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Rapid Automatic Naming (Ran) Across Academic Performance in Fourth Grade Students

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Abstract:- Fluency in reading is defined as the product of accuracy and automaticity in underlying reading processes and systems. Rapid Automatic Naming skill (RAN) is the ability to name a sequence of written or pictured items quickly without conscious thought or deliberation typically by means of spontaneous association. RAN tests the ability of the child to connect visual and verbal information by giving the appropriate names to common objects, colors, letters, and digits. The Rapid Automatic Naming dyslexia is a recent subtype of dyslexia. These dyslexics have deficits in "naming speed". The stimuli used for RAN can be either non-alphanumeric/alphanumeric or single category/alternate category naming. The alphanumeric stimuli include letters & digits, while non-alphanumeric stimuli include objects and colour. Single category RAN naming can be either naming objects, colour, digit or letters and Alternate category RAN naming include naming combinations of digit and letter or colour, digit and letter

AIM:

To compare the performance of RAN in academically above average, below average and average 4th grade students, using Single category & Alternative category tasks / Alphanumeric and Non-alphanumeric stimuli.

METHODOLOGY:

The subjects were a total of 90 CBSE students of 4th grade with a mean age of 9 yrs. Based on academic performance they were categorized as follows

70-100% - Above average
50-70% - Average
Less than 50% - Below average

Each of these three academic groups consisted of 30 students. A questionnaire was distributed to class teachers to identify their reading difficulty. The stimuli used were Non-alphanumeric (RAN-Colour, RAN-Object) & alphanumeric tasks (RAN-Digit, RAN-Letter) along with Single Category & Alternating Category tasks (based on the Neuropsychological model by Vesa Narhi, 2004). The stimuli were arranged in 5 rows by 10 column table. Each task consisted of 5 different stimuli each replicated 10 times in random order. Subjects were instructed to name the stimuli of each category as quickly as possible in the presented sequence and time was recorded using stop watch.

RESULTS:

The statistical tool used for analysis of the data was one way ANOVA and Post Hoc analysis using SPSS version 11.5. Test of homogeneity of variances and One-way ANOVA were carried out for all the three academic groups for all RAN task .The results showed that the difference was statistically significant for all tasks between groups. The Post Hoc analysis (Turkeys HSD) revealed that there is statistically significant difference between below-average and above-average group in RAN-C task (p=.030) and RAN-O task (p=.024), between below-average and average group as well as below-average and above-average group (p=.000) for RAN-D task, RAN-L task RAN-DL task. and RAN-CDL task. For Single Category Vs Alternate Category tasks (p = 0.000) and Alphanumeric Vs Non-alphanumeric tasks (p = 0.001) there was significant difference between the 3 groups

DISCUSSION

SINGLE CATEGORY RAN TASKS:

a) Non- Alphanumeric RAN Tasks:

1) RAN-C:

For this task, academically below- average 4th grade students took comparatively longer time than above-average students. The possible reason for this can be attributed to complex semantic representation involved in colour naming (Dockrell, 1999).

2) ***RAN-O:***

In RAN-O tasks, academically below average students took longer time for naming objects, followed by average and above-average groups. This is explained by the "Information processing model" .According to this model, pathway used for naming digits/letters is shorter than the pathway used for naming objects/colours. Hence, naming the letters/digits takes lesser time than naming objects/pictures.

b) Alphanumeric RAN Tasks:

3) ***RAN-D & RAN-L:***

Academically below-average students took relatively longer time than average and above-average subjects. This is because of the fact that the digit naming and letter naming is more automatized when compared to the object/colour naming tasks (Wolf, 1986).

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ALTERNATE Vs SINGLE CATEGORY RAN:

Below average children took lesser time for single category RAN tasks than alternate category as these tasks require knowledge of two/three different semantic fields and speed of naming task would be compromised . In alternate RAN tasks, RAN-DL score was better than RAN-CDL tasks.

CONCLUSION:

Automatic letter recognition is the key to successful and automatic word recognition. Berninger (2000) reported that below average children need over 20 times more literacy practice in comparison to their peers. Therefore, teachers must individualize instruction to provide ample opportunity for all children to reach an automatic level of letter naming. Since RAN task does not take much time in administering for each child with dyslexia, it can be included in the test battery for assessing dyslexics among children performing poorer in academics in a school set up. Thus, RAN test is a sensitive tool which helps in early identification of children having dyslexia and thus influences the management and prognosis of reading disabled.

I. INTRODUCTION

Dyslexia is most commonly characterized by difficulties with learning how to decode at the word level, to spell, and to read accurately and fluently.Recently the British Dyslexia Association (2007) has defined dyslexia as “A specific learning difficulty which is characterized by difficulties with phonological processing, rapid naming, working memory and processing speed”.This Rapid Automatic Naming Deficit dyslexia is a recent subtype of dyslexia. These dyslexics have deficits in "naming speed", which relates to the inability to rapidly verbalize the names of symbols such as letters and numbers when tested. A deficit in "rapid automatic naming" is seen as related to an impaired mental timing system.

Rapid Automatic Naming skill (RAN) is the ability to name a sequence of written or pictured items quickly without conscious thought or deliberation typically by means of spontaneous association. RAN tests the ability of the child to connect visual and verbal information by giving the appropriate names to common objects, colors, letters, and digits. La Berge and Samuels (1974) proposed an information processing model that posited that good reading requires not only accurate, but also automatic, retrieval so that the reader's attention can be focused on meaning and content. RAN is a measure of a complex naming process that requires the coordination of attentional, perceptual, conceptual, memory, lexical, and articulatory sub-processes (Bowers, & Biddle, 2000).

The underlying mechanism in Rapid Automatic Naming task is still a hidden phenomenon. In 1986, Wolf and Bowers has given a conceptualization of the primary processes involved in both rapid naming and fluent word reading, they focus on the need for a "precise timing mechanism" that is important in the formation of the visually based representations of words that allow them to be recognized as whole units in text. According to this explanation, if children are sufficiently slow at visual recognition of letters, it interferes with their ability to construct a mental representation of a word's spelling which allows the word to be recognized automatically. The normative age limit for the acquisition of various types of RAN is not yet established. Denckla and Rudel (1976) reported that RAN develops between 5 to 11yrs.

Stimuli used in RAN:

RAN is assessed by tasks in which the subject is required to name serially presented visual stimuli as rapidly as possible. The stimuli used for RAN can be broadly divided into Alphanumeric and Non alphanumeric or Single category and Alternate category tasks. The alphanumeric stimuli include letters & digits, while non-alphanumeric stimuli include objects and colour. Van Den Bos (2000) stated that letter and number-naming speeds are superior predictors of word reading speed when compared to colour and picture naming speed. Alphanumeric naming is a better predictor of variation in reading over time than non-alphanumeric naming (Compton, 2003).Alphanumeric naming also appears to be more closely associated with reading difficulties, whereas non-alphanumeric naming appears to be most closely associated with attention difficulties (Guy & Griffin, 2002). RAN tasks can be also either Single category naming (RAN-Object, RAN-Colour, RAN-Digit and RAN-Letters) or Alternate category naming (RAN-Digit Letter, RAN-Colour Digit Letter). In dyslexics, single-item naming performance differs significantly from alternate category naming task (Bowey,2005).Studies on Single category RAN are numerous but studies on Alternate category RAN are only few.

RAN in dyslexics:

The following are studies which substantiate the fact that Rapid Automatic Naming tasks can be used to segregate dyslexics from non-dyslexics. Savage and Frederickson (2005) studied the specificity of the relationship between rapid automatic naming (object and Digit) and reading fluency in 67 children, the majority of whom were very poor readers. This suggested that rapid alphanumeric naming is a highly specific predictor of reading rate and that rapid digit naming and phonological processing are distinct contributors to different aspects of reading in poor readers.

Below-average readers may experience difficulties in making word learning automatic (Wolf & Bowers, 1999). Below average readers show particular difficulty in tasks requiring speeded and serial access to-and retrieval of-verbal labels for visually presented stimuli (Wolf & Bowers, 1999). Savage (2005) found that digit RAN and phonological processing tasks each contributed independent variance to the discrimination of small groups of below-average readers from average readers and spellers. Among the other stimuli, digit RAN was found to be a unique predictor of individual variance in spelling. Wolf and Bowers (1999) stated that alphanumeric RAN effects are strongest among samples of poor readers.

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NEED FOR THE STUDY:

Research reveals that below-average readers experience difficulties in making word learning automatic and hence exhibiting poor scholastic performance (Wolf & Bowers, 1999). This reveals the necessity to assess RAN in poor readers.

OBJECTIVE OF THE STUDY:

To compare the performance of RAN in academically above average, below average and average 4th grade students, using different stimuli i.e. Single category & Alternative category tasks / Alphanumeric and Non-alphanumeric tasks (using RAN model by Vesa Narhi, 2004).

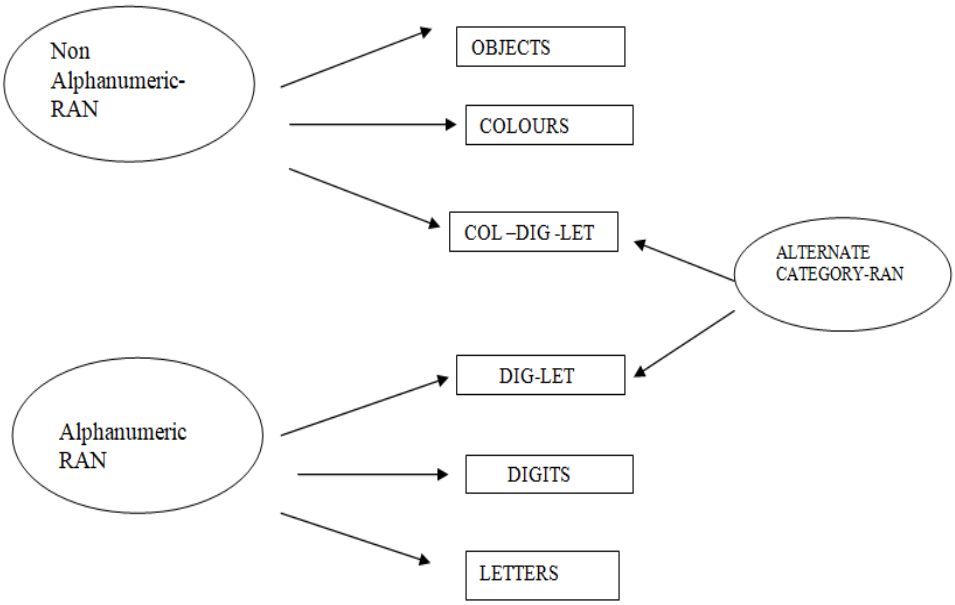

Figure 1: Neuropsychological RAN model by Vesa Narhi (2004)

II. METHODOLOGY

The subjects were a total of 90 CBSE students of 4th grade with a mean age of 9 yrs. Based on academic performance (i.e. average of marks obtained in three terminal exams or marks obtained in final exam), they were categorized as follows: 70-100% - Above average, 50-70% - Average, Less than 50% - Below average students. Each of these three academic groups consisted of 30 students. In addition to the academic performance, respective class teacher's opinion was also taken by distributing a questionnaire for each student. The inclusion criteria's for subject selection were that children should get adequate stimulation at home, no sensory /IQ deficits and should be studying in English medium school since kindergarten.

RAN was assessed using a total of 6 different tasks, out of which four tasks comprised of stimuli from same category (RAN-SC) and remaining two tasks, the stimuli alternated between the categories. Each child was presented with 6 separate charts of different stimuli each presented one at a time. In each chart, stimuli were arranged in 5 rows by 10 column table. Each task consisted of 5 different stimuli each replicated 10 times in random order. Prior to the test presentation, the practice row was presented untimed to familiarize the children with the stimuli and to confirm their knowledge of respective items. No practice trials were included in the RAN-AC tasks. Subjects were instructed to name the stimuli of each category as quickly as possible in the presented sequence. Each child's performance was timed to the nearest second using a stopwatch. Errors made by each subject were recorded.

The RAN tasks are explained as follows:

Non- alphanumeric RAN-SC tasks included:
a) **RAN-O:** The object naming task included pictures of "table, car, pencil, door and ball".
b) **RAN-C:** The colours used in this task were "black, red, blue, green and yellow".

Alphanumeric RAN-SC tasks included:
a) **RAN-L:** The stimuli used were uppercase high frequency English letters *"S, E, A, I and U"*.
b) **RAN-D:** The stimuli used in digit naming task were "2, 4, 6, 7 and 9".

Alternating stimuli RAN tasks included:
a) **RAN-DL:** The stimuli used were digits and letters presented alternately.
b) **RAN-CDL:** The stimuli used were colours, digits and letters presented alternately.

III. RESULTS

The data obtained was subjected to statistical analysis. The statistical tool used was one way ANOVA and Post Hoc analysis using SPSS version 11.5.

		Task	Academic performance	N	Mean	Std. Deviation	Minimum	Maximum
Single category RAN	Non alphanumeric RAN	RAN-colour	Below average	30	47.13	9.82	35	80
			Average	30	41.63	8.68	30	75
			Above average	30	41.07	8.64	27	70
		RAN-object	Below average	30	50.80	10.25	35	70
			Average	30	46.70	8.67	30	75
			Above average	30	44.60	7.92	30	60
	Alphanumeric RAN	RAN-digit	Below average	30	30.73	5.69	22	45
			Average	30	27.00	5.55	18	45
			Above average	30	24.47	4.92	17	35
		RAN-letter	Below average	30	32.37	7.37	25	55
			Average	30	27.30	4.47	19	40
			Above average	30	25.03	5.31	18	40
Alternate category RAN		RAN-digit letter	Below average	30	36.60	6.84	26	56
			Average	30	31.07	7.09	21	58
			Above average	30	29.43	6.44	18	50
		RAN colour digit letter	Below average	30	48.27	9.30	30	70
			Average	30	38.97	8.10	24	60
			Above average	30	35.37	5.42	25	50

Table 1: Descriptive analysis of RAN tasks across the three academic groups: Above average, average & below-average group.

Test of homogeneity of variances and One-way ANOVA were carried out for all the three academic groups for RAN-C,RAN-O,RAN-D,RAN-L,RAN-DL and RAN-CDL task .The results showed that the difference was statistically significant for all tasks between groups,. The "F" value and "P" value is displayed in Table 2.The Post Hoc analysis (Turkeys HSD) revealed that there is statistically significant difference between below-average and above-average group in RAN-C task (p=.030) and RAN-O task (p=.024), between below-average and average group as well as below-average and above-average group (p=.000) for RAN-D task, RAN-L task RAN-DL task. and RAN-CDL task.

Tasks	F	Sig.
RAN-colour	4.099	.020
RAN-object	3.683	.029
RAN-digit	10.230	.000
RAN-letter	12.371	.000
RAN-digit letter	9.168	.000
RAN colour digit letter	21.996	.000

Table 2 : ANOVA results for all RAN tasks between & within the 3 academic groups.

I) Single category Vs Alternate category RAN tasks:

In this particular section, the difference was computed for single and alternate category RAN tasks (on the whole) across 3 academic groups. The mean for Single category RAN and Alternate category RAN task is depicted in Fig.1.

The results of One-way ANOVA showed that the difference was statistically significant for both single category and alternate category tasks. The F (2, 357) value obtained was 9.861 with p = 0.000.The Post Hoc analysis (Turkey's test) for single category RAN tasks and alternate category RAN revealed that there was statistically significant difference between below-average and average groups (p=.007) as well as below-average and above-average group (p=.000). However no significant difference was obtained between average and above average groups (p=.427).

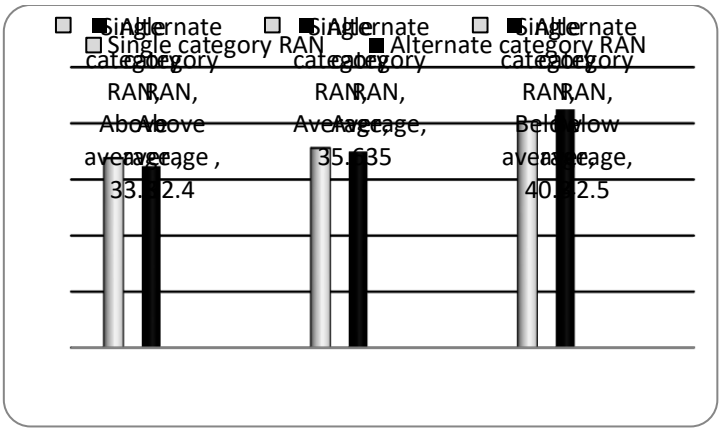

Figure 1 summarizes the performance of academically below average, average and above average 4th grade students in single category and alternate category RAN tasks.

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II) Non- Alphanumeric Vs Alphanumeric RAN tasks

The mean obtained for Non alphanumeric RAN tasks and for alphanumeric RAN tasks is depicted in Fig 2. The results of One-way ANOVA showed that the difference was statistically significant for both non-alphanumeric and alphanumeric tasks. The F (2, 177) value obtained was 7.382 with p = 0.001 for non-alphanumeric RAN tasks. The F (2, 177) value obtained was 22.735 with p value = 0.000 for alphanumeric RAN tasks. The Post Hoc analysis (Turkey's test) for Non alphanumeric and alphanumeric RAN tasks revealed statistically significant difference between above-average and average group (p=.013) and between above-average and below-average group (p=.001).However, no significant difference was obtained between average and below-average group (p=.707).

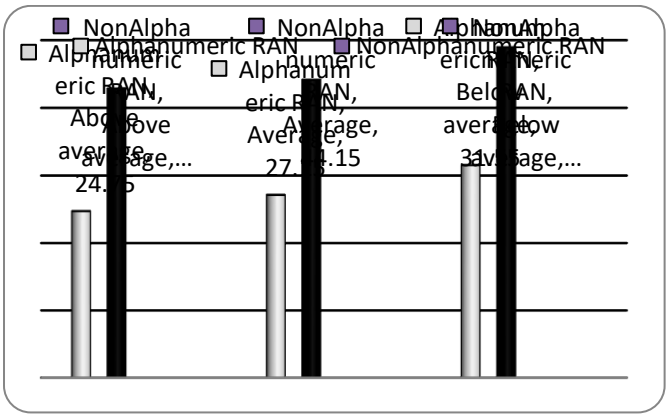

Figure 3 given below summarizes the performance of academically below average, average and above average 4th grade students for non alphanumeric & alphanumeric RAN tasks.

IV. DISCUSSION

I) SINGLE CATEGORY RAN TASKS:

a) Non- Alphanumeric RAN Tasks :

1) RAN-C : For RAN-colour task, academically below-average 4th grade students took comparatively longer time than above-average students. The possible reason for increased time taken for RAN-C task can be attributed to complex semantic representation involved in colour naming (Braisby & Dockrell, 1999). Braisby and Dockrell (1999) reported that children with word finding difficulties were slower in naming colours because colours have minimal semantic content. Thus, colour naming task is complex in nature and resulted in increased naming time. Academically below average 4th grade students also made significantly more errors in RAN-C tasks. Errors were mainly semantic in nature. For example, children said *"red' for "green'*. These errors suggested that academically below average students were likely to have semantic deficits. However, self-corrections by these children were observed.

2) **RAN-O :** In RAN-O tasks, academically below average 4th grade students took longer time for naming objects, followed by average and above-average groups. Studies have reported that academically poor students often have word finding difficulties and these children are slower at naming objects than control groups (Dockrell, 1999). This could be explained based on the "Information processing model" (cited in chapter 22, Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders, 4th Edition by Robert Chapey) which is explained below. For naming objects/colour, initially the visual system gets activated, which in turn triggers the Semantic system followed by graphemic output lexicon activation and finally the target colour /object name is articulated. However, naming a letter/digit, the textual information bypasses the semantic system and reaches Letter-to-Sound conversion route, then triggers the phonological output lexicon and the target letter/digit is named. The pathway used for naming digits/letters is shorter than the pathway used for naming objects/colours. Hence, naming the letters/digits take lesser time in comparison to naming objects/colours (as observed for all three academic groups in the study).

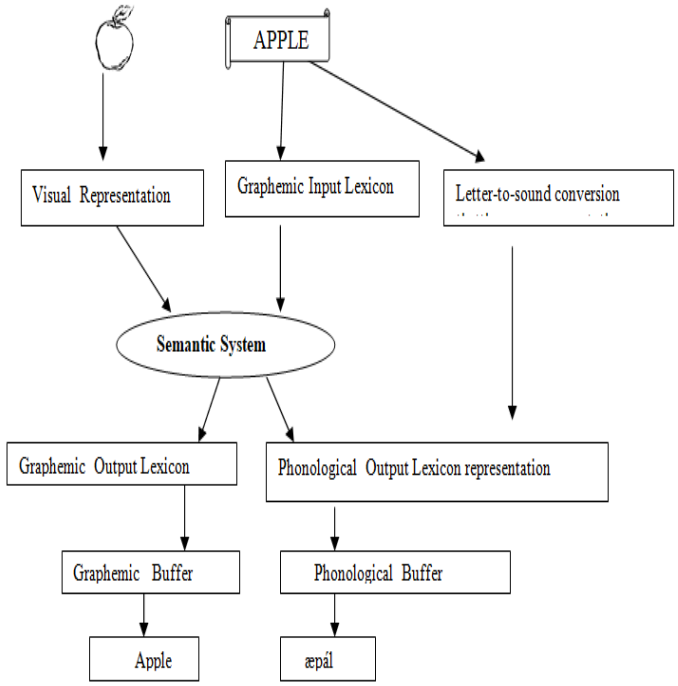

Figure 2: Information Processing Model

Errors observed in RAN-O tasks were similar to the errors noted in RAN-C tasks. Errors made by subjects of below average group were more than the other two academic groups. Predominantly semantic errors were observed such as children said "*Pen" for "Pencil' or 'chair' for 'table"*. These errors suggest deficits in Semantic system for below-average subjects (Dockrell, Messer & George, 2001).

b) Alphanumeric RAN Tasks :

3) **RAN-D & RAN-L:** For RAN-D and RAN-L tasks, academically below-average students took relatively longer time than average and above-average 4th grade subjects. This is because of the fact that the letter/digit naming is more automatized when compared to the object/colour naming tasks (Wolf, 1986). Errors made by academically below-

average students were less compared to other RAN tasks, though variety of errors were observed. Commonly seen errors were semantic errors (Eg: children said *"9" as '4'*), phonological errors (Eg: children said *"4" as "A', '7" as 'T'*) and visual errors (Eg: *"7' as '1', '9" as "6"*). These errors suggested that below-average subjects were likely to have semantic and phonological deficits.

Non-alphanumeric and Alphanumeric RAN Tasks: For both non-alphanumeric and alphanumeric tasks, academically below-average subjects took comparatively longer time for naming compared to average or above-average groups. All the three groups performed better for alphanumeric RAN task than non-alphanumeric RAN task. The alphanumeric naming tasks are more automatized when compared to Non-alphanumeric naming tasks (Wolf, 1986). Hence, better scores were obtained for alphanumeric naming tasks.

II) ALTERNATE CATEGORY RAN:

1) RAN-DL & RAN-CDL:

In this study, academically below average group took longer time for RAN-CDL tasks compared to time taken for RAN-DL tasks. Above average students performed better than average and below-average in RAN-CDL & RAN-DL tasks. These tasks require knowledge of two/three different semantic fields (colour, digit and letters) and speed of naming task would be compromised and becomes more evident and challenging for dyslexics.

V. CONCLUSION

Automatic letter recognition is the key to successful and automatic word recognition. However, not all children learn letters and words at the same rate. Berninger (2000) reported that at-risk children were reported to need over 20 times more practice in comparison to children who were not at-risk. Therefore, teachers must individualize instruction to provide ample opportunity for all children to reach an automatic level of letter naming. Since RAN task does not take much time in administering, it can be included in the test battery for assessing dyslexics among children performing poorer in academics (mainly in reading and writing skills) in a school set up. As this test is simple to administer and less time consuming, it can be administered in children with poor academic skills either by a speech pathologist, resource teacher or class teacher during the school hours. Thus, RAN test is a sensitive tool which helps in early identification of children having dyslexia and thus influences the management and prognosis of reading disabled.

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APPENDIX – A

TEACHER CHECKLIST
SCREENING FOR DYSLEXIC TENDENCIES

STUDENT NAME : **DATE :**

GRADE : **DOB :**

If the following behaviors are observed in classroom put " tick mark " across ' **YES**' and if not put ' cross mark' across '**NO**'…

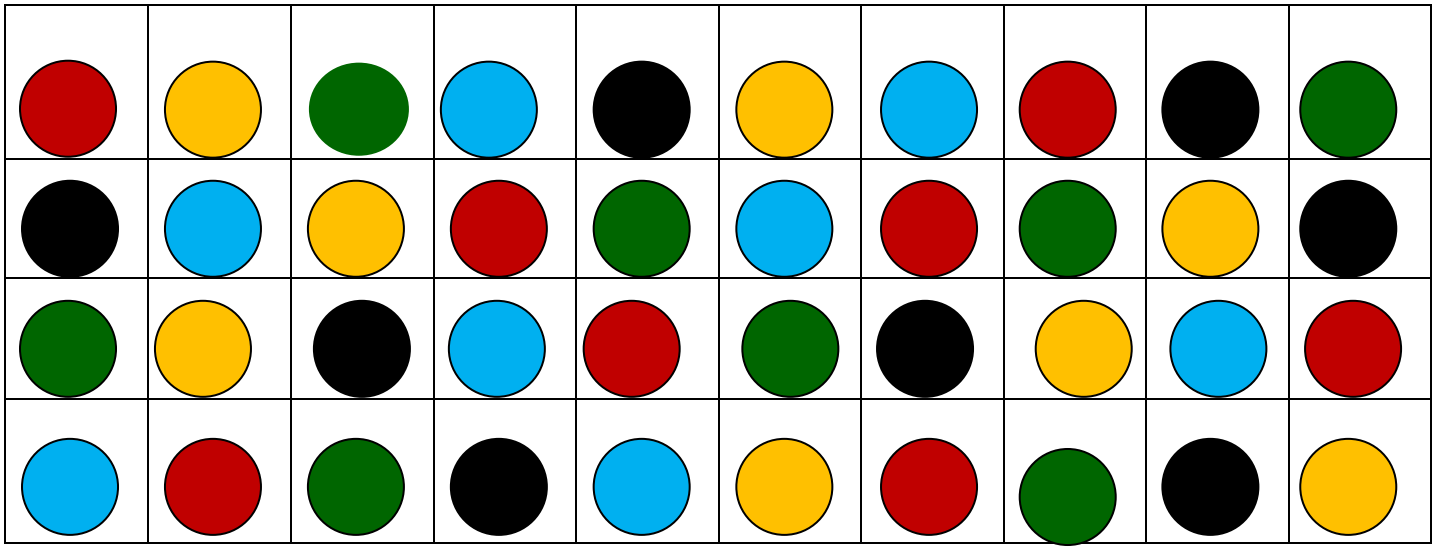
DOES THE STUDENT…….	**YES**	**NO**
READING & WRITING SKILLS : - Have difficulty learning names of letters & their associated sounds? - Have difficulty decoding unfamiliar words? - Have difficulty with learning to spell ? - Have difficulty recalling names of familiar objects, colours, letters? - Have difficulty comprehending story when read silently but comprehends when read aloud ? - Have difficulty writing alphabets in sequence ? - Poor handwriting skills ? - Reads slowly ? - Reverses some letters or sequences of letters ? -Have direction confusions / have difficulty with spatial orientation? - Have problem in learning the time concept ? - Have short attention span ? - Have difficulty in copying correctly from board ?		

SCHOLASTIC PERFORMANCE : Based on the average of the child's three Terminal exam/ Annual exam marks where would you classify the child.

a) BELOW AVERAGE [Less than 50 %] **b) AVERAGE** [50 % to 70%] **c) ABOVE AVERAGE** [70 % to 100%]

APPENDIX – B

Single category RAN:
1) RAN -C



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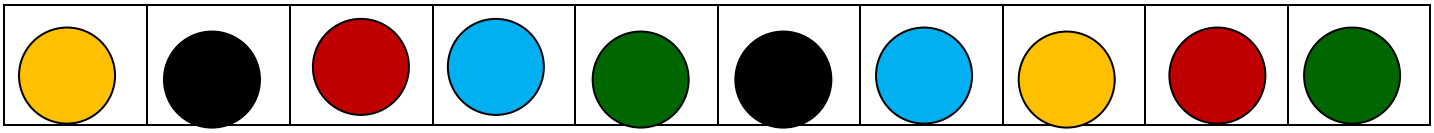
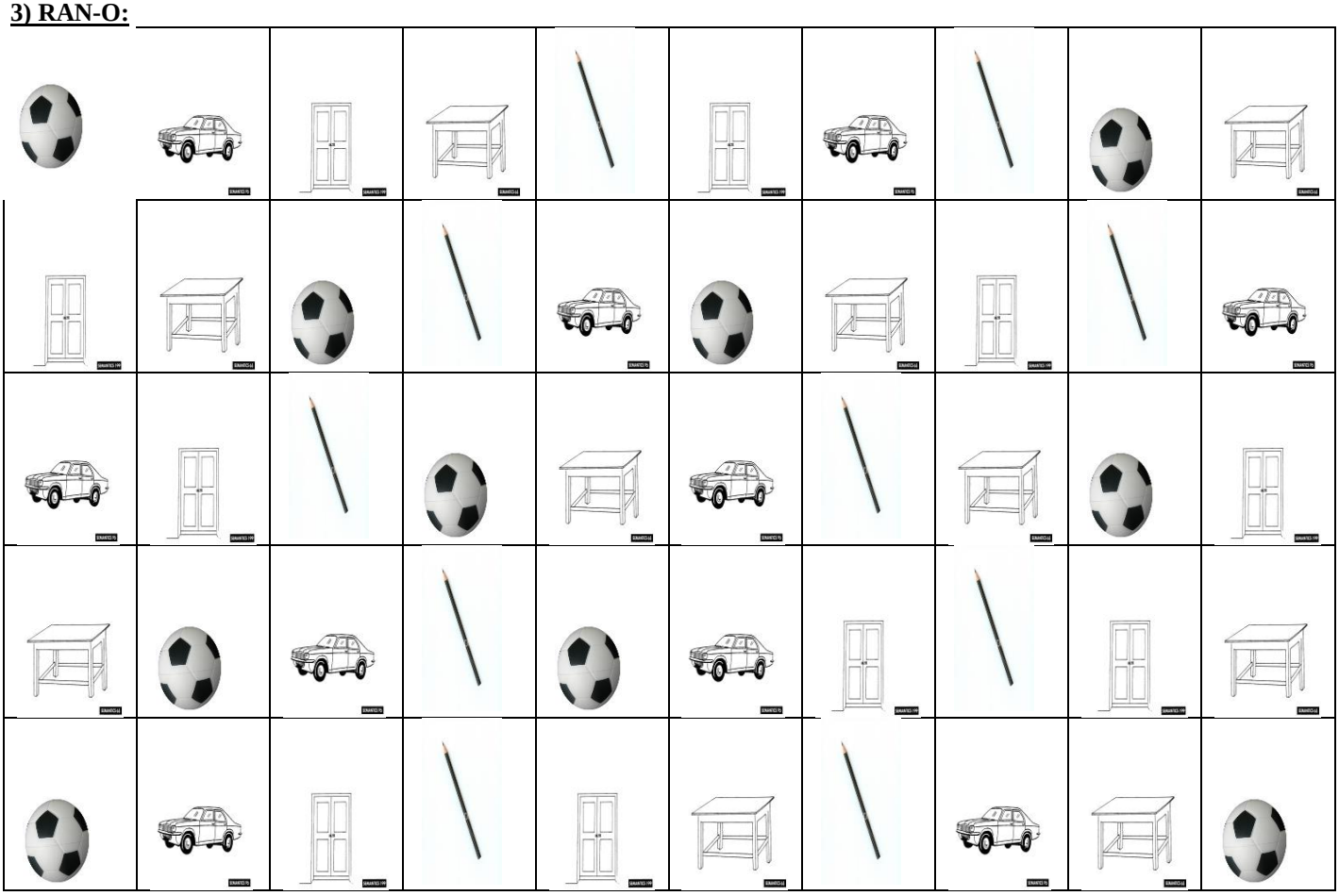


2) RAN-D

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

3) RAN-O:



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4) RAN-L

S	E	A	I	U	A	E	U	S	I
E	U	A	E	S	I	U	A	I	S
I	A	S	I	E	U	S	U	E	A
U	E	I	U	A	E	I	S	A	S
A	I	U	A	I	S	E	S	U	E

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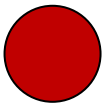
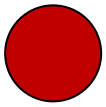
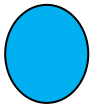
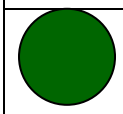
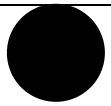
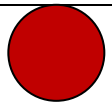
Alternate category RAN :

5) RAN-CDL

	2	E	S		9	U	6	4	
I	7	9		U	E		4	A	S
2		6	4	S	I	7		2	4
9	6	I	U		E	S	4		A
	E	6	9	I	4		S	U	

6) RAN-DL

S	4	E	I	6	9	A	U	2	7
6	S	A	9	4	S	E	7	U	I
S	E	7	I	2	A	4	9	6	U
U	A	9	6	S	I	7	4	E	2
9	S	U	I	6	4	E	2	7	A