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Rapid Naming and Phonological Processing as Predictors of Reading and Spelling

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This study examined the relationships between the cognitive processes of rapid naming and phonological processing and various literacy skills. Variables measured and used in this analysis were phonological processing, rapid naming, reading comprehension, isolated and nonsense word reading, and spelling. Data were collected from 65 second-to-fifth grade children referred for learning difficulties. Regression analysis was performed to determine which of the cognitive processes was the strongest predictor of the literacy skills measured. Rapid naming was found to be a stronger predictor of word reading, reading comprehension and spelling than was phonological processing. When a measure of decoding skills was included as a predictor, it was found to account for the most variance in word reading and spelling. The implications of these results for assessing and designing interventions with reading disabled children are discussed as well as the need to further investigate the double deficit hypothesis.

KEYWORDS: Reading, Rapid Naming, Phonological Processing

Much has been learned about reading and the underlying cognitive processes that are associated with success or struggle in acquiring literacy. For example, there is strong support for the link between phonological processing skills and the development of reading. Basic phonological skills have been identified as strong predictors of future reading success (Bradley & Bryant, 1983; Castles & Coltheart, 2004; Fox & Routh, 1976; Liberman, Shankweiler & Liberman, 1989; Mann & Liberman, 1984; Stanovich, Cunningham & Feeman, 1984; 1984; Wagner & Torgeson, 1987; Yopp, 1988) when comparing poor readers with both age and reading level matches. That is, poor readers are less proficient at tasks requiring phonological awareness, relative to their skilled reader age mates and also than younger readers of equal reading proficiency. Differences are even seen in studies comparing college age dyslexics with normal readers (Kitz & Tarver, 1989).

Rapid automatic naming, as first conceptualized by Denckla and Rudel (1976a; 1976b), consisted of four separate series of letters, numbers, colors, and objects presented over and over in random order on a 50-item matrix. Students would be asked to name the series as quickly as possible, and separate times were kept for each. Rapid naming is considered by some researchers to be subsumed under phonological skills (Felton & Brown, 1990; Wagne, Torgesen, & Rashotte, 1999; Shaywitz, 2003) and by others as a marker for processing speed (Ackerman, Holloway, Youngdahl & Dykman, 2001; Hammill & Mather, 2003). It has also been shown to predict reading development. Poor readers are slower at rapid naming of letters, digits, colors and familiar objects (Ackerman, Dykman, & Gardner, 1990; Denckla & Rudel, 1976; Fawcett & Nicolson, 2001; Spring & Capps, 1974; Spring & Farmer, 1975; Spring & Davis, 1988; Torgesen & Houck, 1980; Wolf, 1986; Wolf, 1991; Wolf & Obergon, 1992). Naming speed differences distinguish reading disabled children from those

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with other learning disabilities and from children with attention deficit disorders (Denckla & Rudel, 1976, Felton, Wood, Brown & Campbell, 1987). It has been shown to account for a significant amount of variance in reading skills beyond that accounted for by a phonological processing measure (Manis & Freedman, 2001; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002; Spring & Davis, 1988). Naming speed can be evaluated in both discrete (the time necessary to produce the name for one item) and continuous (the time necessary to produce the names of a series of items) naming trials. Differences have been found under both conditions (Wolf & Goodglass, 1986; Wolf & Obergon, 1992); however, serial naming tasks have generally been seen as a stronger predictor of future reading success (Allor, 2002; Bowers & Swanson, 1991; Walsh, Price & Gillingham, 1988; Wolf, 1991). Wagner et al (1993) found a significant correlation between word identification with serial naming of both letters and digits but not with isolated naming. Spring & Davis (1988) suggested that continuous naming tasks are more like reading than discrete trial naming because of the necessity of overlapping cognitive demands (naming one while accessing next).

Bowers (1996) also proposed that "naming speed influences the ability to learn the orthographic pattern of words" (p.1). In a study requiring subjects to recall letter strings of nonsense words briefly flashed, she found a relationship between the facilitative effects of orthographic redundancy and rapid naming that was independent of phonological processing. That is, orthographic redundancy was more helpful for those students who were slower on rapid naming tasks.

The relationship between these two variables, phonological processing and rapid automatic naming, remains unclear. Wolf (1996) sees these two variables as being markers for separate cognitive processes. Along with other researchers (Bowers, 1996, 2001; Bowers & Wolf, 1993; Spring, personal communication; Wolf, 2001; Wolf & Bowers, 1999), she has suggested a double deficit theory of reading disability to account for the common co-occurrence of deficits in rapid automatic naming and phonological processing that are seen in disabled readers. According to this view, the two tasks represent independent cognitive functions and the most severely disabled readers are deficient in both. Naming speed has been found to have long-term predictive power, independent of phonological processing skills, for measures of reading proficiency (Newhaus & Swank, 2002; Spring & Davis, 1988; Torgeson et al, 1997). In a dyslexia subtyping study, Morris and Shaywitz (1998) identified seven subtypes of reading disability based on a series of cognitive assessments. Six of these subtypes displayed a core deficit in phonological processing while the seventh was categorized as displaying a rate deficit. Further complicating the picture, the relationship between naming speed and reading skills changes across levels of reading skill and across age of the reader (Manis, Seidenberg & Doi, 1999; Meyer, Wood, Hart & Felton, 1998a, 1998b; Torgesen, Wagner, Rashotte, Burgess & Hecht, 1997). In their review of evidence regarding the double deficit hypothesis Vukovic and Siegal (2006) concluded that "the existence of a naming speed only subtype of dyslexia has not been consistently documented" (p. 44). Vukovic and Siegal also note that the research on naming speed deficits is difficult to interpret due to considerable variation in how samples are chosen and defined. Vukovic and Siegal's review of the literature highlights the need for studies that more clearly explicate how naming speed and phonological processing may differentially affect different aspects of literacy.

Bowers (1996) in studying recall of orthographic patterns found an interaction effect between phonological processing and rapid naming. Students who were only deficient in phonemic awareness were better able to recall briefly presented letter strings than those who were poor at both rapid naming and phonological tasks. In addition, for students with phonological processing problems, proficiency in rapid naming appeared to improve performance.

Researchers have also found differential responses to intervention depending on whether the reader is deficient in one or both areas (and which one area) (Bowers, 1993; Bowers & Wolf, 1993; Levy, Bourassa & Horn, 1999). Such studies suggest that rather than being indicators of a single phonological core deficit (Torgeson, Wagner & Rashotte, 1994) naming speed and phonological processing may represent two different cognitive processes.

It is also unclear which skill is more critical to reading and which to spelling (Cossu et al, 1993; Perin, 1983). Both phonological processing and rapid naming performance are linked to reading and spelling performance across ages (Adams, 1990; Wagner & Torgeson, 1987). Bowers, Sunseth and Golden (1999) investigated one possible mechanism for this link. They developed and administered the Quick Spelling Test in which students reported the letters they had seen in briefly (250 msec) presented words, pseudowords and nonwords. The authors found that third graders with naming speed deficits were less successful at finding letter strings in illegal words than third graders with phonological deficits only. They suggest that naming speed deficits interfere with the ability to learn orthographic patterns. Levy, Bourassa and Horn (1999) found that children with naming speed deficits were slower to learn words, particularly when learning the words as whole units. Spring and Davis (1988) see naming speed as measuring the automaticity of lower level processes that are critical in developing word recognition. For the beginning reader, decoding words requires producing beginning phonemes while accessing the ones following. This is necessary because following phonemes affect the articulation of the preceding one. Thus, accurate blending is dependent upon fluent and rapid identification of constituent phonemes. Children with slow naming speed will have difficulty with this and thus require more learning trials with each individual word in order to develop accurate automatic recognition (even if they have good phonological processing and accurate decoding skills).

More information is needed regarding the uniqueness and co-occurrence of these deficits in relationship to both reading and spelling. The purpose of this study was to further investigate the relationships between phonological processing, rapid naming, reading and spelling in a specific group: children who had been referred for difficulties in reading and/or spelling. Specifically, this study examined the predictive value of naming speed and phonological processing for single word reading, decoding nonsense words, reading comprehension and spelling.

METHOD

Participants

Participants were children in grades 2 through 5 who had been referred to one of two clinics (Raskob Learning Institute at College of Holy Names and School Diagnostic Clinic at California State University, California) for assessment and possible intervention in regard to difficulties in reading or spelling. Data were collected from 65 students. Students were predominantly white and from urban settings. The socio-economic status of the homes was mixed. All students were native English speakers.

Cognitive ability scores were used to screen out students whose reading difficulties might be due to overall cognitive or language deficits. Students whose verbal scores fell below 80 were not included in the data analysis.

Measures

WISC-III (Wechsler, 1991): The WISC-III is an individually administered test of general cognitive ability. The 12 subtests on this test are divided between a Verbal and a Performance Scale. Standard scores are derived for a Full Scale, Verbal and Performance I.Q. with mean = 100 and SD = 15.

Wechsler Individual Achievement Test (WIAT) (Wechsler, 1991): *Basic Reading*: Students are presented with a series of individual, real words, printed on a card, and are asked to read the words in a row-by-row manner. *WIAT Comprehension*: The child reads a series of brief passages and responds orally to questions presented by the examiner. The test measures the ability to recall detail and make inferences. *WIAT Dictation*: *Dictation* is a measure of spelling skill in which words are presented orally and the student is asked to write the words.

Woodcock-Johnson Word Attack (Woodcock & Johnson, 1989)***:*** Students are required to read nonsense words that follow standard orthographic patterns. Words are presented on a flip chart card in groups of six. This test assesses skill in applying knowledge of phonics and in orthographic analysis.

Test of Auditory Analysis Skills (TAAS) (Rosner, 1975): The *TAAS* consists of 13 items evaluating a child's phonological processing ability through manipulation of constituent sounds in words orally presented to the child. The test items increase in complexity. Beginning items require the child to split compound words; complex items require removing phonemes and saying the new word.

Digit Naming Speed (DNS) (Spring & Davis, 1988). On the *DNS*, students are presented with a 5" x 8" card on which 50 digits are presented. Students are instructed to read the digits as quickly as possible. Two trials (with different number series) are given. Time to read all digits is recorded. The *DNS* is a measure developed for use in research projects only and does not have psychometric data available (Spring & Davis, 1988). However the format is similar to that of other naming speed measures (Denckla & Rudel, 1976; Compton, Olson, deFries & Pennington, 2002: Wagner, Torgesen and Rashotte, 1999). Wagner and colleagues report test-retest reliabilities for the Rapid Digit Naming Test on the Comprehensive Test of Phonological Processing to range from .80 to .91, depending on age group.

Procedures

All students were tested individually in quiet rooms. Additional psycho-educational testing, unrelated to the present study, was also completed during the testing sessions. Testing was generally done over two-to-three testing sessions. No session lasted longer than 2 ½ hours.

RESULTS

The means and standard deviations for all measures used in this analysis are presented in Table 1. All measures, except the *TAAS*, resulted in standardized age-normed scores. Therefore, prior to further statistical analysis, the *TAAS* raw scores were regressed on age and converted to a standard score. Because the *TAAS* is subject to ceiling effects the distribution of scores was analyzed for deviance from a normal distribution. The *TAAS* scores for the sample population were normally distributed (Pcs = -.42).

TABLE 1

Means (M), Standard Deviations (SD) and Zero-order Correlations of Study Variables (N=65)

Measure	M	SD	1	2	3	4	5	6	7
1. Verbal IQ	101	17							
2. DNS	85	14	-.165						
3. TAAS	8.5	2.9	.168	.275*					
4. Word Attack	93	13.1	.083	.508**	.412**				
5. Basic Read	90	13.1	.137	.616**	.349**	.772**			
6. Comprehension	89	11.9	.241	.458**	.430**	.521**	.686**		
7. Dictation	88	10	.238	.616**	.449**	.724**	.760**	.600**	

Note: DNS= Digit Naming Speed; TAAS= Test of Auditory Analysis Skills; Word Attack= a nonsense word decoding task; Basic Reading= a real word reading task; Comprehension= a reading comprehension task; Dictation= a spelling task.

Correlations

The inter-correlations among the measures are presented in Table 1. As expected there is strong correlation among these measures of literacy. The weakest correlations are between verbal IQ and the literacy measures. Because verbal IQ did not correlate at a significant level with any of the literacy measures reported it was not used in further analysis. *DNS* and *TAAS* are the variables used to measure the identified underlying cognitive processes of rapid naming and phonological processing, respectively. The correlation between these two variables was significant at the .05 level but weak (r=.28). This suggests that these measures are indeed measuring different skills. Given the stronger correlations between these two variables (*DNS* and *TAAS*) and measures of literacy (*Dictation*, *Basic Reading* and *Reading Comprehension*) than between the two variables themselves, it was expected that they would have independent contributions to predicting performance on these measures. In addition, both variables were more strongly correlated with *Word Attack* than with each other.

Regression analysis

Regression analysis was used to test the predictive power of rapid naming, as measured by the *DNS*, and phonological processing, as measured by the *TAAS*, to *Dictation*, *Basic Reading* and *Reading Comprehension*. Each analysis was done in the same manner as described below.

- First, stepwise regression was performed with the selected literacy measure as dependent variables and both *DNS* and *TAAS* entered as independent variables. Stepwise regression determines the strongest predictor and builds models based upon the predictive value of each possible variable.
- Next, two-step forced entry regression was performed entering the weaker of the two predictors first to check for its contribution to prediction.
- To further analyze the independent and overlapping contributions of the two independent variables, partial correlations with the dependent variable were computed for each independent variable.

Basic Reading. The results of the regression analysis with *Basic Reading* as the dependent variable and *DNS* and *TAAS* as predictors are presented in Table 2. Only *DNS* contributed significantly to the prediction of the *Basic Reading* score. In this analysis, *DNS* accounted for 40% of the variance in performance on Basic Reading. Adding *TAAS* to the equation did not add any significant predictive power. When the order was reversed and *TAAS* was entered into the regression equation first, it accounted for 12% of the variance. , when entered into the regression equation second, it contributed an additional 31%. Partial correlation statistics revealed that both variables correlated significantly with *Basic Reading* independent of the other variable. Those values are also presented in Table 2.

TABLE 2

Regression Analysis Predicting WIAT Basic Reading

Variable	R^2 (Change)	F Change	Sig. F Change	Partial r^2
DNS	.400(.400)	42.592	.000	.632
		Forced Order with TAAS First		
TAAS	.117(.117)	8.471	.005	.226
DNS	.430(.313)	34.643	.000	.596

Note: DNS= Digit Naming Speed; TAAS= Test of Auditory Analysis Skills; WIAT = Wechsler Individual Achievement Test

Reading Comprehension. The results of the regression analysis with *Reading Comprehension* as the dependent variable and *DNS* and *TAAS* as predictors are presented in Table 3. Both *DNS* and *TAAS* contributed significantly to the prediction of the Comprehension score. *DNS* was the strongest predictor, accounting for 22% of the variance in scores. The *TAAS* accounted for an additional 9% when entered after *DNS*. When the order was reversed and *TAAS* was entered into the regression equation first, it accounted for 19% of the variance. *DNS*, when entered into the regression equation second, contributed an additional 13%. Partial correlation statistics revealed that both variables correlated significantly with *Reading Comprehension* independent of the other variable. Those values are also presented in Table 3.

TABLE 3

Regression Analysis Predicting WIAT Reading Comprehension

Variable	R^2 (Change)	F Change	Sig. F Change	Partial r^2
DNS	.223(.223)	16.911	.000	.397
TAAS	.316(.094)	7.934	.007	.347
Forced Order with TAAS First				
TAAS	.188(.188)	13.701	.000	.347
DNS	.316(.128)	10.845	.002	.397

Note: DNS= Digit Naming Speed; TAAS= Test of Auditory Analysis Skills; WIAT=Wechsler Individual Achievement Test

Dictation. The results of the regression analysis with *Dictation* as the dependent variable and *DNS* and *TAAS* as predictors are presented in Table 4. Both *DNS* and *TAAS* contributed significantly to the prediction of the *Dictation* score. However, *DNS* was clearly the strongest predictor, accounting for 40% of the variance in scores. The *TAAS* accounted for an additional 7% when entered after *DNS*. When the order was reversed and *TAAS* was entered into the regression equation first, it accounted for 19% of the variance. *DNS*, when entered into the regression equation second, contributed an additional 28%. Partial correlation statistics revealed that both variables correlated significantly with *Dictation* independent of the other variable. Those values are also presented in Table 4.

TABLE 4

Regression Analysis Predicting WIAT Dictation

Variable	R^2 (Change)	F Change	Sig. F Change	Partial r^2
DNS	.395(.395)	41.174	.000	.585
TAAS	.466(.071)	8.198	.006	.342
Forced Order with TAAS First				
TAAS	.188(.188)	14.567	.000	.342
DNS	.466(.278)	32.277	.000	.585

Note: DNS= Digit Naming Speed; TAAS= Test of Auditory Analysis Skills; WIAT =Wechsler Individual Achievement Test

Word Attack. *Word Attack* can be considered both a predictor of other literacy skills as well as a foundational literacy skill. Examination of the correlations presented in Table 1 shows that *Word Attack* was the variable most highly correlated with performance on the common markers of literacy: Basic Reading, *Reading Comprehension*, and *Dictation*. In addition, the correlations between *Word Attack* and both *DNS* and *TAAS* were stronger than the correlation between *DNS* and *TAAS*. This gives support to the proposal that *DNS* and *TAAS* are measuring independent cognitive processes, but that both are important in developing decoding skills. To further analyze the part that rapid naming and phonological processing play in developing decoding skills and likewise the part that decoding skills play in predicting literacy, regression analysis was performed with *Word Attack* included with *DNS* and *TAAS* as predictor variables. The results are presented in Table 5. Word attack proved to be a strong predictor of *Dictation* and Basic Reading. It also predicted scores on the *Reading Comprehension* measure.

TABLE 5

Regression Analysis Predicting WIAT Scores Including Word Attack Scores

Variable	R^2 (Change)	F Change	Sig. F Change	Partial r
		Predicting WIAT Basic Reading		
Word Attack	.616(.616)	94.486	.000	.695
DNS	.677(.061)	10.977	.002	.399
		Predicting WIAT Dictation		
Word Attack	.531(.531)	66.845	.000	.565
DNS	.612(.081)	12.143	.001	.398
TAAS	.799(.026)	4.178	.046	.261
		Predicting WIAT Comprehension		
Word Attack	.278(.278)	21.203	.000	.341
TAAS	.362(.084)	7.099	.010	.291

Note: Word Attack= a nonsense word decoding task; DNS= Digit Naming Speed; TAAS= Test of Auditory Analysis Skills; WIAT=Wechsler Individual Achievement Test

Word Attack was also a stronger predictor for *Basic Reading* than either *DNS* or *TAAS*. It accounted for 62% of the variance in scores on Basic Reading. *DNS* added 8% to the predictive power of the model. *TAAS*, however, did not add to the predictive value of the model after the variance accorded to *Word Attack* and *DNS* was accounted for.

In predicting *Reading Comprehension*, *Word Attack* was also the strongest predictor of the three variables. However, its predictive power was much less: stepwise regression resulted in an R^2 of .28 with *Word Attack* as the only predictor. At the next level, *TAAS* was found to significantly add to the power of the equation resulting in an R^2 change of .08. The addition of *DNS* to the model did not add significantly to its predictive power.

Finally, *Word Attack* was a more potent predictor of *Dictation* than either *DNS* or *TAAS*, accounting for 53% of the variance in scores when entered alone. *DNS* added 8% more predictive value and the addition of *TAAS* as an additional predictor increased the amount of variance accounted for by 2%.

Word Attack was also investigated as a dependent variable, to measure the predictive power of rapid naming (*DNS*) and phonological processing (*TAAS*) to the development of decoding skills. *DNS* was the strongest predictor of performance on the *Word Attack* test (Table 6). It accounted for 26% of the variance in these scores. Adding *TAAS* to the model increased the amount of variance predicted by 7%. Partial correlations of *DNS* and *TAAS* with *Word Attack* indicated that both variables had significant independent correlation with *Word Attack*.

TABLE 6

Regression Analysis Predicting Woodcock-Johnson Word Attack Scores

Variable	R^2 (Change)	F Change	Sig. F Change	Partial r^2
DNS	.259(.259)	20.594	.000	.441
TAAS	.325(.066)	5.690	.020	.299

Note: DNS= Digit Naming Speed; TAAS= Test of Auditory Analysis Skills

DISCUSSION

This study sought to further exam the double deficit hypothesis and the unique contribution of rapid naming and phonological processing to different aspects of literacy. It was expected that phonological processing (*TAAS*) would be most strongly predictive of *Word Attack* and *Dictation*. It was also expected that both *TAAS* and *DNS* would contribute significantly and uniquely to all aspects of literacy measured.

The results were surprising because of the clear superiority of *DNS*, a measure of rapid naming, in predicting scores on tests of spelling, word reading and reading comprehension. For each of these variables *DNS* accounted for considerably more variance than did *TAAS*, whether entered first or second into the regression equations. Indeed, *TAAS* added no additional power to the prediction of Word Reading. In contrast to the results of this study, the bulk of previous research shows phonological processing to be a strong and consistent predictor of literacy. It is likely that the results of this study are counter to this trend because of the population sampled. Recall that the participants in this study were all students who had been referred for literacy-related problems. A review of their mean scores on the literacy-related measures reveals that these students were indeed performing below average on these tasks. With a Mean verbal IQ of 101, the group's mean scores on Word Reading, 90; *Dictation*, 88; and *Reading Comprehension*, 88 are lower than would be expected. Despite average verbal ability, these students are performing below average on literacy-related measures. Scarborough (1998) found that rapid naming was a stronger predictor of future reading success for disabled readers than for the normal reading population. The results of this study lend further support to the important role that rapid naming plays in developing reading for poor readers. However, it is still unclear exactly what these rapid naming measures are measuring. Shaywitz (2003) explains rapid naming as a measure of phonological accessing, Roberts and Mather (1997) as orthographic processing, and Fawcett and Nicolson (2000) as a variety of timing related deficits attributable to abnormal cerebellar functioning. It is clear that more research needs to be done to better understand this set of measures.

These results also strengthen the double deficit hypothesis. Rapid naming and phonological processing were found to have strong partial correlations with literacy measures, independent of each other. This provides support for conceptualizing rapid naming and phonological processing measures as markers for two separate cognitive processes, rather than as markers of a general underlying phonological processing disorder.

These students were deficient in both rapid naming and phonological processing in comparison to their peers. The mean for *DNS* was 85 (M=100). On the *TAAS* the mean raw score was approximately two grade levels below the students' mean grade placement. As a group they exhibited significant deficits in phonological processing and rapid naming.

Decoding skills

The power of decoding skills as measured by *Word Attack* to predict success in reading and spelling was striking. It accounted for over 50% of the variance on both *Dictation* and *Basic Reading*. It was less strong in predicting reading comprehension, indicating that there are other important variables to consider as well. When *Word Attack* was entered into the regression equations predicting *Dictation* and *Basic Reading*, both *DNS* and *TAAS* lost much of their predictive significance. Understanding of sound-symbol relationships and the ability to use them on novel words is a strong predictor of reading success even for disabled readers.

The contribution of rapid naming and phonological processing to decoding skills was also analyzed. Surprisingly, rapid naming (*DNS*) was a stronger predictor of performance on the *Word Attack* test than was phonological processing (*TAAS*). However, with both variables in the model only 33% of the variance in scores was accounted for. It is possible that instructional differences may account for a significant amount of the remaining variance in decoding skills. The students were from many different schools; therefore, it is likely that the amount of direct instruction regarding phonics that the students received varied considerably amongst the participants.

Implications for school psychology practice

Referrals for reading difficulties are one of the most common referring problems encountered by school psychologists. Therefore, it is important for them to be aware of the cognitive processes that appear to underlie and predict success or failure in literacy activities. Such knowledge will lead to a more informed and useful diagnostic protocol. The results of this study suggest that psychologists should look beyond the overall measures of reading ability and assess underlying processes of rapid naming and phonological processing. This information will be useful in formulating interventions and projecting the level of support that might be needed. Several current tests provide measures of both phonological processing and rapid naming. These include comprehensive achievement test batteries such as the Kaufman Test of Educational Achievement II (Pearson Assessment) and the Woodcock Johnson Tests of Achievement and Tests of Cognitive Abilities (Riverside Publishing) and reading batteries such as the Comprehensive Test of Phonological Processing (Pro-Ed) and the Process Assessment of the Learner II (Psychological Corporation).

This study also emphasizes the importance of looking at the subskills of reading, particularly decoding of nonsense words. In doing so, diagnosticians will be have a more complete picture of a child's reading skill. The strength of decoding as a predictor of other reading related measures also underscores the importance of including direct instruction in decoding in the reading curriculum. This study suggests that it is particularly important for struggling readers.

Further directions

These results strengthen the case for investigating the double deficit hypothesis more intensely and for recognizing the critical role of rapid naming in developing literacy. It is particularly important to consider rapid naming when investigating the struggles that disabled readers have and how to differentiate among these students. Rapid naming appears to be a marker for a cognitive process for which a threshold level of proficiency is critical to becoming a successful reader. That is, one just needs to be "good enough." Differences in rapid naming wash out in the general population – more is not necessarily better. However, in the disabled reading population they are of central importance. Students who are strong in rapid naming may be able to compensate for poor phonological processing skills.

As an example, consider the role that rapid naming might play in developing the decoding skills measured by *Word Attack*. Understanding and being able to internally manipulate the sounds of language makes gaining decoding skills easier. However, if a student struggles with phonological processing, he can still learn common sound-symbol patterns through repeated exposures to their association. If he is quick at recognizing individual letters and then forming common digraphs, he will link the letters to the sounds in the word. This word will become a sight word and the letter-sound associations will form a part of his data bank, accessible for identifying like words. If he is impaired in naming speed, he will not label and recognize the letters and digraphs as quickly and these associations will form more slowly. When asked to decode novel words this student will have a smaller store of common sound-symbol patterns to access.

Though this study did not explore differential response to interventions based upon deficits in rapid naming and/or phonological processing other studies suggest differential response. This study, however, in demonstrating the important role that rapid naming plays in developing literacy for disabled readers, adds support to the need to further investigate differential response to intervention.

Finally, this study did not include a measure of reading fluency. However, studies suggest that naming speed measures are good predictors of reading fluency (Kame'enui, Simmons, Good & Harn, 2001; Petrill, Deater-Deckard, Thompson, DeThorne, & Schatschneider, 2006). Further research in this area is needed as being able to differentiate between the components of proficient reading and the processes that are predictive of each will promote more targeted interventions.

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