RAPID AUTOMATIZED NAMING - KANNADA (RAN-K) IN 6-8 YEARS OLD TYPICALLY DEVELOPING CHILDREN

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Register No: 09SLP027

A Dissertation Submitted in Part Fulfillment of Final Year

Master of Science (Speech-Language Pathology)

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JUNE-2011

To mum, dad, beloved brother and a loved one

CERTIFICATE

This is to certify that this dissertation entitled "***Rapid Automatized Naming - Kannada (RAN-K) in 6-8 years old typically developing children***" is the bonafide work submitted in part fulfillment for the Degree of Master of Science (Speech-Language Pathology) of the student with Registration No. : 09SLP027. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore
June, 2011

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CERTIFICATE

This is to certify that the dissertation entitled "***Rapid Automatized Naming - Kannada (RAN-K) in 6-8 years old typically developing children***" has been prepared under my supervision and guidance. It is also certified that this has not been submitted earlier in any other University for the award of any Diploma or Degree.

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DECLARATION

This is to certify that this Master's dissertation entitled "*R**apid Automatized Naming - Kannada (RAN-K) in 6-8 years old typically developing children"*** is the result of my own study under the guidance of Mr. Rajasudhakar. R, Lecturer in speech sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted in any other University for the award of any Diploma or Degree.

Mysore
June, 2011 **Register No. 09SLP027**

Acknowledgement

I consider it as privilege to express my deep sense of gratitude to the Hon'ble Director, Dr. S. R. Savithri of All India Institute of Speech & Hearing (AIISH), Mysore, for permitting me to carry out this study…

I express my heartfelt gratitude to my Guide Mr. Rajasudhakar R for his constant support, efficient guidance and patient listening throughout the course of this dissertation…

I would like to thank Dr. K. S. Prema, Professor in Language pathology, for her guidance and support to carry out this dissertation…

My parents, brother and family who are always a constant support for me in all the difficult situations are the reason for my happiness and wellbeing. My joy knows no bounds in expressing my profound sense of love and honour to them…

My sincere thanks to all my classmates who made my two years in AIISH colourful…

To some dear ones, its not right only to say thanks, my gratitude for you would last a life time. Love you all ..... Ramya, Lakshmi, Sangu, Nayana, Paddu, Nirmal, Madhu, Soumya…

Last but not the least, I am extremely grateful to the participants of my study, to all those loving children, to their parents and teachers for supporting and being part of my study…

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CHAPTER I

Introduction

In today's world reading has become pre requisite for adequate living in the society and the person who is unable to read is always at a loss at social and personnel level. Importance of reading was emphasized by Strang (1968), who has pointed out "reading is the key to continuing education, employment and enjoyment"

Extensive research has been carried out from decades to break the complicated code of reading process. Investigators from many facets have tried to understand and analyze the problems underlying dyslexia. Smythe and Everatt (2000) define dyslexia as "Difficulty in the acquisition of literacy skills that may be caused by combination of phonological processing, visual and auditory system deficits. Lexical confusions and speed of processing difficulties may also be present. The manifestation of dyslexia in any individual will depend upon not only individual cognitive differences, but also the language used."

The rapid automatized naming tasks assess the child's ability to name serially presented familiar visual stimuli as rapidly as possible. A restricted number of familiar visual stimuli are selected for the task. The usual tasks used are naming- letters, digits, colors and pictures of familiar objects, each presented as a separate task.

The speed of processing, assessed by rapid naming tasks are usually associated with reading success and children with dyslexia. Denckla and Rudel published two articles (1974, 1976) reporting that children with specific reading disability performed more slowly than controls on a task requiring rapid naming of pictured objects, numbers, colors and letters. Furthermore, they showed that the slowing was not restricted to letter or number symbols but applied as well to colors and concrete objects. It was not related to generalized slowing on other cognitive tasks, such as performance IQ score on the Wechsler intelligence scale for children (WISC).

Subsequent research in the past years have shown rapid automatized naming as predictive of reading success (Cutting & Denckla, 2001; Denckla & Rudel, 1974, 1976a, 1976b; Wolf, 1984, 1991; Wolf & Bowers, 1999) independently from phonological awareness (Wolf, Bowers, & Biddle, 2000). The Double Deficit Hypothesis proposed by Wolf and Bowers (Bowers and Wolf, 1993; Wolf & Bowers, 1999) depicts naming speed deficits as an independent source of reading dysfunction.

Studies on naming-speed deficits in dyslexic readers have been conducted across languages of varying degrees of orthographic regularity, including German (Wimmer, 1993), Finnish (Korhonen, 1995), Dutch (Van den Bos, 1998; Yap & Vander Leij, 1993) and Spanish (Novoa & Wolf, 1984). The findings of these studies suggest that in languages with regular orthography, rapid naming tasks play a more crucial role in predicting the reading success in children and in evaluation of dyslexic children. But, there is a dearth of literature in Indian languages.

Need for the study:

In the past few years, many researchers in the western country have documented naming-speed deficits in dyslexic children. A very few Indian studies are available in the literature in this area. Unlike English, Kannada language is more transparent and possesses regular orthography. The findings of the western studies cannot be generalized to children who speak Kannada language. So the naming deficit in Kannada speaking children needs to be explored.

As cautioned by Rudel (1985) RAN tasks play a major role in the assessment of dyslexia, as poor readers who have adequate to good phonological decoding skills slip through our diagnostic batteries. This view is supported by the double-deficit hypothesis (Wolf, Bowers and Biddle, 2000) which proposed that the processes underlying naming-speed deficits as one of the independent sources of reading dysfunction. Wolf, Bowers and Biddle (2000) have also viewed that the hypothesized naming-speed deficit readers would either be misclassified as having phonological deficits and given inappropriate intervention, or missed altogether because of their near normal phonological-decoding skills. Many studies have reported that the RAN task identified below average children from above average children in terms of academic achievements. Considering the time involved for RAN task, it could be employed as screening tool because of its less time consumption. Yet there are no empirical normative data available for Kannada speaking children on RAN tasks. Hence, there is a need to establish normative data for RAN tasks for native Kannada speaking children.

Aim of the study:

To establish normative data for Rapid Automatized Naming (RAN) for typically developing Kannada speaking children in the age range of 6-8 years.

Objectives of the study are:

i) To establish normative score for rapid automatized naming for colors (RAN-C)

ii) To establish normative score for rapid automatized naming for objects (RAN-O)

iii) To establish normative score for rapid automatized naming for digits (RAN-D)

iv) To establish normative score for rapid automatized naming for letters (RAN-L)

v) To establish normative score for rapid automatized naming for digits, letters (RAN-DL)

vi) To establish normative score for rapid automatized naming for colors, digits, letters (RAN-CDL)

CHAPTER II

Review of literature

The words of Malmquist (1968) emphasizes the importance of reading in our world today,

"The person…… who has not been given the opportunity to learn to read cannot function in a proper way, cannot live a full human, individual and social life….. the ability to read is an indispensable element in a person's equipment for living in every corner of the world today".

The ability to read is probably more important today than it has been at any other time in history. Extensive research has been carried out from centuries to understand the process of reading, components of reading and reading problems. Catts and Kamhi (1986) define reading as a cognitive process by which one derives meaning from printed symbols. Reading is considered as a process of decoding printed symbols into sounds and then extracting meaning from it. The basic process of reading involves the recognition of symbols. Speed of perception, use of analogy and memory for sequences are found to be important for learning to read.

According to Prema (1997) reading is a complex cognitive process that involves multiple skills. Components of reading ability include phonological awareness, phonological decoding, reading comprehension, spelling, orthographic knowledge and rapid automatized naming (Gayan & Olsen, 2003). Deficits in any one of the components can result in specific reading disability, otherwise called dyslexia.

Smythe and Everatt (2000) define dyslexia as "Difficulty in the acquisition of literacy skills that may be caused by combination of phonological processing, visual and auditory system deficits. Lexical confusions and speed of processing difficulties may also be present. The manifestation of dyslexia in any individual will depend upon not only individual cognitive differences, but also the language used."

Investigators have proposed several causes for dyslexia in the literature. They are heredity (Pennington, 1989), brain differences (Galaburda, 1991), defects in rapid temporal Information processing (Tallal, Miller & Fitch 1993), selective attention and attention deficit disorder (Zentall, 1993), processing speed (Wolf and Bowers, 1999), Cognitive rigidity and learned helplessness.

In the past few years, the speed of processing, assessed by rapid naming tasks has been widely investigated in relation to reading and dyslexia.

Rapid automatized naming and Reading

The RAN/ RSN (Rapid Serial Naming) tasks assess the child's ability to name serially presented familiar visual stimuli as rapidly as possible. A restricted number of familiar visual stimuli are selected for the task. The usual tasks used are naming- letters, digits, colors and pictures of familiar objects, each presented as a separate task.

The relationship between rapid naming and reading was first posited by Geschwind and Fusillo (1966) in their description of patients with the visual–verbal disconnection syndrome alexia with-out agraphia. The authors had argued that color naming and reading relied on the same neurocognitive processes i.e., reliably and quickly attaching a spoken word to a visual stimulus. Following this investigation, Denckla

(1972) examined inefficiency in color naming as a marker for unexpected reading failure in young children In the past years, several investigations have shown rapid automatized naming as predictive of reading success (Cutting & Denckla, 2001; Denckla & Rudel, 1974, 1976a, 1976b; Wolf, 1984, 1991; Wolf & Bowers, 1999) independently from phonological awareness (Wolf, Bowers, & Biddle, 2000).

There are several hypotheses underlying the relationship between rapid automatized naming (RAN) and reading skills. This includes hypotheses in which rapid naming is considered a component of phonological processing (Torgesen, 1997) and other hypotheses that argue that rapid naming and phonological deficits are independent facets contributing to reading skill (Wolf & Bowers, 1999). Apart from these, other hypotheses have argued that rapid naming speed and reading are both influenced (at least in part) by more global processing speed (Cutting & Denckla, 2001; Kail, Hall, & Caskey, 1999).

In the past decade the study of reading disability has been dominated by the phonological deficit hypothesis, which posits that reading disability "derives from deficits in the representation and use of phonological information" (Joanisse, Manis, Keating, & Seidenberg, 2000). Although the phonological deficit hypothesis is able to account for the large majority of reading impairments, there remain individuals with adequate phonological skills but poor reading abilities (Wolf, 1999). Evaluation based on phonological deficit hypothesis may fail to identify these individuals.

Although researchers who work within a phonological core deficit framework regularly acknowledge the independent contributions of naming speed to reading, they tend to categorize naming speed as "part of the phonological family" (Torgesen, Wagner, Rashotte, Burgess, and Hecht, 1997). However, Wolf, Bowers and Biddle (2000) argue that though naming speed, like any linguistic task (e.g., semantic generation, expressive vocabulary), involves accessing a phonological code; it cannot be categorized and subsumed under phonology. They argue that rapid naming is an independent entity contributing to reading difficulties.

Wolf, Bowers and Biddle (2000) emphasize multiple processes underlying RAN using a model of visual naming which is depicted in figure 2.1 (adopted from Wolf & Bowers, 1999). In their model, RAN requires the integrated and coordinated use of attentional, perceptual, conceptual, memory, lexical (semantic and phonological access), and motoric sub-processes. The poor performance on RAN tasks can be a result of deficiency on any of the sub-processes, or in their integrated use.

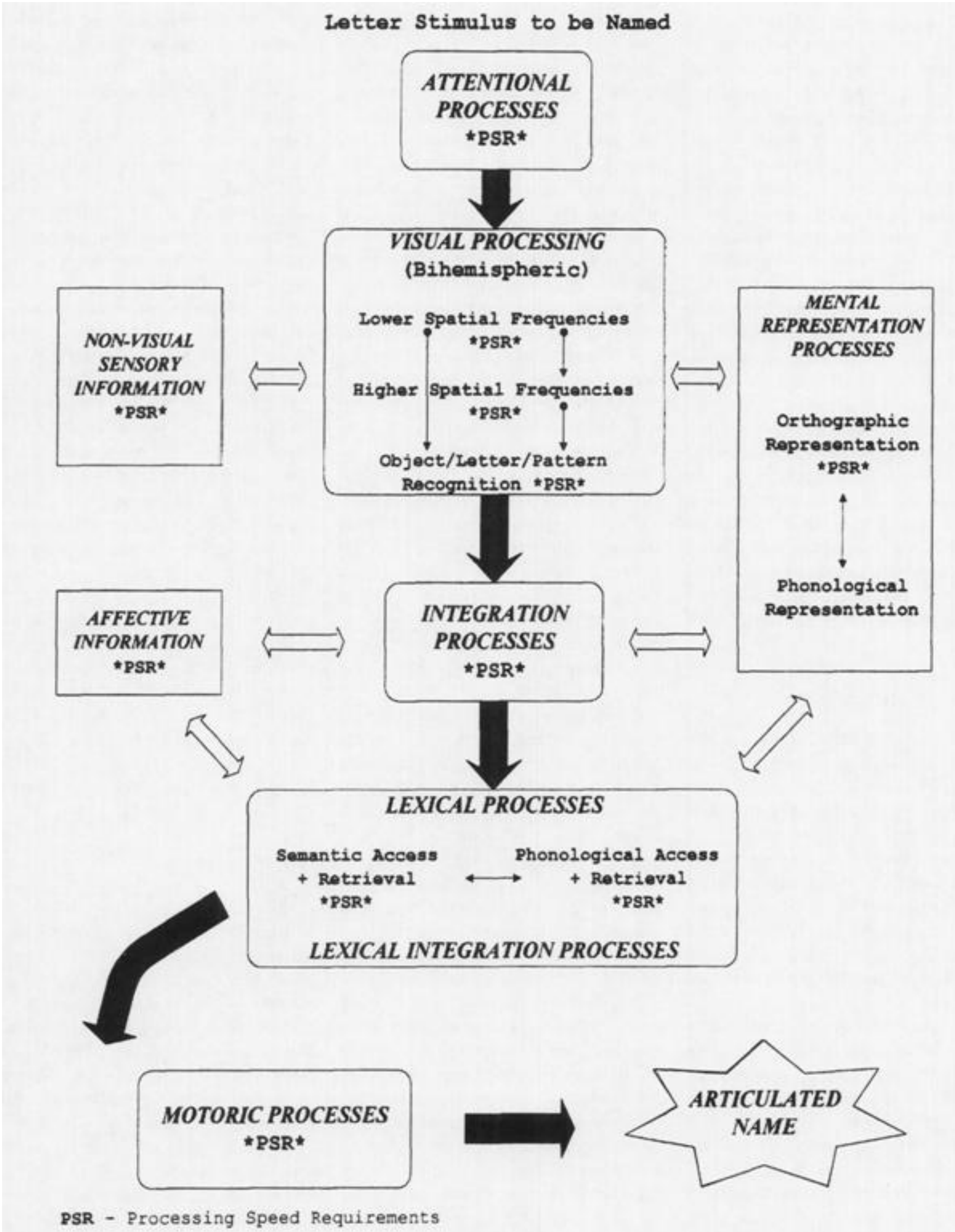


Figure 2.1: Model of Visual naming (Adopted from Wolf and Bowers, 1999)

As depicted in Figure 1, the model of visual naming represents a demanding array of attentional, perceptual, conceptual, memory, lexical, and articulatory processes. When there is activation of attentional processes this in turn activates bi- hemispheric visual processing at multiple levels. This allows for identification or recognition processes, where integration of information about the present stimulus and known mental representations takes place, the quality of this will influence the speed of the processing. Additional components may also influence the integration of the cumulative visual and representational information. They are affective factors and associative input from other sensory modalities. Lexical processes-including semantic, phonological access and retrieval processes-are integrated with the cumulative information. Motor commands translate this phonological information into an articulated name. The entire process occurs within 500 ms (Winfield, 1968).

As demonstrated by the model, figure 2.1, the processing speed requirements (PSRs) accompany each of the components in naming. The authors propose that continuous naming-speed tasks add to the visual naming model the extra demands of rapidity and serial processing to the ordinary PSRs found in each subprocess. The complexity of this underlying structure, the extent of ordinary processing speed demands, and the addition of rapid rate and seriation to PSRs make naming speed a different cognitive task from phonology. And, this particular combination of requirements makes naming speed a significant predictor of reading. This is because naming speed (particularly serial naming speed) provides an early, simpler approximation of the reading process, with reading's similar combination of rapid, serial processing and integration of attentional, perceptual, conceptual, lexical, and motoric subprocesses. However, the role of each of these components in RAN has not been fully clarified.

Based on their research, Wolf and Bowers (Bowers and Wolf, 1993; Wolf & Bowers, 1999) proposed an alternative conceptualization of dyslexia- the Double Deficit Hypothesis- which depicts phonological deficits and the processes underlying naming-speed deficits as two large independent sources of reading dysfunction. According to this hypothesis, the authors classify three subtypes of dyslexia, two subtypes with single deficits (either phonological deficit or naming speed deficit) and one double deficit subtype. They propose that the double deficit subtype represents the most impaired readers across all dimensions of reading, potentially because the co-occurrence of phonological and naming speed deficits allows limited compensatory routes.

Literature presents several evidences in favor of the double-- deficit hypothesis (Manis, Doi, & Bhadha, 2000; Wolf & Bowers, 1999, 2000). Four main lines of evidence have implicated poor naming speed as a separate source of reading problems. First, naming speed tasks, such as the ability to rapidly name letters, have consistently predicted reading performance beyond what was accounted for by phonological awareness skills (Manis et al., 2000; Wolf & Bowers, 1999). It was this finding that led to the conclusion that the effects of naming speed on reading extend beyond phonological processing, with naming speed tapping non-- phonological components of cognitive functions that are important to reading (Wolf & Bowers, 1999).

The second line of evidence comes from studies that have grouped children into different subtypes based on their performance on phonological awareness tasks and naming speed tasks. These studies have demonstrated that children with deficits in both phonological awareness and naming speed have significantly lower scores on reading tasks than children with a deficit in only one of these areas (Lovett, Steinbach, & Frijters, 2000; Wolf & Bowers, 1999, 2000).

A third finding cited to support the independent contribution of naming speed skill beyond phonological awareness is that these two constructs appear to be differentially related to different aspects of reading. Specifically, phonological awareness has been found to be more strongly related to pure decoding ability, whereas naming speed appears to be more strongly related to reading fluency (Manis et al., 2000).

Finally, studies that used methods like cluster analysis to search for naturally occurring subtypes of reading disability have found evidence for a subtype with impairments in both phonological awareness and naming speed and for subtypes with impairment only in phonological awareness or only in naming speed (Morris et al., 1998). Of particular interest is that the subtype with deficits in both cognitive skills shows more impairment in reading than the subtypes with impairments only in phonological awareness or only in rate of processing. The group with naming speed deficits showed difficulties not only in rapid naming, but also in other measures requiring speed of processing, such as timed paper-and-pencil cancellation tasks.

Measures of Rapid automatized naming

The Rapid automatized naming (RAN) tasks- were first designed by Denckla and Rudel (1974, 1976a, 1976b) to measure continuous, serial naming-speed performance on common visual stimuli. Their work was mainly based on the hypothesis given by Geschwind (1965), that the cognitive components involved in color naming (those components involved in attaching a verbal label to an abstract, visual stimulus) would make a good early predictor of later reading performance.

The RAN task involves visually presented arrays of high-frequency items like letters, digits, colors, or objects. These items will be repeated in a random order. Typically five of these items, each repeated 10 times will be placed in 5 rows and 10 columns. The participant names all the items, from left to right across the page, as quickly as possible.

Wolf (1984, 1986) introduced a continuous rapid automatized naming task with alternating visual stimuli, Rapid Alternating Stimuli (RAS) task, in which stimuli from different categories were used, i.e., the stimuli alternate between digits and letters and between digits, letters and colors. This task requires knowledge and production of names that represent more than one semantic field (letters, numbers and colors) and is highly automated in proficient readers. Semel and Wiig (1980) and Wiig, Semel, and Nystrom (1982) used repeated colors, shapes, and color-shape combinations to explore continuous rapid naming in children with typical language development and with diagnosed language disorders.

Wolf, Bowers and Biddle (2000) emphasized the complexity of RAN tasks. They argue that RAN involves multiple processes, and in order to fully understand the relations between RAN and reading skills, the complexity of RAN has to be taken in to account.

Researchers have adopted variant presentation methods of the standard RAN test, given by Denckla and Rudel (1976). Jones, Branigan and Kelly (2009) examined the extent to which multi-item processing versus discrete processing in RAN discriminates between non-dyslexic and dyslexic readers' naming times. The task involved letter naming and they compared reaction times (RTs) across three RAN variations that represented different levels of complexity: (1) a discrete- static format, in which individual letters were presented serially in a single location; (2) a continuous-matrix version (the original and most complex form of RAN); and (3) a novel discrete-matrix version, in which individual letters were presented serially but in positions analogous to the continuous-matrix version.

Rapid automatized naming in typically developing children

In 1974, Denckla and Rudel conducted a developmental study for rapid automatized naming in typically developing children of age 5 years 11 months through 10 years 11months. 180 typically developing children comprising of 90 boys and 90 girls participated in the study. The measures included rapid naming of color, number, letter, animal and object. 9 charts were prepared, which were similar to the color naming chart used by Denckla (1972) in his previous study. Each chart consisted, a total of 50 stimuli, arrayed in five horizontal rows of 10 items per row. Children were asked to name the charts as fast as possible without mistake. The examiners noted the time taken by individual child to complete naming each task in seconds and errors made by the child. Two-way analysis of variance was performed for each task. Results revealed significant age differences on all nine naming tasks, however the differences seven and eight year olds were either less or non-significant on all nine tasks. Results also revealed significant differences between males and females though the differences were of lesser significance compared to age differences. But no age-by-sex interactions were found. The authors also noted that children over age of six years made very few errors.

Several investigators have found continuous rapid naming tasks as strongest predictors of reading success in typically developing children (Blachman, 1984; Badian, 1993, 1994). Blachman (1984) studied the relationship of rapid naming ability and reading achievement in kindergarten and first grade typically developing children. 34 kindergarten and 34 first grade children participated in the study. They were administered language analysis tasks and rapid automatized naming tasks, which included object, color and letter naming tasks. Results revealed that in kindergarten children rapid naming of colors was significantly related to 5 of 6 reading measures and rapid naming of objects, syllable segmentation, and rhyming were related to at least 3 of the 6 reading measures. In first grade children, rapid naming of letters and phoneme segmentation were significantly related to all 3 measures of first grade reading achievement. The authors found that subjects who could do better in letter naming task as indicated by speed on the letter naming task were more likely to be among the better readers at the end of the first grade.

Badian (1993) examined phonemic awareness, rapid continuous and confrontation naming, and visual symbol processing in 170 school children of average intelligence, aged 6 to 10 years. The results revealed that when IQ and reading experience were controlled, naming speed for letters and pictured objects emerged as one of the strongest differentiators of adequate and poor readers. Letter naming speed made the largest independent contribution to word recognition, and object naming speed to reading comprehension. It was concluded that naming speed tasks were one of the valuable components of a diagnostic battery when testing children with possible reading disability. In another study, Badian (1994) studied RAN objects in 118 children in the age range of 4.5- 5.5 years. He discovered that RAN objects task is a strong predictor of first-grade reading outcome.

Rapid Automatized Naming in children with dyslexia

Over the years, considerable research in the area of dyslexia has shown that, naming speed deficit which is one of the major factors contributing to reading disabilities in children. Ackerman and Dykman (1993) studied naming speed in three groups of population: dyslexic, attention deficit disorder (ADD) and slow learner in the age range of 7.5- 12 years. The measures included rapid automatized naming (RAN) and rapid alternating stimuli (RAS). The authors found that dyslexics were slower than ADD readers and slow learners on RAN and RAS. They concluded that continuous naming is robust correlate of reading skill. Similar findings were reported by Obregon (1994), in comparing dyslexic and control groups on RAN letters, colors and objects measures.

Wolf (1986) found that the most severely reading disabled children had not been able to complete tasks in which the stimuli alternate between categories (RAN- AC tasks) in kindergarten, and those tasks were predictive of later reading skills. Ackerman, Dykman, & Gardner (1990) also found that RAN- AC tasks were related to reading skills of older children with reading disability.

Meyer, Wood, Hart, and Felton (1998) examined color/object and number/letter naming tasks in third through eighth grade children. They found that both alphanumeric (letters and numbers) and non- alphanumeric (colors and objects) naming tasks are equally sensitive to, and predictive of, sight word identification. Similar results were obtained by other researchers (Cornwall 1992; Fawcett and Nicholson 1994; Korhonen 1995). Cornwall (1992) examined rapid naming along with phonological awareness and verbal memory in 54 children with severe reading disabilities. 48 boys and 6 girls with a mean age of 9 years 7months participated in the study. The participants were given rapid automatized naming tests (Denckla and Rudel, 1976) where they were asked to name a series of letters or colors as quickly as possible. They also underwent different tests assessing word attack, word identification, reading comprehension, reading comprehension and spelling skills. Results of the study revealed that after controlling for age, socioeconomic status, behavior problems and intelligence, rapid letter naming added significantly to the prediction of word identification and prose passage speed and accuracy scores. The results of the study also supported the contention that rapid retrieval is related to reading speed and fluency. The author concluded that several independent processes interact to determine the extent and severity of reading problems.

The persistence of difficulties in rapid serial naming and reading and spelling from childhood in to adulthood was assessed by Korhonen (1995). 9 children, consisting of 6 boys and 3 girls, with reading disabilities and specific difficulties in rapid serial naming were followed from age 9 years to age 19 years. These groups of children were taken from an earlier study sample which consisted of 82 third grade children with learning disabilities. All the children selected from earlier study sample had special problems in rapid automatized naming of colors and objects. A matched control group of 10 children also participated in the study. In the initial study RAN tests significantly differentiated the children with reading disabilities from the control group. Children with reading disabilities made significantly more errors and were slower than the control group. At the follow-up, though the differences between the groups were not as robust as in the initial study, many of the differences were still significant. The author suggested the possibility that naming speed problems in children with dyslexia do not disappear when they reach adulthood.

However, other investigators found graphological stimuli to be more sensitive measures. Wold, Bally, and Morris (1986) found that kindergarten rate of response, for both graphological and nongraphological stimuli, predict an impaired readers from average readers in Grade 2. However, by second grade, only the speed of naming of letters and numbers-the graphological symbols-predicted Grade 2 reading level. Consistent with the Wolf et al (2000) findings are those of Bowers, Steffy, and Tate (1988) who looked only at colors and numbers.

Naming speed can be evaluated in both discrete (the time necessary to produce the name for one item) and continuous (the time necessary to produce the names of a series of items) naming trials. Differences have been found under both conditions (Wolf & Goodglass, 1996; Wolf & Obergon, 1992); however, serial naming tasks have generally been seen as a stronger predictor of future reading success (Allor, 2002; Bowers & Swanson, 1991; Walsh, Price & Gillingham, 1988; Wolf, 1991). Wagner, Torgesen, Laughon, Simmons, & Rashotte (1993) found a significant correlation between word identification with serial naming of both letters and digits but not with isolated naming. Spring & Davis (1988) suggested that continuous naming tasks are more like reading than discrete trial naming because of the necessity of overlapping cognitive demands (naming one while accessing next).

Rapid Automatized Naming in children with language disorders

Many researchers have explored rapid naming deficits in children with language disorders. German (1986, 1990, 1991) found that many children with language disorders lack accuracy and fluency on verbal association and other naming tasks as well as in spontaneous language production. Wiig, Zureich and Chan (2000) studied the developmental patterns for three continuous rapid naming tasks in students with typical language development and those diagnosed with language disorders. The normative sample consisted of 2,450 children, in the age range of 6 to 21years and the clinical sample consisted of 136 children who were age matched and gender matched. Results revealed that in the clinical sample, mean naming times were significantly longer than in the normative sample at all age levels, except the two upper age levels (ages 15 and 16).

RAN across different languages

Studies on naming-speed deficits in dyslexic readers have been conducted, across languages of varying degrees of orthographic regularity, including German (Wimmer, 1993), Finnish (Korhonen, 1995), Dutch (Van den Bos, 1998; Yap & Vander Leij, 1993) and Spanish (Novoa & Wolf, 1984). In both German (Wimmer, 1993) and Dutch (Van den Bos, 1998), two languages reported to be of more transparent and regular orthography than English, naming speed appears a more robust predictor of reading performance than phonological awareness measures. Wolf, Bowers and Biddle (2000) emphasize these cross-linguistic finding as they eliminate the irregularity of English orthography as a possible explanatory factor in the naming-speed findings. These findings suggest that, in languages where a regular structure can be decoded using relatively lower levels of phonological skill than needed in English, the speed- of-processing variable emerges as a stronger predictor of reading performance than phonological awareness tasks.

Narhi, Ahonen, and Aro (2005) examined the six rapid automatized naming tasks, colors, objects, letters, digits, digit-letter, color-digit-letter, in typically developing children in the age range 8 to 11 years old. The number of subjects was 166, 147, 151 and 141 in the age of 8-, 9-, 10-, and 11- years, respectively. The participants were all native speakers of Finnish. The results of the study revealed significant main effect of age on all the measures of rapid naming. However the significant of age was observed only on a preliminary analysis of variance (ANOVA), but when age was added as a linear covariate, significant differences between the age groups were no longer present.

Kuppuraj (2009) developed dyslexia assessment profile for Indian children in English. The author used Rapid automatized naming test as subtest in the assessment profile. In his study, two groups of subjects were considered. First group comprised of 60 normal school going children of grades I to V and the second group comprised of 16 children with dyslexia. The rapid naming subtest was administered to all the participants, where they were asked to name randomly placed pictures as fast as possible. The stimuli consisted of five pictures which were randomly repeated to make a total of 35 items. The author found that the children showed increasing performance from lower to higher grades suggesting a developmental pattern. Rapid naming improved significantly in higher grades and a significant difference between the performance of typically developing children and children with dyslexia was present.

Raj (2009) studied rapid automatized naming in fourth graders studying in English medium across their academic performance. A total of 90 students of 4th grade with a mean age of 9years participated in the study. The author had categorized students in to three groups based on their academic performance as above average, average and below average groups, each group consisting of 30 students. The author found that in all the tasks, the below average group performed poorer than the above average group.

All the above factors emphasize the importance of rapid automatized naming tasks in the prediction of reading success and evaluation of reading skills in children. Hence there is a need to develop normative data for rapid automatized naming tasks in typically developing children in Kannada language.

CHAPTER III

Method

The aim of the study was to establish normative data for Rapid Automatized Naming (RAN) for typically developing Kannada speaking children in the age range of 6-8 years.

Participants:

120 typically developing children in the age range of 6-8 years participated in the study. All the participants were native Kannada speakers and were selected from different schools located in Mysore. The participants were divided into 4 groups based on their age range. The details of the participants are shown in Table 1.

Group	Age range	No. of participants		
		Male	Female	Total
I	6-6.6 years	15	15	30
II	6.6-7 years	15	15	30
III	7-7.6 years	15	15	30
IV	7.6-8 years	15	15	30
Total number of participants				120

Table 1: Details of different participants group

Selection criteria for participants:

The following criteria were considered for selection of participants;

- The participants should have normal speech and language development.

- The participants should have normal hearing sensitivity and normal/ corrected to normal vision.
- The participants should be native speaker of Kannada.
- The participants should be physically fit at the time of examination/testing.
- The participants should not have any history of neurological and/or psychological disorder.

Screening procedure:

A WHO Ten- Question Disability Screening Checklist (cited in Singhi, Kumar, Prabhjot & Kumar, 2007) was used to screen all the subjects in terms of hearing, intelligence, motor functions, emotional and behavioral factors. Subjects were matched on their socioeconomic status based on the NIMH socioeconomic status scale by Venkatesan (2009).

Teacher's opinion regarding each child's scholastic performance was also taken in to account. Children with average and above average scholastic performance were selected.

The objectives of the study, procedure and outcome were briefed to the parents of all the subjects and both oral and written consent was taken prior to testing.

Procedure:

The study was conducted in two phases. First phase included development of test material and the second phase included test administration on typically developing children.

Phase I: *Development of test material*

Rapid Automatized Naming (RAN) was assessed using six different tasks; the tasks were selected based on the Measure model given by Vesa Narhi (2004). The model comprises of both single category tasks designed by Denckla and Rudel (1974, 1976a, 1976b) and relatively complex alternate category tasks given by Wolf (1984, 1986). The six tasks selected to measure rapid naming are shown in table 2.

Sl. No.	**TASKS**		
1.	RAN- Single Category (RAN-SC)	Non- alphanumeric tasks	RAN- objects (RAN- O)
2.			RAN- colors (RAN- C)
3.		Alphanumeric tasks	RAN- letters (RAN- L)
4.			RAN- digits (RAN- D)
5.	RAN- Alternate Category (RAN-AC)		RAN- digit-letter (RAN- DL)
6.			RAN- color-digit-letter (RAN- CDL)

Table 2: Details of rapid automatized naming tasks

The RAN- SC consisted of four tasks: RAN- O, RAN- C, RAN- L and RAN- D; where RAN- objects and RAN- colors were termed as non-alphanumeric tasks and RAN- letters and RAN- digits were called as alphanumeric tasks. The stimuli in all the four RAN- SC tasks were selected from a single lexical category. The RAN-AC consisted of two tasks, RAN- DL and RAN- CDL and the stimuli in the two tasks were selected from 2 or 3 different categories.

Selection of test stimulus

The test material comprised of four categories- objects, colors, letters and digits. Each category consisted of five stimuli. A list of ten colors and ten line drawings of objects were taken from 'With a little bit of help…' Early language training manual, developed by Karanth, Manjula, Geetha and Prema (1999) and the selection were based on 6-8 year old children's speech language repertoire of. The list was given to 3 speech language pathologists, 3 special educators and 3 primary school teachers to rate the familiarity of the items for typically developing 6-8 years old children. The items were rated on a three point rating scale- unfamiliar, familiar and most familiar. The most familiar items for objects and colors rated by more number of judges were selected.

For letters and digits category, five Kannada alphabets which are acquired earlier in the phonological development and articulated earlier by children were selected. Digits were selected based on the previous study by Denckla and Rudel (1974).

The stimuli/items in each category include:

1) Colors - /kappu/, /ni:li/, /hasiru/, /biḷi/, /kempu/.
2) Objects- /t̪atte/, /tʃppali/, /nalli/, /baḷe/, /tʃa:ku/
3) Letters- /a/, /u/, /ka/, /pa/, /t̪a/
4) Digits- 2, 4, 6, 7, 9

Preparation of charts

The test material consists of six charts; one chart for each task and additionally a separate chart to check for the familiarity of the test stimuli, so totally seven charts were prepared. The chart used to check the familiarity of test stimuli include all the test stimuli from four different categories printed on an A4 size sheet. Each of the six charts for the six tasks consisted a total of 50 items/stimuli which were printed in 5 row by 10 column in an A3 size sheet. In single category charts (RAN- C, RAN- O, RAN- L, RAN- D), each of the five items were repeated 10 times and were arranged in random order in 5 rows by 10 columns. In alternating category chart, RAN-DL and RAN- CDL, the items were randomly arranged in D-L-D-L and C-D-L-C-D-L sequences respectively.

Phase II*: Administration of the test*

The subjects selected from screening were tested individually. The subjects were seated comfortably in a quiet room with adequate lighting facilities. Prior to the task presentation, an untimed familiarity test which assessed the subject's familiarity of all the stimuli was done. Participants were required to give accurate naming responses for the stimuli in the familiarity test before proceeding to the experimental naming tasks. The order of task presentation was RAN -O, RAN -C, RAN -L, RAN -D, RAN -DL, RAN -CDL.

Instruction

Each child was instructed in Kannada as following: "you have to name all the items which you see in this chart as fast as possible, without making mistakes. When I say 'start', you start naming the items from first row (examiner sweeps finger across row 1) and second row (again examiner sweeps finger across row 2)…etc. until you come to the last item on the chart".

Measurements:

The response of each child during task presentation was recorded using digital audio recorder. The total time taken by the subject to complete each naming task (in seconds) and the accuracy of naming (number of correct responses) were measured. Time measurement began with the child's first response after 'start'. Number of errors were noted down to find the number of correct responses. Accurate self-corrections by the child were also considered as correct responses. Self-corrections were therefore reflected as increase in the time to complete a given naming task.

Statistical analyses:

Mean and standard deviation of 'total time' taken to complete each of the six tasks and accuracy of naming were calculated. Statistical analysis was done using SPSS software (Statistical Package for the Social Sciences package, version 16.0).

The following statistical techniques were used to analyze the obtained data:

a) Two-way MANOVA (Multivariate Analysis of variance) was used to compare the time taken for each task across age group and gender.
b) Two-way MANOVA (Multivariate Analysis of variance) was used to compare the accuracy of naming for each task across age group and gender.
c) MANOVA was followed by Duncan's post-hoc test for pair wise comparison of age groups
d) MANOVA (Multivariate Analysis of variance) within each gender to see the effect of age group
e) Independent t-test was carried out for comparing males and females within each age group

CHAPTER IV

Results

The present study made an attempt to establish normative data for rapid automatized naming (RAN- K) in Kannada for typically developing children in the age range of 6-8 years. A total of 120 typically developing Kannada speaking children participated in the study. The participants were divided in to four groups: group I (6-6.6 years), group II (6.6- 7 years), group III and group IV with the age range 6-6.6 years, 6.6-7 years, 7-7.6 years and 7.6-8 years.

Participants were administered six rapid automatized naming tasks: RAN-objects, colors, letters, digits, digit-letter and color-digit-letter. The time taken to complete the task and the number of correct responses (accuracy) for each task were measured from the participants. The data was subjected to a series of statistical analysis using SPSS software (version 16.0). Mean and standard deviation were calculated for each of the six tasks. The data were analysed and compared across age group and gender. The results of the study for each task are discussed under two headings:

a) Time taken to complete the task

b) Accuracy/ number of correct responses

Performance in task I: RAN objects

a) Time taken to complete RAN objects

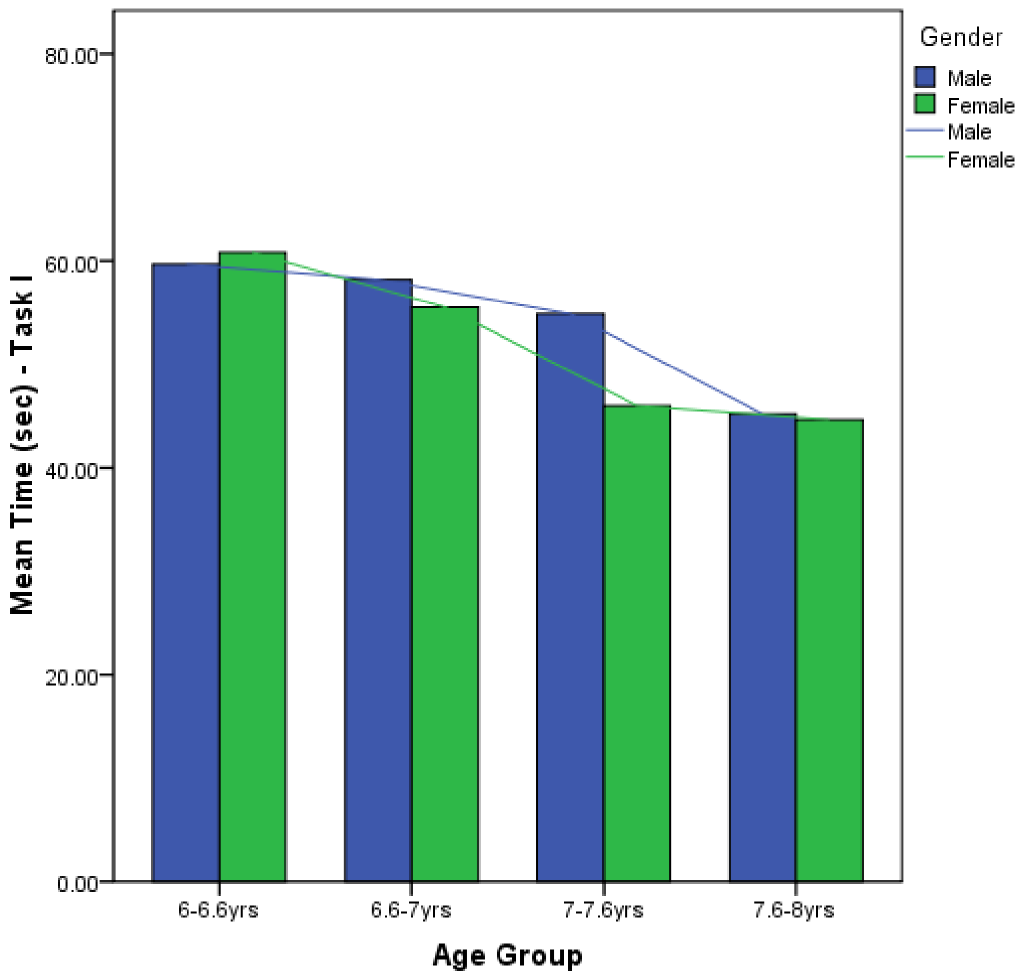
In this task, the mean time taken (in sec) to complete the task by males across group I, II, III and IV was 59.66 (SD = 6.34), 58.20 (SD = 7.12), 54.86 (SD = 6.47) and 45.20 (SD = 6.73), respectively. In females, the mean time taken (in sec) to complete the task by group I, II, III and IV was 60.80 (SD = 7.49), 55.53 (SD = 6.32), 46.00 (SD = 5.20) and 44.66 (SD = 4.93) respectively. The mean time and standard deviation values across age group and gender for task I are shown in table 4.1.

Task I: RAN objects					
Gender		Group I (6 - 6.6 years)	Group II (6.6 - 7 years)	Group III (7 - 7.6 years)	Group IV (7.6-8years)
Males	Mean	59.67	58.20	54.86	45.20
	SD	6.34	7.12	6.47	6.79
Females	Mean	60.80	55.53	46.00	44.66
	SD	7.49	6.32	5.20	4.93
Total	Mean	60.23	56.86	50.43	44.93
	SD	6.84	6.75	7.32	5.80

Table 4.1: Mean time (in sec) and standard deviation for task I across different groups

Table 4. 1 showed that the mean ‘time’ decreased from group I (6 - 6.6 years) to group IV (7.6 - 8 years) in both males and females. That is, group I took longer time to complete the naming task compared to group II, group II had taken longer time than group III and group III took longer time compared to group IV. Graph 4.1 shows the mean values for time taken to complete RAN- objects by

males and females across different age groups. For RAN-object (task 1), 2 - way MANOVA revealed that there was significant difference across the age groups [F (3, 112) = 34.08, $p < 0.05$] and between gender [F (1,112) = 5.50, $p < 0.05$]. Also, the results revealed significant interaction effect of age group and gender [F (3, 112) = 3.52, $p < 0.05$]. Pair-wise comparison of age group was done because of significant difference present across age group.



Graph 4.1: Mean time values for different age groups for task I- RAN objects

The Duncan's post- hoc test was employed which revealed that the total time taken by each group on task I was significantly different from one another at

0.05 level of significance. The results of Duncan's post- hoc test for task I are as shown in table 4.2. Further, MANOVA was carried separately for males and females, for comparison across age group. Results showed that both in males [F (3, 56) = 14.24, $p < 0.05$] and females [F (3, 56) = 24.30, $p < 0.05$] there was significant difference across age groups.

Age group	N	Subset			
		1	2	3	4
6-6.6 years	30	+			
6.6-7 years	30		+		
7-7.6 years	30			+	
7.6-8 years	30				+

Table 4.2: Duncan's post hoc test results for task I (RAN object)

(Note: '+' in same column indicate no significant difference; '+' in different column indicate significant difference)

Independent t- test was carried out for gender difference comparison within each age group. In task I, there was no significant difference between males and females in the age group I, II and IV at 0.05 level of significance. Where as in group III, the mean 'time taken' between males and females were significantly different [t = 4.130, $p < 0.05$].

b) Accuracy on RAN objects

The accuracy of naming was similar in all the age groups and even across both males and females. The mean and standard deviation values for accuracy/ number of correct responses across age group and gender are shown in table 4.3.

The total mean accuracy for group I, II, III and IV are 49.70, 49.70, 49.90 and 49.83 respectively.

2-way MANOVA showed that there was no significant difference between age groups [F (3, 112) = 1. 26, $p > 0.05$] and between gender [F (1, 112) = 0. 141, $p > 0.05$]. Also, there was no interaction of age group and gender [F (3, 112) = 1.26, $p > 0.05$] on number of correct responses produced by participants in task I.

Task I: RAN object					
Gender		Group I 6- 6.6years	Group II 6.6- 7years	Group III 7- 7.6years	Group IV 7.6- 8years
Males	Mean	49.73	49.60	49.80	49.93
	SD	0.59	0.73	0.41	0.25
Females	Mean	49.66	49.80	50.00	49.73
	SD	0. 61	0.41	0.00	0.45
Total	Mean	49.70	49.70	49.90	49.83
	SD	0.59	0.59	0.30	0.37

Table 4.3: Mean and standard deviation for number of correct responses for task I across different age groups

Since 2-way MANOVA for number of correct responses did not show any significant differences in performance across age group and between genders. Also there was no interaction effect of age and genders on RAN object tasks.

2. Performance in task II: RAN colors

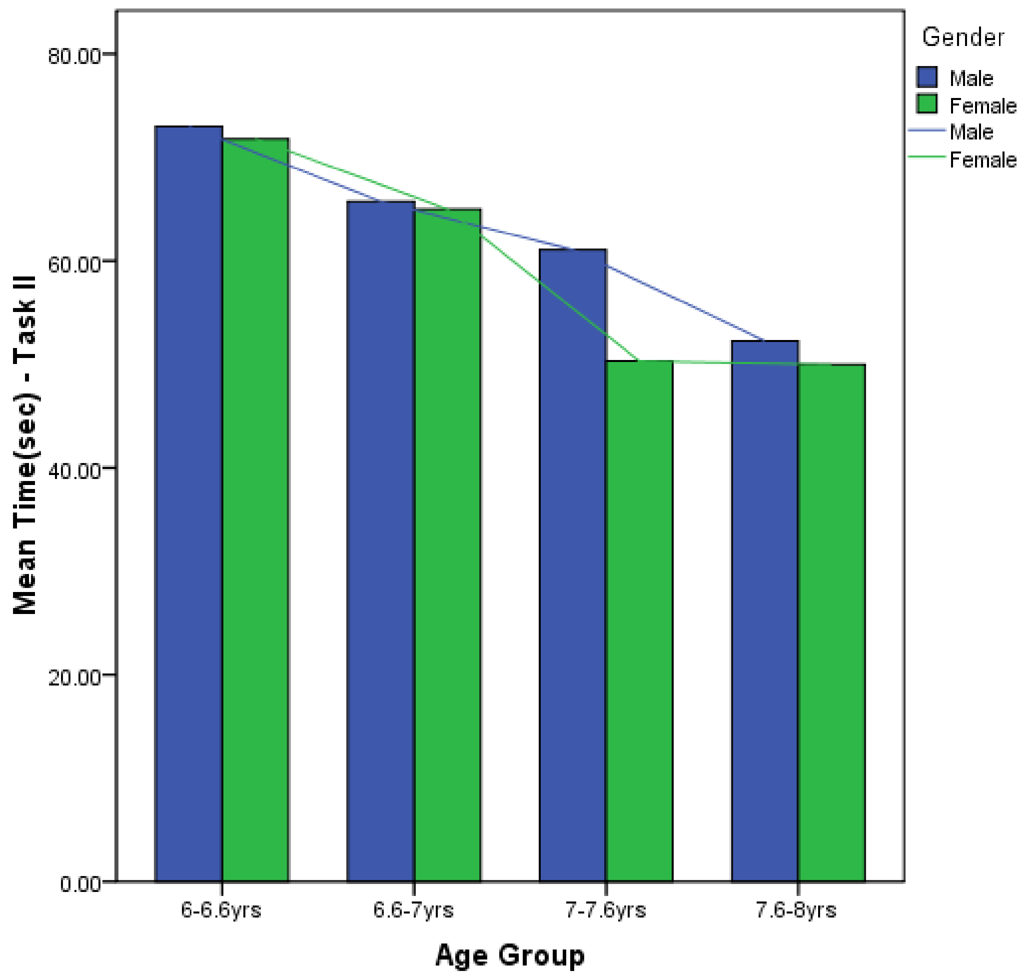
a) Time taken to complete RAN colors

The mean time taken (in sec) to complete the task by group I, II, III and IV was 73.00 (SD = 11.09), 65.73 (SD = 9.49), 61.06 (SD = 7.84) and 52.26 (SD = 10.47) respectively in males. In females the mean time taken (in sec) by group I, II, III and IV was 71.80 (SD = 8.86), 65.00 (SD = 9.41), 50.33 (SD = 8.70) and 50.00 (SD = 6.03) respectively. The mean values decreased from group I to group IV in both males and females i.e group I had longer time to name colours and group IV had taken shortest time to name colours. The mean time and standard deviation values across age groups and gender for task II are shown in table 4.4.

Task II: RAN colors					
Gender		Group I 6- 6.6 years	Group II 6.6- 7 years	Group III 7- 7.6 years	Group IV 7.6- 8 years
Males	Mean	73.00	65.73	61.06	52.26
	SD	11.09	9.49	7.84	10.47
Females	Mean	71.80	65.00	50.33	50.00
	SD	8.86	9.42	8.70	6.03
Total	Mean	72.40	65.37	55.70	51.13
	SD	9.81	9.29	9.80	8.47

Table 4.4: Mean time (in sec) and standard deviation for task II across different groups

The results of 2- way MANOVA revealed that there was significant difference across age groups [F (3, 112) = 33.07, $p < 0.05$] and between males and females at [F (1,112) = 5.04, $p < 0.05$]. But the results revealed that there was no significant interaction effect of age group and gender. Graph 4.2 shows the mean values for time taken to complete RAN- colors by males and females across different age groups.



Graph 4.2: Mean time values for different age groups for Task II- RAN colors

Results of Duncan's post hoc test for pair wise comparison showed that in task II, the mean time values of group III and IV was similar whereas, the other groups performed significantly different from each other at 0.05 level of significance. The results of Duncan's post Hoc test for task II are shown in table 4.5.

Age group	N	Subset		
		1	2	3
6-6.6 years	30	+		
6.6-7 years	30		+	
7-7.6 years	30			+
7.6-8 years	30			+

Table 4.5: Duncan's post hoc test for task II

(Note: '+' in same column indicate no significant difference; '+' in different column indicate significant difference)

Comparison of age group differences using MANOVA was carried out separately for males and females. Results showed that both in males [F (3, 56) = 11.78, $p< 0.05$] and females [F (3, 56) = 25.45, $p< 0.05$] there was significant difference across age groups. Comparison of gender difference within each age group was done using independent t- test. In task II, the mean time values between males and females were significantly different [t = 3.54, $p< 0.05$] in group III and not for groups I, II and IV at 0.05 level of significance.

b) Accuracy on RAN colors

The mean and standard deviation values for accuracy (number of correct responses) across age group and gender are shown in table 4.6. The total mean accuracy for group I, II, III and IV are 49.36, 49.63, 49.53 and 49.70, respectively. The accuracy of naming was almost similar in all the age groups in both males and females and there was no significant difference between age groups and between in 2- way MANOVA. Also there was no interaction effect of age and gender on number of correct responses produced by participants in task II.

Task II: RAN colour					
Gender		Group I 6-6.6years	Group II 6.6- 7years	Group III 7- 7.6 years	Group IV 7.6- 8 years
Males	Mean	49.40	49.73	49.53	49.86
	SD	0.91	0.457	0.63	0.35
Females	Mean	49.33	49.53	49.53	49.53
	SD	0.81	0.516	0.63	0.743
Total	Mean	49.36	49.63	49.53	49.70
	SD	0.85	0.49	0.62	0.59

Table 4.6: Mean and standard deviation for number of correct responses for task II

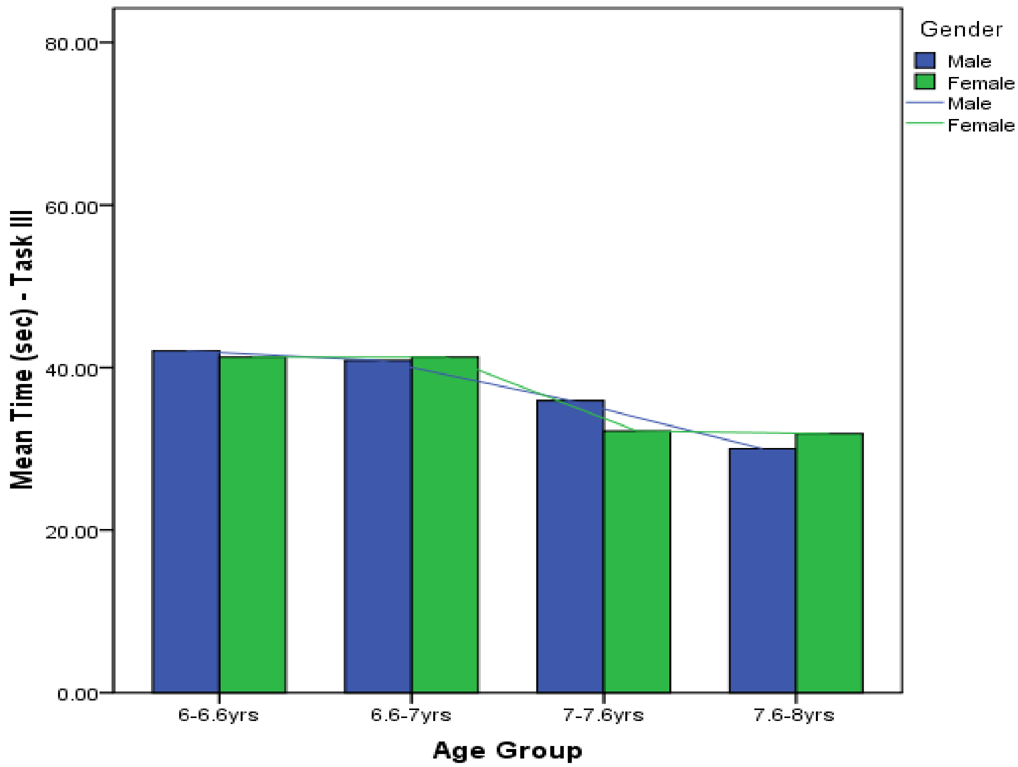
3. **Performance in task III: RAN letters**

   a) *Time taken to complete RAN letters*

In males, the total time taken (in sec) to complete the task (RAN letters) by group I, II, III and IV was 42.06 (SD = 9.24), 40.86 (SD = 6.37), 35.93 (SD = 5.04) and 30.00 (SD = 3.60), respectively. Whereas, in females, the mean time taken (in sec) by group I, II, III and IV was 41.26 (SD = 7.03), 41.26 (SD = 8.02), 32.20 (SD = 4.39) and 31.86 (SD = 5.06), respectively. The mean time and standard deviation values across age groups and gender for task III are as shown in table 4.7. Similar to previous tasks, the mean time taken to complete the task increased with increase in age range from group I to group IV in both males and females. Where in, group I (6- 6.6 years) took longer duration to complete the task than other groups and group IV (7.6- 8 years) finished the task faster than other groups.

Task III: RAN letters					
Gender		Group I 6-6.6years	Group II 6.6-7years	Group III 7-7.6years	Group IV 7.6-8years
Males	Mean	42.06	40.86	35.93	30.00
	SD	9.24	6.37	5.04	3.60
Females	Mean	41.26	41.26	32.20	31.86
	SD	7.03	8.02	4.39	5.06
Total	Mean	41.67	41.06	34.06	30.93
	SD	8.08	7.12	5.02	4.42

Table 4.7: Mean time (in sec) and standard deviation values for task III



Graph 4.3: Mean time taken for Task III- RAN letters

The mean time taken to complete RAN- letters between males and females across different age groups are shown in graph 4.3. Analysis of data by 2-way MANOVA revealed that there was significant difference between the age groups [F (3, 112) = 20.69, $p < 0.05$]. But there was no significant gender difference and interaction effect was found. The Duncan's post hoc test for pair wise comparison of age groups showed that group III and group IV performed significantly different from group I and group II at 0.05 level of significance. The results of Duncan's post hoc test for task III are as shown in table 4.8.

Age group	N	Subset	
		1	2
6-6.6 years	30	+	
6.6-7 years	30	+	
7-7.6 years	30		+
7.6-8 years	30		+

Table 4.8: Duncan's post hoc test for task III

(*Note: '+' in same column indicate no significant difference; '+' in different column indicate significant difference)*

Further, MANOVA was carried separately for males and females, for comparison of age groups. Results showed that both in males [F (3, 56) = 10.99, $p < 0.05$] and females [F (3, 56) = 10.74, $p < 0.05$] there was significant difference between age groups. Results of independent t-test for comparison of gender difference within each age group showed that, there was no significant difference between males and females in age group I, II and IV at 0.05 level of significance. Whereas, in group III, gender difference was noticed [t = 2.16, $p < 0.05$].

b) Accuracy on RAN letters

The accuracy of naming task III remained almost similar in all the age groups between both genders. The mean and standard deviation values for accuracy (number of correct responses) across age groups and gender are shown in table 4.9. The total mean accuracy for group I, II, III and IV are 49.86, 49.80, 49.83 and 49.86 respectively. 2-way MANOVA showed that there was no significant difference between age groups and between genders in terms of accuracy of responses.

Task III: RAN letters					
Gender		Group I 6-6.6years	Group II 6.6- 7years	Group III 7- 7.6years	Group IV 7.6-8years
Males	Mean	49.86	49.73	49.86	49.93
	SD	0.35	0.45	0.35	0.25
Females	Mean	49.86	49.86	49.80	49.80
	SD	0.35	0.35	0.56	0.41
Total	Mean	49.86	49.80	49.83	49.86
	SD	0.35	0.40	0.46	0.34

Table 4.9: Mean and standard deviation for number of correct responses for task III

Also, there was no interaction effect for age and gender on accuracy of naming in task III.

4. Performance in task IV: RAN digits

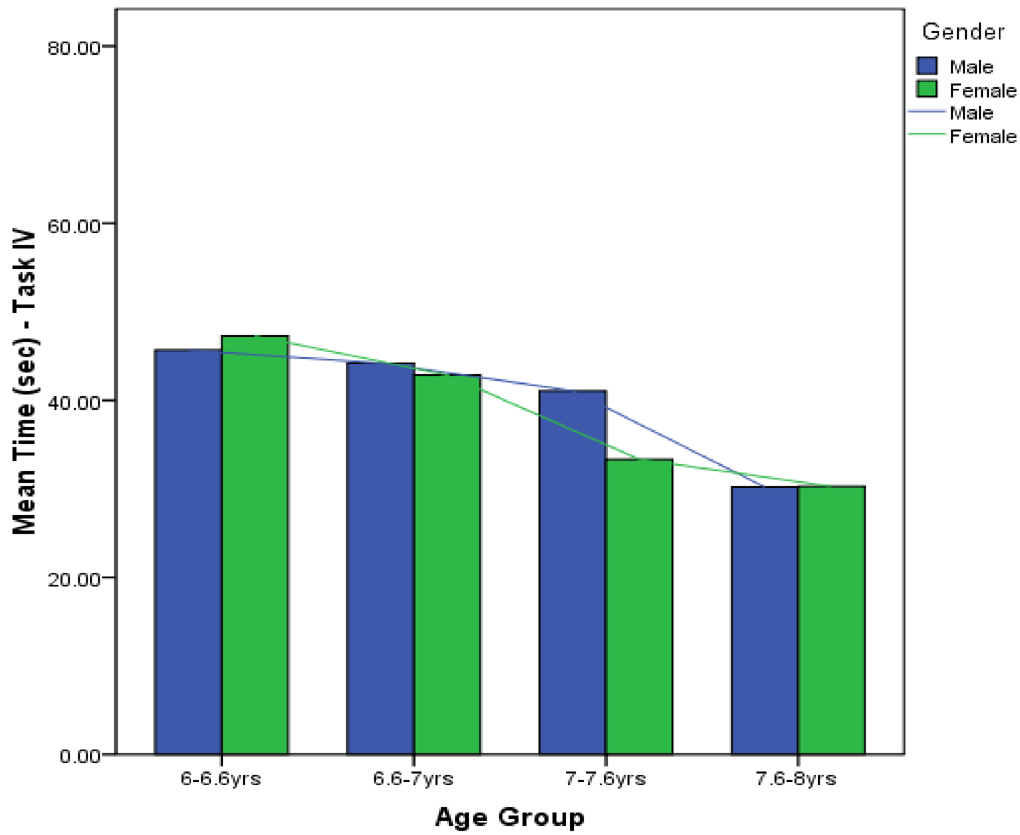
a) Time taken to complete RAN digits

The mean time (in seconds) for males in group I, II, III and IV was found to be 45.66 (SD = 9.61), 44.20 (SD = 6.37), 41.06 (SD = 3.99) and 30.20 (SD = 3.83), respectively. In females, the mean time (in seconds) for group I, II, III and IV was 47.26 (SD = 6.35), 42.86 (SD = 8.26), 33.33 (SD = 5.05) and 30.26 (SD = 4.87), respectively. The mean time taken to complete the task was longer in group

I and shorter in group IV in both males and females. The mean time and standard deviation values across age groups and gender for task IV are shown in table 4.10.

Task IV: RAN digits					
Gender		Group I 6-6.6 years	Group II 6.6- 7years	Group III 7- 7.6years	Group IV 7.6- 8years
Males	Mean	45.67	44.20	41.06	30.20
	SD	9.61	6.37	3.99	3.83
Females	Mean	47.26	42.86	33.33	30.26
	SD	6.35	8.26	5.05	4.87
Total	Mean	46.46	43.53	37.20	30.23
	SD	8.04	7.28	5.95	4.31

Table 4.10: Mean time (sec) and standard deviation values for task IV



Graph 4.4: Mean time values in seconds for different age groups for Task IV-RAN digits

Graph 4.4 shows the mean values of time taken (in seconds) to complete RAN- digits between males and females across different age groups. The results of 2- way MANOVA revealed that there was significant difference between the age groups [F (3, 112) = 38.78, $p < 0.05$]. But, there was no significant difference obtained between males and females. The results also revealed that there was significant interaction effect of age group and gender present [F (3, 112) = 3. 138, $p < 0.05$]. Results of Duncan's post hoc test for pair wise comparison of age groups showed that the performance of group I and group II was similar in task IV, but the other groups performed significantly different from the others at 0.05

level of significance. The results of Duncan's post hoc test for task IV are shown in table 4.11.

Age group	N	Subset		
		1	2	3
6-6.6 years	30	+		
6.6-7 years	30	+		
7-7.6 years	30		+	
7.6-8 years	30			+

Table 4.11: Duncan's post hoc test for task IV

(Note: '+' in same column indicate no significant difference; '+' in different columns indicate significant difference)

Comparison of age effect within each gender was assessed using MANOVA which showed that both in males [F (3, 56) = 17.917, $p < 0.05$] and females [F (3, 56) = 24.111, $p < 0.05$] there was significant difference between each age group. Comparison of gender effect across age group was done using independent t- test which revealed in task IV, the mean time taken between males and females were significantly different [t = 4.652, $p < 0.05$] in group III. But there was no significant gender difference in group I, II and IV at 0.05 level of significance.

b) Accuracy on RAN digits

The total mean accuracy for group I, II, III and IV are 49.73, 49.93, 49.93 and 49.96 respectively. The number of correct responses produced by participants across different age groups was almost similar between both males and females.

The mean and standard deviation values for accuracy/ number of correct responses across age group and gender are shown in table 4.12.

Task IV: RAN digits					
Gender		Group I 6-6 .6years	Group II 6.6- 7years	Group III 7-7.6years	Group IV 7.6- 8years
Males	Mean	49.60	49.87	49.86	49.93
	SD	0.63	0.35	0.35	0.25
Females	Mean	49.86	50.00	50.00	50.00
	SD	0.35	2.38	0.00	0.00
Total	Mean	49.73	49.93	49.93	49.96
	SD	0. 520	1.70	0.25	0.18

Table 4.12: Mean and standard deviation for number of correct responses for task IV

The mean accuracy values for different age groups in task IV are shown in table 4.12. Results of 2- way MANOVA showed that there was no significant difference between age groups and between genders. Also there was no interaction effect of age group and gender [$F (3, 112) = 0.517$, $p > 0.05$] on accuracy of naming responses produced by participants in task IV.

5. Performance in task V: RAN digit-letter

a) Time taken to complete RAN digit-letter

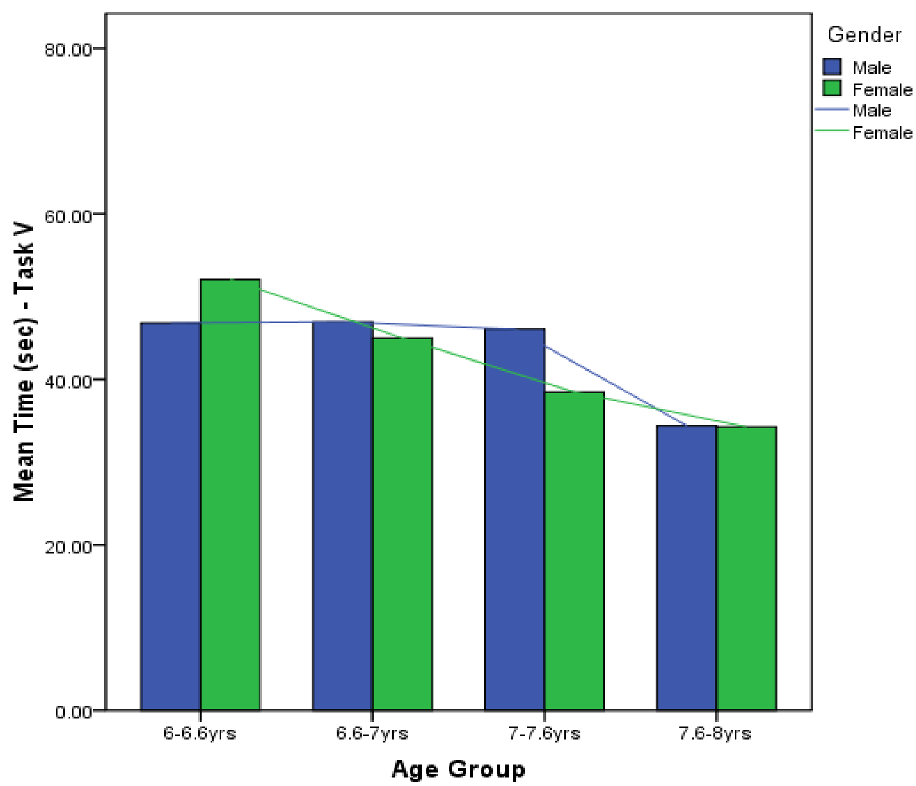
This task consisted of alternating stimuli, digits and letters, printed in a chart. The children were asked to name the 50 stimuli in this chart as fast and accurately as possible. The total time taken (in seconds) to complete the task in males in the group I, II, III and IV was 46.80 (SD = 9.26), 46.93 (SD = 8.51), 46.06 (SD = 6.87) and 34.40 (SD = 6.03), respectively. In females, the total time taken in group I, II, III and IV was found to be 52.06 (SD = 7.62), 45.00 (SD = 9.23), 38.46 (SD = 6.24) and 34.26 (SD = 4.30), respectively. The mean time and standard deviation values across age group and gender for task V are shown in table 4.13.

Task V: RAN digit-letter					
Gender		Group I 6- 6.6years	Group II 6.6- 7years	Group III 7- 7.6years	Group IV 7.6- 8years
Males	Mean	46.80	46.93	46.06	34.40
	SD	9.26	8.51	6.87	6.03
Females	Mean	52.06	45.00	38.47	34.26
	SD	7.62	9.23	6.24	4.30
Total	Mean	49.43	45.96	42.27	34.33
	SD	8.75	8.78	7.51	5.14

Table 4.13: Mean time (in sec) and standard deviation values for task V

In males, time taken to name all the items in task V was shortest in group IV, although the values did not vary much between group II, III and IV and group I took longer time to complete the task. Similarly, in females the time taken was shortest (7.6- 8 years) in group IV and highest in group I (6- 6.6 years).

The mean time values in seconds for different age groups for task V are shown in graph 4.5. Results of 2- way MANOVA revealed that there was significant difference between the age groups [F (3, 112) = 22.73, $p < 0.05$]. But there was no significant difference between males and females [F (1,112) = 0.65, $p > 0.05$]. The results revealed that there was significant interaction effect of age group and gender [F (3, 112) = 3.813, $p < 0.05$].



Graph 4.5: Mean time values for different age groups for Task V: RAN digit-letter

Duncan's post hoc test for pair wise comparison of age groups showed that in task V, groups I, II and groups II, III performed similarly. But group IV performed significantly different from the other groups at 0.05 level of significance. The results of Duncan's post hoc test for task V are shown in table 4.14.

Age group	N	Subset		
		1	2	3
6-6.6 years	30	+		
6.6-7 years	30	+	+	
7-7.6 years	30		+	
7.6-8 years	30			+

Table 4.14: Duncan's post hoc test for task V

(Note: '+' in same column indicate no significant difference; '+' in different columns indicate significant difference)

MANOVA which was employed separately between genders for age group differences which showed that both in males [F (3, 56) = 9.262, $p < 0.05$] and females [F (3, 56) = 18.107, $p < 0.05$] there was significant difference between age groups. Results of independent t-test revealed that the mean 'time taken' between males and females were significantly different [t = 3.171, $p < 0.05$] in group III. But there was no significant difference in age group I, II and IV at 0.05 level of significance.

b) Accuracy on RAN digit-letter

The accuracy of naming in task V across different age groups was almost similar in both genders. The total mean accuracy for group I, II, III and IV are 49.66, 49.56, 49.80 and 49.76, respectively. The mean and standard deviation values for accuracy/ number of correct responses across age group and gender are shown in table 4.15. There was no statistical significant difference between age groups and between gender in 2- way MANOVA.

Task V: RAN digit-letter					
Gender		Group I 6-6.6years	Group II 6.6-7years	Group III 7-7.6years	Group IV 7.6-8years
Males	Mean	49.60	49.60	49.80	49.67
	SD	0.63	0.63	0.56	0.61
Females	Mean	49.73	49.53	49.80	49.86
	SD	0.45	0.63	0.41	0.35
Total	Mean	49.66	49.56	49.80	49.76
	SD	0.54	0.62	0.48	0.50

Table 4.15: Mean and standard deviation for number of correct responses for task V

Also there was no interaction effect of age group and gender on accuracy of naming (correct responses) produced by participants.

6. Performance in task VI: RAN color-digit-letter

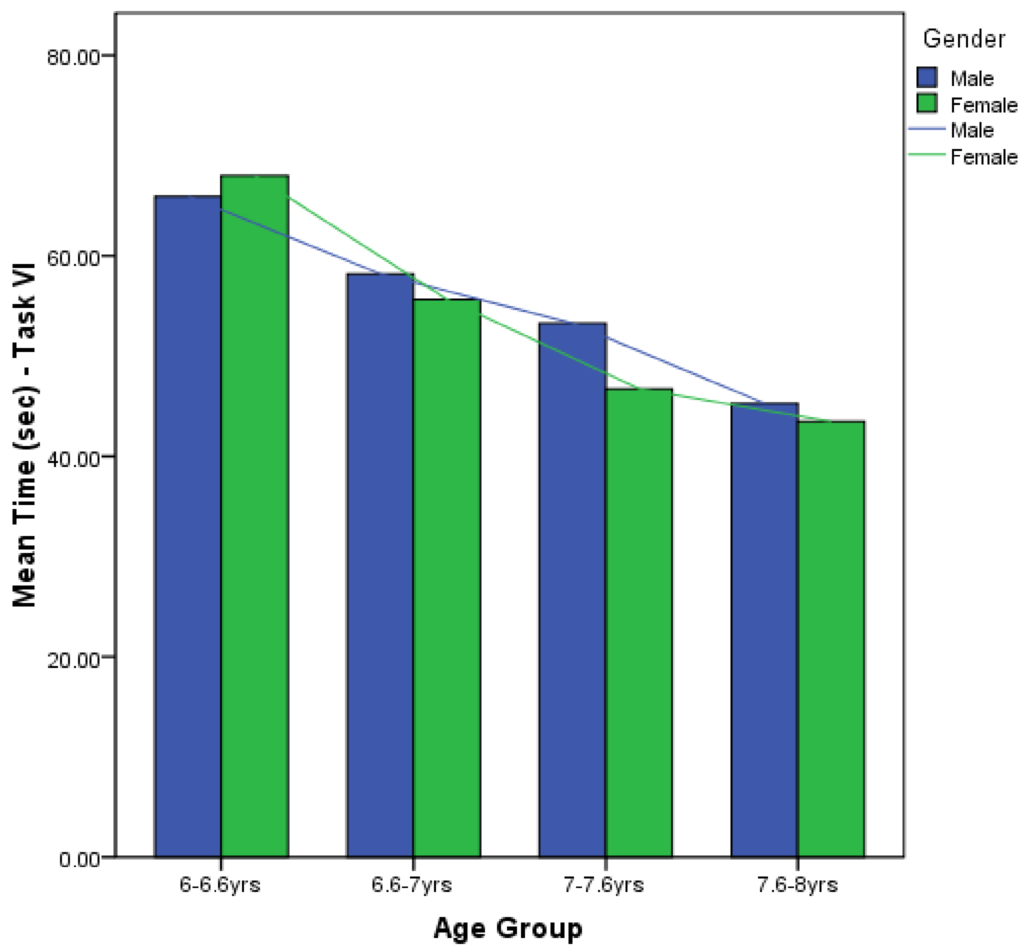
a) *Time taken to complete RAN color-digit-letter*

Task VI was also an alternating stimuli task where the stimuli were taken from three different categories, colors, digits and letters. Participants were asked to name the 50 alternating stimuli printed in the chart as fast and accurately as possible. The mean time and standard deviation across age group and gender for task VI are shown in table 4.16. In males, the mean time taken (in seconds) in naming the alternating stimuli RAN color-digit-letter for group I, II, III and IV was 65.93 (SD = 14.48), 58.20 (SD = 11.27), 53.26 (SD = 5.09) and 45.26 (SD = 7.95), respectively. The mean time taken by females in group I, II, III and IV was 68.00 (SD = 8.76), 55.66 (SD = 9.06), 46.73 (SD = 6.68) and 43.46 (SD = 5.08), respectively.

Task VI: RAN color-digit-letter					
Gender		Group I 6- 6.6years	Group II 6.6- 7years	Group III 7- 7.6years	Group IV 7.6- 8years
Males	Mean	65.93	58.20	53.26	45.26
	SD	14.48	11.27	5.09	7.95
Females	Mean	68.00	55.66	46.73	43.46
	SD	8.76	9.06	6.68	5.08
Total	Mean	66.96	56.93	50.00	44.36
	SD	11.81	10.13	6.71	6.62

Table 4.16: Mean time (in secs) and standard deviation for task VI

Graph 4.11 shows the mean time values (in seconds) for task VI for different age groups. Results of 2- way MANOVA revealed that there was significant difference across the age groups [F (3, 112) = 34.67, *p< 0.05*]. But, there was no significant gender difference and interaction effect of age group and gender was found. The mean values for time taken to complete RAN- letters by males and females in different age groups are shown in graph 4.6.



Graph 4.6: Mean time values in seconds for different age groups for Task VI: RAN color-digit-letter

Results of Duncan's post hoc test for pair wise comparison of age groups showed that the performance of all the four groups was significantly different from each other on task VI at 0.05 level of significance. The results of Duncan's post hoc test for task VI are shown in table 4.17.

Age group	N	Subset			
		1	2	3	4
6-6.6 years	30	+			
6.6-7 years	30		+		
7-7.6 years	30			+	
7.6-8 years	30				+

Table 4.17: Duncan's post hoc test for task VI

(Note: '+' in same column indicate no significant difference; '+' in different columns indicate significant difference)

Further, the results of MANOVA for comparison of age group differences between gender showed that both in males [F (3, 56) = 10.593, $p < 0.05$] and in females [F (3, 56) = 31.484, $p < 0.05$] there was significant difference across age groups. Results of independent t-test for gender difference within each age group, showed that the mean time taken between males and females were significantly different [t = 3.012, $p < 0.05$] for group III. But there was no significant difference between males and females in the age group I, II and IV at 0.05 level of significance.

b) Accuracy on RAN color-digit-letter

Similar to previous tasks the accuracy of naming for task VI was similar for different age groups in both the genders. The total mean accuracy for group I, II, III and IV are 49.20, 49.43, 49.30 and 49.60, respectively. The mean and standard deviation values for accuracy/ number of correct responses across age group and gender are shown in table 4.18.

Task VI: RAN color-digit-letter					
Gender		Group I 6-6.6years	Group II 6.6-7years	Group III 7-7.6years	Group IV 7.6-8years
Males	Mean	49.26	49.53	49.13	49.40
	SD	0.70	0.74	0.83	0.91
Females	Mean	49.13	49.33	49.46	49.80
	SD	0.99	0.81	0.51	0.41
Total	Mean	49.20	49.43	49.30	49.60
	SD	.84	0.77	0.70	0.72

Table 4.18: Mean and standard deviation for number of correct responses for task VI

There was no significant difference between age groups and between gender in 2- way MANOVA. Also there was no interaction effect of age group and gender on naming accuracy (correct responses) produced by participants in task VI.

CHAPTER V

Discussion

Rapid automatized naming was examined in 120 typically developing children in the age range of 6-8 years, who were all native speakers of Kannada. The study was undertaken with the objective of establishing normative data for the six rapid automatized naming tasks: RAN- objects, colors, letters, digits, digit-letter and color-digit-letter. The tasks comprised of both single category (RAN-SC) and alternate category (RAN-AC) tasks. The RAN- SC consisted of four tasks: RAN- O, RAN- C, RAN- D, RAN- L; where RAN- objects and RAN-colors were termed as non-alphanumeric tasks and RAN- letters and RAN- digits were called as alphanumeric tasks. The RAN-AC consisted of two tasks, RAN-DL (digit-letter) and RAN- CDL (color-digit-letter).

The typically developing children were divided in to four age groups: group I (6-6.6 years), group II (6.6- 7 years), group III (7-7.6 years) and group IV (7.6-8 years). Each group of participants had equal number of males (30) and females (30). The age group and gender formed the two independent variables of the study.

All the participants were administered the six rapid automatized naming tasks. The measures included, the total time taken to complete the task (in seconds) and the accuracy of naming (number of correct responses). The data was subjected to series of statistical analysis using SPSS software (version 16.0). 2-way MANOVA was employed to find mean, standard deviation and interaction effect of the variables. Duncan's post hoc test for pair wise comparison of age groups and MANOVA for age group differences within gender was done. Independent t-test was carried out to find the gender difference within each age group.

The results were appropriately tabulated and analyzed. The results for each task are discussed under two headings:

a) Time taken to complete the task

b) Accuracy/ number of correct responses

1) Performance in task I: RAN object

Task I is a single category task where the participants were expected to name 50 line drawings of objects printed in a chart as fast as possible without any mistakes.

a) Time taken to complete RAN object

The results showed a developmental trend in the 'time taken' to complete the task by participants. The participants in the lower age group I (6- 6.6 years) took longer time to complete the naming task (mean time = 59.66 seconds) and the participants of group IV (7.6- 8 years) took the minimum time (mean time = 45.20 seconds) for the same.

The results revealed that there was significant age and gender effect on RAN object. Also, significant interaction effect of age and gender was noted. The age effect was also significant within gender, but the effect of gender was statistically significant only in the age group III.

b) Accuracy on RAN object

The accuracy of naming (number of correct responses) was stabilized across age group and gender. The maximum score obtained by a participant was could be 50. The participants in all the groups performed correctly in naming nearing 100% accuracy in task I, with the maximum and minimum total mean score of 49.90 and 49.70 respectively. There was no significant age effect and gender effect, also no significant interaction effect of age and gender noted for accuracy.

The above results of the present study are in consonance with the developmental study done by Denckla and Rudel (1974). The authors had noted statistically significant differences in time taken to complete the random object naming task across age group and gender. The authors reported that the age differences were far more significant than gender differences. But the interaction effect of age and gender was not documented in their study. Similar results were obtained by Badian (1993, 1994) in the rapid automatized naming of objects. Denckla and Rudel (1974) observed that very few errors were made by children over six years of age and there were no significant differences across age groups .

Narhi et al (2005) also found significant age effect in object naming task in typically developing Finnish children of age 8- 11 years. Kuppuraj (2009) assessed picture naming task in 60 typically developing children, also showed significant age effect in the task. The author found that the children in higher grades took lesser time than children in lower grades, except for grade II, in completing the rapid naming task. The author reported significant age effect in grade V. However, no significant differences were reported among grades I through III. The results suggested a developmental pattern which supports the present study.

2) Performance in task II: RAN color

RAN color is also a single category task. It assessed the ability of children to rapidly name the colors, which are randomly repeated in a chart.

a) Time taken to complete RAN color

The RAN color task also showed a developmental pattern in the 'time taken' to complete the naming task by the participants. Group I (6- 6.6 years) took longer time to complete the RAN color task (mean time = 72.40 seconds), where as the higher age group IV (7.6- 8 years) took the minimum time (mean time = 51.13 seconds) to complete the task.

The results revealed significant differences across age and gender on RAN color. But no significant interaction effect of age and gender was observed. The age effect was also significant within gender, but the gender difference was noticed only in the age group III (7- 7.6 years).

b) Accuracy on RAN color

The participants in all the age groups named correctly nearing 100% accuracy in task II, with the maximum and minimum total mean score of 49.70 and 49.36, respectively. The accuracy of naming (number of correct responses) was almost constant across age group and gender. No significant age effect and gender effect was noticed, also no significant interaction effect of age and gender was noted for accuracy.

The results of the study discussed above are in accordance with the results of the study done by Denckla and Rudel (1974). The results in their study showed statistically significant differences in time taken to complete the color naming task across age group and gender. The age differences between the groups were noticed significant more than the gender differences. But the authors did not report of interaction effect of age and gender. Badian (1993) had examined RAN colors in 6 to 8 years old typically developing children. The result of the present study supports the findings of Badian (1993), and found a developmental pattern in the time taken to complete the task across the age groups, Narhi et. al (2005) found significant differences across age groups in color naming task in typically developing Finnish children of age 8- 11 years. However he had not considered gender as a variable while discussing the study.

Denckla and Rudel (1974) had examined the number of errors made by children in color naming task and observed that very few errors were made by children over six years of age. In the present study, very few participants made errors in naming colors, even when they made it was about one or two errors on a task of 50 naming responses. There were no significant differences noticed across age groups in the number of errors made on RAN color task. Similarly Wiig, Zureich and Chan (2000) also found that the mean percentage of accuracy remained stable for the color naming task. For color naming task the mean percentage of accuracy ranged from 99.8% to 99.1% in their study. Hence the results of the present study support the findings of Denckla and Rudel (1974) and Wiig et. al (2000), who reported very minimal errors noticed in RAN color task and maximum accuracy, respectively

3) Performance in task III: RAN letter

Task III- RAN letter is a single category alphanumeric task which comprised of 50 randomly arranged Kannada alphabet printed in a chart. The children were asked to name the chart as fast and accurately as possible without doing mistakes.

a) Time taken to complete RAN letter

In RAN-letter task, the participants in the lower age group I (6- 6.6 years) took longer time to complete the task (mean time = 41.66 seconds) and the participants of group IV (7.6- 8 years) took the minimum time (mean time = 30.93seconds). The results showed a developmental pattern where time taken to complete the task reduced as age increases.

The differences in performance were significant across age groups where as gender differences were not significant. Also, significant interaction effect of age and gender was noted. Comparison of age groups within each gender showed significant age effect. But the effect of gender within each age group was not statistically significant, except in the age group III.

b) Accuracy on RAN letter

The RAN letter task is highly automatized and all the participants performed almost 100% accuracy in this task. The accuracy of naming (number of correct responses) was stabilized across age group and gender. The participants score did not vary significantly, with the maximum and minimum total mean score of 49.86 and 49.80, respectively. There was no significant age effect and gender effect, also no significant interaction effect was noted for accuracy.

The results of the present study on RAN letter supports the developmental study done by Denckla and Rudel (1974). The authors had noted statistically significant differences in time taken to complete the letter naming task across age groups. However, similar to the present study findings, the effect of gender on time taken to complete letter naming was not observed by Denckla and Rudel (1974). And also, the interaction effect of age and gender was not noted in their study. The authors also observed that very few errors were made by children over six years of age and there were no significant differences across age groups. Similar results were obtained by Badian (1993) in the rapid automatized naming of letters. Narhi et. al (2005) also found significant age effect in letter naming task in typically developing Finnish children of age 8- 11 years. Hence, the present study findings on RAN letter are in consonance with the findings of Denckla and Rudel (1974), Badian (1993) and Narhi et.al. (2005).

4) Performance in task IV: RAN digit

RAN digit is also a single category alphanumeric task where the participants were expected to name 50 randomly arranged digits printed in a chart as fast and accurately as possible.

a) Time taken to complete RAN digits

Similar to previous tasks, the results showed a developmental trend in the time taken by the participants to complete the task. The participants in the lower age group I (6- 6.6 years) took longer time to complete the task (mean time = 46.46 seconds) and the participants of group IV (7.6- 8 years) had taken minimum time (mean time = 30.23 seconds) for the same.

The results revealed that there was significant age effect on RAN digit, but there was no gender effect noted. Also, significant interaction effect of age and gender was noted. The age effect was also significant within gender, but the gender effect was statistically significant only in age group III.

b) Accuracy on RAN digit

The accuracy of naming (number of correct responses) was stabilized across age group and gender. The participants in all the age groups performed nearly 100% accuracy in task IV, with the maximum and minimum total mean score of 49.96and 49.73, respectively. There was no significant age effect and gender effect, also no significant interaction effect noted for accuracy.

The above findings receive support from the developmental study done by Denckla and Rudel (1974). The authors reported significant differences in time taken to complete the digit naming task across age group, but the gender effect was not noted. However, the author reported that the age differences were far more significant than gender differences. But the interaction effect of age and gender was not reported in their study. They also observed that very few errors were made by children over six years of age and there were no significant differences across age groups for errors. Similar results were obtained by Badian (1993) in the rapid automatized naming of digits. Narhi et al (2005) also found significant age effect in digit naming task in typically developing Finnish children of age 8- 11 years. The present study results are in agreement with the findings of Denckla and Rudel (1974), Badian (1993) and Narhi et al. (2005).

5) Performance in task V: RAN digit-letter

This task consisted of alternating stimuli, digits and letters, printed in a chart. The children were asked to name the 50 stimuli in this chart as fast and accurately as possible.

a) Time taken to complete RAN digit-letter

The RAN digit-letter task also showed a developmental pattern in the time taken by the participants to complete the task. Group I (6- 6.6 years) took longer time to complete the task (mean time = 49.43 seconds), where as the higher age group IV (7.6- 8 years) took the minimum time (mean time = 34.33 seconds) to complete the RAN digit-letter task. The results revealed significant differences across age on RAN digit-letter. But no significant gender effect was noted although there was significant interaction effect of age and gender was noted. The age effect was also significant within gender, but the effect of gender was statistically significant only in age group III.

b) Accuracy on RAN digit-letter

The participants in all the groups performed correctly nearing 100% accuracy in task V, with the maximum and minimum total mean score of 49.80 and 49.56, respectively. The accuracy of naming (number of correct responses) was almost constant across age group and gender. No significant age effect and gender effect was noticed, also no significant interaction effect of was noted for accuracy.

Narhi et. al (2005) adopted two alternating category tasks RAN digit-letter and RAN color-digit-letter in their study for examining the relationship between tasks of different stimuli. The authors found significant difference across age groups for RAN digit-letter in typically developing Finnish children of age 8- 11 years. However they had not considered gender as a variable while discussing the study. The present study is supported by the findings of Narhi et al's (2005) study who reported developmental changes in performance on RAN digit-letter task.

6) Performance in task VI: RAN color-digit-letter

Task VI was also an alternating stimuli task where the stimuli were taken from three different categories, colors, digits and letters.

a) Time taken to complete RAN color-digit-letter

In RAN color-digit-letter task, the participants in the lower age group I (6-6.6 years) took longer time to complete the task (mean time = 66.96 seconds) and the participants of group IV (7.6- 8 years) took the minimum time (mean time = 44.36 seconds) for the same. The results showed a developmental trend where time taken to complete the task reduced as age increases.

The differences in performance were significant across age whereas, gender differences were not significant. Also, interaction effect of age and gender was not found. Comparison of age groups within each gender showed significant age effect. But, the gender difference noticed only in the age group III.

b) Accuracy on RAN color-digit-letter

The RAN color-digit-letter task where the stimuli comprised of three different categories, and the tasks considered was relatively complex than single category tasks (Wolf, 1984, 1986). Similar to other tasks, all the participants performed almost accurately 100% in this task. The accuracy of naming (number of correct responses) was constant across age group and gender. The participants score did not vary significantly, with the maximum and minimum total mean score of 49.60 and 49.20, respectively. There was no significant age effect and gender effect, and also no significant interaction effect for accuracy.

The study by Narhi et al (2005) where they examined the relationship between tasks of different stimuli supports the findings on RAN color-digit-letter.

On analysis of variance (ANOVA) investigators found significant main effect of age on RAN color-digit-letter task.

Performance across RAN tasks

It could be observed from the results of the present study that the performance of participants was better in single category alphanumeric tasks: RAN letters and digits when compared to non-alphanumeric tasks. This finding is in accordance with the findings of previous studies (Cronin & Carver, 1998; Denckla & Rudel, 1976; Wolf et al., 1986) which showed a consistent finding that after the start of formal schooling, digits and letters are named faster than colors and objects (non-alphanumeric task).

Also, the participants in the present study took longer time for RAN color-digt-letter task than any other tasks. The longer time in alternating category task (RAN- CDL) can be attributed to the complexity of the task. Since in these tasks the stimuli included were from more than one semantic category, this may have increased the complexity of the task thereby increasing the time required to complete the tasks. Wolf (1984,1986) suggested that RAN- alternating category tasks require integration of those lower level skills needed in the traditional measures of RAN- single category tasks with higher level skills such as attending to the broader context and to the patterns in order to facilitate processing. This supports the findings of the present study, where participants have taken relatively longer time on RAN alternating category tasks than RAN single category tasks.

Age differences

The findings that the older children named all tasks with greater speed compared to younger children suggests that the children in the age range of 6- 8 years are in the developmental period of acquiring naming speed processes. Denckla and Rudel (1976) thought that the naming speed differences in children as an expected outcome and need no comment.

Gender differences

Although the results revealed significant gender differences, it was not as significant as age differences seen in all the tasks. The independent t-test used for analyzing gender effect revealed that only age group III showed singnificant differences between males and females in total time taken to complete the task. Hence gender cannot be considered as a major variable in the development of naming speed processes.

Accuracy (number of correct responses)

In all the RAN tasks, participants in all the age groups performed with nearly 100% accuracy. The high level of accuracy scores could be attributed to the fact that all the stimuli used in the study were familiar to the children in the younger age itself and the children had to pass the familiarity test prior to the administration of rapid naming tasks.

CHAPTER VI

Summary and Conclusions

The present study was aimed to establish normative data for the rapid automatized naming tasks for typically developing Kannada speaking children in the age range of 6-8 years. The study was carried out with the objective of establishing normative score for the six rapid automatized naming tasks- RAN objects, colors, letters, digits, digit-letter and color-digit-letter. A thorough review of literature revealed the significance of rapid automatized naming tasks in predicting the reading success in children and in evaluation of naming speed deficits in children with dyslexia and with other language disorders.

An Early study by Denckla (1972) revealed that, inefficiency in color naming could be a marker for unexpected reading failure in young children. Since then, several investigators have reported the predictive value of rapid automatized naming in reading success of children (Cutting & Denckla, 2001; Denckla & Rudel, 1974, 1976a, 1976b; Wolf, 1984, 1991; Wolf & Bowers, 1999; Wolf, Bowers, & Biddle, 2000). Wolf and Bowers (Bowers and Wolf, 1993; Wolf & Bowers, 1999) proposed the Double Deficit Hypothesis which depicts naming-speed deficits as an independent source of reading dysfunction.

Naming-speed deficits in dyslexic readers have been examined across different languages with varying degrees of orthographic regularity, including German (Wimmer, 1993), Finnish (Korhonen, 1995), Dutch (Van den Bos, 1998; Yap & Vander Leij, 1993) and Spanish (Novoa & Wolf, 1984). The findings from these studies suggested that in languages with regular orthography, the speed- of-processing variable emerged as a stronger predictor of reading performance than phonological awareness. The dearth of literature and unavailability of the empirical data related to rapid automatized naming in Indian languages emphasized the need for the present study.

The current study was carried out in 120 typically developing children in the age range of 6-8 years. All the participants were native Kannada speakers and they were divided in to four age groups based on age range. All the participants were administered six rapid automatized naming tasks individually. The time taken by the participants to complete the task and the accuracy on each task were measured. The data was subjected to several statistical measures using SPSS software (version 16.0). The mean and standard deviation for the two measures, time taken to complete the task and accuracy, were compared across age group and gender for each task.

Detailed analysis of the results on time taken to complete the rapid automatized naming tasks by typically developing children of the four age groups showed that

a) The participants from the four age groups showed a developmental pattern in the mean time taken to complete the task.
b) In all the six rapid automatized naming tasks, RAN- objects, colors, letters, digits, digit-letter and color-digit-letter, the participants in the younger age group took more time to complete the tasks compared to participants in the older age group. The mean time taken to complete the task reduced as the age range increased from 6-6.6years to 7.6-8years.
c) Differences in mean time taken to perform all the six tasks across the age group were statistically significant 0.05 level of significance.

d) The performance of rapid automatized naming tasks showed gender differences in some of the tasks. It was found that there was significant differences between males and females in task I (RAN- object) and task II (RAN- color), though the gender differences were not found to be significant in other tasks.
e) Significant interaction effect of age and gender was also found for task I and task V.

And, the results on accuracy/ number of correct responses produced by the four groups of participants on rapid automatized naming task revealed that

a) The participants in all the age group performed similarly in all the six RAN tasks
b) There was no significant difference between the age groups in accuracy in all the six rapid naming tasks.
c) The number of correct responses was nearly hundred percent in all the six tasks
d) Gender effect was not found in all the six tasks studied.
e) Also, there was no interaction effect of age group and gender in all the six rapid naming tasks

The results of the study receive support from various studies by Denckla and Rudel (1974), Badian (1993, 1994), Wiig, Zureich and Chan (2000), Narhi et. al (2005), Kuppuraj (2009). The results of the study are conclusive of the fact that there is a developmental pattern noted in all the six rapid automatized naming tasks, given the significant differences in performance across age groups for mean time values. The accuracy of naming are almost stabilized for all the six tasks in typically developing children above 6 years of age.

Implications of the study

The data obtained from the study forms a basis for the evaluation of rapid automatized naming in Kannada speaking children in the age range of 6- 8 years i.e. the obtained data can be served as normative values for children in the age range of 6- 8 years. Since Kannada language has regular orthography compared to English, as proposed by previous investigators (Wolf, Bowers and Biddle, 2000), the measures of rapid automatized naming can become stronger predictor of reading success in children than phonological awareness skills. Also, the measures of rapid automatized naming play crucial role in identifying children with reading disabilities who do not show phonological deficits. Since these children are tend to be missed out during screening and evaluation of dyslexia based solely on phonological measures. However further research in this area is necessary in Indian languages, as the results from one study cannot be generalized to other languages.

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APPENDIX

Test Material:

Charts for the rapid automatized naming tasks

RAN- FAMILIARITY CHECK

RAN- OBJECTS

RAN- COLORS

RAN- LETTERS

RAN- DIGITS

RAN- DL

RAN- CDL

RAN – FAMILIARITY CHECK

2 4 6 7 9

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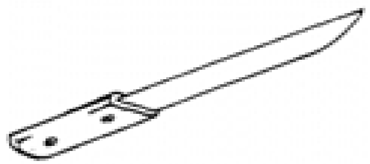
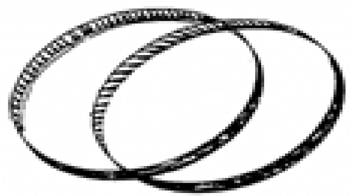
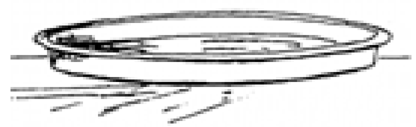
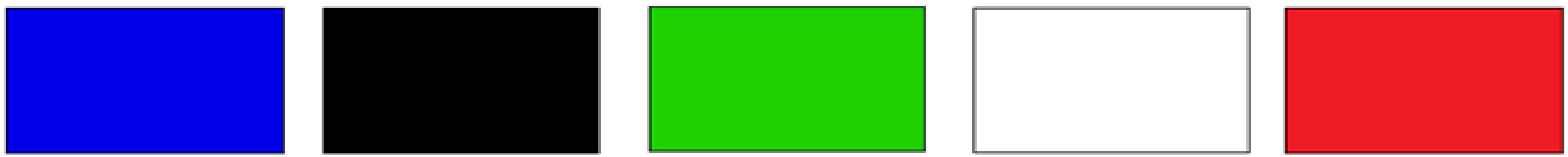
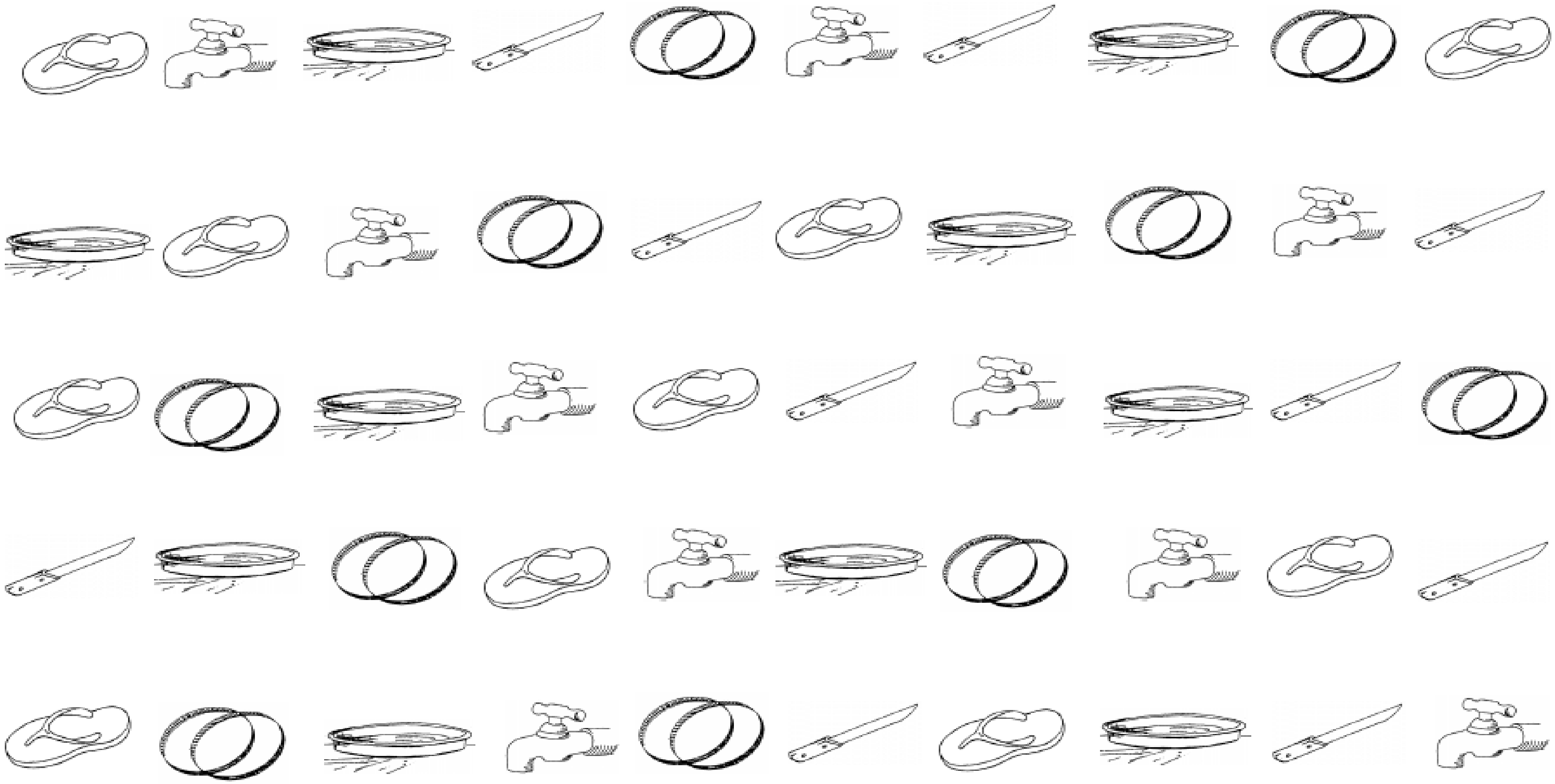
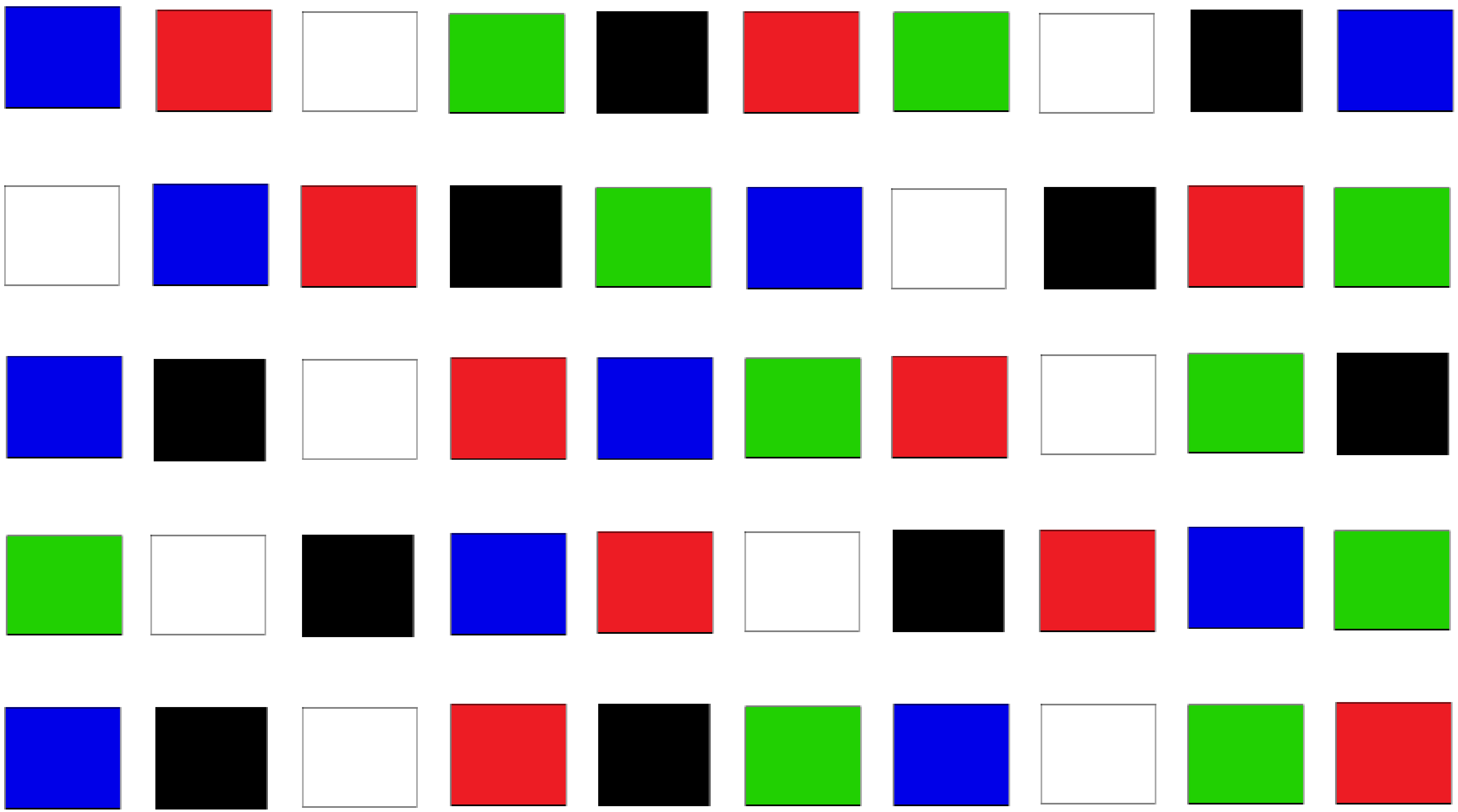
    



RAN - OBJECTS



RAN - COLORS



RAN - DL

4	ಉ	7	ಪ	2	ಅ	6	ಕ	9	ತ
6	ಪ	4	ಕ	7	ತ	9	ಅ	2	ಉ
7	ಅ	6	ಉ	9	ಪ	2	ತ	4	ಕ
2	ಉ	9	ಅ	4	ತ	7	ಕ	6	ಪ
4	ಅ	2	ತ	9	ಕ	6	ಪ	7	ಉ

RAN - LETTERS

ಉ	ಫ	ಅ	ಕ	ತ	ಫ	ಕ	ಅ	ತ	ಉ
ಅ	ಉ	ಫ	ತ	ಕ	ಉ	ಅ	ತ	ಫ	ಕ
ಉ	ತ	ಅ	ಫ	ಉ	ಕ	ಫ	ಅ	ಕ	ತ
ಕ	ಅ	ತ	ಉ	ಫ	ಅ	ತ	ಫ	ಉ	ಕ
ಉ	ತ	ಅ	ಫ	ತ	ಕ	ಉ	ಅ	ಕ	ಫ

RAN - CDL

RAN - DIGITS

4	7	2	6	9	7	6	2	9	4
2	4	7	9	6	4	2	9	7	6
4	9	2	7	4	6	7	2	6	9
6	2	9	4	7	2	9	7	4	6
4	9	2	7	9	6	4	2	6	7