DEVELOPMENT OF RAPID AUTOMATIZED NAMING TEST IN TAMIL (RAN-T)

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A Dissertation submitted in part fulfilment of degree of

Master of Speech Language Pathology

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April, 2018

CERTIFICATE

This is to certify that this dissertation entitled **"*Development of Rapid Automatized Naming Test in Tamil (RAN-T)*"** is a bonafide work submitted in part fulfilment for Degree of Master of Science (Speech and Language Pathology) of the student Registration Number: 16SLP033. 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,
April, 2018

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CERTIFICATE

This is to certify that this dissertation entitled "***Development of Rapid Automatized Naming Test in Tamil (RAN-T)***"is a bonafide work submitted in part fulfilment for the Degree of Master of Speech and Language Pathology of the student Registration Number: 16SLP033. This has been carried out under my supervision and guidance. It is also been certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this Master's dissertation entitled **"*Development of Rapid Automatized Naming Test in Tamil (RAN-T)***"is the result of my own study under the guidance of Dr. Rajasudhakar. R, Reader in Speech Sciences, Department of Speech and Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore, **Registration No. 16SLP033**

April, 2018


I DEDICATE THIS TEST
TOOL TO ALL THE
CHILDREN WITH READING
DISABILITIES

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Friends (Makes your life beautiful)

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CHAPTER 1

Introduction

Reading is crucial for a child's success in society and the person who are lacking in that, provided with a loss of social well-being. Now a days, children are often facing obstacle with difficulty in reading that is caused by deficits in phonological processing, auditory and visual and system deficits, processing speed and lexical confusion deficits.

Many researchers have tried to understand and analyze the problems of dyslexia. Learning depends largely upon one's ability to interpret the printed pages accurately and fully. Padget, Knight, and Sawyer (1996) stated that "Dyslexia as a learning based disorder with a biological origin and it primarily interferes with the acquisition of print literacy (reading, writing and spelling)''.

According to, International Dyslexia Association (2002) *"Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/ or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge."*

It is universal and not restricted to particular languages, nationalities or cultures, much investigation has focused on the prevalence or number of people expected to be affected by this disorder across the globe and age groups. The differences between

languages in prevalence rates have been shown to vary, depending on the orthographic complexity of a written language (Grigorenko, 2001).

Role of Linguistic and cognitive factors in acquisition of reading

A study with primary school children have identified five individual but integrated linguistic factors that play a pivotal role in reading acquisition were namely, phonological synthesis, phonological analysis, phonological coding, serial and isolated naming (Wagner et al., 1994).

Model of visual naming

Miceli et al, (1996) given the cognitive processes which involved in visual naming were schematically represented as,

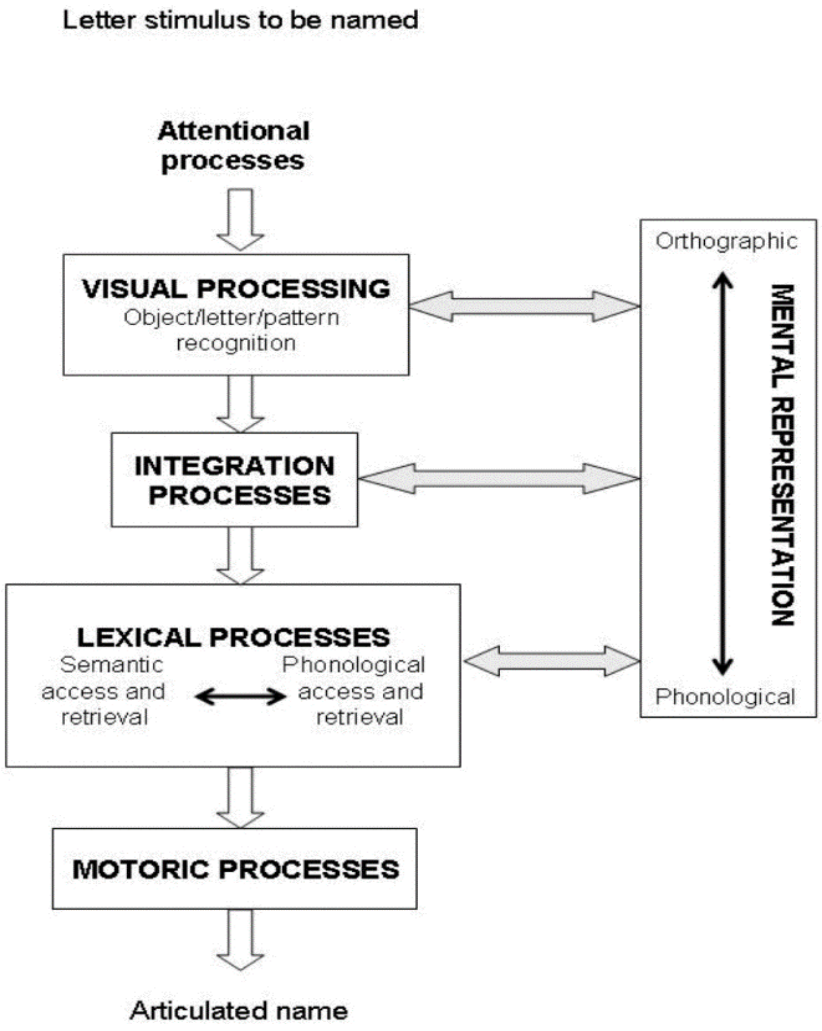


Figure 1: Schematic representation of cognitive processes for visual naming

The figure 1 depicts the series of cognitive processes involve in visual naming, such as attentional processes, visual processing of the orthographic symbols (objects, letters, colors) and the mental representation of those symbols, how those symbols are integrating with the lexical items which is already present in our vocabulary, ends with a motoric sequence to articulate a name.

Rapid automatized naming (RAN)

RAN is the ability or skill to name sequence of visually presented familiar stimuli such as colors, objects, digits, and letters. The focus on naming speed tests begun by Geschwind (1965) and tested and developed by Denckla (1972) and Denckla and Rudel (1974, 1976a, 1976b). Denckla and Rudel created a series of continuous naming-speed tasks, called Rapid Automatized Naming (RAN) tests that have been used as a prototype for measuring serial naming.

Rapid automatized naming (RAN) Vs Rapid Alternating Stimuli (RAS)

The instruments, that contain a single type of stimuli and require access to a single semantic category, are known as Rapid Automatized Naming (RAN). Other kind of rapid naming tests combine stimuli from different and alternated semantic categories within the same test requiring, for instance, the alternated naming of digits and letters or shapes and colors. These instruments, that require access to two or more semantic categories, are known as Rapid Alternating Stimulus (RAS). Many studies have resorted to the administration of RAN tests, and only very few studies (Wagner et al., 1994; Korkman et al., 1999; Wiig et al., 2000; Wolf & Denckla, 2005) have analyzed the developmental progression of RAS tests.

Hypothesis for RAN

According to Denckla and Cutting (1999), the interrelationship between language and executive functions would be clearly exemplified by rapid naming.

The existing literature (Kail & Hall, 1994; Kail, Hall & Caskey, 1999), suggested that processing speed could measure by rapid naming tasks. During the developmental stages, very fast processing of information occurs, which results in faster naming of digits, colors, or other stimuli in a rapid naming task. Thus, the phenomenon reflects "a global developmental change in the speed with which many cognitive processes are executed"

Researchers had investigated the above hypothesis and found that it is the speed of naming the colors that identifies children with dyslexia and not the accuracy of naming. The naming speed contributes in differentiating between children with dyslexia and typically developing children in RAN test. There have been many works of literature that have probed into the association amongst reading ability and performance on rapid automatized naming tasks (RAN) and had suggested several viewpoints like poor readers are consistently slower than control groups on RAN tasks. Further, a correlation of the two (Rapid naming and reading) was also suggested (Manis, Doi & Bhadha, 2000).

Phonological core deficit Vs Double deficit Hypothesis

Aspects of naming speed may present as a core aspect of the deficit in reading disabilities (RD) specifically in the developmental population. (Wolf and Bowers, 1999) This came to be known as the phonological-core-deficit hypothesis of RD. According to their presumption, rapid automatized naming (RAN) and phonological processing discrepancies are variable facets of the reading disorder, and affect its development independently. The double-deficit hypothesis predicts the existence of three separate subtypes of individuals with reading disabilities (RD), namely the phonological, rate, and double deficit subtypes. Significant phonological processing deficits together with unaffected naming speed processes constitute the phonological-

deficit subtype. The rate-deficit subtype has the reverse profile, with significant deficits in naming speed processes with comparatively normal phonological processes. Lastly, the double-deficit subtype constitutes deficits in both naming speed and phonological processes.

Schatschneider (2001) has argued that when compared to both single and double-deficit groups, the double-deficit group may possess lower phonological awareness skills, resulting in poor reading abilities in the latter.

Need for the study

RAN is a vital tool for the assessment of dyslexia and it provides the information of naming speed deficits as one of the prominent feature in reading dysfunction. RAN measures of younger children may be vital indicators of word reading abilities, in primary school children. (Wolf, Bally, & Morris, 1986; Badian, 1998 and Hu & Catts, 1998). According to various studies in the literature, RAN task helps in identifying the reading disability in early stages of life. The main advantage of this test would be less time consuming, so it could be employed as a screening tool. Many western studies have documented the naming speed deficits in dyslexic children and they also developed and provided normative for RAN in English, Spanish and Mexican languages. A very few Indian studies are available in the literature for RAN, mostly done in Kannada language (Kuppuraj, 2009; Ranjini, 2011; Impu et al., 2011; Siddaiah et al., 2016) and another in Malayalam language (Haritha, 2016). The findings of these studies cannot be generalized to children who speak Tamil language. So, the naming deficit in Tamil speaking children with the complaint of reading difficulty needs to be explored. Also, the severity of naming deficit in dyslexic children need to be understood by comparing with typically developing children. Yet, there are no

normative data available for Tamil speaking children on RAN tasks. Hence, there is a need to establish normative data for RAN tasks for native Tamil speaking children.

Aim of the study

To adapt and establish normative scores for rapid automatized naming test (RAN) in Tamil speaking children in the age range of 5-8 years.

Objective of the study

- To establish normative scores for Rapid automatized naming for colors (RAN-C)
- To establish normative scores for Rapid automatized naming for digits (RAN-D)
- To establish normative scores for Rapid automatized naming for objects (RAN-O)
- To establish normative scores for Rapid automatized naming for letters (RAN-L)
- To establish normative scores for Rapid automatized naming for digits, letters (RAN-DL)
- To establish normative scores for Rapid automatized naming for colors, digits, letters (RAN-CDL)
- To compare rapid automatized naming scores across 3 age groups.
- To determine gender difference on RAN tasks (if any).
- To compare the Rapid automatized naming efficiency in single category with alternate category task in typically developing Tamil speaking children.
- To differentiate between the performance of Government and Private school children on RAN tasks.

CHAPTER 2

Review of Literature

Many researchers have suggested that a poor scores in the subsections of RAN is associated with slow reading rate (Bowers & Swanson, 1991; Young & Bowers, 1995), poor reading accuracy, reading comprehension and poor reading performance (Frijters et al., 2011). Hence, the subtests in the RAN determine the issues to varying levels in children with learning disabilities. They help determine the severity level of the RD. Many researchers found that the poorer performance of children with SLI when compared to normal age groups, on RAN tasks.

In the context of Language disorders

Katz, Curtiss and Tallal (1992) investigated whether language-impaired (LI) children show deficits in rapid automatized naming and the RAN performance is specific to verbal output (or to rapid motor output in general). A total of 67 LI and 54 age-matched control children in the age range of 4-8 years were tested using Rapid Automatized Naming (RAN) test and with a manual version of the RAN (RAN-manual) in which subjects were required to provide a nonverbal, pantomime response. The subjects also completed tests of rapid oral and manual sequencing skills and standardized tests of reading ability. The results showed that LI children performed significantly poorer on both versions of the RAN than age-matched controls and the correlations between RAN scores and tests of reading ability were significant for normal and LI subjects. Also, they found that RAN and RAN-manual scores for the LI children correlated significantly with these children's manual sequencing abilities, whereas this was not the case for the control subjects. The findings of this study suggested that LI children's rapid sequential processing deficits are not limited to verbal output, but also generalize to other motoric domains.

Watson and Willows (1995) found differences between older poor readers who were matched in reading level with controls and young poor readers who were matched in age with controls. The older poor readers showed similar rapid naming skills when compared to young controls matched for reading age. While the control group showed increased in speed on RAN tasks, the poor readers (both young and old) showed the slowest speeds. This finding may be related to increased exposure to letters and numbers as well as decreased reaction time with age suggesting that processes tapped by the RAN tasks slowly become more automatized.

Franklin et al. (2000) studied the relationship among different measures of naming speed, phonological awareness, orthographic skill, and other reading sub skills in a representative samples of 85 second graders, 44 boys and 41 girls. They have excluded the children who were not proficient in English and high socio economic status. The tests used for the evaluation were Rapid automatized naming test (Denckla & Rudel, 1976) for assessing the naming speed, sound, syllable and phoneme deletion task, blending tasks for assessing the phonological awareness skills, letter string choice tasks, 25 pairs of non-word look alike word reading task for assessing orthographic skills, Wood cock word identification sub test, Non word reading test and reading comprehension test for assessing other reading skills. In the results, they have found that unique contribution of naming speed to reading was relatively stronger for orthographic skills, whereas the contribution of phonemic skills was stronger for non-word decoding. The phonological disorder were highly correlated with RAN reading task. Further they found marked deficits on a range of reading tasks, including orthographic processing. In that, children with double deficit showed slow naming speed and low phonemic awareness than children with single deficit. These findings were in agreement with Bowers and Wolf's (1993; Wolf & Bowers, 1999) double-

deficit hypothesis of reading disability. Also, they have classified the children into four subgroups based on their performance on digit naming and sound deletion. A 25th-percentile cutoff score was used to form a naming-speed deficit (NSD) subgroup (n = 8), a phonemic awareness deficit (PD) subgroup (n = 13), a double-deficit (DD) subgroup (n = 8), and a no-deficit (ND) subgroup (n = 50). The results were consistent with analyses reported by Bowers et al. (1999), Sunseth and Bowers (1997), and Wolf and Bowers (1999).

The authors have concluded that the single-deficit subgroups scored slightly below-average readers as a group, as indicated by Wood cock Word Identification percentile scores. The single phonological deficit (PD) group scored significantly lower than the ND subgroup on each of the phonologically related tests not used to define the group (Non-word Reading, Word Attack, and Sound Blending). The single naming speed deficit (NSD) subgroup scored low on RAN-Letters and RAN Pictures (as well as the defining measure, RAN-Digits), confirming the picture of an overall naming-speed deficit. Contrary to expectations, the NSD group was closely comparable to the PD and ND subgroups on the two orthographic tasks-Letter String Choice and Orthographic Choice-and comparable to the PD subgroup on Exception Words, indicating that a selective naming-speed deficit was not associated with low levels of orthographic skill in the current sample. The double-deficit hypothesis received some confirmation from the comparison of the double-deficit (DD) group to the other groups. The DD group was generally the lowest performing subgroup across tasks. DD readers performed significantly more poorly than the PD subgroup on Orthographic Choice. The study did not account for the contribution of naming deficit to reading disability, is one of the limitation of the study.

Literature quotes studies on the developmental patterns for three continuous rapid naming tasks like Wiig, Zureich and Chan (2000) studied 2,450 typically developing children and 136 children with Spoken language disorders (both receptive and expressive type) without any associated conditions in the age range of 6-21 years. There were 200 students (100 girls and 100 boys) at each 1-year age level from 6 through 16 years and 250 students (125 girls and 125 boys) in the age range from 17 through 21 years. The continuous naming measures used in this study are part of the CELF-3 supplementary tasks (Word Associations, Listening to Paragraphs, and Rapid Automatized Naming).The results revealed that the Naming time in seconds differed significantly between the groups for color naming (Task 1) at age 12, shape naming (Task 2) at age 6, and color-shape naming (Task 3) at ages 6, 7, 9, and 12. Naming accuracy did not differ significantly between groups at the majority of the age levels compared. In the normative group, naming speed increased with age in a monotonic progression. The developmental trajectory in the LD group was essentially parallel, but elevated. The percentages of individuals who failed the naming-time criteria for Task 3 (color-shape naming) differed significantly in the two groups at all ages compared. These findings indicate that the requirements for two-dimensional, continuous naming (Task 3 color-shape naming) resulted in reduced naming speed (longer total times) and interference with fluency in language production in about half of the clinical sample. The merits of this study holds that shape naming was part of the continuous naming measures and it evidences for prolonged time taken to finish that task at all age groups. This task was not included in most of the studies done for the assessment of reading disabilities.

Clikeman, Guy and Griffin (2000) investigated with seventy-one children with the age range of 6-12 years in three groups (reading disabilities, ADHD without reading

disabilities, and normal controls) on their ability to rapidly name colors, letters, numbers, and objects (RAN tasks) and alternating letters/numbers and letters/numbers/colors (Rapid Alternating Stimuli- RAS tasks). Wolf (1986) given a continuous rapid automatized naming task with alternating visual stimuli known as Rapid Alternating Stimuli; RAS in the form of randomly sequenced letters and digits. This task requires knowledge and production of names that represent two different semantic fields (letters and numbers) and is highly automated in proficient readers. Children with reading disabilities were found to be slower on letter- and number-naming tasks and exhibited more errors on all tasks than controls and children with ADHD. Also, there was an age effect for the RAN/RAS tasks, with younger children with reading disabilities performing more poorly on all tasks, while the older children with reading disabilities showed poorer performance only on the letter- and number-naming tasks. The merits of the study were, they clearly explained about the automaticity requires for successful reading performance. Also, this was the first study to explain that children with ADHD shows difficulty in naming (that is, takes more time to name), but it diminishes with increase in age and was not reflected in accuracy. The limitations of the study were no gender matched group was taken.

Donald et al. (2001) proposed that deficits in phonological processing and rapid automatized naming (RAN) are separable sources of reading dysfunction. Further, the double-deficit hypothesis predicts that the presence of deficits in both phonological processing and RAN have an additive negative influence on reading performance above and beyond that of a single deficit. This study investigated the additive nature of phonological awareness and RAN-deficits on written language skill in children with reading disabilities. The relationships between Phonological awareness, RAN, and written language skills were studied in 476 children with reading abilities, in the age

range from 8 to 18 years of age. The analysis of the study found that the phonological awareness and RAN skill have an interaction effect on a majority of the reading and spelling measures. When participants were classified into three deficit subtypes based on the double-deficit model (i.e. phonological, naming speed, and double-deficit), comparisons across the subtypes confirmed that individuals with double-deficits performed below the single-deficit groups on both subtyping variables (RAN and Phonological awareness) and all measures of written language. When the double and single-deficit groups were matched on the subtyping variable (i.e. double- and naming speed-deficit groups matched on RAN and double- and phonological-deficit groups matched on Phonological awareness) differences between the double and phonological-deficit groups remained in non-word reading, timed word recognition and reading comprehension. The results of the study supported that an additive model in which RAN-deficits primarily affect tasks that require speeded/fluent response, and phonological awareness deficits primarily affect tasks that emphasize phonological processing skill in children.

Albuquerque and Simões (2010) administered the Digits Rapid Automatized Naming (RAN) test and a Colors and Shapes Rapid Alternating Stimulus (RAS) on 904 Portuguese, normally achieving children (age range: 7 to 15 years), in order to examine these tests scores follows developmental course. The results showed that the two tests had slightly different developmental route, which were digits naming accuracy was greater and stable across ages, while colors and shapes naming accuracy is lesser at the age range of 7-8 years and improves thereafter; naming time reduces, noticeably, between age range of 7 and 12 years for digits and between the age range of 7 and 9 years for colors and shapes; naming speed, in both tests, continues to improve until the age of 15.

Katzir, Kim, Wolf, O'Brien, Kennedy, Lovett, and Morris (2006) investigated the relative participation of phonological awareness, orthographic pattern recognition, and rapid letter naming to a fluent word and connected text reading in a participants of 123 dyslexic children from second and third grade. In their study, the relationship between rapid letter naming and phonological measures was investigated. They found that the phonological awareness, rapid letter naming, and orthographic pattern recognition contribute to word-reading skills. Also, rapid naming, orthographic pattern recognition, and word reading fluency helps in predicting the different dimensions of connected-text reading (i.e., rate, accuracy, and comprehension) whereas phonological awareness contributes only to the receptive dimension of connected-text reading.

Stainthrop, Powell, and Stuart (2013) studied the relations between phonological awareness, naming speed and spelling ability among 146 children in the age of 3 and 4 years. Seventy-two children who had participated in the study, were identified as having normal phonological awareness but poor rapid automatized naming (RAN) performance. A group of 74 children was then assessed further and were matched on verbal and nonverbal IQ, phonological awareness, and visual acuity, with all members of this group having normal RAN performance. RAN pays a unique contribution towards performance in spelling. The analyses showed that participants with low naming performance were noted as significantly poorer spellers in overall observation and had a specific difficulty in terms of spelling irregular words. The authors have concluded that the significant participation of RAN on spelling performance among children and the children who scored lesser in the performance on RAN were considered as the children poor spellers.

Poulsen, Juul, and Elbro (2015) showed that One hundred and sixty-nine preschool students were given measures of RAN and additional measures of

phonological awareness, lexical search speed, and letter knowledge. Their reading skills were tested a year later along with speed of processing. Phonological awareness and letter knowledge significantly mediated the RAN–reading relationship, each accounting for a moderate part of the correlation between RAN and reading fluency. Thus, the RAN–reading correlation was partly, but not fully, accounted for precursors of reading that are currently known. Thus, the authors concluded that the RAN identifies early reading skills and it can be measured before reading curriculum starts. RAN performance is also considered as a good indicator of present and future reading skills as it needs many cognitive processes, from visual to working memory and also connects the orthographic and phonological representation. These results were supported by Norton & Wolf, (2012).

RAN on Bilinguals

Wood, Bustamante, Fitton, Brown and Petscher (2017) examined the feasibility of a rapid automatic naming (RAN) task for young Spanish–English speaking dual language learners (DLLs) and to find the relationship between children's performance on RAN and other standardized language and literacy assessments. A total of 275 Spanish–English speaking children in kindergarten and first grade attempted a RAN task and completed assessments of language and early literacy. The RAN task was attempted by only 74% (n = 203) of the DLLs; however, 42% of participants in kindergarten were unable to complete the task. The analysis of results revealed positive correlation between performance on RAN and receptive vocabulary scores and letter-identification, a small positive correlation with non-verbal intelligence, and no significant relationship with phonological awareness that becomes contradictory to the previous research evidences. The relation was found to be variable between the current test and repetition tasks of sentences in English. There were a differential relation

between RAN and English sentence repetition tasks. As the tasks included in the current test were easy to perform it was a good measure of performance in the primary school children.

Siddaiah et al. (2016) investigated the RAN performance in Kannada-English bilingual children in India. A total of 600 children who were studying in four English medium schools from first grade through tenth grade participated in the study and the age range was from 6 to 16 years. Each grade consisted of 60 children including 30 boys & 30 girls. The participants were scored well in academics and not having any physical and mental issues. The children were administered RAN tasks Digit Naming, Color Naming, Object Naming, Letter Naming individually in both English and Kannada languages. The responses were recorded and calculated the total time taken and accuracy using Sound Forge Software. Also, the study revealed that the faster naming abilities in all the tasks across the different age groups in both the languages. Another interesting finding showed that the children performance on RAN in English was significantly better (faster) than in Kannada. The error rate was increased in Kannada but there was no significant difference between these two languages. The authors suggested that the differences in the performance may be because of plausible bilingualism.

However, majority of the studies that were published on issues related to RAN are in English and other languages. A very few studies have done in Dravidian languages.

RAN as a Sub-test in Dyslexia Assessment Tool

Kuppuraj (2009) developed dyslexia assessment profile for Indian children (DAPIC) in English. The author used Rapid automatized naming test as one of the 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 participants, where they were asked to name randomly placed pictures (objects) as fast as possible. The stimuli consisted of five items which were randomly repeated to make a total 35 items. The author found that the children showed increased performance from lower to higher grades suggesting a developmental pattern. Rapid naming improved in higher grades and a significant difference between the performance of typically developing children and children with dyslexia was reported.

Sarika (2011) studied the development of emergent literacy in Kannada-speaking English Language Learners (ELLs) in the age range of three to six years. The objective of the study was carried out in the following phases: Survey of emergent literacy experiences of preschool children by assessing the literacy environment at home, in the classroom and the quality of books available to them. Development of a Tool for Emergent Literacy Assessment (TELA). Assessment of emergent literacy skills by evaluating the oral language, print knowledge and phonological processing skills of preschool children using TELA. The author has studied the relationships among the emergent literacy skills and investigated that the developmental pattern of Emergent literacy domains such as Oral language, Orthographic knowledge and Phonological processing in three to six years children. Also, investigated how it shares the inter-relationships with one another on Emergent literacy domains such as Oral language, Orthographic knowledge and Phonological processing. 95 participants in the

age range of 3 — 6 years were selected from preschools with similar literacy environments after a series of three surveys that were conducted in ten preschools with English as the medium of instruction. Several measures were designed to assess each emergent literacy component in detail (vocabulary, story retell, and concepts about print, alphabet knowledge, emergent writing, phonological awareness, short term memory and *rapid automatized naming*). TELA was designed specifically for preschool children and therefore, majority of tasks were accompanied with colour pictures. Participants were assessed in a quiet room of the school after obtaining informed consent from the parents and the school authorities. Participants' responses were recorded on TELA score sheets; some responses were audio recorded and timed as per requirement of the task. Based on the results of the study, the investigator derived a developmental pattern for Emergent Literacy skills in ELLs. This developmental pattern included only those emergent literacy measures, which showed 75% accuracy of response in Pre-KG, LKG and UKG. This findings highlight that emergent literacy emerges in overlapping developmental stages and the stage were the children enters formal literacy. Also, revealed that oral language, orthographic knowledge and phonological processing skills shared high intra- and inter-correlations among each other. It was observed that emergent literacy measures shared higher correlations in UKG followed by Pre KG and LKG, respectively. This indicates that in Pre KG, literacy skills emerged, in LKG they underwent a period of progression, where they operated at varying levels of development and by UKG, majority of emergent literacy skills were well developed, as reported by the author. The important finding of this study was that the inter-relationships among emergent literacy skills changes over time. The implication of the study suggested that not all emergent literacy skills need to be focused upon for all preschoolers during the assessment. Depending upon the age of

the child, professionals may choose certain skills that play a significant role in the acquisition of literacy at that age and/or grade.

RAN performance in Adolescents (Indian population)

Impu, Shwetha and Shyamala (2011) aimed to find out the relationship between phonological awareness and naming speed in adolescents with and without dyslexia. A total of 50 participants, of these, 20 adolescents with dyslexia and 30 normal readers, of chronological age 12 to 15 years were considered. All the participants were native Kannada speakers. The standardized tools such as Phonological awareness test and Rapid Automatized Naming Speed test were administered with verbal and tangible reinforcements. The results showed that adolescents without dyslexia performed better both in RAN as well as phonological awareness test compared to adolescents with dyslexia. Authors found that there was no significant relation between naming speed and phonological awareness, which suggests poor reading performance in adolescents with dyslexics may be due to dominant deficits in either phonological awareness or rapid naming speed measure. The authors suggested a future implication of the study such as to explore the other subtypes of LD and a need to develop test batteries in Indian languages and therapy activities on both phonological awareness and RAN can be attempted.

Development of RAN in various Dravidian languages

a. Rapid Automatized Naming test in Kannada (RAN-K)

Ranjini (2011) examined the performance of RAN task in 120 typically developing children in the age range of 6-8 years with the objective to establish normative data. All the participants were native Kannada speakers and they were divided in to four groups, each group consisted of 30 individuals (15 boys and 15 girls) in the age range of 6-6.6 years, 6.7-7 years, 7-7.6 years, 7.6-8 years. All the participants

were administered six rapid automatized naming tasks (single category such as colors, objects, digits, letters and alternate categories such as digits-letters, colors-digits - letters) individually. The time taken and accuracy on each task were measured. The results of the study revealed that there was a significant difference between the younger age group and the older age group of children. Younger children took longer time (Total mean for time taken of 6-6.6 years was 60.23 secs) to complete the task compared to older group (Total time taken of 7.6-8 years was 44.93 secs) across all the six rapid naming tasks. And, there was no significant difference in accuracy measures across all the age groups as well as no gender effect reported. Also, the measures obtained in the study provides the normative values for the children in 6-8 years of age for Rapid Automatized Naming. This test plays crucial role in identifying children with reading disabilities who do not show phonological deficits. The RAN-K (Rapid Automatized Naming in Kannada) can be employed to children whose native language is Kannada and cannot administer to other Indian Languages. This is a screening tool that was designed only for assessing the rapid naming ability which act as a precursor to find the reading disabilities.

b. Rapid Automatized Naming test in Malayalam (RAN-M)

Haritha (2016) investigated the relationship between rapid automatized naming (RAN) and reading in Malayalam speaking children with SLI. The author considered two groups: clinical group (children with SLI) and age and gender matched control group (typically developing children-TD) in the age range of 5-7 years. Rapid automatized naming (RAN) of colors, digits, objects, letters (single category) and digits-letters, colors-digits-letters and reading tasks were assessed in TD children and children with SLI. Author has measured accuracy of responses and total time taken for RAN tasks. The results revealed that the children with SLI performed poorer in RAN

tasks and in reading tasks compared to TD children. That is, there was a significant difference found between TD children and children with SLI on RAN and reading tasks on both the age groups (5 to 6 and 6 to 7 years). Also, the author found a good correlation between RAN and reading task in young children (5-6 years of age) and the same was not found in 6 to 7 years group children with SLI and control group. Author also found that older TD children performed better than the younger TD children on both RAN and reading tasks. Both typically developing children and children with SLI showed a developmental trend on RAN and reading tasks. The speed of processing was not found to have relation between RAN and reading skills in younger aged children with SLI. This study emphasis on RAN could be assessed as one of the early predictor of literacy skills in younger age typically developing children, children with reading disability and SLI. The author reported the limitation of the study, that is, the samples of SLI are collected from a particular district (sample from particular region cannot represent the whole population, also responses might differ due to cultural dialectal differences) and so it could not be generalized to all Malayalam speaking children with SLI in 5-7 years of age.

Hence, the development of RAN test was done only in two Dravidian languages. Let this study would be the third one in the series to adapt, develop and provide normative scores for Rapid automatized naming test in Tamil.

CHAPTER 3

Method

The aim of the present study was to adapt and establish normative scores for rapid automatized naming test (RAN) in Tamil speaking children in the age range of 5-8 years.

Participants

Three groups of participants were participated in the study. Group I included 70 typically developing children in the age range of 5-6 years. Group II consisted 70 typically developing children in the age range of 6-7 years. Group III included 70 typically developing children in the age range of 7-8 years. Each group consisted of 35 boys & 35 girls from two types of school set ups such as Government & Private Schools. A total of 210 children including 119 from Government schools and 91 from the private schools participated in the study. The details of the participants are shown in table 1.

Table 1: Participants information across three groups

Groups	Age range	No. of boys	No. of girls	Total no. of participants
I	5-6 years	35	35	70
II	6-7 years	35	35	70
III	7-8 years	35	35	70
Total		105	105	210

Inclusion criteria

- The participants had Tamil as their first language (mother tongue) and studying in English medium school.

- Participants with no history or complaint of speech, language, hearing or any other communication disorders were considered.
- Participants belonging to middle and upper socio economic status were considered as this was ensured through NIMH socio economic status scale developed by Venkatesan (2011).
- Participants had good or average rank in academics were considered (this was verified by their class teachers).
- They were not exhibited symptoms of any severe emotional, behavioral or physical disorders.
- A WHO Ten-Question Disability Screening Checklist (Singhi, Kumar, Prabhjot & Kumar., 2007) was used to screen all the subjects for hearing, intelligence, motor functions, behavioral and emotional factors.

Materials and Procedure

The study was conducted in two phases. They are

1. Development of the test material
2. Administration of the test

PHASE 1: Development of the test material

RAN test was originally designed and developed by Denckla and Rudel (1974). The same was developed and standardized in Kannada by Ranjini (2011). This test contains six different tasks; the tasks are selected based on the measure model given by Narhi et al. (2005). It consists of single category tasks designed by Denckla and Rudel (1976) and relatively complex alternate category tasks given by Wolf (1984). The RAN-SC (Single category) consists of four tasks: RAN-O, RAN-C, RAN-L and RAN-D; where RAN-objects and RAN-colors are termed as non-alphanumeric tasks and RAN-letters and RAN-digits are called as alphanumeric tasks. The stimuli in all the

four RAN-SC tasks are selected from the single lexical category. The RAN-AC consists of two tasks, RAN-DL and RAN-CDL and the stimuli in the two tasks are selected from 2 and 3 different categories, respectively. The six tasks of the test to measure rapid naming are shown in table 2;

Table 2: Different categories in RAN-T test

RAN-**Single category**	Non-alphanumeric tasks	RAN-OBJECTS (RAN-O) RAN-COLORS (RAN-C)
	Alphanumeric tasks	RAN-LETTERS (RAN-L) RAN-DIGITS (RAN-D)
RAN-**Alternate category**		RAN-Digit Letter (RAN-DL) RAN-Color Digit Letter (RAN-CDL)

Stimulus selection

The test material comprised of four categories namely; objects, colors, letters and digits naming. In that, objects, colors, digits are taken from RAN-K (Ranjini, 2011) and the letters (g k l f m) which are acquired earlier in the phonological development and articulated earlier with ease by the tamil speaking children was selected based on the frequency of occurrences in 1st, 2nd & 3rd grade Tamil text books and the selected letters in Tamil was found to occur more frequently than others. The stimuli in each category included:

1. Colours: /karuppu/; /ni:lam/; /paʧai/; /sivappu/; /vellaI/
2. Objects: /t̲aṭṭu/ ; /serupu/; /nI:rkulai/; /valaiyal/; /kat̲t̲i/
3. Digits : 2, 4, 6, 7, 9
4. Letters : ப ம ட க அ

Preparation of charts

The test material included 6 charts (one for each task). A additional chart was prepared to use it for familiarity check / Practice trial. Hence, a total of 7 charts were prepared. Each of the 6 charts for 6 RAN tasks had 50 stimuli. These 50 stimuli were arranged in 5 row by 10 column in a A4 size sheets. The same was followed for both RAN single category and RAN alternate category.

PHASE 2: Administration of the test

210 participants (70 in each group) were administered RAN tasks individually in Tamil language in a quiet room provided in the school premise. Before administering the test, both oral & written consent was obtained from the teachers / parents. The participants were briefed about the test and also check for familiarity of stimuli. Later, instructions were given in the following manner: "Now, I want you to name the objects/colors/digits/letters from the first row to the last row as fast as you can without making any mistakes and skipping items". With the above instructions, 'start' signal was given verbally and the responses were recorded using a (DAT) digital audio tape recorder (Olympus LS, 100 model). Order of presentation of RAN tasks were randomized.

Analysis

Recorded responses in the digital voice recorder was transferred to the computer or laptop. By using 'Play back' option, the accuracy of responses was calculated. The total time taken to complete the task was measured by using a stop-watch. Self-corrections were considered as a correct response and errors were noted. For every correct response, a score of '1' was given and for wrong response, no score was provided. The total score in each of the RAN task was '50' and the present study

measured two variables from participants, time taken and accuracy scores to complete RAN tasks.

Statistical analysis

Mean and standard deviation of total time taken to complete each tasks and accuracy of the naming was calculated. The following series of Statistical analysis was done using SPSS (Statistical Package for Social Sciences) Software (version 17.0).

- Shapiro Wilks test was administered to check whether the data follows normal distribution. As the data did not follow the normal distribution further Non-Parametric tests were employed for the analysis.
- Descriptive statistics was carried out to find the mean, standard deviation and median of for time taken and accuracy scores for typically developing children from Government and Private schools performance on RAN tasks.
- Kruskal Wallis test was carried out to compare the age groups on RAN tasks. If significant difference observed, then Mann Whitney U test was performed to see the pair wise significant difference in terms of age group.
- Mann Whitney U test was performed to see the gender effect on total time taken and accuracy on RAN tasks.
- Friedman's test was performed to determine any statistical significant difference across six different RAN tasks. Further, Wilcoxon signed rank test was performed to check the pair wise comparison.
- Mann Whitney U test was performed to compare the children between Government schools and Private schools in terms of total time taken and accuracy scores on RAN tasks.

CHAPTER 4

RESULTS

The aim of the present study was to establish normative (Mean, S.D and Median) scores for rapid automatized naming test (RAN-T) in Tamil for typically developing children in the age range of 5-8 years. A total of 210 children including 119 from Government schools and 91 from the private schools participated in the study. They were divided in to three groups. Group I (5-6 years) consisted of 14 boys and 30 girls from Government schools & 21 boys and 5 girls from Private schools, Group II (6-7 years) consisted of 22 boys and 30 girls from Government schools & 13 boys and 5 girls from Private schools and Group III (7-8 years) included 6 boys and 16 girls from Government schools & 29 boys and 19 girls from Private schools. The study also attempted to compare the RAN scores across 3 age groups and to determine gender difference on RAN tasks. The comparison of RAN efficiency between children from Government and Private schools was done. Also, to check the tasks differences the comparison between single category and alternate category was done in the present study. The data was analyzed using the measures of total time taken (time taken to complete the task) and accuracy (number of correct responses) on six rapid automatized naming tasks such as RAN- *Single category* -Colors, Objects, Digits, Letters, *Alternate category*- Digits-Letters & Colors-Digits-Letters. Appropriate Statistical analysis was employed using SPSS Software (Statistical Package for the Social Sciences package, version 17.0) to compare across groups, gender, school types and different tasks.

The results of the present study discussed under the following sub headings;

- Performance of typically developing children on six RAN tasks
- Effect of age on RAN tasks
- Effect of Gender on RAN tasks
- Effect of tasks differences (Single vs Alternate category)
- Effect of different schools on RAN tasks.

Performance of typically developing children on Six RAN tasks

a. Total time taken

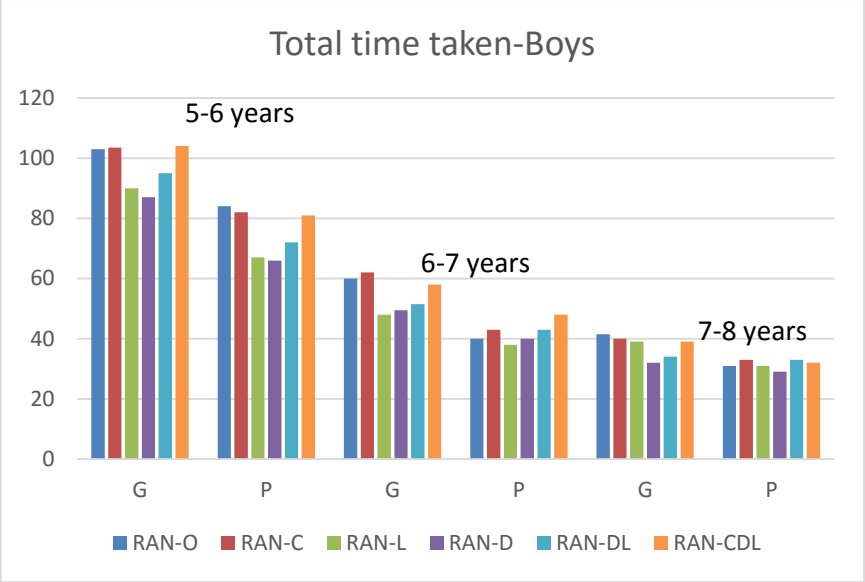
The mean, SD and median values for boys and girls of 3 different age groups were depicted in the table 3 and 4, respectively. It shows that the Mean and Median time reduces from group I to group III in both boys and girls. The children in Group I (5-6 years) has taken relatively longer time to complete the tasks compared to Group II and Group III. Group III has taken very lesser time to complete all the six RAN tasks compared to Group I and Group II. Figure 1 & 2 shows the median values for time taken to complete RAN tasks for boys and girls, respectively across three different age groups.

Table 3: Mean, Standard deviation (S.D) and Median total time taken for boys on six RAN tasks

Age groups	RAN tasks (Time taken in seconds)	Boys					
		Mean		SD		Median	
		G	P	G	P	G	P
5-6 years	Objects	102	76.5	27.9	16.6	103	84
	Colors	105.2	90.2	28.9	34..7	103.5	82
	Letters	94.2	70	31.5	20.1	90	67
	Digits	89.5	71.4	27.9	26.6	87	66
	DL	95	75	24	20	95	72
	CDL	109	82	28.6	18.5	104	81
6-7 years	Objects	61.3	39.4	10.6	5.9	60	40
	Colors	65.2	43	15.2	12.6	62	43
	Letters	47.7	38.8	11.6	7.9	48	38
	Digits	55.3	39.5	18.4	9.5	49.5	40
	DL	55	42	12.4	8.2	51.5	43
	CDL	66	47	16.2	13.5	58	48
7-8 years	Objects	43.3	31.3	5.8	4.1	41.5	31
	Colors	40.1	33.4	6.2	6.3	40	33
	Letters	39.8	29.7	3.9	5.8	39	31
	Digits	33.5	30.6	5.1	8.4	32	29
	DL	35.5	32.5	6.2	4.9	34	33
	CDL	40.3	33.4	6.9	6.6	39	32

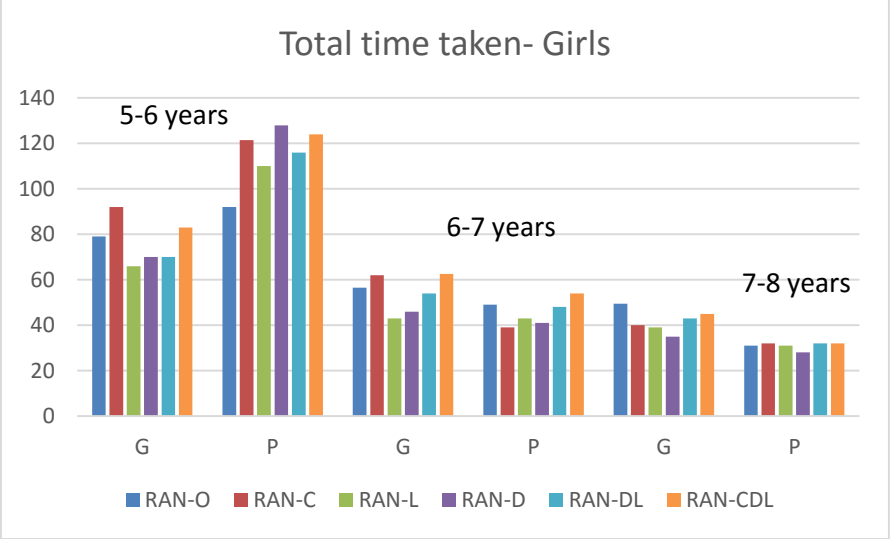
Table 4: Mean, Standard deviation (S.D) and Median total time taken for girls on six RAN tasks

Age groups	RAN tasks (Time taken in seconds)	Girls					
		Mean		SD		Median	
		G	P	G	P	G	P
5-6 years	Objects	79.2	90.7	22.2	8.1	79	92
	Colors	93.6	125.2	24.7	27.5	92	121.5
	Letters	67.5	104	20.7	35	66	110
	Digits	74	127	28.9	39.6	70	128
	DL	72	122	22.6	30.3	70	116
	CDL	88	125	27.9	33.3	83	124
6-7 years	Objects	62.1	46.6	16.4	7.7	56.5	49
	Colors	70.7	39	31.4	6	62	39
	Letters	46.4	41.2	14.9	3.4	43	43
	Digits	51	40	13.9	7.1	46	41
	DL	54	50	15.3	6.8	54	48
	CDL	65.7	57.6	17	8.6	62.5	54
7-8 years	Objects	49.6	30.7	11	3.7	49.5	31
	Colors	42.5	32.2	11.7	4.3	40	32
	Letters	39.8	29.8	8.1	5.6	39	31
	Digits	35.3	27.4	6.9	4.2	35	28
	DL	40	30.5	6.5	3.9	43	32
	CDL	43.8	32.7	7.5	4.9	45	32



G-Government school; P-Private school

Figure 2: Median total time taken for boys on six RAN tasks



G-Government school; P-Private school

Figure 3: Median total time taken for girls on six RAN tasks

It can be inferred from figure 1 and 2, that younger children (group I) are relatively took more time to name these RAN tasks when compared to older children (Group III).

b. Accuracy measures

The mean, SD and median values of accurate responses for boys and girls across 3 different age groups were depicted in table 5 and 6, respectively. It shows that the mean and median of accuracy scores were similar across 3 groups in both boys and girls. Though, there were no major differences, consistent correct responses noticed for children in Group II (6-7 years) and III (7-8 years) compared to Group I (5-6 years) because of the ceiling effect. Group I has reduced accuracy scores mainly in alternate category tasks such as RAN-DL, RAN-CDL and in single category for the complex task, RAN-C. Figure 3 and 4 shows the median values for number of correct responses on RAN tasks in boys and girls, respectively across different age groups.

Table 5: Mean, Standard deviation (S.D) and Median accuracy scores for boys on six RAN tasks

Age groups	RAN tasks (out of 50)	Boys					
		Mean		SD		Median	
		G	P	G	P	G	P
5-6 years	Objects	49.7	49.4	0.8	0.8	50	50
	Colors	49	49.4	0.9	0.8	49	50
	Letters	49.8	49.8	0.3	0.4	50	50
	Digits	49.7	49.9	0.7	0.3	50	50
	DL	49.5	49.4	0.7	0.9	50	50
	CDL	49.1	49.3	0.9	0.8	49	50
6-7 years	Objects	50	49.7	0.0	0.5	50	50
	Colors	50	49.9	0.0	0.2	50	50
	Letters	50	49.9	0.0	0.2	50	50
	Digits	50	50	0.0	0.0	50	50
	DL	49.6	49.3	0.7	0.8	50	50
	CDL	49.6	49.3	0.4	0.7	50	50
7-8 years	Objects	50	49.9	0.0	0.18	50	50
	Colors	50	49.9	0.0	0.1	50	50
	Letters	50	50	0.0	0.0	50	50
	Digits	50	50	0.0	0.0	50	50
	DL	50	49.9	0.0	0.1	50	50
	CDL	50	49.7	0.0	0.5	50	50

Table 6: Mean, Standard deviation (S.D) and Median accuracy scores for girls on six RAN tasks

Age groups	RAN tasks (out of 50)	Girls					
		Mean		SD		Median	
		G	P	G	P	G	P
5-6 years	Objects	49.7	49.5	0.5	1.0	50	50
	Colors	49.7	48.7	0.5	1.5	50	49
	Letters	49.9	50	0.5	0.0	50	50
	Digits	49.9	50	0.3	0.0	50	50
	DL	49.5	49	0.7	0.8	50	49
	CDL	49.3	48.5	0.7.	0.5	49	48.5
6-7 years	Objects	50	50	0.0	0.0	50	50
	Colors	49.9	50	0.2	0.0	50	50
	Letters	49.9	50	0.1	0.0	50	50
	Digits	50	50	0.0	0.0	50	50
	DL	49.9	49.8	0.3	0.4	50	50
	CDL	49.5	49.6	0.8	0.5	50	50
7-8 years	Objects	50	50	0.0	0.0	50	50
	Colors	50	50	0.0	0.0	50	50
	Letters	50	50	0.0	0.0	50	50
	Digits	50	49.9	0.0	0.2	50	50
	DL	50	49.9	0.0	0.2	50	50
	CDL	49.9	49.7	0.2	0.5	50	50

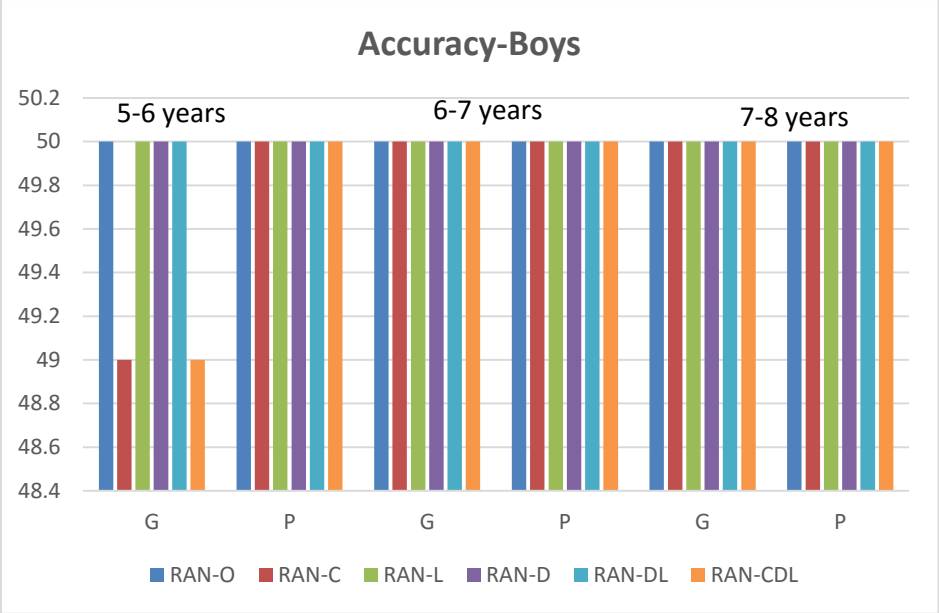


Figure 4: Median accuracy scores for boys on six RAN tasks across age groups

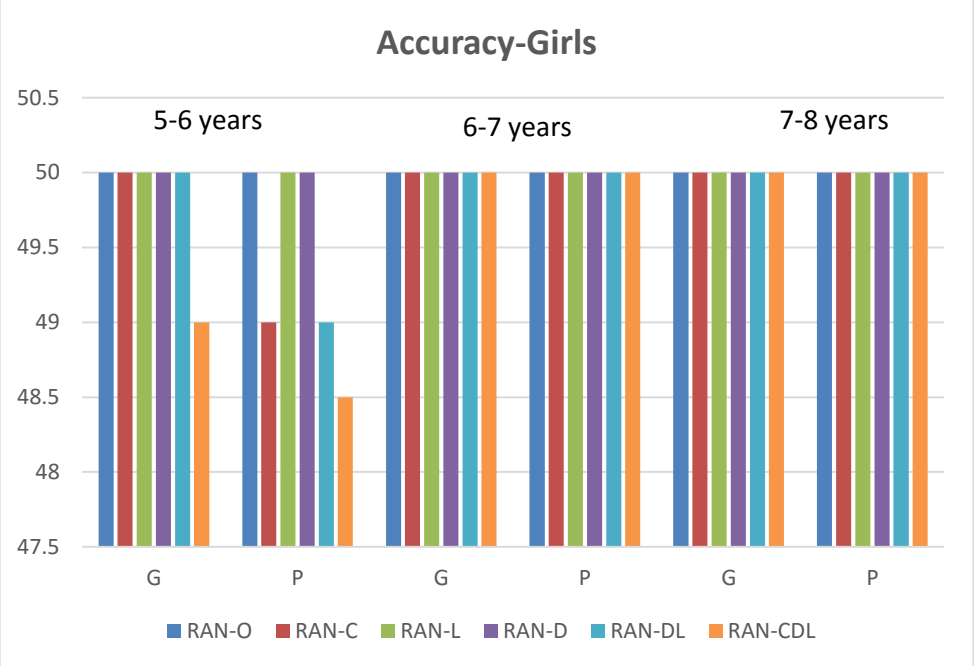


Figure 5: Median accuracy scores for girls on six RAN tasks across age groups

From figure 4 and 5, it can be inferred that the accuracy scores in boys and girls were reached the ceiling effect in 6-7 years (Group II) and 7-8 years (Group-III). Only 1 or 2 RAN tasks in younger age (Group I) participants did not achieve the ceiling effect.

Effect of age on RAN tasks

a. Total time taken

Kruskal Wallis test was performed to compare the time taken to complete the tasks across 3 different age groups and the results revealed that there was a significant difference ($p<0.01$) on all the six tasks across different age groups within each gender and schools.

Further Mann Whitney U test was done to check the pair wise difference across 3 age groups and the results revealed that there was a significant difference between Group I and group II, group II and group III, group III and group I. The values were tabulated in table 7, 8 and 9.

Group I versus Group II

Table 7: Results of the Mann-Whitney U test for group I and II comparison on time taken scores across the RAN tasks

RAN-Tasks	Private				Government			
	Boys		Girls		Boys		Girls	
	/z/	*p*-value	/z/	*p*-value	/z/	*p*-value	/z/	*p*-value
RAN-O	4.63	0.00	2.44	0.01	4.09	0.00	3.27	0.01
RAN-C	4.50	0.00	2.46	0.01	4.17	0.00	4.07	0.00
RAN-L	4.52	0.00	2.46	0.01	4.58	0.00	4.26	0.00
RAN-D	4.09	0.00	2.49	0.01	3.75	0.00	3.88	0.00
RAN-DL	4.61	0.00	2.47	0.01	4.38	0.00	3.37	0.00
RAN CDL	4.25	0.00	2.46	0.01	4.22	0.00	3.68	0.00

The group II was performed better on all the RAN tasks compared to group I in each school type and gender. It means that the children in group II taken significantly least time to complete the task compared to group I.

Group II versus Group III

Table 8: Results of the Mann-Whitney U test for group II and III comparison on time taken scores across the RAN tasks

RAN-Tasks	Private				Government			
	Boys		Girls		Boys		Girls	
	/z/	*p*-value	/z/	*p*-value	/z/	*p*-value	/z/	*p*-value
RAN-O	5.99	0.00	3.10	0.00	3.42	0.00	4.26	0.00
RAN-C	5.99	0.00	3.08	0.00	3.46	0.00	5.36	0.00
RAN-L	5.97	0.00	3.09	0.00	3.46	0.00	4.63	0.00
RAN-D	5.60	0.00	3.09	0.00	3.46	0.00	5.24	0.00
RAN-DL	5.99	0.00	3.11	0.00	3.47	0.00	4.65	0.00
RAN CDL	5.96	0.00	3.10	0.00	3.46	0.00	5.32	0.00

The group III was performed better on all the RAN tasks compared to group II children in each school type and gender. It means that the children in group III had taken significantly least time to complete the RAN tasks compared to group II.

Group I versus Group III

Table 9: Results of the Mann-Whitney U test for group II and III comparison on time taken scores across the RAN tasks

RAN-Tasks	Private				Government			
	Boys		Girls		Boys		Girls	
	/z/	*p*-value	/z/	*p*-value	/z/	*p*-value	/z/	*p*-value
RAN-O	3.78	0.00	3.15	0.00	3.39	0.00	2.88	0.00
RAN-C	2.74	0.00	2.10	0.00	3.44	0.00	4.36	0.00
RAN-L	3.42	0.00	3.24	0.00	1.96	0.00	1.30	0.19
RAN-D	3.24	0.00	3.18	0.00	3.42	0.00	4.17	0.00
RAN-DL	3.42	0.00	3.40	0.00	3.36	0.00	3.63	0.00
RAN CDL	3.11	0.00	3.39	0.00	3.16	0.00	4.56	0.00

The Group III was performed better on all the RAN tasks compared to Group I in both private & government schools and also in both boys & girls. It means that the children in group III (older group) had taken significantly lesser time to complete the task compared to group I (younger group).

Overall, the results depicted the developmental trend across the age groups on all the RAN tasks in both type of schools and in gender. The Median values indicates that group III performed better (had taken significant least time to complete the task) in all the RAN tasks compared to group I and II. Also, the group I has taken significantly more time compared to group II and III. The group II performance scores was in between group I and III in terms of time taken to complete the RAN tasks.

b. Accuracy measures:

Kruskal Wallis test was performed to compare the accuracy scores across 3 different age groups within each school type and gender and the results revealed that there was a significant difference ($p<0.05$) on most of the tasks across different age groups within each school type and gender except RAN-L of private school boys and RAN-D, RAN-L, RAN-DL of Government school boys, RAN-D, RAN-L of government and private school girls.

Further, Mann Whitney U test was done to check the pair wise difference across 3 groups and the results revealed that there was a significant difference between group I and group II, group II and group III, group III and group I.

Group I and II

Results of Mann Whitney U test revealed that there was a significant difference ($p<0.05$) found only in RAN-O, RAN-CDL, RAN-C scores. Based on the median scores, group I (Grade 1) was performing less accurately compared to group II (Grade II) children.

Group II and III

The results of Mann-Whitney U test revealed that there was no significant difference on accuracy scores between group II and group III children on all the RAN tasks.

Group I and III

The results of Mann Whitney U test revealed that there was a significant difference on accuracy scores ($p<0.05$) between group I and group III children on almost all the RAN tasks such as RAN-O, RAN-C, RAN-D (only in boys of private schools), RAN-DL, RAN-CDL. The Median scores of RAN tasks revealed that the group 1 (Grade 1) were performing less accurately compared to group III.

Effect of Gender on RAN tasks

a. Total time taken

Mann Whitney U test was administered to check whether there was a gender difference within each age group and each school type on total time taken to complete the RAN tasks. The results revealed that there was a significant difference on time taken only in group I between boys and girls across all the tasks in both (Government and Private) schools where as in group II and III, there was no significant difference. Table 10 shows the results of Mann-Whitney U test for gender difference in group I across RAN tasks.

Table 10: Results of the Mann-Whitney U test for gender comparison across the RAN tasks in group I

RAN-Tasks	Government		Private	
	/z/	*p*-value	/z/	*p*-value
RAN-O	2.601	0.00*	1.634	0.10
RAN-C	1.301	0.19	2.412	0.16
RAN-L	2.871	0.00*	1.892	0.59
RAN-D	1.876	0.06*	2.335	0.20
RAN-DL	2.637	0.00*	2.818	0.00*
RAN CDL	2.566	0.01*	0.314	0.01*

*indicate significance at 0.05 level

In group 1, girls had taken lesser time to complete at almost all the RAN tasks compared to boys in Government school. This was found to be statistically significant at 0.05 level (table 10). Whereas in private schools, generally boys performed relatively better (took lesser time) in completing RAN tasks than girls. This was found to be statistically significant between boys and girls at 0.05 level for RAN-DL; RAN-CDL only.

b. Accuracy measures

Mann Whitney U test was administered to check whether there was a gender difference within each age group and each school type on accuracy measures on all RAN tasks. The results revealed that there was no significant difference between boys and girls on accuracy scores across all the tasks except in group 1 from Government and Private Schools in the tasks RAN-C & RAN-CDL. Table 11 shows the values of Mann-Whitney U test for gender difference on accuracy scores in group I on all RAN tasks.

Table 11: Results of the Mann-Whitney U test for gender comparison on accuracy scores across the RAN tasks in group I

RAN-Tasks	/z/		*p*-value	
	G	P	G	P
RAN-O	0.545	0.304	0.58	0.76
RAN-C	2.486	0.827	0.01*	0.40
RAN-L	1.304	0.933	0.92	0.35
RAN-D	1.362	0.630	0.17	0.52
RAN-DL	0.728	1.222	0.46	0.22
RAN CDL	0.644	2.170	0.51	0.03*

*indicate significance at 0.05 level

Table 12: Median accuracy values for Boys and Girls on RAN-C & RAN-CDL

Gender	Tasks	Schools	Median values
Boys	RAN-C	Government	49.0
Girls			50.0
Boys	RAN-CDL	Private	50.0
Girls			48.5

From, table 12, it indicated that the boys were performing significantly better in RAN-CDL alternate category compared to girls in group I from private schools and girls were performing significantly better in RAN-C single category tasks compared to boys of group I from Government schools. The difference in accuracy scores between boys and girls on RAN-C & RAN-CDL showed statistically significant at 0.05 level.

Effect of Tasks differences (12 Sub groups)

a. Total time taken

Friedman's test was done to check whether there the tasks has any significant effect on performance. The results revealed that there was a significant difference ($p<0.05$) across all the tasks within each group, gender and school type. The mean ranks indicates that the non-alphanumeric tasks (RAN-O, RAN-C) has got the highest mean rank compared to alphanumeric tasks (RAN-D, RAN-L) and also, it was found that the RAN-CDL has got the highest rank, indicates children took more time to complete the alternate category than single category.

Wilcoxon signed rank test was administered to check for the pair wise difference on total time taken across all the tasks within each age group, gender and school type. The results revealed that there was a significant difference ($p<0.05$) across most of the tasks except the girls of group I from private schools who had no significant difference between any of the tasks. Based on the mean rank the tasks were compared within each age, gender and school type.

Table 13: Results of Wilcoxon signed rank test by comparing different RAN tasks using time taken scores

Groups	Schools	Genders	Task difference	χ^2 (5)	*p*-value
G1	P	Boys	T6> T2> T1> T5> T3> T4	16.825	0.05
G1	G	Boys	T6 >T2>T1>T5>T3>T4	22.75	0.00
G1	G	Girls	T2>T6>T1>T4>T5>T3	68.063	0.00
G2	P	Boys	T6>T2=T5>T1=T4>T3	10.884	0.05
G2	G	Boys	T6>T2>T1>T5>T4>T3	40.43	0.00
G2	P	Girls	T6>T5>T1>T3>T2>T4	16.42	0.00
G2	G	Girls	T2>T6>T1>T5>T4>T3	65.52	0.00
G3	P	Boys	T2>T5>T6>T1>T4>T3	23.23	0.00
G3	G	Boys	T1>T6=T3>T2>T5>T4	12.56	0.02
G3	P	Girls	T6>T2>T5=T1>T3>T4	15.58	0.00
G3	G	Girls	T1>T6>T2>T3>T5>T4	31.74	0.00

From Table 13, it can be clearly inferred that the tasks which have got more time taken to the least time taken was given in a descending order. The results indicated that the alternate category task RAN-CDL (T6) had taken more time to complete by the children across three groups compared to single category tasks (T1 to T4). Also, the alphanumeric tasks such as RAN-D (T3), RAN-L (T4) were performed significantly in

lesser time by almost all the groups compared to non-alphanumeric tasks such as RAN-O (T1), RAN-C (T2).

b. Accuracy measures

Friedman's test was done to check whether there was a task difference in accuracy scores. The results revealed that there was a significant difference of accuracy scores on all the tasks ($p<0.05$) in group I and group II except girls from private schools, where as in group III there was a significant difference ($p<0.05$) across all the tasks only in boys and girls from private schools.

Further pair wise analysis was done for the accuracy scores using Wilcoxon signed rank test on all the tasks within each age group, gender and school type. The results revealed that there was a significant difference ($p<0.05$) across most of the tasks. Based on the mean rank the tasks were compared within each age group, gender and school type, it indicated that alternate category task (RAN-CDL) were significantly performed less accurately by the children across three groups compared to single category tasks. Alphanumeric tasks such as RAN-D (T3), RAN-L (T4) has got significantly more accurate scores in all the groups compared to non-alphanumeric tasks such as RAN-O (T1), RAN-C (T2). Table 14 shows the result of children across different tasks, that they were performed more accurate in single category tasks compared to alternate tasks.

Table 14: Results of Wilcoxon signed rank test by comparing different RAN tasks using accuracy scores

Groups	Schools	Genders	Task difference	χ^2 (5)	*p*-value
G1	P	Boys	T4> T3> T1> T2=T5>T6	13.52	0.01
G1	G	Boys	T3 >T4>T1>T5>T2>T6	15.45	0.09
G1	G	Girls	T4>T3>T1>T2=T5>T6	23.41	0.00
G2	P	Boys	T4>T3=T2>T1>T5>T6	13.69	0.01
G2	G	Boys	T5>T2=T1=T3=T4>T6	26.00	0.00
G2	G	Girls	T1=T4>T3>T5>T2>T6	26.63	0.00
G3	P	Boys	T3=T4>T1=T2=T5>T6	19.61	0.01
G3	P	Girls	T1=T3=T4>T2=T5>T6	12.85	0.02

Effect of different schools on children's performance on RAN tasks

a. Total time taken

Mann Whitney U test was administered to check whether there was an effect of different types of schools on total time taken to complete the RAN tasks. The comparison between Government and private schools were done across all the tasks within each group and for each gender. The results revealed that there was a significant difference ($p<0.05$) on time taken between Government and private schools. Based on the median scores (in table 3 and 4), it can be inferred that the private school children had performed better compared to Government school in all the RAN tasks within each age group and for gender. That is, children from private schools had taken lesser time (quick in naming) to complete their tasks compared to Government schools.

b. Accuracy measures

Mann Whitney U test was administered to check whether there was an effect of different types of schools on accuracy measures in RAN tasks. The comparison between Government and private schools were done across all the tasks within each group and for gender. The results revealed that there was no significant difference ($p>0.05$) on accuracy measures in all the RAN tasks between Government and private schools within each group and for gender except RAN-CDL in boys of group I from Private school and RAN-C in boys of group I from Government school. That is, children from private schools were more accurate in performing the complex tasks (Alternate category: RAN-CDL and Single category: RAN-C) compared to children from Government schools.

Table 15: Median accuracy scores for boys in group I on RAN & RAN-CDL and the results of Mann Whitney for the school type comparison

Task	School	Median	/z/	*p*-value
RAN-CDL	Private	50.0	2.170	0.03*
	Government	49.0		
RAN-C	Private	50.0	2.486	0.01*
	Government	49.0		

*indicate significance at 0.05 level

To summarize the results of the present study

1. The present study provided the mean, S.D and median values of total time taken and accuracy scores on all RAN tasks for the typically developing Tamil speaking children.
2. The study found that the older children named all the tasks with a greater speed and good accuracy compared to younger children.

3. There was a gender effect seen on total time taken and accuracy scores only in group I whereas in group II and III there was no gender effect. The boys were performing quick and more accurately in complex tasks (RAN-CDL) compared to girls, whereas girls were performing quick and more accurately only in colour tasks (RAN-C) compared to boys.
4. The study found that the children from government schools were performing poorer than the children from the private schools on RAN tasks because of the larger variability in education system and socio-economic status.
5. The present study also found that the performance of participants was better on single category alphanumeric tasks compared to non-alphanumeric tasks. Also, the children were performed better in single category compared to alternate category tasks.

CHAPTER 5

DISCUSSION

The aim of the present study was to establish Mean, S.D and Median scores for rapid automatized naming test (RAN-T) in Tamil for typically developing children in the age range of 5-8 years, a total of 210 children (119 from Government schools and 91 from the private schools) participated in the study. This test was assessed using six different tasks; the tasks were RAN-SC (Single category) consists of four tasks: RAN-O, RAN-C, RAN-L and RAN-D and RAN-AC (Alternate category) such as RAN-DL and RAN-CDL. The measures included were the total time taken and accuracy of naming. The data subjected to statistical analysis using non parametric tests and the Mean, SD and Median scores of time taken and accuracy for the typically developing Tamil children was calculated for each group. The results were appropriately tabulated and analyzed for the further comparison of age, gender, tasks difference on performance on RAN tasks. Also, the comparison between private and government school children performance were studied.

The results of the present study indicated several points of interest:

First, Performance of children on RAN tasks shows a developmental trend on total time taken to complete the tasks. The obtained results can be used clinically as normative scores on RAN tasks in Tamil speaking children between 5 to 8 years of age.

Second, Younger children, group I (5-6 years) performed (took more time) slowly on RAN tasks compared to older children-group III (7-8 years). It clearly depicted that the older children, group III (7-8 years) named all the tasks with a greater speed compared to younger children, group I (5-6 years). This is because of the highly recognized interrelated linguistic factors, like isolated naming, rapid and serial naming which plays an important role in the acquisition of reading are expected to master as

they move from grade to grade and as a function of age. Also, the lexical retrieval that requires complex scanning, sequencing and processing of continuously presented materials improves by the neural maturation as the age increases. Proponents in this area suggested that only the letter identification and letter to sound association achieved in early school age (kindergarten) children, whereas the naming speed increased as a function of age. Thus, it can be conclude that there is an age effect on RAN tasks. This results supports the findings of Denckla and Rudel, 1974; Kail et al., 1999; Wiig et al., 2000; Van den Bos et al., 2002; Wolf and Denckla, 2005; Narhi et al., 2005, Kuppuraj (2009), Albuquerque and Simões, 2010, Ranjini (2011), Siddaiah et al., 2014, Haritha (2016). Majority of the previous studies suggest that ceiling level in naming speed is reached at around eight grade level (Denckla & Rudel, 1974; Meyer et al., 1998; Van den bos et al., 2002; Wolf & Denckla 2005). In case of bilinguals, the large increments in naming speed are made by the end of second grade level in second language but the increments were observed in naming speed up to third grade level in first language (Wolf et al., 1986; Siddaiah et al., 2014).

Third, there was no significant difference on accuracy scores on RAN tasks across the three age groups (except RAN-C, RAN-DL, and RAN-CDL). The results showed that there was no significant difference of accuracy scores on all the six RAN tasks across age groups where as in grade I, it was found that the children performed less accurately in few complex tasks such as RAN-CDL, RAN-DL and RAN-C compared to the older children (group II & group III). Thus, it suggests that the accuracy of naming (number of correct responses) would be stabilized across age groups because of the ceiling effect which means that the concepts of objects, letters, digits and colors have been developed earlier (younger age). This findings of the present study are in agreement with the findings of Denckla and Rudel, 1975; Badian (1993, 1994), Narhi

et al., 2005, Ranjini, 2011 and Haritha (2016) where they also reported that younger age children exhibited very few accuracy errors in RAN tasks and older children had cent percent accuracy scores.

Also, it was found that the group I children have performed less accurately in few RAN tasks such as RAN-CDL, RAN-DL and RAN-C because of the age effect and the complexity of the tasks. Since in these tasks, the stimuli included were from more than one semantic category it may increases the complexity. This results are in consonance with the previous developmental studies done by Denckla and Rudel (1974). They observed that very few errors made by children over 6 years of age on RAN-C compared to other single category tasks but it was not significant. Narhi (2005) found that the younger children performed less accurately on Alternate category tasks RAN-DL and RAN-CDL compared to the older children but it was not statistically significant.

Fourth, there was no difference between boys and girls on RAN tasks across different age groups on total time taken except group I. That is, the present study found no gender effect on total time taken across age groups except in group I children. The girls from government school were performing better compared to boys from government school, because usually the girls have better speed of processing in earlier age compared to boys. This results supports the findings of Kuppuraj (2009); Ranjini (2011); Siddaiah et al, (2014) and Haritha (2016). The above studies reported that higher mean values in boys (indicates taking more time to complete the task) compared to girls but it was not significant. Another contradictory results found in the present study is girls from the private school were performing poorer compared to private school boys. This is because, the total number of girl participants in group I private school was less (n=5) but the boys from private school were more (n=31). Due to the

unequal distribution of boys and girls in group I private school, reveals the contradictory results. Further, the gender difference was not found in group II and group III. Thus, it can be concluded that in general there was no gender effect on RAN tasks across age groups and it is in agreement with the findings of Denckla and Rudel (1975), Wolf and Denckla (2005); Narhi et al, (2005), Kuppuraj (2009); Ranjini (2011); Siddaiah et al, (2014) and Haritha (2016) where they too reported no difference between boys and girls on RAN tasks.

Fifth, there was no significant difference on accuracy scores in RAN tasks between boys and girls (except a few RAN tasks in group I). That is, the present study found that there no significant gender effect across age groups on accuracy scores on RAN tasks except in few tasks in group I (RAN-CDL and RAN-C). It was found that the group I boys were performing better in RAN-CDL tasks compared to group I girls, where as in RAN-C the group I girls were performing better compared to group I boys. This could be because of unequal number in each gender in group I. The results of the present study (no gender effect) are in consonance with the findings of various previous studies done by Denckla and Rudel (1975), Wolf and Denckla (2005); Narhi et al, (2005), Kuppuraj (2009); Ranjini (2011); Siddaiah et al, (2014) and Haritha (2016). Yet no studies have reported significant gender difference on accuracy scores in some of the RAN tasks. This would be the unexpected finding of gender effect on complex RAN tasks (RAN-CDL & RAN-C) observed only in the younger age group (group I in the present study). In future, studies can be done to explore the gender difference on accuracy score in complex RAN tasks in even younger age group lesser than 5 years of age.

Sixth, there was a significant higher/more time to complete alternate category tasks than single category and participants took significantly lesser time for RAN-

alphanumeric tasks than RAN non-alphanumeric tasks in all the three groups. That is, the present study found that the performance of participants in total time taken was better in single category compared to alternate category because of the complexity of the task. Also, the study found that the children's total time taken was better on alphanumeric tasks compared to non-alphanumeric tasks. In these alternate tasks (RAN-DL and RAN-CDL) the developmental pattern was observed in the time taken to complete the tasks by the participants. The group I (5-6 years) took longer to complete the tasks, whereas older children (7-8 years) group III took the lesser time to complete the alternate category tasks, but overall, there is a significant difference on time taken between single and alternate category. Thus it suggests, that the performance by the children across age groups on RAN alternate tasks was poor compared to single category tasks. The reason behind these results are the complexity of the tasks where the participants need to shift the attention between 2 or 3 lexical categories. Thereby, it increases the time to complete the tasks. Wolf (1984, 1986) suggested that RAN-alternate category tasks requires higher level of processing to integrate pictures from three different semantic categories. It needs the higher level skills such as attending to the broader context and to the patterns in order to facilitate processing. The results supports the findings of previous studies such as Denckla and Rudel (1975), Wolf and Denckla (2005); Narhi et al, (2005); Ranjini (2011); Siddaiah et al, (2014) and Haritha (2016) where they reported better performance on single category than alternate category tasks. Also, it could be observed that performance of participants was better in single category alphanumeric tasks compared to non-alphanumeric tasks. This finding is in accordance with the findings of previous studies (Denckla & Rudel, 1976; Wolf et al., 1986; Cronin & Carver, 1998) which showed a reliable finding that after the children start formal schooling, digits and letters are

named faster than the colors and objects because of early stimulation of digits and letters.

Seventh, overall, there was a difference between RAN single and RAN alternate category tasks on accuracy scores across three age groups (except group I). That is, the present study found that there was a significant difference on the performance of participants in accuracy measures across age groups except girls in group I from private school because of the less sample size. Further, in the pair wise comparison, it revealed that the children from government schools of group I and group II had significant difference between tasks and they performed better (good accuracy) in single category compared to alternate category. The poorer performance in alternating category tasks is due to the complexity of the task. This findings is in consonance with the findings of previous studies (Denckla & Rudel, 1976; Wolf et al., 1986; Ranjini, 2011 and Haritha, 2016) which showed a consistent finding across age groups that the children had good accuracy scores in single category tasks than the alternate category tasks.

Eighth, children performed relatively better on RAN tasks from private school than government school background. Interesting finding of this study is difference in the schooling affects the RAN performance. The findings of the present study is the first one in Tamil population to document that the children from private schools across age groups were performing better than the children from the government schools because of the larger variability in systematic education. The obtained results hinted the less familiarity and exposure towards the basic concepts for the children who are studying in the government school. The results of the present study could support the suggestions of Subramanian (2002) about School Education in Tamil Nadu. He suggested that the government schooling in Tamil Nadu, could raise the quality of education at primary and upper primary levels, related to refresher training to teachers,

syllabus and text books, teaching techniques, basic amenities in schools, provision of minimum levels of learning, village libraries, health education, involving the parents in the management of schools and a host of other things. Also, this results are in accordance with the previous study done by Caramen and Escribano (2016) on RAN performance based on the socio economic status as previously discussed that the children from high socio economic status performed better compared to the children from middle and low socio economic status. Also, the authors reported that even within middle socio economic status, the children who were attending day schooling had better performance on RAN tasks compared to noon schooling. Majority of the children studying in government school belongs to low or middle socio economic status in the state of Tamil Nadu. The result of the present study reflected that even different type of schooling (Private vs Government) have a significant effect on RAN performance in children.

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CHAPTER 6

Summary and Conclusion

The present study was aimed to establish normative scores for the rapid automatized naming tasks for typically developing Tamil speaking children in the age range of 5-8 years. The study was carried out with the objective of establishing normative scores for the six rapid automatized naming tasks – RAN Objects (RAN-O), RAN Colors (RAN-C), RAN Digits (RAN-D), RAN Letters (RAN-L), RAN-Digits letters (RAN-DL), RAN-Colors Digits Letters (RAN-CDL) and compared the performance on RAN tasks based on different age groups (5-8 years), gender (boys vs girls), school types (Government vs Private) and tasks (Single vs Alternate category). A comprehensive review of literature revealed the significance of rapid automatized naming tasks in predicting the reading success in children and various evidences for the test of naming speed deficits in children with language disorders. Thus, RAN task helps in identifying the reading disability in early stages of life. Many western studies have documented the naming speed deficits in dyslexic children using RAN in different languages such as English, Spanish and Mexicon languages. Indian studies were found very less in the literature for RAN, mostly done in Kannada language (Kuppuraj, 2009; Ranjini, 2011; Impu et al., 2011; Siddaiah et al., 2016) and another in Malayalam language (Haritha, 2016). The findings of these studies cannot be generalized to other Dravidian languages. So, the RAN test in Tamil language need to be developed and provided with the normative for Tamil population.

210 children were participated in the study. All the participants were native Tamil speakers and they were divided in to three groups, Group I included 70 typically developing children in the age range of 5-6 years. Group II included 70 typically

developing children in the age range of 6-7 years. Group III included 70 typically developing children in the age range of 7-8 years. Each group consisted of 35 boys & 35 girls from two types of school set ups such as Government (n=119) & Private Schools (n=91). Each individual were administered using six rapid automatized naming tasks. The time taken and accuracy scores were measured for each task and the data was subjected to several statistical measures using SPSS software (version 17.0). The mean, standard deviation (S.D) and median for the two measures, time taken and accuracy were compared across age groups, gender, school types and different tasks.

First, for the age difference:

The results revealed that the participants from all the age groups follows a developmental trend in time taken to complete the tasks and good accuracy was found across age groups except in few tasks such as RAN-C (RAN-colors), RAN-CDL (RAN-Colors Digits Letter) and it was statistically significant.

It was 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 in time taken scores and accuracy of naming are almost stabilized across age groups. Hence, it suggests that the age range of 5-8 years are the developmental period for acquiring naming speed processes because of their lexical retrieval skills improves by the neural maturation as the age increases.

Second, for the gender difference:

A gender effect was found on total time taken and accuracy only in younger group (Group I) whereas older group (Group II and III) had no gender effect. The boys had better performance on RAN-CDL task both in time taken and accuracy compared to girls, whereas girls were performing quick and more accurately only in RAN-C compared to boys and differences were statistically significant.

Although the results revealed significant gender difference in group I, it was not as significant as age differences seen in all the tasks. Hence gender cannot be considered as a major variable in the development of naming speed processes.

Third, for the task difference:

The study found that the children were performed better in single category compared to alternate category, within single category the participants had performed better on alphanumeric tasks compared to non-alphanumeric tasks and the difference were statistically significant.

Based on results of task differences in the performance of RAN tasks, it was conclusive that the complexity of the task attributed for longer time taken and lesser accuracy. The findings are in agreement with the results of various studies to conclude the RAN-CDL (colors digits letters) relatively takes more time because this task requires higher level of processing to integrate pictures from three different lexical category. Also, the alphanumeric tasks were performed/named faster than non-alphanumeric tasks. This can be attributed to exposure of children were more to digits and letters rather than colors and objects after they started the formal schooling.

Fourth, for the school type difference:

The present study found statistically significant results that the private school children were performing better than the children from the government school.

The findings of the current study concludes that the children from Private school relatively performs better compared to government school, that is majorly due to the variability in the education system, method of service delivery, curriculum development.

These obtained results were in consonance with various studies done by Denckla & Rudel, 1974; Badian (1993, 1994), Kail et al., 1999; Wiig et al., 2000; Van den Bos et al., 2002; Wolf and Denckla, 2005; Narhi et al., 2005, Kuppuraj (2009), Albuquerque and Simões, 2010, Ranjini (2011), Siddaiah et al., 2014, Haritha (2016).

Implications of the study

1. The obtained data of the present study can be used clinically for the evaluation of rapid automatized naming in Tamil speaking children in the age range of 5-8 years as norm based reference.
2. This screening tool (Rapid automatized naming test) serves as a stronger predictor of reading success in Tamil speaking children. Where, it plays a significant role in early identification of children with reading disabilities.
3. Easy to administer, precise and less time consuming holds the major advantage of this test tool.

Limitations of the present study

1. On a whole, the boys (n=105) and girls (n=105) participated for the study, but unequal number of boys and girls were represented when divided based on school types (Government and Private school) after the data collection.
2. Total time taken was calculated using a stop watch manually from a recorded sample.

Future directions

1. More studies can be done on RAN in other Indian languages
2. Future studies can be to explore gender differences in early age group (5-6 years) as well as less than 5 years.

3. Also, to study and compare the performance on RAN tasks in children from low socio economic status and higher socio economic status of Indian population.
4. Future studies can use software programmed RAN tasks to automatically get the time taken and accuracy scores.

References

Albuquerque, C. P., & Simões, M. R. (2010). Rapid naming tests: developmental course and relations with neuropsychological measures. *The Spanish Journal of Psychology*, *13*(1), 88-100.

Badian, N. A. (1993). Phonemic awareness, naming, visual symbol processing, and reading. *Reading and Writing*, *5*(1), 87-100.

Badian, N. A. (1994). Do dyslexic and other poor readers differ in reading-related cognitive skills?, *Reading and Writing*, *6*(1), 45-63.

Badian, N. A. (1994). Preschool prediction: Orthographic and phonological skills, and reading. *Annals of Dyslexia*, *44*(1), 1-25.

Badian, N. A. (1998). A validation of the role of preschool phonological and orthographic skills in the prediction of reading. *Journal of Learning Disabilities*, *31*(5), 472-481.

Bowers, P. G., & Swanson, L. B. (1991). Naming speed deficits in reading disability: Multiple measures of a singular process. *Journal of Experimental Child Psychology*, *51*(2), 195-219.

Bowers, P. G., & Wolf, M. (1993). Theoretical links among naming speed, precise timing mechanisms and orthographic skill in dyslexia. *Reading and Writing*, *5*(1), 69-85.

Bowers, P. G., Sunseth, K., & Golden, J. (1999). The route between rapid naming and reading progress. *Scientific Studies of Reading*, *3*(1), 31-53.

Compton, D. L. (2003). Modeling the relationship between growth in rapid naming speed and growth in decoding skill in first-grade children. *Journal of Educational Psychology*, *95*(2), 225.

Compton, D. L., DeFries, J. C., & Olson, R. K. (2001). Are RAN-and phonological awareness-deficits additive in children with reading disabilities?, *Dyslexia*, *7*(3), 125-149.

Cronin, V., & Carver, P. (1998). Phonological sensitivity, rapid naming, and beginning reading. *Applied Psycholinguistics, 19*(3), 447-461.

Denckla, M. B., & Cutting, L. E. (1999). History and significance of rapid automatized naming. *Annals of Dyslexia*, *49*(1), 29.

Denckla, M. B., & Rudel, R. (1974). Rapid "automatized" naming of pictured objects, colors, letters and numbers by normal children. *Cortex*, *10*(2), 186-202.

Denckla, M.B. (1972). Color-naming defects in dyslexic boys. Cortex, 8, 164-176.

Denckla, M.B., & Rudel, R.G. (1976a). Naming of objects by dyslexic and other learning-disabled children. Brain and Language, 3, 1-15.

Denckla, M.B., & Rudel, R.G. (1976b). Rapid automatized naming (R.A.N.): Dyslexia differentiated from other learning disabilities. Neuropsychologia, 14, 471-479

Frijters, J. C., Lovett, M. W., Steinbach, K. A., Wolf, M., Sevcik, R. A., & Morris, R. D. (2011). Neurocognitive predictors of reading outcomes for children with reading disabilities. *Journal of Learning Disabilities*, *44*(2), 150-166.

Geschwind,N.,& Fusillo,M.(1966).Color naming deficits in association with Alexia. Archives of Neurology, 15, 137–146.

Grigorenko, E. L. (2001). Developmental dyslexia: An update on genes, brains, and environments. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *42*(1), 91-125.

Haritha, S. M., (2016). Rapid automatized naming and reading in 5-7 year old Malayalam speaking children with Specific Language Impairment. Unpublished Mater's dissertation, Submitted to the University of Mysore, Mysore.

Hu, C. F., & Catts, H. W. (1998). The role of phonological processing in early reading ability: What we can learn from Chinese. *Scientific Studies of Reading*, *2*(1), 55-79.

Impu, C., Shwetha, C., & Shyamala, K. C. (2011). Double deficit hypothesis: the relationship between phonological awareness and rapid automatized naming in adolescents with and without dyslexia. *Journal of the All India Institute of Speech & Hearing*, *30*, 138-145.

Kail, R., & Hall, L. K. (1994). Processing speed, naming speed, and reading. *Developmental Psychology*, *30*(6), 949.

Kail, R., Hall, L. K., & Caskey, B. J. (1999). Processing speed, exposure to print, and naming speed. Applied Psycholinguistics, 20, 303–314.

Katz, W. F., Curtiss, S., & Tallal, P. (1992). Rapid automatized naming and gesture by normal and language-impaired children. *Brain and Language*, *43*(4), 623-641.

Katzir, T., Kim, Y., Wolf, M., O'Brien, B., Kennedy, B., Lovett, M., & Morris, R. (2006). Reading fluency: The whole is more than the parts. *Annals of dyslexia*, 51-82.

Kirby, J. R., Georgiou, G. K., Martinussen, R., & Parrila, R. (2010). Naming speed and reading: From prediction to instruction. *Reading Research Quarterly*, *45*(3), 341-362.

Korkman, M., Barron-Linnankoski, S., & Lahti-Nuuttila, P. (1999). Effects of age and duration of reading instruction on the development of phonological awareness, rapid naming, and verbal memory span. *Developmental Neuropsychology*, *16*(3), 415-431.

Kuppuraj, S. (2009). *Dyslexia Assessment profile for Indian Children*. Unpublished Mater's dissertation, Submitted to the University of Mysore, Mysore.

López-Escribano, Carmen. "Training reading fluency and comprehension of Spanish children with dyslexia." In *Reading Fluency*, pp. 141-161. Springer, Cham, 2016.

Manis, F. R., Doi, L. M., & Bhadha, B. (2000). Naming speed, phonological awareness, and orthographic knowledge in second graders. *Journal of learning disabilities*, *33*(4), 325-333.

Meyer, M. S., Wood, F. B., Hart, L. A., & Felton, R. H. (1998a). Longitudinal course of rapid naming in disabled and nondisabled readers. Annals of Dyslexia, 48, 91–114.

Miceli, G., Amitrano, A., Capasso, R., & Caramazza, A. (1996). The treatment of anomia resulting from output lexical damage: Analysis of two cases. *Brain and Language*, *52*(1), 150-174.

Närhi, V., Ahonen, T., Aro, M., Leppäsaari, T., Korhonen, T. T., Tolvanen, A., & Lyytinen, H. (2005). Rapid serial naming: Relations between different stimuli and neuropsychological factors. *Brain and Language*, *92*(1), 45-57.

Norton, E. S., & Wolf, M. (2012). Rapid automatized naming (RAN) and reading fluency: Implications for understanding and treatment of reading disabilities. *Annual Review of Psychology*, *63*, 427-452.

Padget, Knight & Sawyer (1996). In Marinac, J. V. (2008). *Phonological Core Dyslexia in Secondary School Students: Identification and Intervention*. Plural Publishing.

Poulsen, M., Juul, H., & Elbro, C. (2015). Multiple mediation analysis of the relationship between rapid naming and reading. *Journal of Research in Reading*, *38*(2), 124-140.

Ranjini, G. C., (2011). Rapid automatized naming – Kannada (RAN-K) in 6-8 years old typically developing children. Unpublished Master's dissertation, Submitted to the University of Mysore, Mysore.

Sarika, K., (2011). Development of Emergent Literacy in Kannada speaking English language learners. Unpublished Doctoral Thesis in Speech Language Pathology, Submitted to the University of Mysore, Mysore.

Schatschneider, C. (2001) The relationship of rapid automatized naming and phonological awareness to early reading skill: an investigation of the double deficit hypothesis. Presentation at the Annual Meeting of the Pacific Coast Research Conference, La Jolla, CA.

Semrud-Clikeman, M., Guy, K., Griffin, J. D., & Hynd, G. W. (2000). Rapid naming deficits in children and adolescents with reading disabilities and attention deficit hyperactivity disorder. *Brain and language*, *74*(1), 70-83.

Siddaiah, A., Saldanha, M., Venkatesh, Shyamala. K., Ramachandra, N. B., & Padakannaya, P. (2016). Development of rapid automatized naming (RAN) in simultaneous Kannada-English biliterate children. *Journal of psycholinguistic research*, *45*(1), 177-187.

Singhi, P., Kumar, M., Malhi, P., & Kumar, R. (2007). Utility of the WHO Ten Questions screen for disability detection in a rural community—the north Indian experience. *Journal of tropical pediatrics*, *53*(6), 383-387.

Stainthorp, R., Powell, D., & Stuart, M. (2013). The relationship between rapid naming and word spelling in English. *Journal of Research in Reading*, *36*(4), 371-388.

Subramanian, M. K., (2002), School education in Tamil Nadu, Social Action, Vol. 52, n°4, pp. 365-379.

Sunseth, K., & Bowers, P. G. (1997). The relationship between digit naming speed and orthography in children with and without phonological deficits. In *annual conference for the Society for the Scientific Study of Reading, Chicago*

Torgesen, J. K., Wagner, R. K., Rashotte, C. A., Burgess, S., & Hecht, S. (1997). Contributions of phonological awareness and rapid automatic naming ability to the growth of word-reading skills in second-to fifth-grade children. *Scientific studies of reading*, *1*(2), 161-185.

Van den Bos, K. P., Zijlstra, B. J., & lutje Spelberg, H. C. (2002). Life-span data on continuous-naming speeds of numbers, letters, colors, and pictured objects, and word-reading speed. *Scientific Studies of Reading*, *6*(1), 25-49.

Venkatesan, S. (2011). Socio economic status scale: NIMH revised version. *AIISH, Mysore*.

Wagner, R. K., Torgesen, J. K. & Rashotte, C. A. (1994). Development of reading-related phonological processing abilities: New evidence of bi-directional causality from a latent variable longitudinal study, *Developmental Psychology* 30: 73–87.

Watson, C., & Willows, D. M. (1995). Information-processing patterns in specific reading disability. *Journal of Learning Disabilities*, *28*(4), 216-231.

Wiig, E. H., Zureich, P., & Chan, H. N. H. (2000). A clinical rationale for assessing rapid automatized naming in children with language disorders. *Journal of Learning Disabilities*, *33*(4), 359-374.

Wolf, M. (1984). Naming, reading, and the dyslexias: A longitudinal overview. *Annals of dyslexia*, *34*(1), 87-115.

Wolf, M., & Bowers, P. G. (1999). The double-deficit hypothesis for the developmental dyslexias. *Journal of educational psychology*, *91*(3), 415.

Wolf, M., & Denckla, M. B. (2005). *RAN/RAS: Rapid automatized naming and rapid alternating stimulus tests*. Austin, TX: Pro-ed.

Wolf, M., & Katzir-Cohen, T. (2001). Reading fluency and its intervention. *Scientific Studies of Reading*, *5*(3), 211-239.

Wolf, M., Bally, H., & Morris, R. (1986). Automaticity, retrieval processes, and reading: A longitudinal study in average and impaired readers. *Child Development*, 57, 988-1000.

Wood, C. L., Bustamante, K. N., Fitton, L. M., Brown, D. M., & Petscher, Y. (2017). Rapid Automatic Naming Performance of Young Spanish–English Speaking Children. *Languages*, *2*(3), 13.

Young, A., & Bowers, P. G. (1995). Individual difference and text difficulty determinants of reading fluency and expressiveness. *Journal of Experimental Child Psychology, 60*(3), 428-454.

RAN-FAMILIARITY CHECK

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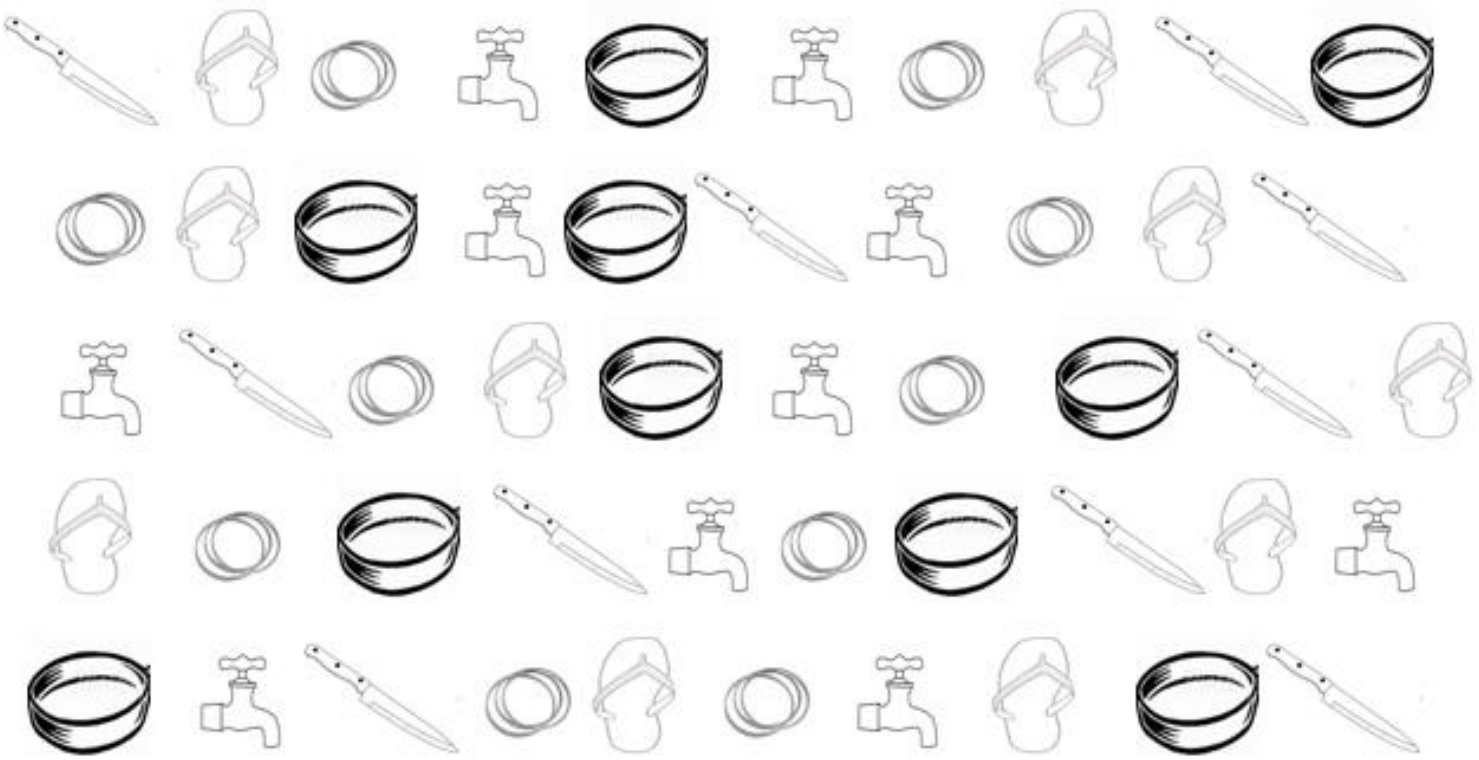
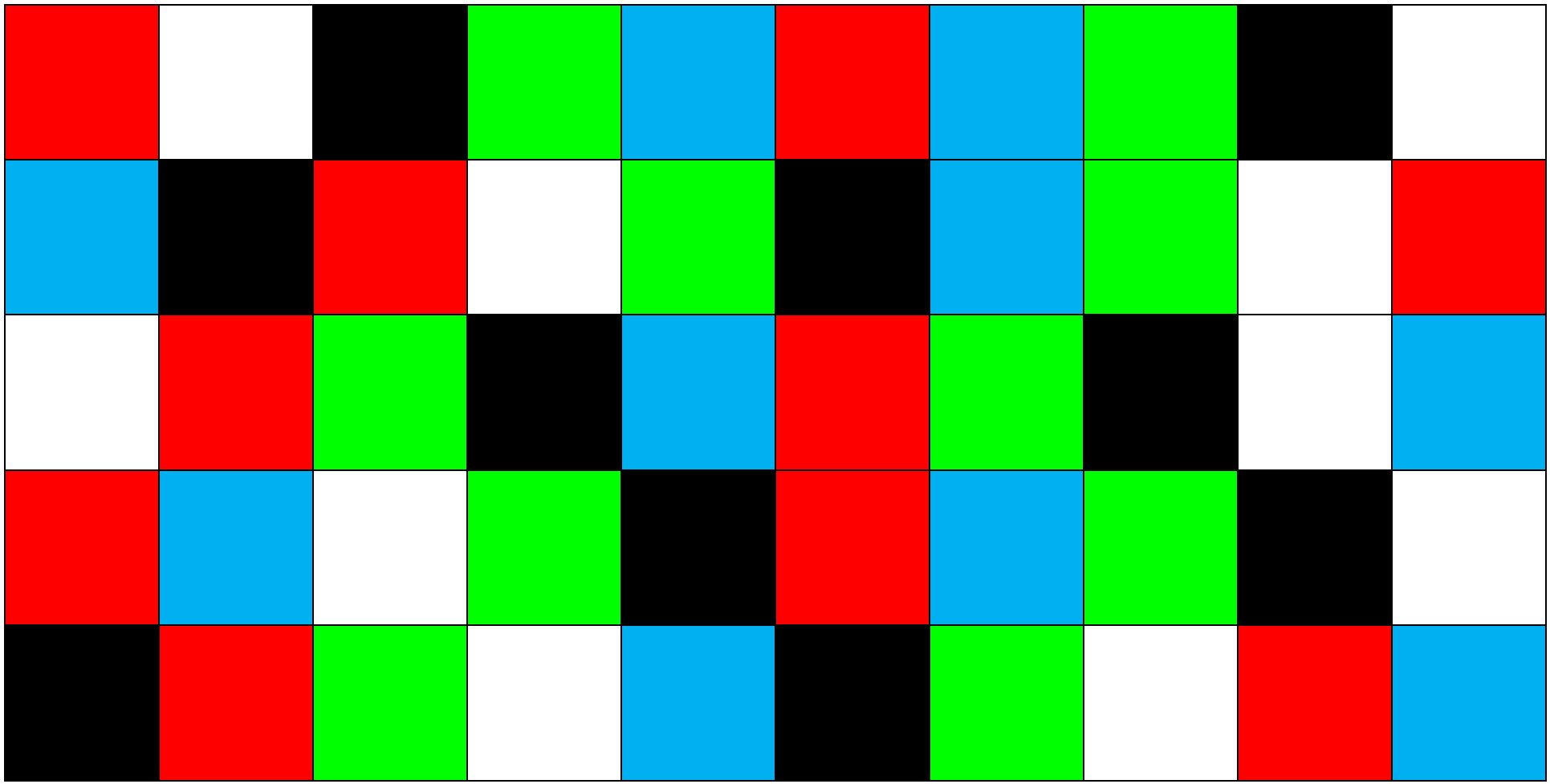
RAN-OBJECTS



RAN-COLORS



RAN-LETTERS

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RAN-DIGITS

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RAN-DL

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2	க	9	ட	4	அ	7	ப	6	ம
4	அ	2	ட	9	ம	6	க	7	ப

RAN-CDL