

## DOUBLE DEFICIT HYPOTHESIS: THE RELATIONSHIP BETWEEN PHONOLOGICAL AWARENESS AND RAPID AUTOMATIZED NAMING IN ADOLESCENTS WITH AND WITHOUT DYSLEXIA

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### Abstract

*Over the past decade, a large amount of evidence has accumulated indicating that deficits in phonological awareness are closely associated with difficulties in learning to read. It is thought that deficits in phonological awareness and deficits in naming speed are additive and will produce more severe reading difficulties in the same child (Wolf & Bowers, 2001); this has been termed as "Double Deficit". The present study aimed to find out the relationship between phonological awareness and naming speed in adolescents with & 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. The tests such as phonological awareness test and Rapid Automatized Naming Speed test were administered with verbal and tangible reinforcements. The obtained data was analyzed using SPSS, an Independent 't' test and correlation analysis was administered to investigate the relationship between phonological awareness and rapid naming in adolescents with dyslexics and typical group. Results of the present study showed that there is no 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 future implication includes-(a) there is a greater need to explore the other subtypes of LD and (b) The test batteries need to be developed in Indian languages and therapy activities on both PA and RAN should be attempted.*

**Key words:** Phonological awareness, Rapid Automatized Naming, Learning Disability (LD), Phonological access.

Over the past decade, a large amount of evidence has accumulated indicating that deficits in phonological awareness are closely associated with difficulties in learning to read (Stanovich & Siegel, 1994; Torgesen, Wagner, Rashotte, Burgess & Hecht, 1997). However, recent research has also focused on deficits in the processes that underlie naming speed as another possible source of reading difficulties (Wolf & Bowers, 1999). This naming speed deficit is thought to provide a source of reading difficulties that is largely independent of phonological awareness difficulties. Furthermore, it is thought that deficits in phonological awareness and deficits in naming speed are additive and will produce more severe reading difficulties in the same child (Wolf & Bowers, 2001), this has been termed as "Double Deficit".

According to Swathi & Shyamala (1994) and Rama (1992) maximum numbers of learning disabled identified in India were within 6-12 years of age. Swathi and Shyamala (1994) also reported male:female ratio as 4:3. Suresh & Swapna (1997) conducted an epidemiological survey of developmental language disorders and LD among school children in Kerala. Results revealed 20 % of school children were found to be learning disabled.

Phonological awareness (PA) refers to the ability to perceive and manipulate the sub lexical sounds in words. Many longitudinal-correlational studies have shown that there is a relationship between early levels of phonological awareness and later reading skill (Wagner et al., 1997; Morris et al., 1998; Scarborough, 1998a; Lovett et al., 2000; Kirby, Parilla & Pfeiffer, 2001; Parrilla, Kirby & McQuarrie, 2004; Bishop & League, 2006). However, it is worth noting that in a careful analysis of 27 samples found in 24 studies, Scarborough (1998a) found that the power of the correlation derives from the children with strong early phonological awareness. These children rarely developed reading problems, but some of the children with weak early phonological awareness developed reading difficulties. For children learning to read in more orthographically transparent languages, early levels of phonological awareness are not strong predictors of later reading difficulties (De Jong & Van der Leij, 1999; Wimmer, Mayringer & Landerl, 2000). In favor of these studies Rekha (1997) reported phonological awareness was not an important factor in children learning to read Kannada and Malayalam (Dinesh, 2002).

Sonali nag (2007) studied the pace of acquisition of orthographic knowledge and phonemic

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awareness in youngest group of Kannada readers and found a greater sensitivity to the syllable when compared with the phoneme. One possible reason for the advanced syllable awareness in this group is the salience of the unstable sound unit in the orthographic representations in Kannada. She also reported that phoneme awareness is slower to emerge in Kannada. Kannada-speaking children in Grades III and IV seem to reach a level of phoneme sensitivity that is equivalent to what is reported in younger English-speaking children.

Wolf, Bowers, and Biddle (2000) raised the issue of a general slowing deficit in discussions of poor reader's problems in rapid naming. A link between naming deficits and reading disabilities was first proposed by Geschwind (1965) and supported in a series of studies by Denckla (1972) and Denckla and Rudel (1974, 1976). This research showed that tasks measuring the speed of name retrieval of letters, digits, colors, and objects (which were termed as *Rapid Automatized Naming*) differentiated individuals with dyslexia from typical readers. Subsequently, numerous studies have documented the deficits of rapid naming skill in poor readers (Ackerman & Dykman, 1993; Badian, 1994; Bowers & Swanson, 1991; Felton & Brown, 1990; Fletcher et al., 1994; Chang & Manis, 1996; Meyer, Wood, Hart & Felton, 1998). Initially, deficits in rapid naming were viewed as part of the phonological core deficit in poor readers (Catts, 1989, 1996; Wagner, Torgesen, Laughon, Simmons & Rashotte, 1993). As such, these deficits have been widely explained in terms of problems in accessing phonological codes in memory.

In the literature, evidences that supported the double deficit hypothesis are given in four view points (Wolf & Bowers, 1999, 2000; Manis, Doi, & Bhadha, 2000). First, naming speed tasks such as the ability to rapidly name letters, have consistently predicted reading performance beyond what was accounted for by phonological awareness skills (Manis et al., 2000; Wolf & Bowers, 1999). It was this finding that led to the conclusion that the effects of naming speed on reading extend beyond phonological processing, with naming speed tapping non-phonological components of cognitive functions that are important for reading (Wolf & Bowers, 1999; Chiappe, Slinger & Siegal, 2002).

The second line of evidence comes from studies that have grouped children into different subtypes of learning disabilities based on their performance on phonological awareness tasks and naming speed tasks. These studies have demonstrated that children with deficits in both phonological awareness and naming-speed have

significantly lower scores on reading tasks than children with a deficit in only one of these areas (Wolf & Bowers, 1999, 2000; Lovett, Steinbach, & Frijters, 2000).

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

Litt (2010) tried to determine whether children considered being at high risk for developing reading difficulties due to weaknesses in either phonological awareness or rapid automatic naming (RAN). Measures of phonological awareness and RAN were administered to 62 children selected for Reading Recovery in the fall of 2001 within the first 2 weeks of their programs. The results demonstrated that there was a notable weakness in both phonological awareness and RAN in children. Among 62 children, only one of them was selected for intervention in the fall fell within the normal range (37th percentile or above) in both areas; 71.4% of the children performed at the 16th percentile or lower in phonological awareness, and 50.6% performed at the 16th percentile or lower in rapid naming. Thus the large percentage of Reading Recovery children with RAN weaknesses could be that the letter identification assessment is a vehicle for capturing RAN weaknesses.

Stefanou & Peck (2010) supported traditional phonics instruction through phonemic awareness and rapid naming and reported improvements in reading decoding, fluency, and comprehension of upper elementary students through instruction. Third, fourth, and fifth grade students were taught with materials containing phonological recoding, phonemic awareness, and naming activities to automatize each step of the reading process. Instruction was delivered in small reading groups by minimally trained regular and special education teachers. Reading comprehension, phonological awareness, short-term auditory memory, and rapid automatic naming were assessed. Results indicated that students in the treatment condition out-performed students in the control condition in comprehension, rapid naming, and phonemic awareness. Third grade students made larger gains in phonemic awareness and rapid naming than fourth and fifth grade students, fourth grade students out-performing fifth grade student in rapid naming. Phonological recoding was shown

to be a highly effective alternative to traditional phonics instruction. A two-year follow-up found significant increases from post-test to follow-up for rapid naming and comprehension for the treatment school (Wolff et al., 1990a, 1990b; Nicolson & Fawcett, 1994; Stringer & Stanovich, 2000). Anjana (2002) studied the efficacy of phonological training in remediation reading disabled children in the higher age range of nine to ten years. The study revealed that even children of higher age group benefit from phonic training.

### Need for the Study

Most of the studies in Indian context have focused on Phonological Awareness (PA) and orthographic skills. There is ongoing debate stating whether the phonological awareness and RAN together impedes the reading ability or not. However, so far studies have not been conducted for verifying or evaluating the double deficit hypothesis in Indian context. These lacunae would have their impact on assessment and intervention aspects. Hence, there is a strong need to conduct the study in order to provide the systematic means of rehabilitation.

### Aim of the Study

Although the researches pinpoint to a deficit in speed of processing in poor readers, the nature of this deficit is unclear. Most of the studies have been limited to one or two processing domains and have not included the combined measures of phonological awareness and rapid naming. Moreover, the studies were concentrated on preschool children. Thus the present study aims to find out the relationship between phonological awareness and naming speed in adolescents with and without dyslexia.

### Method

**Subject:** A group of 20 adolescent with dyslexia (AD) in the age range of 12 to 15 years were taken for the study. The criteria should be met by the participants are as follows:

- Participants who were diagnosed as having dyslexia at AIISH, based on ERS (Ray & Potter, 1981) were included.
- Their IQ should be within normal range as per Weschler's Intelligence Scale for Children-IV (Weschler, 2003).
- They should have poor academic performance as per the teacher report.
- The language abilities were assessed using informal measures where in the information about receptive & expressive skills were collected, which was age adequate.
- All the subjects had Kannada as their mother tongue and English as a medium of instruction in schools.
- Socio economic status of middle or higher category matched
- They should not have any hearing impairment, intellectual disability or neurological dysfunction

A cross sectional sample consisted of 30 chronological age matched adolescents without dyslexia (AWD) were included. The criteria should be met by the participants are as follows:

- All the participants in the study had Kannada as mother tongue and English as medium of instruction in school.
- None of them had difficulty in reading, evidence of cognitive impairment, attention deficit, or a hyperactivity disorder as per teachers report.
- Socioeconomic status of middle or higher category was considered.
- They should not have any neurological or sensory deficit

### Procedure

The overarching evaluation study included mainly the Phonological Awareness Test (Robertson, Walta & Salter, 1997) and Rapid Naming Speed test (Antonio, 1994).

**Phonological Awareness:** Phonological awareness (PA) refers to the ability to perceive and manipulate the sub lexical sounds in words. The Phonological Awareness test of Robertson, Walta & Salter (1997) was used to collect the information on phonological awareness skills, which includes 8 subtests namely Rhyming, Segmentation, Isolation, Deletion, Substitution, Blending, Graphemes, and Decoding of phonemes was administered. The time taken to administer the test was around 45 minutes to 1 hour. The correct response was scored as 1 and incorrect was scored as 0 with a maximum raw score of 278. Participants were instructed with examples for each subtest.

**Rapid Automatized Naming (RAN):** Naming speed was assessed using a subtest of Clinical Evaluation of Language Fundamentals (CELF, Semel, Wiing, & Secord, 1995). CELF consists of 4 subtests; one among them is Rapid Automatic Naming. Here the participants were asked to name colors, shapes and colours with shapes as soon as possible and time taken (in seconds) to complete the task was noted down using stop watch as s response time. The number of errors was also noted simultaneously which reflects the degree to which he/she was able to

sustain self-monitoring (accuracy) of an individual.

The tests were given to 3 trained SLP's (M.Sc. graduates with min 1year of experience) for inter-judge reliability. The test results showed 65% reliability on PA test & 70% on RAN test. Content validity of the battery was assessed by giving the data to 3 SLP's. Three major criteria such as appropriateness of the items, completeness of the items sampled & the way in which the test items assess the content was considered.

Testing took place in a calm and quiet environment. Testing of individual participant's was conducted in 20- to 60-min sessions depending on a participant's attention span and desire to continue. Testing of a given participant took place within a 2 to 3 sessions. Children were given verbal praise (e.g., "Good job," "Nice working," or "Well tried"), physical praise (e.g., high fives), and tangible reinforcements (e.g.,

stickers, chocolates) for participating in the assessments.

### Results and Discussion

Obtained data was analysed using SPSS Statistics 17.0 software. Independent 't' test and correlational analysis were used to investigate the relationship between phonological awareness and rapid naming in Adolescents without dyslexia (AWD) and Adolescents with dyslexia (AD).

*Phonological awareness test:* Average scores of all the subtests for both the groups were analyzed using Independent 't' test and results are tabulated in table 1 & 2 and represented graphically in figure 1.

The table 1 shows that the mean and standard deviation for each phonological awareness subtest score, was high in Adolescent without dyslexia compared to the adolescent with dyslexia group, which indicates there is a poor reading ability in AD group due to deficit in phonological awareness skill.

Table 1: Describes the mean and S.D of subtests of phonological awareness tests in Adolescents without dyslexia (AWD) and Adolescents with dyslexia (AD).

Items	Group	N	Mean	Max.	S.D
Rhyming	Adolescents without dyslexia (AWD)	30	18.03	20	1.51
	Adolescents with dyslexia(AD)	20	14.00	30	3.49
Segmentation	Adolescents without dyslexia(AWD)	30	29.80	30	0.48
	Adolescents with dyslexia(AD)	20	21.45	30	3.99
Isolation	Adolescents without dyslexia(AWD)	30	29.96	20	0.18
	Adolescents with dyslexia(AD)	20	26.55	20	2.83
Deletion	Adolescents without dyslexia(AWD)	30	19.36	20	0.99
	Adolescents with dyslexia(AD)	20	16.60	20	4.84
Substitution	Adolescents without dyslexia(AWD)	30	9.70	20	0.65
	Adolescents with dyslexia(AD)	20	7.40	20	2.74
Blending	Adolescents without dyslexia(AWD)	30	19.43	20	1.86
	Adolescents with dyslexia(AD)	20	14.50	20	5.01
Graphemes	Adolescents without dyslexia(AWD)	30	50.96	58	2.32
	Adolescents with dyslexia(AD)	20	36.25	58	7.69
Decoding	Adolescents without dyslexia(AWD)	30	79.50	80	1.19
	Adolescents with dyslexia(AD)	20	54.25	80	12.81
Total	Adolescents without dyslexia(AWD)	30	256.40	278	3.70
	Adolescents with dyslexia(AD)	20	192.20	278	30.16

Table 2: Independent 't' test measures in Adolescents without dyslexia (AWD) and Adolescents with dyslexia (AD).

Items	't'	Df	P	Results
Rhyming	5.59	48	<0.001	Highly significant
Segmentation	11.38	48	<0.001	Highly significant
Isolation	6.61	48	<0.001	Highly significant
Deletion	3.04	48	<0.001	Highly significant
Substitution	4.92	48	<0.001	Highly significant
Blending	4.43	48	<0.001	Highly significant
Graphemes	9.86	48	<0.001	Highly significant
Decoding	10.77	48	<0.001	Highly significant
Total	11.58	48	<0.001	Highly significant

From the above Table 2, we can observe that there is a highly significant difference between Adolescents without dyslexia (AWD) and Adolescents with dyslexia (AD) in all the subtests of phonological awareness test.

Table 1 and 2 in the present study, clearly suggests that the poor reading skill is mainly due to the deficit in the phonological awareness skill even though there is a deficit in the RAN task. This is supported by the study Scarborough (1998a), analyzed 27 samples found in 24 studies and found that the power of the correlation derives from the children with strong early phonological awareness. These children rarely

developed reading problems, but some of the children with weak early phonological awareness developed reading difficulties.

The above finding is also supported by Stefanou & Peck (2010). They studied the traditional phonics instruction through phonemic awareness and rapid naming. The results showed that phonological recoding was highly effective alternative to traditional phonics instruction.

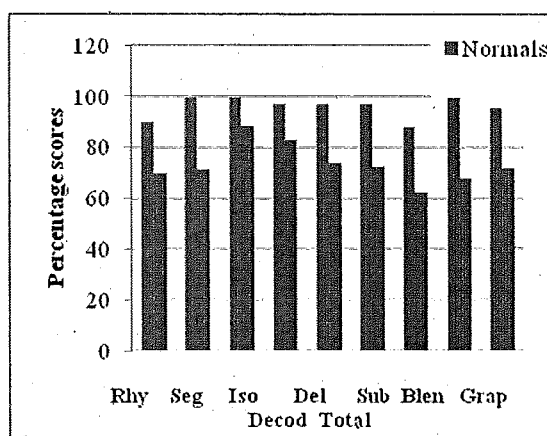


Figure 1: Shows the percentage scores on phonological awareness tasks in adolescents without dyslexia (AWD) and Adolescents with dyslexia (AD).

**Rapid Automatized Naming:** Average time taken (in seconds) to name the colors, shapes and color with shape and number of errors made were tabulated in table 3, 4 and 5 and depicted graphically in-figure 2 & 3

Table 3: Mean and SD for time taken and number errors in RAN task.

Items	Group	Mean	S.D	t	df	P	Results
Time	AWD	105.6	8.91	10.36	48	<0.001	Highly significant
	AD	154.7	23.63				
Errors	AWD	1.83	1.20	4.54	48	<0.001	Highly significant
	AD	3.95	2.08				

Table 4: Mean and SD for time taken and number errors on shape naming of RAN task.

Items	Group	Mean	S.D	t	df	p	Results
Time	AWD	110.9	13.02	14.54	48	<0.001	Highly significant
	AD	174.3	17.58				
Errors	AWD	2.76	0.50	4.53	48	<0.001	Highly significant
	AD	5.20	0.61				

Table 5: Mean and SD for time taken and number errors on color-shape naming of RAN task.

Items	Group	Mean	S.D	t	df	p	Results
Time	AWD	128.4	10.16	15.49	48	<0.001	Highly significant
	AD	200.5	9.52				
Errors	AWD	4.26	0.63	3.56	48	<0.001	Highly significant
	AD	7.30	0.73				

From the above tables 3, 4 and 5, we can see that there is a highly significant difference between AD and AWD in terms of mean and S.D.

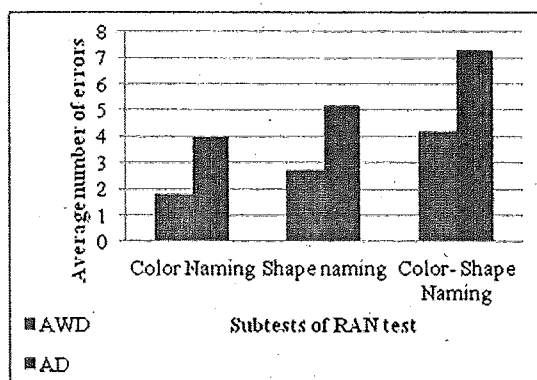


Figure 2: Average No. of errors in RAN task by AWD and AD

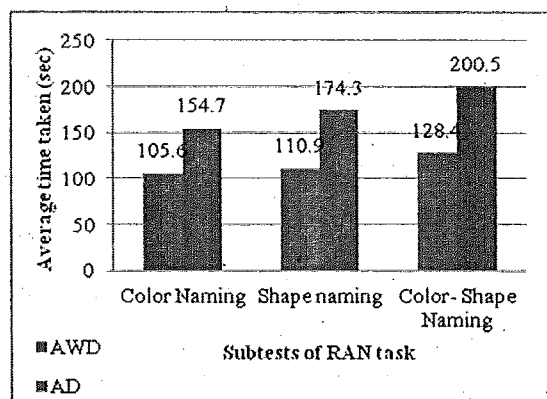


Figure 3: Average time taken in RAN task by AWD and AD

Rapid automatic naming (RAN) consists of the ability to quickly name a limited set of familiar objects presented in random order. In the depicted figure ii and iii of the present study, the average number of errors and the time taken was more in AD than AWD in all 3 tasks such as naming the color, shapes and color with shape suggesting that there is a deficit in rapid naming task. RAN calls upon many of the sub-skills or processes involved in reading, without demanding actual word recognition or comprehension. Suboptimal performance in any of these lower-level skills of tracking, associating an image with its verbal label, retrieving the label, inhibiting a current response to move on to the next image, as well as the coordination of all of these processes can result in poor (slow) performance on the task which in turn interfere with reading connected text. Thus, RAN tasks tap processes used during actual reading, but can identify children who might experience difficulty before they can read or would be expected to read.

The main aim of the present study was to investigate the relationship between naming speed and phonological awareness skills. In order to confirm the relationship between the 2 different task, Carl Pearson correlation co-

efficient was calculated. The results revealed that there is no significant correlation between the naming speed and phonological awareness task ( $p > 0.05$ ). This suggests that the higher phonological awareness scores are more likely to be associated with reading skills than lower phonological awareness scores. This assertion indicates that lower scores in PA test may be associated with a double deficit affecting the decoding ability of an individual which is a prerequisite for reading skills (Manis et al., 2000).

The double-deficit hypothesis (DDH) suggests that Phonological Awareness (PA) and Rapid Automatized Naming (RAN) are important for reading skill, and the individual who show deficits in both PA and RAN have the most significant reading difficulties. The result of the present study revealed that there is a deficit in both phonological awareness skill and rapid Automatized naming in the adolescents with dyslexia compared to adolescents without dyslexia supporting the DDH. This is further supported by the study of Wolf & Bowers (1999), Wolf et al., (2000) and Litt (2010).

#### Limitation

In the present study, the test administered was in English and all of them were found to have poor reading performance in English, while the poor reading performance in Kannada was not explored. Hence, the current evidence indicates that the alphabetic orthographies like English depends on matching of phonemes to graphemes but Kannada, a Dravidian language, is an alpha-syllabary that depends on direct sound-to-symbol mapping (Bright, 1996). So the relationship between PA and RAN may be different in Kannada when compared to English. Therefore, further studies need to explore in Kannada and the present study may be replicated to identify the other subtypes of learning disability.

All the participants in the study had undergone intervention for not more than 9 months and they reported more difficulty in English than Kannada, but this aspect has not been considered in this study. Since poor performance was identified in English, an attempt was made to study the phonological awareness and rapid naming tasks solely in English.

In this study, the participants were not screened for the sub skills necessary for reading such as memory, visuo-spatial skills etc, which is one of the limitations of the study.

#### Conclusions

The main aim of the present study was to investigate the relationship between naming speed and phonological awareness skills using test of phonological awareness and RAN subtest

of CELF. The results of the present study showed that there is a co-morbid deficit in phonological awareness and rapid naming in an individual with dyslexia. The correlation between the two and the exact contribution of each related to poor reading performance need to be explored. And also, there is a greater need to explore the other subtypes of LD. The test batteries need to be developed in Indian languages and therapy activities on both PA and RAN should be done in future research.

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