool and school aged children, as assessed by the PRPP System of Task Analysis?

- Analysis of the specific areas of strategy application, as assessed using the PRPP System, demonstrated some areas proved to be less efficient than others in the study sample. The Freidman Test determined that there were differences in the scores for the different quadrants, with the descriptive statistics suggesting the Plan Quadrant as being consistently the lowest scoring quadrant. The results from the Wilcoxon Signed Rank test demonstrate that the Plan Quadrants for each data collection Time 1, 2, 3 and 5 had a statistically significant lower score than the other quadrants (p<.001). This would indicate that the Plan quadrants were more problematic and the participants had most difficulty in the information processing planning aspects of the tasks presented. The Plan Quadrant in data set 4 was not overall statistically significantly lower scoring, p>.001, but the Plan Quadrant 4 was significantly lower than the Perceive Quadrant 4 (p<.001).

- Additional analysis of the Plan quadrant and sub quadrants indicated that planning strategies as a whole contributed to the lower scores rather than one individual sub quadrant, demonstrating that planning strategies are both inconsistent and less efficient than the strategies applied in the Perceive, Recall and Perform quadrants.

- Stage one analysis results indicated that typically developing preschool and school aged children did demonstrate mastery errors during task performance in
the areas of accuracy, omission, timing and repetition. Errors of accuracy where the most frequent, 75% of total errors, Time 1 to Time 5, followed by errors in omission, 21%, then errors of timing and repetition making up only 4% of total errors. The omission errors were contributed to by participants not wanting to complete the dressing tasks.

4.8.3 Results from Research Question 3

How does strategy application change in children as they move through preschool and into the first year of formal schooling?

- The longitudinal analysis of strategy application abilities in a sample typically developing preschool and school aged children demonstrated that overall strategy use, as assessed using the PRPP System, was not necessarily consistent over a 30 month period. There was greater agreement between scores from each data collection time in the Perform quadrants, followed by total PRPP score, Plan then Recall quadrant scores. Least agreement was found between the scores from the Perceive quadrants over time.

- Additional analysis of the individual quadrant scores from the PRPP System from Time 1 to Time 5 did demonstrate similar individual participant performance in the Recall, Plan and Perform quadrants over time, but significant score differences in the Perceive quadrants between Time 5 and Time 1 and Time 2.
4.8.4 Results from Research Question 4

What was the agreement between a specifically designed questionnaire completed by a preschool or school teacher, based on PRPP information processing behaviours and the information processing strategies as scored by a trained therapist using the PRPP System of Task Analysis?

- A comparison between a teacher completed PRPP System based questionnaire and a therapist scored PRPP System assessment demonstrated that agreement on individual performance was not high.

- Agreement between the therapists PRPP System assessment and the kindergarten teacher completed school questionnaire was higher than that of the preschool teacher completed questionnaire.

- Teachers were found to consistently rate their students strategy application as poorer than the trained therapist.

4.8.5 Results from Research Question 5

What correlation exists between the results of an information processing strategy application assessment, the PRPP System of Task Analysis and teacher assessment of class performance at the end of preschool and in the final term of Kindergarten as children near the move into Year 1, the second year of formal schooling in NSW?

- Informal interview investigating preschool and school teachers’ opinions on readiness for either starting formal school or moving into the next grade at formal school demonstrated greater agreement between the school teachers and the PRPP System assessment than with that of the preschool teachers.
This indicates that school teachers base decisions of school performance on similar criterion to the PRPP System assessment and preschool teachers’ base decisions on additional criterion.

4.8.6 Results from Research Question 6

What is the relationship between information processing strategy application as assessed by the PRPP System and reading and handwriting ability as typically developing children move into formal schooling?

Reading and handwriting form the basis of academic class activity in the early school years. Comparison between the PRPP System scores in Kindergarten children and reading and writing legibility scores indicated that in this sample strategy application performance assessed using the PRPP System did not predict performance in reading and writing ability.

4.8.7 Results from Research Question 7

What is the congruence between the PRPP System of Task Analysis, an information processing strategy application assessment and pretend play as measured by the Child Initiated Pretend Play Assessment (ChIPPA), an assessment of children’s pretend play?

Comparison of strategy application, as assessed using the PRPP System and pretend play, as assessed using another cognitive test, the ChIPPA, indicated that some components of each of the assessments were in agreement with each other, while other components demonstrated poor correlation. In particular there was significant positive agreement between the rankings and raw scores of the total PRPP and the PEPA symbolic components. There was also some agreement between PEPA symbolic raw scores and Plan and Perform scores.
CHAPTER FIVE

CASE STUDIES

The purpose of this chapter is to present the information processing strategy application profiles of three participants in case study format to highlight the strategy application abilities of a child from each of the information processing clusters outlined in the Section 4.1.3. The three case studies were chosen from the recorded profiles of the 32 typically developing children from the study and were selected based on their similarity in age and gender as well as being representative of differing levels of strategy application ability as determined by hierarchical cluster analysis. Their strategy application abilities are presented and discussed across all five data collection times.

5.1 CASE STUDY 1 - PARTICIPANT 17

Participant 17 was aged 4 years 2 months at Time 1 and attended his preschool two days each week. He was in a 2 day a week program specifically for three to four year-old children. At Times 2 and 3 he was attending the same preschool 3 days per week in a specific 3 day a week preschool program. His preschool was a non-profit, government funded preschool, administered by an elected parent committee. The preschool program ran 9am to 3pm five days a week and was closed during school holidays (approximately 12 weeks across the year). The preschool director stated they ran a ‘mixed curriculum program’ with aspects of traditional programming as well as the emergent curriculum. The daily preschool program was a structured routine with fine motor, gross motor, singing, reading and free play time. Participant 17 moved to a local public primary school after preschool, aged 5 years 5 months at time of school entry.
Participant 17 demonstrated consistently effective strategy application skills in all the PRPP System quadrants and sub-quadrants across the five data collection times. He was able to independently complete all tasks presented without additional prompting and to a standard expected of a typically developing child of his age. He demonstrated strong attention skills, was able to search for, locate and respond to sensory information in his environment, recall facts, schemes and procedures and use this information to systematically plan then perform the tasks presented to him. His sub-quadrant, quadrant and total PRPP scores for Time 1 to time 5, expressed as calculated true percentage scores, are displayed in Table 5.1. Participant 17’s PRPP sub-quadrant percentage scores from each data set, Times 1 to 5, are presented on a Radar graph (Figure 5.1). A radar graph was used as it clearly shows individual performance in the four PRPP Quadrants and twelve sub-quadrants in an identical format to the PRPP System Model diagram (see Figure 2.3).
Table 5.1: Participant 17 Information Processing Percentage Scores - Sub-Quadrants, Quadrants and Total PRPP, Time 1 to Time 5

<table>
<thead>
<tr>
<th>Participant 17</th>
<th>PERCEIVE</th>
<th>RECALL</th>
<th>PLAN</th>
<th>PERFORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 1</td>
<td>Attending</td>
<td>Sensing</td>
<td>Perceiving Total</td>
<td>Recall Facts</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>83.3</td>
<td>100</td>
<td>93.8</td>
</tr>
<tr>
<td>Time 2</td>
<td>100</td>
<td>100</td>
<td>75</td>
<td>93.8</td>
</tr>
<tr>
<td>Time 3</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Time 4</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Time 5</td>
<td>100</td>
<td>100</td>
<td>75</td>
<td>93.8</td>
</tr>
</tbody>
</table>

* All scores expressed as %

Figure 5.1: Participant 17 Information Processing Percentage Scores for Sub-Quadrants, Time 1 to Time 5.
The data presented here does indicate some specific areas of weakness, however his overall performance was not hampered by these small difficulties and these strategy application inefficiencies were not consistent across the five data collection times. In the opinion of his preschool teacher, he was ready to commence formal school at the end of Time 3 (Sheeba, 2006).

Participant 17 transitioned well into Kindergarten and his school teacher indicated he was not experiencing difficulties academically, socially or with regular school routines (Burling, 2007). Examples of the work performed by this participant (Figures 5.2 to 5.4) indicate he was able to follow all instructions and complete the colour, cut and paste tasks independently. The handwriting sample, done at the end of Kindergarten demonstrates excellent legibility. This little boy also moved through the Kindergarten reading levels at a slightly above average rate, compared to the peers in his class.

Figure 5.2: Participant 17 Colour, cut and paste task, Time 2

Figure 5.3: Participant 17 Colour, cut and paste task, Time 3
Participant 17 demonstrated average representational drawing skills compared to the entire cohort. Over the time of the study he did demonstrate greater detail in his drawings (as scored using the Goodenough Draw-a-man assessment). His representational drawing skill is shown in Figures 5.5 and 5.6.

**Figure 5.4:** Participant 17 Handwriting task, Time 5

**Figure 5.5:** Participant 17, drawing of a man at Time 2.

**Figure 5.6:** Participant 17, drawing of a man at Time 5
5.2 CASE STUDY 2 - PARTICIPANT 28

Participant 28 was 3 years 10 months old at the time of the first assessment, Time 1. He attended a long day care preschool twice a week over the period of Time 1 to Time 3. He was in a class with other children aged 3 to 5 years. This centre offered long day care extended hours, was open 50 weeks per year and was owned and managed by the preschool director. The curriculum was based on the emergent curriculum. The daily routine was not structured but did encourage participation in both fine and gross motor activities, free play and quiet time. In the opinion of his preschool teacher he was ready to commence school at the time of data collection at Time 3 and no difficulties were identified (Sam, 2006). Participant 28 moved to his local Public School for Kindergarten, aged 5 years 1 month at time of school entry.

Participant 28 demonstrated both effective and ineffective strategy application abilities. His sub-quadrant, quadrant and total PRPP scores for Time 1 to Time 5, expressed as calculated true percentage scores, are displayed in Table 5.2. His PRPP sub-quadrant percentage scores from each data set, Times 1 to 5, are presented on a Radar graph in Figure 5.7.
Table 5.2: Participant 28 Information Processing Percentage Scores for Sub-Quadrants, Quadrants and Total PRPP, Time 1 to Time 5

<table>
<thead>
<tr>
<th>Participant 17</th>
<th>PERCEIVE</th>
<th>RECALL</th>
<th>PLAN</th>
<th>PERFORM</th>
<th>PRPP Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attending</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discriminating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceive Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall Facts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall Schemes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall Procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initiating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRPP Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Participant 28: PRPP Sub-Quadrant Percentage Scores

Figure 5.7: Participant 28 Information Processing Percentage Scores for Sub-Quadrants, Time 1 to Time 5.
Participant 28 demonstrated some difficulties orienting to the tasks and then modulating his attention but in other respects his sensory processing was an area of relative strength. In the Recall quadrant he demonstrated particular difficulty in his preschool years with recalling task procedures which was demonstrated in his limited knowledge of tool use, lack of hand preference for pencil and scissor use and fragmented recall of the steps required for the tasks. This quadrant performance improved as he moved into Kindergarten. His scores in the Plan and Perform quadrants indicate these were his areas of greatest strategy application difficulty. He had ongoing difficulties remembering the original goal, was disorganised, was unaware of the correct sequence and had poor ongoing evaluation. He required prompting to start, stop and complete the tasks and demonstrated some co-ordination difficulties with the fine motor aspects of the tasks.

His school Kindergarten teacher did indicate some areas of difficulty with both academic and class routines (White, 2007). In particular he required additional prompting and repeated instruction to complete tasks and was often disruptive to children seated close by.

Examples of the work performed by Participant 28 (Figures 5.8, 5.9 & 5.10) demonstrate the results of his consistently inefficient strategy application. These tasks were not completed independently and required multiple prompting to reach the results shown here. The handwriting sample shows slightly poorer legibility, compared to Participant 17. This boy also moved well through the Kindergarten reading levels but his teacher did question the level of his overall reading comprehension (White, 2007).
Participant 28 demonstrated below average representational drawing skills as scored using the Goodenough Draw-a-man assessment. He showed only a minimal increase in the detail in his drawings over the time of the study. This is demonstrated in Figures 5.11 and 5.12.
5.3 CASE STUDY 3 - PARTICIPANT 4

Participant 4 was aged 3 years 11 months at Time 1. He attended a long day care preschool twice a week at Time 1 and then 3 days per week at Times 2 and 3. This centre offered long day care extended hours, was open 50 weeks per year and was managed by the director. Participant 4 was in a staged class of three year olds, then moved to a staged class for 4 and 5 years old children in his final year at preschool. This centre ran an emergent curriculum. The daily routine was loosely structured and encouraged but did not insist on participation in fine and gross motor tasks, group reading time and free play. In the opinion of his preschool teacher he was ready for school although it was commented that “...children like XXXXX often slip under the radar as they are quiet and don’t make a fuss.” (Mielekamp, 2006). Participant 4 moved to his local Public school for Kindergarten, aged 5 years 2 months at time of school entry.
Participant 4 demonstrated consistently ineffective strategy application abilities throughout preschool and then on into school. He was unable to complete the set tasks, had difficulty following and remembering instructions, demonstrated inefficient recall of information that would aid task performance, appeared unable to keep the set goal in mind and had difficulty monitoring his ongoing performance. In the preschool phase he demonstrated ineffective tool use and was unable to remember how to use scissors at each data collection time. He did not develop a mature pencil grasp until the end of his Kindergarten year and his colouring was consistently inaccurate. His representational drawing was developmentally immature and his writing inadequately formed and of decreased legibility. Participant 4’s planning strategies were consistently inefficient with limited evidence of any ongoing task evaluation and limited ability to independently sequence a task or organize himself during a task. As a consequence steps in tasks were forgotten or overlooked, aspects of tasks dropped on the floor and not retrieved and the task goal forgotten.

His performance did not flow from one step to the next, tasks being performed in a stop and start fashion and often requiring prompting to continue or persist. He had little idea of how long tasks should take, either rushing or taking too long to complete the tasks. He was unable to complete any of the table top tasks to a level expected of a typically developing preschooler or school student and was also unable to independently complete any of the dressing tasks, indicating his mother helped him at home.

His sub-quadrant, quadrant and total PRPP scores for Time 1 to Time 5, expressed as calculated true percentage scores, are displayed in Table 5.3. His PRPP sub-quadrant percentage scores from each data set, Time 1 to 5, are presented on a Radar graph in Figure 5.13.
**Table 5.3:** Participant 4 Information Processing Percentage Scores for Sub-Quadrants, Quadrants and Total PRPP, Time 1 to Time 5

<table>
<thead>
<tr>
<th>Participant 4</th>
<th>PERCEIVE</th>
<th>RECALL</th>
<th>PLAN</th>
<th>PERFORM</th>
<th>PRPP Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 1</td>
<td>66.7</td>
<td>100</td>
<td>100</td>
<td>87.5</td>
<td>54.4</td>
</tr>
<tr>
<td>Time 2</td>
<td>66.7</td>
<td>33.3</td>
<td>68.7</td>
<td>83.7</td>
<td>47.1</td>
</tr>
<tr>
<td>Time 3</td>
<td>33.3</td>
<td>16.7</td>
<td>0</td>
<td>25</td>
<td>19.1</td>
</tr>
<tr>
<td>Time 4</td>
<td>50.0</td>
<td>66.7</td>
<td>33.3</td>
<td>62.5</td>
<td>50.0</td>
</tr>
<tr>
<td>Time 5</td>
<td>33.3</td>
<td>66.7</td>
<td>33.3</td>
<td>56.2</td>
<td>50.0</td>
</tr>
</tbody>
</table>

**Figure 5.13:** Participant 4 Information Processing Percentage Scores for Sub-Quadrants, Time 1 to Time 5.
Participant 4 was identified by his school teacher as having difficulties in all aspects of his school role and this was evident within the first weeks of commencing Kindergarten at school (Cheeseman, 2007). He was unable to complete class work without help and encouragement, disliked reading, writing and math’s and was also demonstrating some difficulties socially in the playground and in class. Examples of his work (Figures 5.14, 5.15 & 5.16) demonstrate the impact of consistently ineffective strategy application ability on task performance. Ongoing prompting was provided throughout his performance. In class he required continual prompting and his teacher provided only one instructional step at a time (Cheeseman, 2007). As can be seen his overall writing legibility is poor. This little boy had great difficulty with his reading and had not progressed during his year in Kindergarten.

![Figure 5.14: Participant 4 Colour, cut and paste task, Time 2](image1)

![Figure 5.15: Participant 4 Colour, cut and paste task, Time 3](image2)
Participant 4 demonstrated very poor representational drawing skills in his preschool years, only showing minimal features on his people. This improved as he moved into Kindergarten, although his overall representational drawing as scored using the Goodenough Draw-a-Man test was below the average of the entire cohort. Participant 4’s drawings are shown in Figures 5.17 and 5.18.
5.4 ADDITIONAL ANALYSIS FOCUSING ON CASE STUDIES

These case studies were selected as representative of the three strategy application clusters determined in Section 4.1.3 and Section 4.1.4. Additional analysis was performed to establish whether these three individual participants remained reasonably consistent in their performance across the time frame of the study. As the data violated the distribution assumptions for parametric statistical analysis, an Intra-Class Correlation Coefficient was not employed. The alternative non-parametric statistical analysis, Kendall’s Coefficient of concordance, was used. Kendall’s coefficient of concordance was calculated for each quadrant and total PRPP score across the 5 times. Table 5.4 shows the Kendall’s W calculations produced.

**Table 5.4:** Kendall’s W Statistic for Quadrant and Total PRPP scores for 3 case studies

<table>
<thead>
<tr>
<th>Kendall’s W statistic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive W</td>
<td>.768  (p&lt;.021)</td>
</tr>
<tr>
<td>Recall W</td>
<td>.840  (p&lt;.015)</td>
</tr>
<tr>
<td>Plan W</td>
<td>1.000 (p&lt;.007)</td>
</tr>
<tr>
<td>Perform W</td>
<td>1.000 (p&lt;.007)</td>
</tr>
<tr>
<td>Total PRPP</td>
<td>1.000 (p&lt;.007)</td>
</tr>
</tbody>
</table>

These scores indicate a significantly positive correlation and demonstrate that scores for these three participants did remain consistent over the time of the study, particularly the scores from the Plan and Perform quadrants and the total PRPP score.
5.5 CONCLUSION

These three case studies illustrate examples of the three information processing strategy application clusters outlined in the results chapter. The results from the PRPP System of Task Analysis, an information processing strategy application assessment, are reflected in those children that successfully transitioned into school as well as those that have had moderate to major difficulties with academic and class routine.

The case studies serve to highlight the individual differences an example child from each of the determined performance clusters demonstrates. Inefficient mastery of the PRPP System descriptor behaviours in the sub-quadrants and quadrants impacts on ongoing classroom performance and the greater the inefficiency of strategy application across the quadrants the greater the impact on overall, ongoing classroom performance.
CHAPTER SIX

DISCUSSION AND CONCLUSION

This chapter contains a discussion of the main findings from the study. The findings will be examined in light of the literature as well as highlighting areas requiring further research. The strengths and limitations of the study will be outlined and the theoretical, clinical, methodological and empirical significance of the study proposed.

6.1 INTRODUCTION

The purpose of this study was to explore the information processing strategy application abilities of a small cohort of typically developing Australian children as they moved through the final years of preschool into formal schooling. Strategy application abilities were assessed using the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis (Chapparo & Ranka, 1997), a standardised, criterion referenced, occupational therapy assessment. Pretend play skills were also assessed using the Child Initiated Pretend Play Assessment (ChIPPA) (Stagnitti, 2000, 2006) to determine whether there was a link between strategy application ability, as assessed by the PRPP and the cognitive aspect of pretend play, as measured by the ChIPPA. Preschool and school teacher questionnaires and informal interviews were also conducted to determine the teacher’s perspectives on each participant’s progress.

The main findings from the study indicate that typically developing Australian preschool and early school aged children present with a wide range of information processing strategy application abilities and that some areas of strategy application are consistently more unstable than others in this age group. Typically developing
preschool and school aged children also present with a range of pretend play ability, some aspects of which correlate with cognitive strategy application ability. The implementation of informal teacher interviews and teacher questionnaires also highlighted that the formal assessment of strategy application could be used as an indicator of readiness to commence formal schooling and to progress through the grades at school.

6.2 INFORMATION PROCESSING ABILITIES FOUND IN A SAMPLE OF TYPICALLY DEVELOPING AUSTRALIAN PRESCHOOL AND SCHOOL AGED CHILDREN

The information processing strategy application abilities of 32 typically developing Australian preschool aged children were assessed using the PRPP System. Longitudinal assessment was completed at approximately 6 monthly intervals from 14 months prior to school entry in the preschool years until the end of Kindergarten at formal school.

Analysis determined that the study sample of typically developing Australian preschool children presented with a wide range of strategy application abilities. Strategy application abilities fell into three broad groupings, those of efficient strategy application, inconsistent but functional strategies and those with consistently inefficient strategy application ability. This was determined statistically through use of cluster analysis and Rasch facet analysis.

The largest group were those participants with efficient overall strategy application, who were able to independently complete all tasks presented without additional prompting and to a standard expected by their teachers and of a typically developing child of that age. This group demonstrated steady attention skills, were able to search
for, locate and respond to sensory information in the environment, recall facts, schemes and procedures and use this information to systematically plan then perform the tasks presented. These children were all able to complete tasks within expected time frames with accuracy.

The second, smaller group, were those with a range of inconsistent but functional strategy application ability, but who were generally able to complete tasks presented, with the results often being a lesser standard than would be expected for their age. They tended to demonstrate inconsistent use of attention strategies, inconsistent recall of task scheme and procedures, and inefficient planning skills. All of which contributed to a poorer overall task performance outcome in comparison to the first group.

The final and smallest group were those participants with consistently inefficient strategy application ability, whose ability to complete age appropriate tasks was hampered by inefficient strategy application, resulting in incomplete or ineffective task performance. These children demonstrated consistently ineffective attention strategies and had difficulty searching for, locating and responding to sensory information required for task completion in the environment. Their ability to recall facts, schemes and procedures and use this information to systematically plan then perform the tasks was inconsistent. These children were unable to complete tasks within expected time frames and often demonstrated inefficient performance monitoring strategies.

As expected, many participants remained within the same group or cluster across each of the five data collection times, while others, particularly those in the middle group moved between groups across the five data collection times. Kendall’s statistic scores indicate that performance by each participant across the 5 data collection times was not necessarily consistent. This result possibly reflects a normal developmental trajectory as
well as typical paediatric performance, where children will perform differently on different occasions and where everyday task performance is heavily influenced by ongoing health, sleep patterns, not wanting to miss out on routine preschool or school activities and overall interest in the activity. To better determine consistency of performance across the five data collections times, more than one PRPP assessment would be necessary at each data collection point in order to gain a mean performance score. The means could then be correlated to determine their relationship over the time of the entire study. While this amount of assessment was beyond the scope of the study it should be noted that the use a single assessment does more accurately reflect clinical practice contexts, which may be constrained by reduced time availability for assessment.

The results from the middle cluster reflect Siegler’s model of strategy choice and his overlapping waves theory (1998, 2002 & 2005). The overlapping waves theory explains differing uses of different strategies over time as children develop and may account for the variability of performance seen in the participants of this study and particularly from this middle grouping. Children with a reduced repertoire of strategies and inefficient strategy choice, or those unable to develop new, more effective strategies, or those continuing to use less effective strategies may be those children who demonstrated inconsistent strategy application ability at different stages of the study. The variability of performance in this middle group can also be explained by U-shaped development, discussed by Siegler (2004). This explains that although normal development and thus performance generally goes from worse to better, it can go from better to worse, then improve again (Gershkoff-Stowe & Thelen, 2004; Siegler, 2004). This phenomenon is graphically demonstrated in Rasch generated Bias Interaction graphs (Figures A1 and
A2, Appendix VIII) showing the variability of individual participants performance over time.

Similarly the literature on normal cognitive development, including research from Siegler (2002, 2005), Vygotsky (1933/1978), Berger (2003) and Risberg & Grafman (2006), demonstrates that some children develop at an earlier age than others and that cognitive development is not necessarily steady but occurs in an irregular fashion. This would support the movement of some participants between the three information processing clusters or groups seen over time in this study.

It is well established that children’s cognitive abilities mature with age. Maturation of strategy application abilities was catered for in this study by the use of an ecological, standardised, criterion reference assessment at each data collection time during the study. The participants were assessed on appropriate tasks for children their age, as determined by their teachers and with reference to broad developmental expectations. This is supported by the results of the Rasch analysis which demonstrates that in general, the participants where more able than the most difficult PRPP strategy application descriptor behaviour (see Figure 6.2). Efficient occupational performance relies on the ability to select the most appropriate information processing strategies. The literature supports that skilled information processing develops over time and with typical developmental maturation (Berk, 2003; Berger, 2003; Vygotsky, 1933/1978).

The findings from this study support contemporary views on cognitive development. Children do not develop at a uniform rate in neat developmental stages as proposed by Piaget (1952), or by moving up and along steps in a developmental continuum as proposed by Case (1992) but rather development occurs irregularly and is influenced by environment and the social demands placed upon the child (Seigler, 1996, 2002 & 2005;
Vygotsky 1933/1978). The data analysis revealed that although many of the participants did present with variable strategy application skills over the time of the study, those who demonstrated the very strongest and the very weakest information processing skills did so consistently. This finding is supported by the Kendall’s coefficient of concordance statistics demonstrating the overall significantly consistent performance of the three case study examples outlined in Chapter Five.

The participants in this study were identified, prior to the commencement of the study, to be typically developing with no prior diagnosis of a learning or motor difficulty. The information processing strategy application profiles of the participants, as clearly detailed by three representative case studies in Chapter Five, would indicate that a minority of the study participants may have some learning and/or motor difficulties. This finding is supported by the literature which suggests that some children making the transition from preschool to school are found, usually within the first year of school, to have difficulties engaging in the learning process or processing information to learn how new tasks can be done (Scrimsher, College & Trudge, 2003). Informal interviews with many of the teachers involved in this study also support this finding. Teachers have reported that children in Kindergarten present with a large range of ‘individual readiness’ for formal school and that the ability to process the information required for ongoing learning and task performance is a crucial aspect of success in the first year at school and beyond (Aspin, 2009; Bool, 2006; Burling, 2004; Carrol, 2009; Cowley, 2006 & Thorne, 2004).
6.3 SOME AREAS OF INFORMATION PROCESSING ARE MORE VULNERABLE TO INEFFICIENCY THAN OTHERS

Information processing is a complex system consisting of sensory input, memory and recall where information is stored and relocated, the organisation of information via problem solving and decision making strategies (planning) and a planned and monitored outcome, which is the resulting response (Chapparo, 2010). There is also a feedback loop, which explains the laying down or acquisition of new knowledge for future use. The PRPP System categorises the information processing strategies used during task performance into four quadrants: sensory processing in the Perceive quadrant; the establishment and use of knowledge and memory in the Recall Quadrant; planning and evaluation in the Plan Quadrant and motor output in the Perform Quadrant. The PRPP quadrants are all inter related and reliant on one another for adequate task completion.

Statistical analysis of the PRPP System strategy application scores obtained from the participants in this study indicated that as a typically developing sample of Australian children, they do not perform consistently across all areas of strategy application ability. This finding was supported by the Rasch facet analysis.

Descriptive statistics indicate the Plan quadrant as being the most likely to demonstrate inefficiency of the four PRPP quadrants. Wilcoxon Signed Rank test confirmed that the Plan quadrants for each data collection Time 1, 2, 3 and 5 had a statistically significant lower score than the other quadrants (p<.0001). This would indicate that the Plan sub-quadrants were more problematic and the participants had most difficulty in the information processing planning strategy application aspects of the tasks presented. Further analysis of the sub-quadrants of the Plan quadrant did not indicate that any one of the three Plan sub-quadrants consistently demonstrated poorer performance than any
other across the five data collection times. Rasch analysis also indicated the Plan Quadrant descriptors as consistently among the most problematic (see Table 4.10: Rasch PRPP Descriptors in hierarchical order). This finding is consistent with other studies using the PRPP System which have demonstrated planning strategies to be towards the top of a least to most hierarchy of difficulty (Nott & Chapparo, 2006).

‘Thinking’ is the focus of the operations that occur in the Plan quadrant of the PRPP (Chapparo & Ranka, 2003). The planning aspect of information processing requires an ability to formulate a goal, explore and identify any constraints that may affect task completion along with ongoing self monitoring and evaluation of task performance. Planning also requires a level of organisation and an ability to select appropriate items required, sequence the task in a logical order and calibrate movements during task performance.

While some researchers propose planning to be evident in preschoolers only when tasks are familiar and simple (Fabricius, 1988), others have demonstrated that children as young as 18 months are already experimenting with and using multiple strategies to solve problems of everyday life (Siegler, 2002, 2005). Planning skills are refined as children develop and demands for independent planning increase. Planning skills are also refined and reinforced by collaboration with more mature planners (Berk, 2003, Vygotsky, 1933/1978). Planning requires simultaneously having a ‘plan’ and being able to engage in ongoing monitoring of the plan and the response. Preschool aged children may be unable to generate the number of strategies to engage in this level of thinking, even for known tasks. Those participants in the middle and lower information processing clusters or groups displayed less efficient planning strategy application skills than those participants that consistently performed more efficiently. This would indicate
that although the capacity to apply planning strategies vary, typically developing preschool and early school aged children have comparatively less sophisticated planning skills, as compared to their ability to use perceive, recall and perform strategies to the level expected during task performance.

It is also during this stage of child cognitive development that children’s metacognition develops and they begin to understand what it means to think (Berk, 2003 & Flavell, Green & Flavell, 1995). The evaluation aspect of information processing planning requires the ability to effectively question, analyse and make judgements regarding ongoing task performance. These are all metacognitive skills. Differences across the planning scores of individual participants may be accounted for by the fact that children exposed to high levels of strategy instruction have a better developed metacognitive base from which to further develop metacognitive skills than those with low exposure to strategy instruction (Moely et al, 1995). These children may represent the stronger planners of the cohort, although analysis of this variable was beyond the scope of the study.

Two important aspects of planning are ‘knowing the goal’ or keeping the goal in mind and organisation skills. These are skills that have been shown to be still developing in preschool and early school aged children, but may not be as well developed in some children whose parents or carers do those aspects of tasks for them (Vygotsky, 1933/1978). Studies in contemporary parenting indicate a trend for some parents and carers to reduce a child’s potential independence and development by performing many routine tasks for them due to time constraints and habit. In this instance the child can be thought of as a passive participant in the ‘thinking’ stages of performance, rather than an active learner in the ‘zone of proximal development’ (Vygotsky, 1933/1978). This
has been found to impact a child’s transition from assisted to independent learner through to the later years of schooling (Cutright, 2008). Passive participation in routine tasks at this age would also account for those children being exposed to only low levels of strategy instruction, impacting their overall metacognitive development as well. Children need to be active participants in all the planning aspects of tasks to enable them to develop their independent planning skills. Again, further analysis of this type of task was beyond the scope of the study, although it was noted by the researcher that when faced with the dressing tasks at Times 1, 2 and 5, a small number of the participants indicated ‘I can’t’ and usually explained ‘Mummy helps me do this’. One other area impacting on overall planning skills of participants in this study was the ability to regulate the force and speed required for task performance, or the ability to calibrate responses. Planning use of required strategies for calibration of motion demands an understanding that movements are not too forceful, too large, not awkward or unscaled and that they must match the task requirements. ‘Calibrates’ was found to be the most consistently difficult strategy descriptor in the Plan quadrant. The Rasch vertical ruler (Figure 4.26) presented in the results section highlights the overall comparative strengths and weaknesses found in the study participant’s strategy applications.

As outlined in the literature review, fine motor skills are still developing in the age group that was the focus of this study (Mulligan, 2003). Fine motor skill accuracy is dependent on an ability to adequately plan the calibration required for a task. With the descriptor ‘calibrates’ scoring consistently low across all five data collection times it is possible the researcher placed unrealistic developmental expectations on the participant’s fine motor skills, although criterion levels for scissor and pencil use and
colouring control were informed by careful study of the developmental acquisition of these fine motor skills and by teacher expectations. Closer examination of the individual calibrates scores from the PRPP assessment indicates that although some children scored well in this descriptor, ie a ‘3’ indicating no error in this descriptor, the majority of children displaying calibration difficulties scored a ‘2’ or ‘1’ indicating that calibration was lower than expected and affected task performance to a greater or lesser degree.

Poor calibration skills, demonstrated most commonly during the writing, colour and cut steps of the tasks may also have been the result of reduced exposure to fine motor tasks in the preschool years and therefore less opportunity to practice thinking about refining responses. The literature supports that fine motor control is still developing at this age but that unlike gross motor skills, where copying from someone older and more capable aids development, fine motor skill development is very reliant on ongoing practice (Mulligan, 2003). If fine motor tasks are not actively encouraged at home and in the preschool environment, it may be expected that in some children the development of the calibration required for these skills may be delayed.

Compared to use of planning strategies, strengths in application of strategies during task performance demonstrated by the study participants were aspects of the Perceive and Recall quadrants of the PRPP System. Only one descriptor from the PRPP Recall quadrant, recalls steps, demonstrated consistent inefficiency required for task performance. During data collection, each task and all its steps was purposefully only explained at the start of each task in order that recall of steps could be assessed, as is consistent with PRPP System Assessment instruction (Chapparo & Ranka, 2003). It was found that those participants consistently performing strongly on the PRPP were
able to remember all required steps. Those participants who performed poorly were also consistent in their inability to recall task steps, requiring multiple prompting or abandoning the task. Memory skills are still developing in this age of child and the large range of memory strategy application skills found in the study participants supports this.

Two descriptors from the Perceive quadrant, ‘matches’ and the attention ‘modulates’ also proved more problematic for participants than other descriptor behaviours from this quadrant. Poor use of matching strategies were demonstrated in some participants who had difficulty or where unable to match object attributes and inconsistently associated or fitted together same sizes, shapes, objects or body parts. This is an important finding as the early years at school rely heavily on visual matching and discriminating (same/different) analysis to develop recognition of shapes and letters for reading and comprehension. Attention modulation refers to being able to spontaneously narrow, broaden and shift attention during task completion (Chapparo & Ranka, 2003). Early studies by Woody-Ramsey & Miller (1988) found that attention and the ability to filter out distracting stimuli improves as children mature and preschool aged children will only spontaneously restrict attention to a task if it directly relevant to them. Organised selective attention does not mature until well into the formal schooling years (Woody-Ramsey & Miller, 1988). This may explain why some but not all participants had difficulty modulating their attention.

Task mastery, assessed using PRPP System Stage One analysis demonstrated that errors of accuracy and omission were commonly made during task performance, with errors of timing and repetition being less common. The results from the Stage One analysis are reflective of typically developing children. Errors of accuracy would be expected, as children at this stage of late preschool and early school are still developing the fine motor control required for accuracy (Exner, 2001; Mulligan, 2003). It would not be
expected that errors of accuracy would necessarily decrease from Time 1 to Time 5 as the task demands assessed by the PRPP System increased, requiring greater fine motor accuracy as the children moved from preschool to school. The low numbers of timing and repetition errors indicate that the participants were generally able to complete tasks within a reasonable time frame without repeating steps, again an expectation of typically developing children completing age appropriate tasks. The timing errors were largely made by the children demonstrating less efficient strategy application skills. The errors of omission, nearly 30% of which were a direct result of failure to comply, cannot be discussed in relation to typical development suffice to say that children at this age often recalcitrant or refuse to complete some tasks, particularly everyday self care tasks such as dressing.

The assessment of pretend play skills, using the ChIPPA, also highlighted that the study sample of typically developing preschool children demonstrated a range of pretend play ability. Significant positive correlations were found between PRPP System total scores and ranks and PEPA symbolic scores and ranks, indicating agreement between these two constructs. There was also significant correlation between Plan quadrants scores and PEPA symbolic and combined scores. This positive relationship would be expected as Plan quadrant descriptors assess the ability to generate novel strategies (Chapparo & Ranka, 2003), a necessary skill for elaborative pretend play (Stagnitti, 2003). Agreement between the PRPP System Perform quadrant, monitoring motor aspects of strategy application and the ChIPPA scores would not be expected, as the ChIPPA does not monitor and score the quality of motor output.

These PRPP System and ChIPPA comparisons indicate that there is was some positive agreement between the rankings and scores of the participants for the ChIPPA and
PRPP, indicating some constructs are aligned and others not aligned. This may be explained by the fact that the two assessments investigated different tasks, ie pretend play versus preschool table top and dressing tasks. Another explanation may be that these two assessments, although measuring some similar constructs, identify children with different capacities to allocate cognition to different types of tasks.

Previous research (Boland, 2004) found that the ChIPPA and PRPP System do measure similar cognitive constructs and that there was substantial agreement between the two assessments to discriminate between children with and without dysfunctional play. This research only assessed pretend play and did not compare the cognitive constructs seen during pretend play to the cognitive strategy application abilities seen during performance of routine preschool aged tasks.

6.4 SCHOOL READINESS FROM AN INFORMATION PROCESSING PERSPECTIVE

Preschool teachers in Australian Preschools and Long Day Care Centres are often questioned and asked to provide informed opinions on individual school readiness of the children in their care. Opinions are based on ongoing observations of the child in social and pre academic situations as well as completion of ‘checklists’ that outline various skills thought to be pre requisites for readiness for school (Aiossa, 2005; Cochran, 2003; Sherry, 2003 & Public Education, 2008). With a diverse range of preschool curriculum on offer to preschool children in Australia and preschool being a non compulsory aspect of early education, the formal preparation of Australian preschool aged children for school is inconsistent at best.
Analysis of the PRPP descriptor based Questionnaires, the Preschool Performance Questionnaire (PPQ) and School Performance Questionnaire (SPQ) and the PRPP System scores from corresponding data times indicated some level of agreement between teachers and the researcher. A higher level of agreement was indicated between the school teacher completion of the SPQ and the PRPP from Time 5 than between the PPQ and PRPP from Time 1. Overall the teachers, both preschool and school, tended to rate the study participants performance as poorer than their PRPP System scores would indicate. Although the questions used in the questionnaires were made readily understood for people not familiar with the PRPP System or information processing theory and concepts (see Section 3.5.3), use of an information processing strategy application based questionnaire did not adequately reflect PRPP System performance, as assessed by a therapist trained in PRPP System administration and theoretical background. This finding may have been due to the nature of the items on the teachers’ questionnaires or the amount of time assigned to interview the teachers about the participants. Informal interviews were conducted at each stage of data collection. In depth formal interviews were not possible due to the time constraints of the teachers as well as the researcher. A decision was made at the onset of data collection for an emphasis on quantitative not qualitative data, as both were not within the scope of the research project. While valuable information was obtained using the questionnaires, further research is required to develop a more ‘user friendly’ version that teachers are able to complete independently. Reports of recent success in development of teacher and parent PRPP questionnaires indicate this to be a promising future line of research and utilisation of PRPP assessment (Lowe, 2010).

Analysis of the data regarding readiness for the move to school, based on the preschool teachers’ opinion and the findings from the PRPP assessment at Time 3, demonstrated
agreement but it was not highly significant (p<.05). However, analysis of the school teachers’ opinion on school performance at the end of Kindergarten and the PRPP at Time 5 showed highly significant agreement (p<.0001). This would indicate that class performance and information processing skills are closely linked and school teachers assess ongoing ability, not just via formal testing, but by considering each child’s ability to process the information required for ongoing performance in daily school tasks.

The significant, but weak correlation (p<.05) between the Preschool teacher completed questionnaire and the PRPP at Time 1 may be explained by the fact that Preschool teachers consider many traits and a much greater range of skills when providing opinion on individual readiness for school, whereas the PRPP System only assesses strategy application ability, one possible determinant of school readiness. The PRPP System did not assess social skills, physical health, emotional maturity, gross motor skills and levels of independence, all skills deemed important for the transition to formal schooling (McBride, Ziviani & Cuskelly, 2006; Public Education NSW, 2008; Sherry, 2003; Webster-Stratton & Reid, 2004). What it did assess, beyond the specific tasks selected, was each participant’s ability to process information required for the completion of a novel, yet age appropriate task, skills generally accepted as important to the successful adoption of the academic school student role.

There are several reasons why this study found a greater agreement between the PRPP System assessment and the school teacher’s assessment of child performance during Kindergarten in comparison to preschool teachers. First, it is possible that performance in the first formal year of school is more dependent upon children’s ability to apply cognitive strategies to situations of learning in an independent manner. Second, in comparison to preschool, the first year of formal schooling is based on a standard
curriculum with specific criteria for success. It is possible that children’s capacity to use cognitive strategies during task performance in comparison to curriculum expectations is more evident to teachers. Indeed, analysis of the K-6 School Curriculum document indicates that stated levels of learning contain descriptors that are the same as, or similar to, descriptors within the PRPP System of Task Analysis (see for example English K-6 Syllabus, NSW Board of Studies, 1998). The sensitivity and specificity analysis supports the school teacher as being an accurate identifier of strategy application ability and the preschool teacher being a less accurate identifier of those children who have inefficient strategy application. The sensitivity and specificity analysis as well as the Spearman’s Rank Order Correlation support the PRPP System as being both a sensitive and specific test of academic readiness, than other possible readiness criteria such as social and emotional readiness.

Analysis of PRPP System results in comparison to the individual preschool curriculums was not performed as numbers were small and in some instances curriculums were difficult to categorise. It was however noted by the researcher that the participants attending those preschools claiming a ‘traditional’ curriculum, with highly structured timetables, transitioned into Kindergarten more readily. This observation is supported by comments made by Kindergarten teachers regarding the readiness of some children to commence formal schooling and the highly structured nature of the school curriculum in NSW, Australia (Burling, 2004 & Thorne, 2004). Trish Burling and Cathy Thorne (2004), Kindergarten teachers of more than 20 years experience, were interviewed in a formal context as part of a preliminary study to this research. They indicated that a more recent trend found many more children were starting school unprepared for the formal, structured nature of Kindergarten. Both indicated they felt
this was due to the ‘unstructured, modern preschool environment where children, boys in particular, could just play blocks or in the sand pit all day and not be expected to do any fine motor tasks or group activities or comply with a set routine’. While this is the opinion of two experienced teachers only, it is shared by informal interview comments from other Kindergarten teachers involved in this study (Aspin, 2009; Bool, 2006; Carrol, 2009 & Cowley, 2006).

Perhaps the highly structured traditional preschool curriculum encourages learning in the ‘zone of proximal development’ as outlined by Vygotsky (1933/1978) by establishing strong models of cognitive strategy use which children can modify and elaborate according to a wide set of task demands. It encourages all aspects of fine and gross motor play, fosters social interaction and demands periods of concentration and group participation. The ‘emergent’ curriculum also appears to encourage many of these aspects but not necessarily within the same highly structured format and not necessarily with an emphasis on completion of all set activities but rather on the child’s choice of activities.

6.5 STRENGTHS AND LIMITATIONS OF THE STUDY

This study provides a longitudinal analysis of preschool and early school children’s strategy application abilities. It provides clear data on the range of strategy application profiles found in typically developing children during the crucial preschool and early school years as children transition from preschool into formal schooling. Although the literature clearly outlines typical cognitive development trajectory during this stage it lacks detailed information on the range of typically developing children’s strategy application profiles.
Total Participant numbers in this study were small (n=32). A larger cohort was not possible due to time constraints of the researcher and the longitudinal design of the study. Travel time between participant preschools and schools and actual time taken to collect data over five separate time periods also limited participant numbers. Although small in size this study provides a model for further clinical research in this area. Larger numbers of participants would add greater power to the data.

This study was also limited to a small geographical area of Sydney, Australia. An expansion of this study design, targeting children from a larger geographic area and more diverse socio-economic and cultural backgrounds may provide greater insight into typical strategy application development in this age group and the impact or not of cultural background and socio-economic status. It may be concluded that the data from this study represents only a small percentage of the Australian population, and cannot be generalised beyond the research sample.

In addition to information processing strategy application abilities, other areas of child development were investigated, namely reading and writing skills. These skills were assessed not only as steps in the PRPPP System assessed tasks, but also analysed independently. It was found, with the limited data gathered, that strategy application ability, as assessed using the PRPPP System was independent of reading and writing legibility scores in Kindergarten aged children and one did not necessarily predict the other in this study. In order to adequately comment on a link or otherwise between these skills, a more rigorous research design aimed specifically at reading and writing, tasks which present a greater challenge to typically developing children, would be necessary.

All participants attended preschool, a non-compulsory form of education prior to formal school in Australia. The study design and time constrains did not allow for a control
group of participants not attending preschool or long day care. It should, however be noted that according to the Australian Bureau of Statistics (2009) in 2005, 88% of four year old children and 74% of three year old children attended a NSW school, preschool or child care facility. This indicates that the majority of preschool aged children in NSW attend some form of preschool and thus the study is representative of this group. The strategy application profiles presented, as well as the comments on participant school readiness, need to be considered in light of the participant’s attendance at some form of preschool. The available literature does highlight the importance of preschool education in the preparedness of children for formal schooling (Harrington, 2008; Kronemann, 1999; NSW Department of Community Services, nd–b; NSW Department of Education and Training 2005b).

All data was collected by the researcher, formally trained in the use of the PRPP System. Rasch reliability analysis, inter rater reliability and intra rater reliability indicates the PRPP is a reliable and valid assessment tool of children’s information processing strategy application ability. Inter and intra rater reliability was performed, via video analysis, on a small sample of the overall cohort (n=8). This may have produced some inaccuracies in scoring as some components are difficult to see on video and face to face contact with each participant can lead to a more accurate recording of their strategy application abilities. The researcher was also formally trained in the use of the ChIPPA and maintained contact with the ChIPPA developer and author throughout the assessment phase of the study. Other assessment tools utilised did not require formal training, although twenty years as a paediatric occupational therapist provided the researcher with insight into typical and atypical performance that would be considered in preschool and school aged children.
The PRPP System based questionnaires, developed specifically for this study, were tested only for content validity and would benefit from more robust psychometric analysis if utilised in future research. The ChIPPA has undergone initial psychometric analysis but studies of its clinical application and use are limited.

Each setting for data collection varied greatly. All preschool data was collected in an area of the larger preschool room. No effort was made to minimise distraction, as this represented the typical performance environment for the preschooler, although many of the preschool teachers did attempt to minimise interruptions from other class members. School phase data was collected either in a small, quiet room away from the main class, or as in three instances, at the participants desk in the classroom while class continued around us. This may have impacted on the final results and must be taken into account when interpreting the data. Although standardising data collection environments may be an important variable in future studies in this area of research, the notion of assessment that is criterion referenced and ecologically valid would be lost.

6.6 SIGNIFICANCE OF THE STUDY

This research contributes theoretically, empirically, clinically and methodologically to the occupational therapy profession as well as to education. Theoretically it contributes to the occupational therapy profession and practice by providing data to demonstrate a link between cognition and the impact of cognitive information processing strategy application on occupational performance and occupational performance roles in preschool and school aged children. It presents information processing and occupational performance theory as a framework for occupational therapy assessment and resultant intervention. Theoretically this study also links established theories of cognitive

Empirically the data collected is small, but the first of its kind and of interest to occupational therapists and other professions involved in the development and education of young children. To date there is a lack of information about cognitive information processing development and its impact on school readiness and successful adoption of the school student role. The data also contributes to support the clinical and research use of the PRPP System as an assessment tool. The Rasch analysis provides a hierarchy of information processing strategies, strengths and weaknesses, in this population, which is closely supported by cognitive development theory.

Assessment of pretend play demonstrated some agreement between cognitive information processing strategy application, as assessed using the PRPP and the cognitive skills of pretend play, assessed using the ChIPPA. Although previous research by Boland (2004) found that the ChIPPA and PRPP System did measure similar cognitive constructs, this was not strongly demonstrated in the statistical analysis from this study. As previously stated this research only assessed pretend play and did not compare the cognitive constructs seen during pretend play to the cognitive strategy application abilities seen during performance of routine preschool aged tasks.

Clinically this research provides a significant contribution to occupational therapy practice in preschool and early school aged children. It provides evidence for the use of the PRPP System as a clinically useful assessment tool, particularly for use with a population, ie preschoolers, well established developmentally to be ‘poor test takers’.
The PRPP System identifies and quantitatively measures strategy application during everyday occupational task performance by employing a process of task analysis. Specifically it assesses occupational mastery in selected tasks, assessed through the Stage One Analysis and then identifies the information processing strategy application reasons for disordered occupational performance, in the Stage Two Analysis.

Occupational therapists are increasingly seeing young school aged children with ill defined difficulties in the classroom. This research has established that the PRPP is a sensitive and specific assessment tool that can define strategy application abilities and has some predictive value.

This research provides preliminary evidence that early childhood cognitive development and thus aspects of school readiness may be enhanced by preschool curriculum and exposure of preschoolers to situations that foster independent learning, particularly acquisition of calibrated fine motor skills. This has implications for Australian preschool curriculums and investigation of strategy application abilities in Australian preschoolers could be used to inform a more standardised preschool curriculum, something clearly lacking in both NSW and Australia at the time of this study.

Methodologically, use of longitudinal analysis of strategy application abilities is essential if an issue such as school readiness is to be commented upon. Readiness for school does not occur in a single moment or stage but gradually as the child matures through the preschool years. This study concluded at the end of the first year of formal schooling. A continuation of this study is currently underway, investigating the ongoing strategy application abilities of 8 of the original participants from the study. These participants were selected as representative of the three strategy application ability clusters outlined in the results section 4.1.3. All participants were reassessed using the
PRPP System during their third year at formal school, Year 2 in NSW schools. Preliminary results indicate that those participants initially identified as having efficient strategy application abilities were continuing to perform well at school, while those with inefficient and disordered strategy application abilities were struggling with all aspects of the school curriculum and requiring ongoing additional teaching support.

The PRPP System is demonstrated as a reliable and valid method for assessing strategy application ability in this age group and for the purpose of providing additional insight into a child’s school readiness or ‘readiness to learn’. It is acknowledged that school readiness is comprised of many factors, one of which is the ability to apply strategies to process information in situations of learning. The PRPP System is ideally suited to identifying children with disordered strategy application and could be used to plan and guide effective treatment (PRPP System Intervention, Chapparo & Ranka, 2007) in order to ensure greater readiness for the transition to school.

6.7 CONCLUSION

This research focused on strategy application abilities in preschool and early school aged children. It demonstrated that assessment of strategy application abilities using the PRPP System, a standardised, criterion referenced assessment, provided insight into the ultimate school readiness of the study participants. The longitudinal design of the study enabled the predictive value of the PRPP System to be established and that participants found to have disordered and inefficient strategy application abilities also demonstrated difficulties transitioning into formal school.

School readiness is not only an individual but also a community concern. Children
transitioning into formal school without the necessary skills are at risk of failure. Many require ongoing educational support in the classroom and can be disruptive to those immediately around them as well as the class as a whole (Burling, 2004). As mentioned, readiness for school and resultant academic success can be considered a paediatric health outcome and all relevant parties should be working towards the common goal of ensuring that preschool children are ‘ready for school’. Lack of readiness or an inability to adequately identify children ready for school can result in those children potentially not transitioning well into formal school and failing in all aspects of school life, whether academic, social or emotional. More research into this crucial transition period in young children’s lives is essential to ensure children are given the best opportunities to either develop school readiness skills or be identified as requiring additional help in the transition to school.

The PRPP System of Task Analysis (Chapparo & Ranka, 2003), a standardised, criterion based assessment of strategy application abilities is a reliable and valid measure of information processing strategy application ability and could be used to inform the school readiness decision and identify children at risk of not having the ‘individual readiness to learn’ skills required for the successful adoption of the occupational performance role of the school student.
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Stagnitti, K. (2003). *Cognition and Play: Assessment and Treatment for Young Toddlers and Preschool Children*. Course notes. Lidcombe, NSW, School of Occupation and Leisure Sciences, Faculty of Health Sciences, the University of Sydney.


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Bibliography


APPENDICES
APPENDIX I

ETHICS APPROVAL DOCUMENTATION
16 June 2005

Dr C Chapparo
School of Occupation and Leisure Sciences
Faculty of Health Sciences
Cumberland Campus - C42
The University of Sydney

Dear Dr Chapparo

I am pleased to inform you that the Human Research Ethics Committee at its meeting on 14 June 2005 approved your protocol entitled "The assessment of information processing behaviours and development during play and regular preschool and school tasks in typically developing preschool and school aged children"

Details of the approval are as follows:

Ref No.: 06-2005/3/8296
Completion Date of Project: 31 December 2007
No. of Participants: 70 [preschool aged children]
Authorised Personnel: Dr C Chapparo
Mrs K Stewart

To comply with the National Statement on Ethical Conduct in Research Involving Humans, and in line with the Human Research Ethics Committee requirements this approval is for a 12-month period. At the end of the approval period, the HREC will approve extensions for a further 12-month, subject to a satisfactory annual report. The HREC will forward to you an Annual Progress Report form, at the end of each 12-month period. Your report will be due on 30 June 2006.

Conditions of Approval Applicable to all Projects

(1) Modifications to the protocol cannot proceed until such approval is obtained in writing. (Refer to the website www.usyd.edu.au/ethics/human under 'Forms and Guides' for a Modification Form).
(2) The confidentiality and anonymity of all research subjects is maintained at all times, except as required by law.

(3) All research subjects are provided with a Participant Information Sheet and Consent Form, unless otherwise agreed by the Committee.

(4) The Participant Information Sheet and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee.

(5) The following statement must appear on the bottom of the Participant Information Sheet. *Any person with concerns or complaints about the conduct of a research study can contact the Manager, Ethics Administration, University of Sydney, on (02) 9351 4811.*

(6) The standard University policy concerning storage of data and tapes should be followed. While temporary storage of data or tapes at the researcher’s home or an off-campus site is acceptable during the active transcription phase of the project, permanent storage should be at a secure, University controlled site for a minimum of seven years.

(7) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely

[Signature]

Associate Professor J D Watson
Chairman
Human Research Ethics Committee

End: Parental Information Sheet
Parental (or Guardian) Consent Form
Video Consent Form
Score Sheet for 4-7 year old children (copyright: Karen Stagnitti, 2002)
The PRPP system scoring sheet (copyright: Chapparo & Ranka, 2003)
Preschool Performance Questionnaire
Mrs Kirsty Stewart  
722B Old Northern Road  
DURAL, NSW 2158  
AUSTRALIA  

Dear Mrs Stewart:  

SERAP Number 2007064  

I refer to your application to conduct a research project in NSW government schools entitled The assessment of information processing behaviours and development during play and regular preschool and school tasks in typically developing preschool and school aged children. I am pleased to inform you that your application has been approved. You may now contact the Principals of the nominated schools to seek their participation.  

This approval will remain valid until 30 June 2008.  

The following researchers or research assistants have fulfilled the Working with Children screening requirements to interact with or observe children for the purposes of this research for the period indicated:  

<table>
<thead>
<tr>
<th>Name</th>
<th>Approval expires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kirsty Stewart</td>
<td>4 October 2008</td>
</tr>
<tr>
<td>Christine Chapparc</td>
<td>4 October 2008</td>
</tr>
</tbody>
</table>

You should include a copy of this letter with the documents you send to schools.  

I draw your attention to the following requirements for all researchers in NSW government schools:  

- School Principals have the right to withdraw the school from the study at any time. The approval of the Principal for the specific method of gathering information for the school must also be sought.  
- The privacy of the school and the students is to be protected.  
- The participation of teachers and students must be voluntary and must be at the school’s convenience.  
- Any proposal to publish the outcomes of the study should be discussed with the Research Approvals Officer before publication proceeds.  

When your study is completed please forward your report marked to General Manager, Planning and Innovation, Department of Education and Training, GPO Box 33, Sydney, NSW 2001.  

Yours sincerely  

Andrew Rolfe  
A/General Manager, Planning and Innovation  

---  

* Level 6, 35 Bridge Street • GPO Box 33 • Sydney NSW 2001 Australia •  
* Telephone 02 61 2 9561 8744 • Facsimile 02 61 2 9561 8941 • www.det.nsw.edu.au •
APPENDIX II

PARTICIPANT INFORMATION PACKAGE

Parental information Sheet
Consent Form
Video Consent Form

SCHOOL INFORMATION PACKAGE

School Information letter
The purpose of this study is to look at information processing in preschool children. Information processing is the ability to collect relevant information from around you, understand that information and then respond correctly for whatever task you are doing or have been asked to do. This study will look at the development of information processing in regular preschool children from two years before they begin school until the end of Kindergarten. Your child has been selected as a possible participant because your preschool teacher has expressed interest in this area of child development and has consented to possible participation of any regular preschool children from (insert preschool name here) Preschool with interested parents. This is a 2 ½ year study. Your child will be followed from two years before they begin formal school until the end of Kindergarten in 2007.

The study is being conducted by Kirsty Stewart, a Lecturer in Occupational Therapy in the School of Occupation and Leisure Sciences at The University of Sydney and Doctor of Health Sciences student. The study is being conducted under the supervision of Dr Christine Chapparo, Senior Lecturer, School of Occupation and Leisure Sciences, The University of Sydney. The study will form the basis for a Doctor of Health Sciences degree from The University of Sydney.

If you agree to allow your child to participate they will be assessed doing a number of regular preschool tasks, including drawing, colouring, cutting, pasting, dressing and play. Your child will be observed once towards the end of this year and twice each year until they reach the end of Kindergarten. The observations will take place at the preschool at a time that is convenient for your child and the teacher. Each assessment takes about 30 minutes. You do not have to be present, but you can be if you want to. Each session will be videotaped to reduce face to face time with your child. A video consent form is attached. Information, in the form of a questionnaire, would also be required from your child’s preschool and later, school teacher.
Your child will not be subject to any foreseeable risks and there will be no foreseeable inconvenience to you or your family. It is expected that the benefits to you and your child will include detailed analysis of their information processing abilities and the possible identification of any strengths or weaknesses they may have doing everyday activities. We cannot necessarily guarantee or promise that your child will receive any benefits from the study.

Any information obtained in connection with this study and that can be identified with you or your child, will remain strictly confidential and will not be disclosed without your permission. No names or other identifying information will be used in reports on this study.

Participation in this study is entirely voluntary. If you decide to permit your child to participate, you are free to withdraw your consent and discontinue your child’s participation at any time.

If you have any questions now or at a later date please contact Kirsty Stewart on 9351 9490 who will be happy to answer them.

Please keep a copy of this form for your information.

Any person with concerns or complaints about the conduct of a research study can contact the Manager for Ethics Administration, University of Sydney on
PARENTAL (OR GUARDIAN) CONSENT FORM

1. I, ........................................................... agree to permit ..............................................
who is aged ................years, to participate in the study described in the Parental
Information Sheet attached to this form.

2. I have read the Information Sheet, which explains the aims and nature of the study
and the possible risks and the statement has been explained to me to my satisfaction.

3. I understand that I can withdraw my child from the study at any time without
prejudice to my child’s relationship with my child’s preschool or to the University
of Sydney.

4. I agree that research data gathered from the results of the study may be published
provided that neither my child nor I can be identified.

5. I understand that if I have any questions relating to my child’s participation in this
research, I may contact Kirsty Stewart on 9351 9490, who will be happy to answer
them.

6. I have received a copy of this Consent Form and the Information Sheet.

.......................................................
Signature of Parent/Guardian

.......................................................
Please print name

............................................
Date
INFORMATION PROCESSING DEVELOPMENT IN PRESCHOOL AGED CHILDREN

VIDEO CONSENT FORM

1. I have been told that a video tape will be made of my child to assist in assessing his or her ability to perform everyday preschool tasks.

2. I understand that this recording will only be used by the occupational therapist/researcher to assess my child’s abilities. It will not be used for teaching or any other purpose at any time.

3. I understand that I may withdraw my consent for the occupational therapist/researcher to use this recording without repercussion.

4. I understand that the observations of my child’s performance may be discussed with me.

5. I hereby agree that a video tape recording may be made of my child and if I desire this recording it will be returned to me after completion of the assessment.

..........................................................
Signature of Parent/Guardian

..........................................................
Please print name

..........................................................
Date
Information Processing Development in Preschool and School Aged Children

School Principal/Teacher Information Sheet

The purpose of this study is to look at information processing in preschool and school aged children. Information processing is the ability to collect relevant information from around you, understand that information and then respond correctly for what-ever task you are doing or have been asked to do. This study will look at the development of information processing in regular preschool children from two years before they begin school until the end of Kindergarten. The Children who were initially selected as participants were from preschools where their preschool teacher expressed interest in this area of child development and consented to participation of any regular preschool child from their preschool. All participants have signed consent forms from their parents or carers who have also been provided with an information sheet (please find copies of these attached).

The study is being conducted by Kirsty Stewart, a Lecturer in Occupational Therapy in the School of Occupation and Leisure Sciences at The University of Sydney and Doctor of Health Sciences student. The study is being conducted under the supervision of Dr Christine Chapparo, Senior Lecturer, School of Occupation and Leisure Sciences, The University of Sydney. The study will form the basis for a Doctor of Health Sciences degree from The University of Sydney.

The participating children are assessed doing a number of regular preschool or school tasks, including drawing, writing, colouring, cutting, pasting, dressing and play. The children have been observed once towards the end of 2005 and twice each year until they reach the end of Kindergarten. The observations take place at the preschool or school at a time that is convenient for the child and their teacher. The school aged children will need to be seen in term 2 and then again in term 4 this year. The first of
these assessments will take approximately 30 minutes and the second assessment around an hour. The reason for the lengthier second assessment is the use of a standardised play and language assessment.

The children will not be subject to any foreseeable risks and there will be no foreseeable inconvenience to you or your classes. It is expected that the benefits to you and the children will include detailed analysis of their information processing abilities and the possible identification of any strengths or weaknesses they may have doing everyday activities. We cannot necessarily guarantee or promise that the children will receive any benefits from the study.

Any information obtained in connection with this study and that can be identified with you or the children, will remain strictly confidential and will not be disclosed without permission. No names or other identifying information will be used in any reports on this study.

Participation in this study is entirely voluntary. Parents that have decided to permit their child to participate, are free to withdraw their consent and discontinue their child’s participation at any time.

This study has full ethics approval from the University of Sydney Ethics Committee.

If you have any questions now or at a later date please contact Kirsty Stewart on 9351 9490 or k.stewart@usyd.edu.au who will be happy to answer them.

Please keep a copy of this form for your information.
APPENDIX III

PRPP System Stage Two descriptor definitions

PERCEIVE QUADRANT

ATTENDING
Notices: spontaneously reacts by head turning or looking, reaching or listening

Modulates: Spontaneous narrowing and broadening of focus, shifting attention from one part of task to another

Maintains: Sustaining attention long enough for task completion

SENSING
Searches: Active and systematic seeking of sensory information by looking, listening, feeling, smelling

Locates: Finds body parts, objects and parts of the environment that are needed for the task

Monitors: Responds by action to sensory input when body or environment changes during task performance

DISCRIMINATING
Discriminates: Differentiates between (body parts, objects)

Matches: Fits together, associates, same sizes, shapes, objects, body parts

RECALL QUADRANT

RECALLING FACTS
Recognises: Shows recognition of objects, body parts and the task environment

Labels: Names objects, body parts and the task environment. Understands and uses language.

Categorises: Groups objects or body parts according to the task (parts to make the whole)
RECALLING SCHEMES

Contextualises to:

Time: Knows when task occurs (at the right time)

Place: Knows where task occurs

Duration: Knows how long task takes

RECALLING PROCEDURES

Uses Objects: Interacts with and uses known objects appropriately

Uses Body: Demonstrates the general & specific body movements necessary to place self in known positions

Recalls Steps: Performs the general and specific procedures and steps needed for known tasks

PLAN QUADRANT

MAPPING

Knows Goal: Has an outcome, formulates an outcome, keeps outcome in mind

Identifies Obstacles: Examines scheme of action. Explores & identifies potential constraints of task completion (eg. other people, hazards, environment)

Organises: Arranges objects and body to begin task. Rearranges environment as task progresses.

PROGRAMMING

Chooses: Selects appropriate items & body parts. Selects one location. Selects actions & steps for specific task environment

Sequences: Performs task in logical progression. Makes smooth transitions from one part of task to another, sequence complete

Calibrates: Regulates or grades force, speed & extent of movements in performing an action or step
EVALUATING

**Questions:** Verbally inquires about location of missing items. Hesitates, looks or examines aspects of task momentarily prior to making appropriate changes

**Analyses:** Stops to evaluate a specific constraint

**Judges:** Makes safe & informed decisions. Takes into consideration physical capabilities & limitations of task environment.

PERFORM QUADRANT

INITIATING

**Starts:** Begins expected performance. Restarts after interruption

**Stops:** Stops at times appropriate to expected performance

CONTINUING

**Flows:** Smooth performance, easy transitions, no stop-starting

**Continues:** Completes task to expected level

**Persists:** Keeps going when obstacles arise. Performance consistent with ability.

CONTROLLING

**Times:** Correct speed. Performs within functional/expected time frame

**Coordinates:** Smooth musculoskeletal performance. Free from tremor/weakness.

**Adjusts:** Musculoskeletal adjustments are made to match the plan (small or large).
APPENDIX IV

ChIPPA Score Sheets (Stagnitti, 2002)
# Appendices

## SCORE SHEET FOR 4-7 YEAR OLD CHILDREN

**CHILD INITIATED PRETEND PLAY ASSESSMENT (CHIPPA)**

By Karen Stagnitti © 2002

<table>
<thead>
<tr>
<th>Play Action Code</th>
<th>Object Substitution</th>
<th>Child’s Name</th>
<th>Date of Assessment</th>
<th>Date of Birth</th>
<th>Age of Child</th>
<th>Indicate the CHIPPA action</th>
</tr>
</thead>
<tbody>
<tr>
<td>B = behaviour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R = repetitive action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f = functional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a = elaborate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(brief explanation given below)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### First Five Minutes (0 - 5 minutes)

<table>
<thead>
<tr>
<th>Play Action Code</th>
<th>Object Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Second Five Minutes (6 - 10 minutes)

<table>
<thead>
<tr>
<th>Play Action Code</th>
<th>Object Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Final Five Minutes (11 - 15 minutes)

<table>
<thead>
<tr>
<th>Play Action Code</th>
<th>Object Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© Karen Stagnitti, 2002
<table>
<thead>
<tr>
<th>Play Action Code</th>
<th>Object Substitution Code</th>
<th>Child's Name</th>
<th>Age of Child</th>
<th>Indicate the CHPPA session</th>
</tr>
</thead>
<tbody>
<tr>
<td>B = behavior</td>
<td>record the number of objects used in object substitution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R = repetitive action</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f = functional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e = elaborate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(other explanation given below)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First FIVE minutes (0 - 5 minutes)

[Table entries for first five minutes]

Final FIVE minutes (11 - 15 minutes)

[Table entries for final five minutes]

Second FIVE minutes (6 - 10 minutes)

[Table entries for second five minutes]

---

Play Action Codes:
- B = non-play action, child is not engaged with the play materials.
- R = repetitive series of actions or action more than once. Third time, child is scored 'F'.
- f = functional actions are when the play materials are used functionally.
- e = functional actions are used in sequence of sequential actions, attributes, properties, refer to other objects.

© Karen Stagnitti, 2002
### SCORING

**Conventional-imaginative play session**

PEPA Score calculation

<table>
<thead>
<tr>
<th>Percentage of Elaborate Pretend Play Actions score calculation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Actions =</td>
</tr>
<tr>
<td>Elaborate actions =</td>
</tr>
<tr>
<td>Percentage = elaborate actions ( \times 100 ) = ( \times 100 )</td>
</tr>
<tr>
<td>Total actions</td>
</tr>
</tbody>
</table>

Percentage of elaborate pretend play actions score (PEPA):

Number of object substitutions score (NOS):

Number of initiative actions score (NIA):

**Symbolic play session**

PEPA Score calculation

<table>
<thead>
<tr>
<th>Percentage of Elaborate Pretend Play Actions score calculation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Actions =</td>
</tr>
<tr>
<td>Elaborate actions =</td>
</tr>
<tr>
<td>Percentage = elaborate actions ( \times 100 ) = ( \times 100 )</td>
</tr>
<tr>
<td>Total actions</td>
</tr>
</tbody>
</table>

Percentage of elaborate pretend play actions score (PEPA):

Number of object substitutions score (NOS):

Number of initiative actions score (NIA):

---

### SCORE SUMMARY FOR CHIPPA ASSESSMENT

Child’s Name:

<table>
<thead>
<tr>
<th></th>
<th>Raw Score</th>
<th>Standard Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEPA conventional (conventional imaginative play)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEPA symbolic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEPA combined (PEPA conventional + PEPA symbolic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOS (conventional imaginative play)</td>
<td>range 0-6</td>
<td></td>
</tr>
<tr>
<td>NOS symbolic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOS combined (NOS conventional + NOS symbolic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIA (conventional imaginative play)</td>
<td>range 0-2</td>
<td></td>
</tr>
<tr>
<td>NIA symbolic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIA combined (NIA conventional + NIA symbolic)</td>
<td>range 0-2</td>
<td></td>
</tr>
</tbody>
</table>

Recommendations

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APPENDIX V

Preschool Performance Questionnaire (PPQ)

School Performance Questionnaire (SPQ)
Preschool Performance Questionnaire

The Preschool Performance Questionnaire provides information about how well various preschool tasks are performed by a child. It helps identify the specific information processing operations that are assisting or hampering a child in the performance of regular preschool tasks.

This questionnaire provides a greater insight into a child’s performance of regular preschool tasks from the unique perspective of the preschool teacher.

Questionnaire Instructions

The questions have been written to require either a ‘Yes’ / ‘No’ / ‘Sometimes’ response or a response using a 5-point scale. This scale is outlined at the bottom of each page. Please circle a response for each question. The questions are not directed at all general preschool tasks, but specifically at tasks you expect the child to be able to do in the classroom at preschool. There are five sections to the questionnaire. The first is general information and asks you to outline specific tasks you expect the child to be able to complete and the final four sections are questions on specific areas of information processing.

Please complete all the sections of the questionnaire. The questionnaire should take approximately 10 minutes to complete on each child.

Thankyou for your assistance and time in completing this questionnaire. If you have any questions please contact Kirsty Stewart.

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Faculty of Health Science, The University of Sydney
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K.Stewart@hhs.usyd.edu.au
General Information

Child's Name: __________________________ Date: ________________
Date of Birth: __________________________ Male/Female (please circle)
Name of Preschool: _______________________
Preschool Stage (ie. 1 or 2 years before school): ______________________
Number of days at preschool each week: __________________________
Name of Preschool Teacher: __________________________

Please provide any information you feel is relevant that may affect or impact upon the child’s performance of regular preschool tasks. Examples may include: English as a second language, regular absences or long periods of illness, or a pre-diagnosed condition such as a visual or hearing impairment, autism, ADD/ADHD, specific learning disability or a specific physical disability.

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Tasks Expected of the Child

Please list up to five specific tasks you would expect this child to be able to complete or do as part of their everyday preschool routine. This may include such tasks as: colouring, cutting, painting, puzzles, managing and eating lunch, listening to stories and taking off and putting on clothing. Please keep these specific tasks in mind when answering all the questions in parts A, B, C and D.

> ___________________________________________________________________
> ___________________________________________________________________
> ___________________________________________________________________
> ___________________________________________________________________
> ___________________________________________________________________
### Part A

The first section of this questionnaire investigates a child's sensory processing. It looks at whether the child is able to attend to and gather all the sensory information that is required for the task and not be distracted by irrelevant sensory information around them.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the child notice when things happen around them?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ Do they listen?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>➢ Do they turn their head &amp; look?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Can the child pay attention to 2 or more parts of a task at the same time?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Can the child shift their attention from 1 task to another?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Is the child able to concentrate until a task is done?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Does the child sit in seat/still for the duration of a task?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Can the child find things needed for a task quickly?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ Can they find objects?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>➢ Can they find body parts?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>➢ Can they find parts of the environment?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Does the child recognize changes that occur during a task and respond appropriately?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Can the child locate objects in a cluttered environment?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Does the child use excessive tactile input to distinguish between things?</td>
<td>Yes / No / Sometimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Does the child use excessive visual input to distinguish between things?</td>
<td>Yes / No / Sometimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Is the child able to correctly match objects together?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ Can they match by size?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>➢ Can they match by shape?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>➢ Can they match by attributes?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Scoring:**
- 1 = no/rarely
- 2 = not without individual help/instruction
- 3 = sometimes, often requires some help/instruction
- 4 = usually
- 5 = yes, always
### Part B

The second part of this questionnaire investigates a child's ability to **establish and use knowledge**. It looks at whether a child is able to remember information from past experiences about aspects of tasks and use that information to make decisions about what they are doing in the present.

1. Does the child show recognition of:
   - Task objects?
   - People?
   - Parts of their body?

2. Is the child able to understand and name things correctly?
   - Do they understand spoken words?
   - Do they have trouble remembering nouns?
   - Are they able to recognise written words?
   - Are they able to read?

3. Is the child able to group related things together for a task?

4. Does the child know **when** a task or parts of a task should take place?

5. Does the child know **where** a task or parts of a task should take place?

6. Does the child know **how long** a task should take?
   - Does the child take too long to do a task?
   - Does the child lose track of time?

7. Does the child know how to use objects correctly for a task?

8. Does the child move their body parts to suit the task?

9. Does the child know the sequence of how to do a task?
   - Does the child forget some steps in the sequence?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
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<td>4</td>
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<td>5</td>
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<td>6</td>
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<td>7</td>
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<tr>
<td>8</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Score:** 1 = No/never  2 = No/without individual help/instruction  3 = Sometimes, often requires some help/instruction  4 = Usually  5 = Yes/always
Part C

The third part of this questionnaire investigates a child’s thinking ability. It looks at whether a child is able to work out a plan to deal with new or different tasks and cope with novelty?

1. Can the child develop a realistic and complete goal and keep that goal in mind while doing a task?
   1 2 3 4 5

2. Does the child identify obstacles and deal with them during a task?
   - Does the child see too many obstacles?
   - Does the child recognize only some obstacles?
   1 2 3 4 5

3. Is the child able to organize themselves and their work space?
   1 2 3 4 5

4. Is the child too organized?
   1 2 3 4 5

5. Is the child able to choose objects or actions correctly to suit a task?
   - Does the child make incorrect choices?
   1 2 3 4 5

6. Does the child perform tasks in a logical sequence?
   1 2 3 4 5

7. Does the child move smoothly from one part of a task to another?
   1 2 3 4 5

8. Does the child’s motion/movement match specific tasks?
   - Are the child’s movements too forceful?
   - Are there many extraneous movements?
   1 2 3 4 5

9. Does the child question:
   - their performance?
   - the location of objects needed for a task?
   1 2 3 4 5

10. Does the child make necessary changes to a task once they have questioned their performance of the task?
    1 2 3 4 5

Scale: 1 = not at all, 2 = not without individual help/instruction, 3 = sometimes, often requires some help/instruction, 4 = usually, 5 = yes, always
<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Does the child ask too many questions?</td>
<td>Yes / No / Sometimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Does the child analyse or evaluate aspects of tasks, whilst doing the tasks?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. Does the child make safe judgments about tasks?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Do they correctly judge their own physical abilities?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Do they correctly judge environmental limitations?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

*Scale: 1 = Not at all 2 = Not without individual help/instruction 3 = Sometimes, often requires some help/instruction 4 = Usually 5 = Yes, always*
Part D

The fourth part of this questionnaire investigates a child's motor output. It looks at whether a child is able to appropriately initiate, monitor and cease active participation in a task in a smooth and controlled manner as demanded by a task.

1. Is the child able to independently start a task? 1 2 3 4 5
2. Can the child restart a task after an interruption? 1 2 3 4 5
3. Does the child stop a task at the right time? 1 2 3 4 5
4. Does the child stop tasks too early or not stop a task? Yes / No / Sometimes
5. Is the child able to perform a task in a smooth manner without frequent stops? 1 2 3 4 5
6. Does the child complete tasks to expected level? 1 2 3 4 5
   - Does the child abandon tasks?
   Yes / No / Sometimes
7. Does the child keep going with tasks, even when the tasks get difficult? 1 2 3 4 5
   - Is the child's performance consistent with their ability?
   Yes / No / Sometimes
8. Does the child do tasks within an expected time frame? 1 2 3 4 5
9. Is the child: too fast? or too slow? Yes / No / Sometimes
   Yes / No / Sometimes
10. Does the child control their actions? 1 2 3 4 5
    - Is the child affected by Trismus? 1 2 3 4 5
    - Weakness? 1 2 3 4 5
    - Clumsiness? 1 2 3 4 5
11. Is the child able to make small or large muscular changes to suit specific tasks? 1 2 3 4 5

Scale: 1 = Rarely  2 = not without individual help/instruction
       3 = sometimes, often requires some help/instruction  4 = usually  5 = yes, always
School Performance Questionnaire

This questionnaire is aimed at gaining some insight, from the teachers perspective, on the specific information processing operations that are assisting or hampering a child in their interactions at school.

All the questions can be answered using a 3-point scale. The scale is outlined at the bottom of each page. Please circle a response for each question. All the questions are directed at a child’s social interactions and class work habits.

Child’s Name:___________________________

Child’s
School:________________________________

Date:___________________________

Thank you very much for your time and assistance in completing this questionnaire. Please contact Kirsty Stewart if you have any questions.

Kirsty Stewart,
BAppSc(OT), MAppSc(OT)

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Faculty of Health Sciences
The University of Sydney
Ph: 9351 1996
ksste454@unsw.edu.au
During **social interactions** does the child:

- notice other children and adults around them and listen to them?  
  - 1 2 3
- concentrate?  
  - 1 2 3
- find things or other children they need quickly?  
  - 1 2 3
- recognise changes that occur and respond appropriately? (eg. body language, voice tone)  
  - 1 2 3
- understand and use language appropriately?  
  - 1 2 3
- know when to do things?  
  - 1 2 3
- know where to do things?  
  - 1 2 3
- know how long to do things for?  
  - 1 2 3
- identify problems that might affect their social performance?  
  - 1 2 3
- choose the correct way to perform socially? (eg: correct place, choose correct actions or steps)  
  - 1 2 3
- periodically question their social actions and make appropriate changes?  
  - 1 2 3
- make appropriate and safe judgments about their interaction? (eg. is it socially acceptable?, keep going?, change? or stop?)  
  - 1 2 3
- independently initiate a social interaction and restart after an interruption?  
  - 1 2 3
- stop at the right time?  
  - 1 2 3
- interact smoothly without frequent stop / starts? (emotionally, verbally & non verbally)  
  - 1 2 3
- persevere with social situations, even when the situation gets difficult?  
  - 1 2 3

**Scale:**

1 – No, rarely  
2 – Sometimes, often requires some help/instruction  
3 – Yes, always
During *class work time* does the child:

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>notice and listen to other children and adults around them?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>concentrate?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>find things they need for work quickly?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>understand and use language appropriately?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Know when &amp; where work should be done? (desk, floor, work books, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>remember the correct sequence of familiar work routines? (journal writing, number work, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keep the teachers desired outcome in mind?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keep their work space organised?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>choose the correct way to perform? (eg: correct place, choose correct actions or steps)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>periodically question their actions/work and make appropriate changes?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>independently initiate work and restart after an interruption?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stop work at the right time?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>work smoothly without frequent stop / starts?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete work to an expected level?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>persevere with work, even when the work gets difficult?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Scale: 1 = No, rarely 2 = sometimes, often requires some help/instruction 3 = Yes, always*
Appendix VI

Assessment of Normality of Data – SPSS output

Table A1: Kolmogorov-Smirnov and Shapiro-Wilk Statistics on Data Time 1 to Time 5

<table>
<thead>
<tr>
<th></th>
<th>Kolmogorov-Smirnov</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>df</td>
</tr>
<tr>
<td>PRPP</td>
<td>Time 1</td>
<td>.240</td>
</tr>
<tr>
<td>PRPP</td>
<td>Time 2</td>
<td>.233</td>
</tr>
<tr>
<td>PRPP</td>
<td>Time 3</td>
<td>.250</td>
</tr>
<tr>
<td>PRPP</td>
<td>Time 4</td>
<td>.236</td>
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<tr>
<td>PRPP</td>
<td>Time 5</td>
<td>.182</td>
</tr>
</tbody>
</table>

a. Lilliefors Significance Correction
APPENDIX VII

Descriptive data analysis: Frequency Tables for PRPP individual quadrant scores Time 1 to Time 5 – SPSS output

Table A2: Frequency Table for PRPP 1 Individual Quadrant Scores, Time 1

<table>
<thead>
<tr>
<th></th>
<th>Perceive 1</th>
<th>Recall 1</th>
<th>Plan 1</th>
<th>Perform 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Valid</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>94.9219</td>
<td>90.2778</td>
<td>78.8194</td>
<td>87.1094</td>
</tr>
<tr>
<td>Median</td>
<td>100.0000</td>
<td>94.4444</td>
<td>88.8889</td>
<td>93.7500</td>
</tr>
<tr>
<td>Mode</td>
<td>100.00</td>
<td>94.44</td>
<td>94.44</td>
<td>100.00</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>7.35024</td>
<td>8.81239</td>
<td>20.61565</td>
<td>17.60177</td>
</tr>
<tr>
<td>Variance</td>
<td>54.026</td>
<td>77.658</td>
<td>425.005</td>
<td>309.822</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.403</td>
<td>-.957</td>
<td>-1.010</td>
<td>-1.873</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.414</td>
<td>.414</td>
<td>.414</td>
<td>.414</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.367</td>
<td>.061</td>
<td>-.031</td>
<td>3.862</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.809</td>
<td>.809</td>
<td>.809</td>
<td>.809</td>
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<tr>
<td>Range</td>
<td>25.00</td>
<td>27.78</td>
<td>72.22</td>
<td>75.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>75.00</td>
<td>72.22</td>
<td>27.78</td>
<td>25.00</td>
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<tr>
<td>Maximum</td>
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<tr>
<td>Percentiles</td>
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</tr>
<tr>
<td>25</td>
<td>87.5000</td>
<td>88.8889</td>
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<td>50</td>
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<td>75</td>
<td>100.0000</td>
<td>94.4444</td>
<td>94.4444</td>
<td>100.0000</td>
</tr>
</tbody>
</table>
**Table A3:** Frequency Table for PRPP 2 Individual Quadrant Scores, Time 2

<table>
<thead>
<tr>
<th></th>
<th>Perceive 2</th>
<th>Recall 2</th>
<th>Plan 2</th>
<th>Perform 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mean</td>
<td>94.7581</td>
<td>91.2186</td>
<td>79.0323</td>
<td>89.7177</td>
</tr>
<tr>
<td>Median</td>
<td>100.0000</td>
<td>94.4444</td>
<td>83.3333</td>
<td>93.7500</td>
</tr>
<tr>
<td>Mode</td>
<td>100.00</td>
<td>100.00</td>
<td>88.89</td>
<td>93.75a</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>7.7555</td>
<td>11.18257</td>
<td>18.24105</td>
<td>13.74511</td>
</tr>
<tr>
<td>Variance</td>
<td>60.148</td>
<td>125.050</td>
<td>332.736</td>
<td>188.928</td>
</tr>
<tr>
<td>Skewness</td>
<td>-.2004</td>
<td>-.1696</td>
<td>-.2195</td>
<td>-.1832</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.421</td>
<td>.421</td>
<td>.421</td>
<td>.421</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>4.114</td>
<td>2.720</td>
<td>5.239</td>
<td>2.961</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.821</td>
<td>.821</td>
<td>.821</td>
<td>.821</td>
</tr>
<tr>
<td>Range</td>
<td>31.25</td>
<td>44.44</td>
<td>83.33</td>
<td>50.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>68.75</td>
<td>55.56</td>
<td>16.67</td>
<td>50.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Percentiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>93.7500</td>
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<td>77.7778</td>
<td>81.2500</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>100.0000</td>
<td></td>
<td>83.3333</td>
<td>93.7500</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>100.0000</td>
<td></td>
<td>88.8889</td>
<td>100.0000</td>
</tr>
</tbody>
</table>

* a. Multiple modes exist. The smallest value is shown
**Table A4:** Frequency Table for PRPP 3 Individual Quadrant Scores, Time 3

<table>
<thead>
<tr>
<th></th>
<th>Perceive 3</th>
<th>Recall 3</th>
<th>Plan 3</th>
<th>Perform 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Valid</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>92.1875</td>
<td>90.2778</td>
<td>78.8194</td>
<td>86.5234</td>
</tr>
<tr>
<td>Median</td>
<td>93.7500</td>
<td>94.4444</td>
<td>83.3333</td>
<td>93.7500</td>
</tr>
<tr>
<td>Mode</td>
<td>100.00</td>
<td>100.00</td>
<td>94.44</td>
<td>100.00</td>
</tr>
<tr>
<td>Variance</td>
<td>196.573</td>
<td>205.098</td>
<td>415.049</td>
<td>380.820</td>
</tr>
<tr>
<td>Skewness</td>
<td>-3.873</td>
<td>-2.971</td>
<td>-1.834</td>
<td>-2.389</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.414</td>
<td>.414</td>
<td>.414</td>
<td>.414</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>17.697</td>
<td>11.393</td>
<td>3.628</td>
<td>6.378</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.809</td>
<td>.809</td>
<td>.809</td>
<td>.809</td>
</tr>
<tr>
<td>Range</td>
<td>75.00</td>
<td>72.22</td>
<td>88.89</td>
<td>87.50</td>
</tr>
<tr>
<td>Minimum</td>
<td>25</td>
<td>27.78</td>
<td>11.11</td>
<td>12.50</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Percentiles</td>
<td>25</td>
<td>87.5000</td>
<td>83.3333</td>
<td>72.2222</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>93.7500</td>
<td>94.4444</td>
<td>83.3333</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>100.0000</td>
<td>100.000</td>
<td>94.4444</td>
</tr>
</tbody>
</table>

*Table A5:* Frequency Table for PRPP 4 Individual Quadrant Scores, Time 4

<table>
<thead>
<tr>
<th></th>
<th>Perceive 4</th>
<th>Recall 4</th>
<th>Plan 4</th>
<th>Perform 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Valid</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>93.1250</td>
<td>91.1111</td>
<td>84.6296</td>
<td>89.5833</td>
</tr>
<tr>
<td>Median</td>
<td>93.7500</td>
<td>94.4444</td>
<td>88.8889</td>
<td>93.7500</td>
</tr>
<tr>
<td>Mode</td>
<td>93.75a</td>
<td>94.44</td>
<td>88.89</td>
<td>93.75</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>8.09926</td>
<td>10.17095</td>
<td>14.71189</td>
<td>12.85418</td>
</tr>
<tr>
<td>Variance</td>
<td>65.598</td>
<td>103.448</td>
<td>216.440</td>
<td>165.230</td>
</tr>
<tr>
<td>Skewness</td>
<td>-2.043</td>
<td>-2.014</td>
<td>-1.070</td>
<td>-1.579</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.427</td>
<td>.427</td>
<td>.427</td>
<td>.427</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>6.018</td>
<td>4.786</td>
<td>.558</td>
<td>4.514</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.833</td>
<td>.833</td>
<td>.833</td>
<td>.833</td>
</tr>
<tr>
<td>Range</td>
<td>37.50</td>
<td>44.44</td>
<td>55.56</td>
<td>68.75</td>
</tr>
<tr>
<td>Minimum</td>
<td>62.50</td>
<td>55.56</td>
<td>44.44</td>
<td>43.75</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>112.50</td>
</tr>
<tr>
<td>Percentiles</td>
<td>25</td>
<td>87.5000</td>
<td>88.8889</td>
<td>72.2222</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>93.7500</td>
<td>94.4444</td>
<td>88.8889</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>100.0000</td>
<td>100.000</td>
<td>94.4444</td>
</tr>
</tbody>
</table>

*a. Multiple modes exist. The smallest value is shown*
Table A6: Frequency Table for PRPP 5 Individual Quadrant Scores, Time 5

<table>
<thead>
<tr>
<th></th>
<th>Perceive 5</th>
<th>Recall 5</th>
<th>Plan 5</th>
<th>Perform 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>90.2344</td>
<td>92.0139</td>
<td>80.0347</td>
<td>90.2344</td>
</tr>
<tr>
<td>Median</td>
<td>93.7500</td>
<td>94.4444</td>
<td>83.3333</td>
<td>93.7500</td>
</tr>
<tr>
<td>Mode</td>
<td>93.75</td>
<td>100.00</td>
<td>83.33</td>
<td>93.75</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>11.21831</td>
<td>8.09854</td>
<td>16.80702</td>
<td>14.88680</td>
</tr>
<tr>
<td>Variance</td>
<td>125.851</td>
<td>65.586</td>
<td>282.476</td>
<td>221.617</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.855</td>
<td>-1.231</td>
<td>-1.311</td>
<td>-1.078</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.414</td>
<td>.414</td>
<td>.414</td>
<td>.414</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.686</td>
<td>1.725</td>
<td>1.373</td>
<td>2.671</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.809</td>
<td>.809</td>
<td>.809</td>
<td>.809</td>
</tr>
<tr>
<td>Range</td>
<td>43.75</td>
<td>33.33</td>
<td>66.67</td>
<td>75.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>56.25</td>
<td>66.67</td>
<td>33.33</td>
<td>43.75</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>118.75</td>
</tr>
<tr>
<td>Percentiles 25</td>
<td>87.5000</td>
<td>88.8889</td>
<td>72.2222</td>
<td>87.5000</td>
</tr>
<tr>
<td>50</td>
<td>93.7500</td>
<td>94.4444</td>
<td>83.3333</td>
<td>93.7500</td>
</tr>
<tr>
<td>75</td>
<td>100.0000</td>
<td>100.0000</td>
<td>93.0556</td>
<td>100.0000</td>
</tr>
</tbody>
</table>
APPENDIX VIII

Rasch generated Bias / Interaction graphs

Bias / Interaction Graphs - Participants scores in Logits and in Standardised T values

Bias / Interaction Graphs – Item’s measure in Logits and in Standardised T values
Figure A1: Bias / interaction Graph – Participants scores in Logits

* Shows each participants score, in logits, on each test occasion relative to their own overall score.
**Bias/Interaction: 1. child, 2. time**

*Figure A2: Bias / Interaction Graph – Participants scores in standardised t-value*

* Shows participants scores with standardised t-values instead of logits, on each test occasion
**Bias/Interaction: 3. items, 2. time**

* shows each item’s measure, in logits, on each test occasion relative to the items average overall score.
Figure A4: Bias / Interaction Graph – Item scores in standardised t-values

* Shows Item scores with standardised t-values instead of logits, on each test occasion
SPSS output Freidman Test results and Wilcoxon Test results relevant to Section 4.2.

Series one analysis:

**Table A7:** Friedman Test series 1 comparing the four quadrant scores at each Time against each other.

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean rank</th>
<th>Chi-square</th>
<th>Asymp. Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 1</td>
<td>Perceive 1</td>
<td>3.05</td>
<td>24.849</td>
</tr>
<tr>
<td></td>
<td>Recall 1</td>
<td>2.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan 1</td>
<td>1.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform 1</td>
<td>2.59</td>
<td></td>
</tr>
<tr>
<td>Time 2</td>
<td>Perceive 2</td>
<td>3.18</td>
<td>46.956</td>
</tr>
<tr>
<td></td>
<td>Recall 2</td>
<td>2.87</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan 2</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform 2</td>
<td>2.71</td>
<td></td>
</tr>
<tr>
<td>Time 3</td>
<td>Perceive 3</td>
<td>3.20</td>
<td>43.233</td>
</tr>
<tr>
<td></td>
<td>Recall 3</td>
<td>2.95</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan 3</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform 3</td>
<td>2.44</td>
<td></td>
</tr>
<tr>
<td>Time 4</td>
<td>Perceive 4</td>
<td>2.83</td>
<td>10.855</td>
</tr>
<tr>
<td></td>
<td>Recall 4</td>
<td>2.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan 4</td>
<td>1.93</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform 4</td>
<td>2.43</td>
<td></td>
</tr>
<tr>
<td>Time 5</td>
<td>Perceive 5</td>
<td>2.66</td>
<td>28.183</td>
</tr>
<tr>
<td></td>
<td>Recall 5</td>
<td>3.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan 5</td>
<td>1.64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform 5</td>
<td>2.48</td>
<td></td>
</tr>
</tbody>
</table>
The following Tables A6 to A11 display the Wilcoxon Test results, series 1, comparing the pattern of score differences at each data collection time.

**Table A8: PRPP Quadrants Time 1 - Wilcoxon Signed Ranks Test**

<table>
<thead>
<tr>
<th></th>
<th>Recall1 - Perceive1</th>
<th>Plan1 - Perceive1</th>
<th>Perform1 - Perceive1</th>
<th>Plan1 - Recall1</th>
<th>Perform1 - Recall1</th>
<th>Perform1 - Plan1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z</strong></td>
<td>-2.583&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-4.173&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.067&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.610&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.026&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.744&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.010</td>
<td>.000</td>
<td>.039</td>
<td>.000</td>
<td>.305</td>
<td>.000</td>
</tr>
</tbody>
</table>

<sup>a</sup> Based on positive ranks, <sup>b</sup> Based on negative ranks.

**Table A9: PRPP Quadrants Time 2 - Wilcoxon Signed Ranks Test**

<table>
<thead>
<tr>
<th></th>
<th>Recall2 - Perceive2</th>
<th>Plan2 - Perceive2</th>
<th>Perform2 - Perceive2</th>
<th>Plan2 - Recall2</th>
<th>Perform2 - Recall2</th>
<th>Perform2 - Plan2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z</strong></td>
<td>-1.901&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-4.728&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.731&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-4.665&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.417&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-4.396&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.057</td>
<td>.000</td>
<td>.006</td>
<td>.000</td>
<td>.157</td>
<td>.000</td>
</tr>
</tbody>
</table>

<sup>a</sup> Based on positive ranks, <sup>b</sup> Based on negative ranks.

**Table A10: PRPP Quadrants Time 3 - Wilcoxon Signed Ranks Test**

<table>
<thead>
<tr>
<th></th>
<th>Recall3 - Perceive3</th>
<th>Plan3 - Perceive3</th>
<th>Perform3 - Perceive3</th>
<th>Plan3 - Recall3</th>
<th>Perform3 - Recall3</th>
<th>Perform3 - Plan3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z</strong></td>
<td>-1.523&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-4.769&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.674&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-4.312&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.573&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.913&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.128</td>
<td>.000</td>
<td>.007</td>
<td>.000</td>
<td>.010</td>
<td>.000</td>
</tr>
</tbody>
</table>

<sup>a</sup> Based on positive ranks, <sup>b</sup> Based on negative ranks.
## Wilcoxon Signed Ranks Test: Test Statistics

### Table A11: PRPP Quadrants Time 4 - Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th></th>
<th>Recall4 - Perceive4</th>
<th>Plan4 - Perceive4</th>
<th>Perform4 - Perceive4</th>
<th>Plan4 - Recall4</th>
<th>Perform4 - Recall4</th>
<th>Perform4 - Plan4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z</strong></td>
<td>-1.031^a</td>
<td>-3.391^a</td>
<td>-2.175^a</td>
<td>-2.783^a</td>
<td>-1.144^a</td>
<td>-2.476^b</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.303</td>
<td>.001</td>
<td>.030</td>
<td>.005</td>
<td>.253</td>
<td>.013</td>
</tr>
</tbody>
</table>

^a. Based on negative ranks, ^b. Based on positive ranks.

### Table A12: PRPP Quadrants Time 5 - Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th></th>
<th>Recall5 - Perceive5</th>
<th>Plan5 - Perceive5</th>
<th>Perform5 - Perceive5</th>
<th>Plan5 - Recall5</th>
<th>Perform5 - Recall5</th>
<th>Perform5 - Plan5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z</strong></td>
<td>-1.513^a</td>
<td>-4.296^a</td>
<td>-1.187^c</td>
<td>-4.154^a</td>
<td>-1.948^c</td>
<td>-3.602^a</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.130</td>
<td>.000</td>
<td>.852</td>
<td>.000</td>
<td>.051</td>
<td>.000</td>
</tr>
</tbody>
</table>

^a. Based on negative ranks, ^b. Based on positive ranks.
Series two analysis:

**Table A13**: Friedman Test series 2 comparing the quadrant scores Time 1 to Time 5 against each other.

<table>
<thead>
<tr>
<th></th>
<th>Mean rank</th>
<th>Chi-square</th>
<th>Asymp. Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive 1</td>
<td>3.33</td>
<td>10.903</td>
<td>.028</td>
</tr>
<tr>
<td>Perceive 2</td>
<td>3.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceive 3</td>
<td>2.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceive 4</td>
<td>2.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceive 5</td>
<td>2.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall 1</td>
<td>2.67</td>
<td>4.451</td>
<td>.348</td>
</tr>
<tr>
<td>Recall 2</td>
<td>3.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall 3</td>
<td>2.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall 4</td>
<td>3.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall 5</td>
<td>3.36</td>
<td></td>
<td></td>
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</tr>
<tr>
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**Table A14**: Perceive Quadrants 1 to 5 Wilcoxon Signed Rank Test

<table>
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<th></th>
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<th>Perceive2</th>
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<th>Perceive5</th>
<th>Perceive3</th>
<th>Perceive4</th>
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<th>Perceive4</th>
<th>Perceive5</th>
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<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
<td>Perceive1</td>
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<td>Asymp. Sig. (2-tailed)</td>
<td>.923</td>
<td>.397</td>
<td>.226</td>
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<td>.058</td>
<td><strong>.006</strong></td>
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</tr>
</tbody>
</table>
APPENDIX X

Longitudinal analysis of information processing abilities: Spearman’s Rank Order Correlation coefficient (Spearman’s rho) (Results Section 4.3)

**Table A 15:** Spearman’s rho for Perceive Quadrants Time 1 to Time 5

<table>
<thead>
<tr>
<th></th>
<th>Perceive1</th>
<th>Perceive2</th>
<th>Perceive3</th>
<th>Perceive4</th>
<th>Perceive5</th>
</tr>
</thead>
<tbody>
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<td>.438*</td>
<td>.261</td>
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<td>.300</td>
</tr>
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<td>Sig. (2-tailed)</td>
<td>.014</td>
<td>.148</td>
<td>.597</td>
<td>.096</td>
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<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
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<tr>
<td>Perceive2</td>
<td></td>
<td>1.000</td>
<td>.433*</td>
<td>.380*</td>
<td>.543**</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.014</td>
<td>.015</td>
<td>.042</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.148</td>
<td>.15</td>
<td>.31</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>31</td>
<td>29</td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td>Perceive3</td>
<td>.261</td>
<td>.433*</td>
<td>1.000</td>
<td>.571**</td>
<td>.369*</td>
</tr>
<tr>
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<td>.148</td>
<td>.015</td>
<td>.001</td>
<td>.038</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
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<td>.380*</td>
<td>.571**</td>
<td>1.000</td>
<td>.409*</td>
</tr>
<tr>
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<td>.597</td>
<td>.042</td>
<td>.001</td>
<td>.025</td>
<td></td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>30</td>
<td>29</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
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<td>N</td>
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<td>29</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
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<td>Perceive5</td>
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<td>.543**</td>
<td>.369*</td>
<td>.409*</td>
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<td>.096</td>
<td>.002</td>
<td>.025</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).
### Table A 16: Spearman’s rho for Recall Quadrants Time 1 to Time 5

<table>
<thead>
<tr>
<th>Spearman's rho</th>
<th>Recall1</th>
<th>Recall2</th>
<th>Recall3</th>
<th>Recall4</th>
<th>Recall5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall1</td>
<td>1.000</td>
<td>.338</td>
<td>.456</td>
<td>.006</td>
<td>.262</td>
</tr>
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<td>Correlation Coefficient</td>
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<td>.063</td>
<td>.009</td>
<td>.977</td>
<td>.148</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Recall2</td>
<td>.338</td>
<td>1.000</td>
<td>.436</td>
<td>.266</td>
<td>.563</td>
</tr>
<tr>
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<td>.063</td>
<td>31</td>
<td>.014</td>
<td>.164</td>
<td>.001</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>Recall3</td>
<td>.456</td>
<td>.436</td>
<td>1.000</td>
<td>.315</td>
<td>.491</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.009</td>
<td>.014</td>
<td>.090</td>
<td>.004</td>
<td>.</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Recall4</td>
<td>.006</td>
<td>.266</td>
<td>.315</td>
<td>1.000</td>
<td>.576</td>
</tr>
<tr>
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<td>.977</td>
<td>.164</td>
<td>.090</td>
<td>.001</td>
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</tr>
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<td>29</td>
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<tr>
<td>Recall5</td>
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<td>.563</td>
<td>.491</td>
<td>.576</td>
<td>1.000</td>
</tr>
<tr>
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<td>.001</td>
<td>.004</td>
<td>.001</td>
<td>.</td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
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</table>

**. Correlation is significant at the 0.01 level (2-tailed).**

* Correlation is significant at the 0.05 level (2-tailed).

### Table A 17: Spearman’s rho for Plan Quadrants Time 1 to Time 5

<table>
<thead>
<tr>
<th>Spearman's rho</th>
<th>Plan1</th>
<th>Plan2</th>
<th>Plan3</th>
<th>Plan4</th>
<th>Plan5</th>
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</thead>
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<td>.339</td>
<td>.334</td>
<td>.289</td>
</tr>
<tr>
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<td>.</td>
<td>.012</td>
<td>.058</td>
<td>.071</td>
<td>.108</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Plan2</td>
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<td>.656</td>
<td>.147</td>
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<tr>
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<td>31</td>
<td>.000</td>
<td>.024</td>
<td>.017</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>31</td>
<td>29</td>
<td>31</td>
</tr>
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<td>.656</td>
<td>1.000</td>
<td>.561</td>
<td>.549</td>
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<tr>
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<td>.000</td>
<td>.001</td>
<td>.001</td>
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<tr>
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<td>30</td>
<td>32</td>
</tr>
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<td>.573</td>
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<tr>
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<td>.549</td>
<td>.573</td>
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</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.108</td>
<td>32</td>
<td>.017</td>
<td>.001</td>
<td>.001</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).**. Correlation is significant at the 0.01 level (2-tailed).
### Table A18: Spearman’s rho for Perform Quadrants Time 1 to Time 5

<table>
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<tr>
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<th>Perform1</th>
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<th>Perform3</th>
<th>Perform4</th>
<th>Perform5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>.457*</td>
<td>.606*</td>
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<tr>
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<td>.005</td>
<td>.008</td>
<td>.000</td>
<td>.001</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
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<td>30</td>
<td>32</td>
</tr>
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<td>Perform2</td>
<td>Correlation Coefficient</td>
<td>.490*</td>
<td>1.000</td>
<td>.554*</td>
<td>.508*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.005</td>
<td>.001</td>
<td>.005</td>
<td>.079</td>
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<tr>
<td>N</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>29</td>
<td>31</td>
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<td>Perform3</td>
<td>Correlation Coefficient</td>
<td>.457*</td>
<td>.554*</td>
<td>1.000</td>
<td>.441*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.008</td>
<td>.001</td>
<td>.015</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Perform4</td>
<td>Correlation Coefficient</td>
<td>.606*</td>
<td>.508*</td>
<td>.441*</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.005</td>
<td>.015</td>
<td>.000</td>
<td></td>
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<td>30</td>
<td>29</td>
<td>30</td>
</tr>
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<td>.544*</td>
<td>.321</td>
<td>.578*</td>
<td>.623*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.079</td>
<td>.001</td>
<td>.000</td>
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</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
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</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

### Table A19: Spearman’s rho for PRPP total scores Time 1 to Time 5

<table>
<thead>
<tr>
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<th>PRPP2</th>
<th>PRPP3</th>
<th>PRPP4</th>
<th>PRPP5</th>
</tr>
</thead>
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<td>.456</td>
<td>.396</td>
<td>.290</td>
</tr>
<tr>
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<td>.010</td>
<td>.025</td>
<td>.120</td>
<td>.065</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>PRPP2</td>
<td>Correlation Coefficient</td>
<td>.456*</td>
<td>1.000</td>
<td>.680*</td>
<td>.516*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.010</td>
<td>.001</td>
<td>.004</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>PRPP3</td>
<td>Correlation Coefficient</td>
<td>.396*</td>
<td>.680*</td>
<td>1.000</td>
<td>.566*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.025</td>
<td>.004</td>
<td>.001</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>PRPP4</td>
<td>Correlation Coefficient</td>
<td>.290</td>
<td>.516*</td>
<td>.566*</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.120</td>
<td>.004</td>
<td>.001</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>N</td>
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<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>PRPP5</td>
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<td>.640*</td>
<td>.648*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.065</td>
<td>.001</td>
<td>.000</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>32</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
APPENDIX XI

Comparison of Preschool Performance Questionnaire (PPQ) and PRPP Time 1 (PRPP 1):

Wilcoxon’s and Spearman’s statistics PPQ and PRPP Time 1 (Results Section 4.4.1)

**Table A20**: Wilcoxon’s statistics for the PPQ and PRPP Time 1: Quadrant and Total scores

<table>
<thead>
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<th></th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceive1 – PPQ Perceive</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Ranks</td>
<td>$5^a$</td>
<td>8.00</td>
<td>40.00</td>
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<tr>
<td>Positive Ranks</td>
<td>$21^b$</td>
<td>14.81</td>
<td>311.00</td>
</tr>
<tr>
<td>Ties Total</td>
<td>$6^c$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$32$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recall1 – PPQ Recall</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Ranks</td>
<td>$16^a$</td>
<td>16.75</td>
<td>268.00</td>
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<tr>
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<td>15.20</td>
<td>228.00</td>
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<tr>
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<td>$1^c$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$32$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Plan1 – PPQ Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Ranks</td>
<td>$10^a$</td>
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<td>210.00</td>
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<td>$22^b$</td>
<td>14.45</td>
<td>318.00</td>
</tr>
<tr>
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<td>$0^c$</td>
<td></td>
<td></td>
</tr>
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<td></td>
<td>$32$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perform1 – PPQ Perform</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Ranks</td>
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<td>Positive Ranks</td>
<td>$13^b$</td>
<td>16.92</td>
<td>220.00</td>
</tr>
<tr>
<td>Ties Total</td>
<td>$4^c$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$32$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRPP1 – PPQ Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Ranks</td>
<td>$11^a$</td>
<td>17.14</td>
<td>188.50</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>$21^b$</td>
<td>16.17</td>
<td>339.50</td>
</tr>
<tr>
<td>Ties Total</td>
<td>$0^c$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$32$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Perceive1 < PPQ Perceive; b. Perceive1 > PPQ Perceive; c. Perceive1 = PPQ Perceive; d. Recall1 < PPQ Recall; e. Recall1 > PPQ Recall; f. Recall1 = PPQ Recall; g. Plan1< PPQ Plan; h. Plan1> PPQ Plan; i. Plan1= PPQ Plan; j. Perform1 < PPQ Perform; k. Perform1 > PPQ Perform; l. Perform1 = PPQ Perform; m. PRPP1 < PPQ Total; n. PRPP1 > PPQ Total; o. PRPP1 = PPQ Total

**Test Statistics**

<table>
<thead>
<tr>
<th></th>
<th>Perceive1 – PPQ Perceive</th>
<th>Recall1 – PPQ Recall</th>
<th>Plan1 – PPQ Plan</th>
<th>Perform1 – PPQ Perform</th>
<th>PRPP1 – PPQ Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-3.443$^a$</td>
<td>-.392$^b$</td>
<td>-1.010$^a$</td>
<td>-.387$^b$</td>
<td>-1.412$^a$</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.001</td>
<td>.695</td>
<td>.313</td>
<td>.699</td>
<td>.158</td>
</tr>
</tbody>
</table>

a. Based on negative ranks. b. Based on positive ranks. c. Wilcoxon Signed Ranks Test
Table A21: Spearman’s statistics for the PPQ and PRPP Time 1: Quadrant and Total scores

<table>
<thead>
<tr>
<th>Spearman’s rho</th>
<th>PPQ Perceive</th>
<th>PPQ Recall</th>
<th>PPQ Plan</th>
<th>PPQ Perform</th>
<th>PPQ Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive1</td>
<td>Correlation Coefficient</td>
<td>.312</td>
<td>.171</td>
<td>.139</td>
<td>.276</td>
</tr>
<tr>
<td>Recall1</td>
<td>Correlation Coefficient</td>
<td>.293</td>
<td>.004</td>
<td>.126</td>
<td>.190</td>
</tr>
<tr>
<td>Plan1</td>
<td>Correlation Coefficient</td>
<td>.338</td>
<td>.135</td>
<td><strong>.223</strong></td>
<td>.229</td>
</tr>
<tr>
<td>Perform1</td>
<td>Correlation Coefficient</td>
<td><strong>.418</strong></td>
<td>.301</td>
<td>.347</td>
<td><strong>.271</strong></td>
</tr>
<tr>
<td>PRPP1</td>
<td>Correlation Coefficient</td>
<td>.400</td>
<td>.191</td>
<td>.256</td>
<td>.289</td>
</tr>
</tbody>
</table>

(n = 32 for all correlations, sig. 2 tailed * =p<.05, ** =p<.01)
Comparison of School Performance Questionnaire (SPQ) and PRPP Time 5 (PRPP5): Wilcoxon’s and Spearman’s statistics SPQ and PRPP Time 5 (Results Section 4.4.2)

**Table A22**: Wilcoxon’s statistics for the SPQ (Social and Work) and PRPP Time 5: Quadrant and Total scores

**Ranks**

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>SPQ (Social and Work)</th>
<th>PRPP5 (Social and Work)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive5 – Social Perceive</td>
<td>Negative Ranks: 7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Positive Ranks: 12&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Recall5 – Social Recall</td>
<td>Negative Ranks: 8&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Positive Ranks: 10&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>Plan5 – Social Plan</td>
<td>Negative Ranks: 7&lt;sup&gt;g&lt;/sup&gt;</td>
<td>Positive Ranks: 17&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Perform5 – Social Perform</td>
<td>Negative Ranks: 6&lt;sup&gt;j&lt;/sup&gt;</td>
<td>Positive Ranks: 17&lt;sup&gt;k&lt;/sup&gt;</td>
</tr>
<tr>
<td>Perceive5 – Work Perceive</td>
<td>Negative Ranks: 8&lt;sup&gt;m&lt;/sup&gt;</td>
<td>Positive Ranks: 13&lt;sup&gt;n&lt;/sup&gt;</td>
</tr>
<tr>
<td>Recall5 – Work Recall</td>
<td>Negative Ranks: 11&lt;sup&gt;p&lt;/sup&gt;</td>
<td>Positive Ranks: 6&lt;sup&gt;q&lt;/sup&gt;</td>
</tr>
<tr>
<td>Plan5 – Work Plan</td>
<td>Negative Ranks: 11&lt;sup&gt;s&lt;/sup&gt;</td>
<td>Positive Ranks: 13&lt;sup&gt;t&lt;/sup&gt;</td>
</tr>
<tr>
<td>Perform5 – Work Perform</td>
<td>Negative Ranks: 6&lt;sup&gt;v&lt;/sup&gt;</td>
<td>Positive Ranks: 17&lt;sup&gt;w&lt;/sup&gt;</td>
</tr>
<tr>
<td>PRPP5 – Social Total</td>
<td>Negative Ranks: 5&lt;sup&gt;y&lt;/sup&gt;</td>
<td>Positive Ranks: 21&lt;sup&gt;z&lt;/sup&gt;</td>
</tr>
<tr>
<td>PRPP5 – Work Total</td>
<td>Negative Ranks: 9&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>Positive Ranks:</td>
</tr>
<tr>
<td></td>
<td>Positive Ranks</td>
<td>Ties</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>17&lt;sup&gt;ac&lt;/sup&gt;</td>
<td>0&lt;sup&gt;ad&lt;/sup&gt;</td>
</tr>
<tr>
<td>Negative Ranks</td>
<td>7&lt;sup&gt;ae&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Positive Ranks</td>
<td>19&lt;sup&gt;af&lt;/sup&gt;</td>
<td>0&lt;sup&gt;ag&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PRPP5 – Social/Work Total**

- a. Perceive5 < Social Perceive
- b. Perceive5 > Social Perceive
- c. Perceive5 = Social Perceive
- d. Recall5 < Social Recall
- e. Recall5 > Social Recall
- f. Recall5 = Social Recall
- g. Plan5 < Social Plan
- h. Plan5 > Social Plan
- i. Plan5 = Social Plan
- j. Perform5 < Social Perform
- k. Perform5 > Social Perform
- l. Perform5 = Social Perform
- m. Perceive5 < Work Perceive
- n. Perceive5 > Work Perceive
- o. Perceive5 = Work Perceive
- p. Recall5 < Work Recall
- q. Recall5 > Work Recall
- r. Recall5 = Work Recall
- s. Plan5 < Work Plan
- t. Plan5 > Work Plan
- u. Plan5 = Work Plan
- v. Perform5 < Work Perform
- w. Perform5 > Work Perform
- x. Perform5 = Work Perform
- y. PRPP5 < Social Total
- z. PRPP5 > Social Total
- aa. PRPP5 = Social Total
- ab. PRPP5 < Work Total
- ac. PRPP5 > Work Total
- ad. PRPP5 = Work Total
- ae. PRPP5 < Social/Work Total
- af. PRPP5 > Social/Work Total
- ag. PRPP5 = Social/Work Total

**Values**

<table>
<thead>
<tr>
<th></th>
<th>16.06</th>
<th>273.00</th>
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<tbody>
<tr>
<td>7.86</td>
<td>55.00</td>
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</tr>
<tr>
<td>15.58</td>
<td>296.00</td>
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</tr>
</tbody>
</table>
Table A23: Spearman’s statistics for the SPQ Social and PRPP Time 5: Quadrant scores

<table>
<thead>
<tr>
<th></th>
<th>SPQ Social Perceive</th>
<th>SPQ Social Recall</th>
<th>SPQ Social Plan</th>
<th>SPQ Social Perform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceive 5</td>
<td>0.644**</td>
<td>0.654**</td>
<td>0.454*</td>
<td>0.455*</td>
</tr>
<tr>
<td>Recall 5</td>
<td>0.570**</td>
<td>0.464*</td>
<td>0.304</td>
<td>0.357</td>
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<tr>
<td>Plan 5</td>
<td>0.490*</td>
<td>0.479*</td>
<td>0.300</td>
<td>0.263</td>
</tr>
<tr>
<td>Perform 5</td>
<td>0.610**</td>
<td>0.619**</td>
<td>0.454*</td>
<td>**255</td>
</tr>
</tbody>
</table>

*(n=26 for all correlations, sig. 2 tailed * = p<.05, ** = p<.01)
Table A24: Spearman’s statistics for the SPQ Work and PRPP Time 5: Quadrant scores

<table>
<thead>
<tr>
<th></th>
<th>SPQ Work Perceive</th>
<th>SPQ Work Recall</th>
<th>SPQ Work Plan</th>
<th>SPQ Work Perform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman’s rho</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceive5</td>
<td>.428*</td>
<td>.674**</td>
<td>.581**</td>
<td>.486*</td>
</tr>
<tr>
<td>Recall5</td>
<td>.263</td>
<td>.562**</td>
<td>.508**</td>
<td>.369</td>
</tr>
<tr>
<td>Plan5</td>
<td>.504**</td>
<td>.545**</td>
<td>.489*</td>
<td>.391*</td>
</tr>
<tr>
<td>Perform5</td>
<td>.460*</td>
<td>.579**</td>
<td>.436*</td>
<td>.383</td>
</tr>
</tbody>
</table>

(n=26 for all correlations, sig. 2 tailed * =p<.05, ** =p<.01)

Table A25: Spearman’s statistics for the SPQ Social and Work and PRPP Time 5:
Total scores

<table>
<thead>
<tr>
<th></th>
<th>Social Total</th>
<th>Work Total</th>
<th>PRPP5a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman’s rho</td>
<td>Social Total</td>
<td>Correlation Coefficient</td>
<td>.833**</td>
</tr>
<tr>
<td></td>
<td>Work Total</td>
<td>Correlation Coefficient</td>
<td>.833**</td>
</tr>
<tr>
<td></td>
<td>PRPP5a</td>
<td>Correlation Coefficient</td>
<td>.528*</td>
</tr>
</tbody>
</table>

(n=26 for all correlations, sig. 2 tailed * =p<.05, ** =p<.01)
APPENDIX XII

SENSITIVITY AND SPECIFICITY DATA

Calculated using WINPEPI
Preschool Teachers (disease) and PRPP 3 (Test)  Sensitivity and Specificity

"Disease" refers to whatever attribute the test or measure is designed to indicate.

**Sensitivity**  
= 80.00%  95% C.I. = 0.00 to 0.00%  
Chance-corrected  = 78.40%  95% C.I. = -25.09** to 96.27%

**Specificity**  
= 92.59%  95% C.I. = 0.00% to 0.00%  
Chance-corrected  = 90.74%  95% C.I. = 62.31 to 97.73%

** Less than chance expectation.

**False positive rate** = 7.41%  95% C.I. = 100.00 to 100.00%

**False negative rate** = 20.00%  95% C.I. = 100.00% to 100.00%

**Youden's index**  
= 0.73  95% C.I. = 0.36 to 1.00

**Area under ROC curve**  
= 86.3%  95% C.I. = 68.1 to 100.0%

**Likelihood ratio:**

  - For positive test  = 10.80  95% C.I. = 2.65 to 43.96
  - For negative test  = 0.22  95% C.I. = 0.04 to 1.25

**Diagnostic odds ratio**  
= 50.0  95% C.I. = 3.6 to 688.4

Doing the test multiplies the pre-test odds in favour of a correct decision on "ruling in positives" by 4.9, and on "ruling out negatives" by 3.5 [Kullback-Leibler distances]

**Martin and Femia's chance-corrected indices (delta model):**

  - "Overall index" (analogous to percentage agreement):  72.5% (S.E. 11.09%* / 11.48%**)
  - Agreement on diseased:  7.1% (S.E. 5.09%* / 6.84%**)
  - Agreement on nondiseased: 65.4% (S.E. 6.26%* / 9.56%**)

  "Conformity" of ratings:
  - Index analogous to sensitivity:  36.4% (S.E. 29.14%* / 30.06%**)
  - Index analogous to specificity:  81.2% (S.E. 8.35%* / 8.54%**)

* If numbers of diseased and nondiseased were fixed.

** If numbers of diseased and nondiseased were not fixed.

N.B. Negative indices may be regarded as zero.

The overall index may be misleading if it is similar to either of the two "agreement" indices.
School Teachers (disease) and PRPP 5 (Test) Sensitivity and Specificity

"Disease" refers to whatever attribute the test or measure is designed to indicate.

**Sensitivity**

\[ \text{Sensitivity} = 100.00\% \quad \text{95% C.I.} = 0.00 \text{ to } 0.00\% \]

Chance-corrected  \[ = 100.00\% \]

**Specificity**

\[ \text{Specificity} = 95.83\% \quad \text{95% C.I.} = 0.00 \text{ to } 0.00\% \]

Chance-corrected \[ = 95.83\% \quad \text{95% C.I.} = 71.62 \text{ to } 99.39\% \]

**False positive rate**

\[ \text{False positive rate} = 4.17\% \quad \text{95% C.I.} = 100.00 \text{ to } 100.00\% \]

**False negative rate**

\[ \text{False negative rate} = 0.00\% \quad \text{95% C.I.} = 100.00\% \text{ to } 100.00\% \]

**Youden's index**

\[ \text{Youden's index} = 0.96 \quad \text{95% C.I.} = 0.88 \text{ to } 1.00 \]

**Area under ROC curve**

\[ \text{Area under ROC curve} = 97.9\% \quad \text{95% C.I.} = 93.9 \text{ to } 100.0\% \]

**Likelihood ratio:**

- For positive test \[ = 24.00 \quad \text{95% C.I.} = 3.52 \text{ to } 163.50 \]
- For negative test \[ = 0.00 \]

**Diagnostic odds ratio** \[ = 266.3^* \]

\[ ^* \text{Adjusted by adding 0.5 in each cell} \]

**Martin and Femia's chance-corrected indices (delta model):**

- "Overall index" (analogous to percentage agreement): \[ 83.8\% \quad \text{(S.E. 9.05\%* / 9.09\%**)} \]
- Agreement on diseased: \[ 21.1\% \quad \text{(S.E. 4.52\%* / 7.93\%**)} \]
- Agreement on nondiseased: \[ 62.7\% \quad \text{(S.E. 5.29\%* / 9.04\%**)} \]

"Conformity" of ratings:

- Index analogous to sensitivity: \[ 75.9\% \quad \text{(S.E. 16.89\%* / 17.10\%**)} \]
- Index analogous to specificity: \[ 86.9\% \quad \text{(S.E. 7.53\%* / 7.60\%**)} \]

\[ ^* \text{If numbers of diseased and nondiseased were fixed.} \]

\[ ^{**} \text{If numbers of diseased and nondiseased were not fixed.} \]

N.B. Negative indices may be regarded as zero.

The overall index may be misleading if it is similar to either of the two "agreement" indices.
APPENDIX XIII

COMPARISON OF PRPP SCORES TO READING AND WRITING LEGIBILITY SCORES – Spearman’s statistics for Section 4.6

Table A26: Spearman’s statistic for Writing legibility and reading scores and PRPP scores from Time 4 and Time 5.

Correlations

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
<th>Read_4</th>
<th>Total_4</th>
<th>Read_5</th>
<th>Total_5</th>
<th>PRPP4</th>
<th>PRPP5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman’s rho</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Total_4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
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<td>.099</td>
<td>.375</td>
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<tr>
<td>N</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
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</tr>
<tr>
<td>Read_5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.504**</td>
<td>.099</td>
<td>1.000</td>
<td>.312</td>
<td>.267</td>
<td></td>
</tr>
<tr>
<td>N</td>
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<td>29</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Total_5</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Correlation Coefficient</td>
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<td>.375</td>
<td>.312</td>
<td>1.000</td>
<td>.370</td>
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<td>29</td>
<td>31</td>
<td>31</td>
<td>31</td>
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<td>PRPP4</td>
<td></td>
<td></td>
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<td>Correlation Coefficient</td>
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<td>.618**</td>
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<td>31</td>
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<td></td>
<td></td>
<td></td>
<td>.267</td>
<td>.370**</td>
<td>.618**</td>
</tr>
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<td>31</td>
<td>31</td>
<td>29</td>
<td>31</td>
<td>29</td>
<td>31</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).
Table A27: Spearman’s rho statistic for Reading rankings and PRPP rankings for Time 5.

<table>
<thead>
<tr>
<th></th>
<th>Perceive_5</th>
<th>Recall_5</th>
<th>Plan_5</th>
<th>Perform_5</th>
<th>PRPP_5</th>
<th>Reading_</th>
</tr>
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<tbody>
<tr>
<td>Spearman's rho</td>
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<td></td>
<td></td>
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<tr>
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<td>.561**</td>
<td>.610**</td>
<td>.784**</td>
<td>.849**</td>
<td>.168</td>
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<tr>
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<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>Recall_5 Correlation Coefficient</td>
<td>.561**</td>
<td>1.000</td>
<td>.581**</td>
<td>.397*</td>
<td>.620**</td>
<td>.203</td>
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<tr>
<td>N</td>
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<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>Plan_5 Correlation Coefficient</td>
<td>.610**</td>
<td>.581**</td>
<td>1.000</td>
<td>.480**</td>
<td>.670**</td>
<td>.254</td>
</tr>
<tr>
<td>N</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
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</tr>
<tr>
<td>Perform_5 Correlation Coefficient</td>
<td>.784**</td>
<td>.397*</td>
<td>.480**</td>
<td>1.000</td>
<td>.834**</td>
<td>.003</td>
</tr>
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<td>32</td>
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</tr>
<tr>
<td>PRPP_5 Correlation Coefficient</td>
<td>.849**</td>
<td>.620**</td>
<td>.670**</td>
<td>.834**</td>
<td>1.000</td>
<td>.268</td>
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<td>31</td>
</tr>
<tr>
<td>Reading Correlation Coefficient</td>
<td>.168</td>
<td>.203</td>
<td>.254</td>
<td>.003</td>
<td>.268</td>
<td>1.000</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).
## APPENDIX XIV

SPEARMAN’S RHO STATISTIC FOR PRPP AND CHIPPA RANKINGS (Section 4.7)

**Table A28:** Spearman’s rho statistic for PRPP and ChipPA Rankings

<table>
<thead>
<tr>
<th>Variables</th>
<th>Spearman’s r</th>
<th>Approx. Sig *based on normal approximation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRPP total &amp; PEPacon</td>
<td>-.109</td>
<td>.581</td>
<td>Poor relationship</td>
</tr>
<tr>
<td>PRPP total &amp; PEPAsym</td>
<td>.580</td>
<td><strong>.001</strong></td>
<td>Positive, p &lt;.05</td>
</tr>
<tr>
<td>PRPP total &amp; PEPAcomb</td>
<td>.380</td>
<td>.046</td>
<td>Positive, p&lt;.05</td>
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<tr>
<td>PRPP total &amp; NIAsym</td>
<td>.061</td>
<td>.759</td>
<td>Very poor relationship</td>
</tr>
<tr>
<td>PRPP total &amp; NIAcomb</td>
<td>.086</td>
<td>.663</td>
<td>Very poor relationship</td>
</tr>
<tr>
<td>Perceive &amp; PEPacon</td>
<td>-.192</td>
<td>.328</td>
<td>Poor relationship</td>
</tr>
<tr>
<td>Perceive &amp; PEPAcomb</td>
<td>-.069</td>
<td>.728</td>
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</tr>
<tr>
<td>Perceive &amp; NIAsym</td>
<td>.228</td>
<td>.243</td>
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</tr>
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<td>Perceive &amp; NIAcomb</td>
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<td>.592</td>
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</tr>
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<td>Recall &amp; PEPacon</td>
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<td>.337</td>
<td>Poor relationship</td>
</tr>
<tr>
<td>Recall &amp; PEPAcomb</td>
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<td><strong>.003</strong></td>
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<td>Recall &amp; NIAcomb</td>
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<tr>
<td>Plan &amp; PEPacon</td>
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<td>.610</td>
<td>Poor relationship</td>
</tr>
<tr>
<td>Plan &amp; PEPAcomb</td>
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<td><strong>.001</strong></td>
<td>Negative, p&lt;.05</td>
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<tr>
<td>Plan &amp; NIAsym</td>
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<td>.032</td>
<td>Negative, p&lt;.05</td>
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<tr>
<td>Plan &amp; NIAcomb</td>
<td>.025</td>
<td>.899</td>
<td>Very poor relationship</td>
</tr>
<tr>
<td>Perform &amp; PEPacon</td>
<td>.087</td>
<td>.660</td>
<td>Very poor relationship</td>
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<td>Perform &amp; PEPAcomb</td>
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<td>.068</td>
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<td>Perform &amp; NIAsym</td>
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<tr>
<td>Perform &amp; NIAcomb</td>
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<td>.901</td>
<td>Very poor relationship</td>
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