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Word-Level Reading Achievement and Behavioral Inattention: Exploring Their Overlap and Relations with Naming Speed and Phonemic Awareness in a Community Sample of Children

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Abstract

This study investigated the contribution of naming speed and phonemic awareness to teacher inattention ratings and word-level reading proficiency in 79 first grade children (43 boys, 36 girls). Participants completed the cognitive and reading measures midway through the school year. Teacher ratings of inattention were obtained for each child at the same time point. A path analysis revealed that behavioral inattention had a significant direct effect on word reading proficiency as well as significant indirect effects through phonemic awareness and naming speed. For pseudoword reading proficiency, the effects of inattention were indirect only through phonemic awareness and naming speed. A regression analysis indicated that naming speed, but not phonemic awareness, was significantly associated with teacher inattention ratings controlling for word reading proficiency. The findings highlight the need to better understand the role of behavioral inattention in the development of emergent literacy skills and reading proficiency.

Keywords: Behavioral inattention; Reading achievement; Phonemic awareness; Rapid naming; Mediation

Introduction

A substantial number of children who exhibit inattention symptoms also display reading difficulties (e.g., Dally, 2006; Dittman, 2013). The comorbidity between inattention and word reading difficulties is evident in clinical as well as community samples (Mayes & Calhoun, 2006; Willcutt & Pennington, 2000). Understanding the nature of this comorbidity is important because this knowledge can guide early intervention and treatment efforts (Dally, 2006; Dittman, 2013; Ebejer et al., 2010; Rabiner & Coie (2000); Rabiner, Murray, Skinner, & Malone, 2010). One potential reason for this high level of comorbidity is that the inattention and word reading difficulties share a common cognitive deficit (Pennington, 2006). Recent findings support this hypothesis and have highlighted the role of processing and naming speed as potential shared cognitive risk factors (e.g., Arnett et al., 2012; McGrath et al., 2011). In fact, evidence indicates that word reading proficiency, symptoms of attention-deficit hyperactivity disorder (ADHD), and processing and naming speed have common genetic influences (e.g., Willcutt et al., 2010). A second potential explanation for the frequent overlap of reading and attention problems is that children with attentional difficulties begin formal reading instruction with weaknesses in important emergent literacy skills that underlie the development of reading proficiency (e.g., naming speed, phonemic awareness; Sims & Lonigan, 2013; Willcutt, Betjemann, et al., 2007). It is also possible that inattentiveness in the classroom may be a unique correlate of reading proficiency as students' lack of attention and focus during instruction and activities may affect the development of their reading proficiency regardless of their level of emergent literacy skill (Sáez, Folsom, Al Otaiba, & Schatschneider, 2012). Below we expand on each of these hypotheses and briefly review literature pertaining to inattention and its relationship with emergent literacy skills and reading proficiency.

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Naming Speed: Evidence of Its Role as a Cognitive Risk Factor for Reading Difficulties and Behavioral Inattention

Naming speed tasks typically require individuals to rapidly name common stimuli such as letters, digits, objects, or colors (Denckla & Rudel, 1976). Naming speed correlates strongly with processing speed ($r = .77$; Kail, Hall, & Caskey, 1999) and both have been implicated in reading disorder as well as ADHD (Katz, Brown, Roth, & Beers, 2011; Shanahan et al., 2006; Tannock, Martinussen, & Frijters, 2000). Given the shared association of naming speed with ADHD and reading disorder, researchers are now exploring whether weaknesses in naming speed and/or processing speed contribute to the high degree of comorbidity between the two disorders (Shanahan et al., 2006). In the present study, we approached this question using a nonclinical community sample of young children and focused on naming speed. We investigated whether individual differences in naming speed are related to variability in attentiveness as well as reading proficiency. Our approach is consistent with the view that inattention and reading ability are distributed on a continuum of ability within the population, and understanding those factors that contribute to this overlap in nonclinical samples can provide insight into the nature of this comorbidity (Greven, Harlaar, Dale, & Plomin, 2011; Polderman et al., 2007; Willcutt et al., 2010).

There is considerable evidence showing that naming speed is a consistent concurrent and longitudinal predictor of early reading proficiency (National Early Literacy Panel, 2008; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997). For example, Compton (2000) reported that naming speed predicted growth in word and pseudoword reading across first grade. There is also growing evidence that naming speed is associated with variability in ADHD symptoms ($r = .28$; Shanahan et al., 2006). Moreover, a recent study tested the reciprocal relations between inattention and naming speed across the early school years (pre-K, K, first, and fourth grade) in a large community sample of children (Arnett et al., 2012). Arnett and colleagues (2012) reported that naming speed was a reliable predictor of later inattention symptom severity at each time point even when phonological awareness was controlled in the analyses. In contrast, when the analyses were repeated using hyperactivity–impulsivity symptoms (controlling for inattention), there were no significant associations between naming speed and hyperactivity–impulsivity symptoms. Collectively, these findings suggest that naming speed is an important cognitive process to consider when exploring the nature of the overlap between inattention and reading proficiency in children in the early stages of formal reading instruction.

Phonemic Awareness: A Potential Mediator of the Effect of Inattention on Word-Level Reading Skills

Phonological awareness refers to "the child's sensitivity to various phonological units that make up spoken speech, including words, syllables, onsets, rimes, and phonemes" (Justice, 2006, p. 291). Phonemic awareness is a component of phonological awareness and reflects children's awareness of individual sounds in words and their ability to manipulate these sounds (Ehri, 2005). It supports children's ability to decode novel words and encode words into print (Byrne & Fielding-Barnsley, 1993; Ehri et al., 2001). Evidence shows that phonemic awareness is an important correlate and predictor of children's reading proficiency (e.g., Nation & Hulme, 1997; Parrila, Kirby, & McQuarrie, 2004; Torgesen et al., 1997) with a meta-analysis reporting a correlation of .48 with word reading (Swanson, Trainin, Necoechea, & Hammill, 2003).

Recent data show that behavioral inattention is related to weaknesses in phonological awareness in preschool children ($r = -.21$; Sims & Lonigan, 2013). Sims and Lonigan (2013) suggested that this association may be the result of the impact of inattentive classroom behavior on young children's ability to engage in learning activities targeting phonological awareness skills. The results of two recent studies are generally consistent with this argument (Dally, 2006; Walcott, Scheemaker, & Bielski, 2010). For example, Walcott and colleagues (2010) small scale study demonstrated that preschool teachers' ratings of inattention accounted for unique variance in children's scores on phonemic awareness and letter naming tasks 1 year later (in kindergarten) controlling for their initial levels of phonemic awareness, letter naming, and oral language. Overall, these findings suggest that children who display attention problems are likely to make less progress than their peers in the development of phonological and phonemic awareness skills during preschool and begin reading instruction in first grade with weaknesses in core emergent literacy skills. As a result, the relationship between behavioral inattention and reading difficulties may be the result of the association between inattention and phonemic awareness.

Inattention in the Classroom as a Risk Factor for Poor Reading Achievement

One final possibility is that behavioral inattention may constrain reading acquisition during formal reading instruction, despite children demonstrating proficiency in emergent literacy skills such as phonemic awareness or naming speed (Dally, 2006; Dittman, 2013). Classroom observations of children exhibiting high levels of ADHD symptoms, but without a formal diagnosis of ADHD (Lauth, Heubeck, & Mackowiak, 2006), show that the children met teacher expectations (e.g., listening, reading) during whole-class teaching ~50% of the time, whereas their peers without ADHD symptoms met these expectations ~75% of the time.

These results suggest that students with attentional difficulties may lack engagement with daily classroom work, which may have an adverse impact on their ability to attain academic skills and knowledge.

Support for a direct effect of inattention on reading proficiency is provided by studies demonstrating that teacher ratings of inattention in kindergarten predict later reading performance controlling for emergent literacy skills such as phonemic awareness, letter knowledge, and naming speed (Dally, 2006; Dittman, 2013; Stephenson, Parrila, Georgiou, & Kirby, 2008). For example, Stephenson and colleagues (2008) reported that children's task-focused behavior in kindergarten explained unique variance in first grade word reading scores controlling for preschool vocabulary knowledge, nonverbal IQ, phonemic awareness, and letter knowledge. In addition, Sáez and colleagues (2012) found that the effect of differentiated literacy instruction on kindergarten students' word reading achievement depended on children's level of inattention and teachers' behavior management practices. Differentiated literacy instruction was associated with stronger beginning reading skills in children with attention problems only when the classroom teacher also provided frequent prompts that redirected children's focus to the task at hand. As noted by Sáez and colleagues (2012), this latter finding suggests that children's behavior during literacy instruction is important to their reading development.

Evidence of Emergent Literacy Skills as a Mediator Between Inattention and Reading Achievement

To our knowledge, only two studies have examined whether emergent literacy skills mediate the relationship between inattention and early reading proficiency. Stephenson and colleagues (2008) reported that the effect of kindergarten task-focused behavior on grade one reading achievement was partially mediated by kindergarten emergent literacy skills; that is, task-focused behavior had both direct and indirect effects on first grade reading proficiency. Somewhat analogous findings were reported recently by Dice and Schwanenflugel (2012). In this study, a latent variable indexing four preschool emergent literacy skills (phonemic awareness, alphabetic knowledge, and both expressive and receptive vocabulary) mediated the effect of preschool teacher attention ratings on children's end-of-kindergarten decoding proficiency. No direct effect of inattention on later decoding was tested; hence, it is not clear whether inattention may have also contributed directly to decoding proficiency in kindergarten. These results support the need for further work that examines both the direct and indirect effects of behavioral inattention on reading proficiency to better understand the specific associations between these two domains.

Objectives and Hypotheses

A major objective of the present study was to determine whether naming speed is a shared risk factor for inattentive behavior in the classroom and less proficient word and pseudoword reading proficiency. In contrast to prior research (e.g., Dally, 2006; Dittman, 2013), we included word and pseudoword reading as outcome measures because evidence indicates that the genetic relations between inattention and reading proficiency vary by reading outcome (Willcutt, Pennington, Olson, & DeFries, 2007). We hypothesized that naming speed would account for unique variance in behavioral inattention ratings independent of word reading proficiency (Shanahan et al., 2006) and mediate the relationship between inattention and word and pseudoword reading proficiency (Willcutt et al., 2010). A second aim of the study was to determine whether the relationship between behavioral inattention and reading in children in the early stages of reading acquisition was also mediated by phonemic awareness. We hypothesized that children with greater attention problems would also display less proficient phonemic awareness (Walcott et al., 2010) and that phonemic awareness would mediate the relationship between inattention and word and pseudoword reading proficiency (Stephenson et al., 2008). Finally, given evidence indicating that inattention is related to reading proficiency independent of naming speed and phonemic awareness (e.g., Dally, 2006), we also hypothesized that there would be a direct "behavioral" pathway (Hart et al., 2010; Rapport, Scanlan, & Denney, 1999) from inattention to word and pseudoword reading.

Method

Participants

We recruited participants from five small rural elementary schools from one school board. Nine teachers (and their principals) consented to take part in the study. The study was approved by the university institutional review board as well as by the participating school board. The participating teachers asked each of their students to take home an information and consent package in the fall of the school year. Three of the teachers taught split classes (e.g., K/1; 1/2) students and only those students in first grade were provided with the consent package. The classroom teachers also consented to complete a behavior rating scale assessing inattention for each participating child in the study. Seventy-nine children received parental permission to take part in the study (43 boys, 36 girls). All participating children also provided their verbal assent to take part in the study. Three of the 79 students were missing

data on the phonemic decoding efficiency subtest of Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999) because they were unable to successfully complete the practice items, and one of these three children also was unable to complete the practice items on the sight word reading efficiency subtest. Although we did not collect data on the children's first language, very few students in this rural school board are identified as an English Language Learner (∼1%), and thus the majority of children speak English as their first language. In no case was testing discontinued due to the student having limited English proficiency. All participants were Caucasian.

Procedure

Testing took place in the children's schools between late November and early January. Trained graduate students administered the measures in a quiet area of the school during a single session that was ∼20 min in length. All measures were double scored and two graduate students separately entered all data for analyses. Any discrepancies in entry were resolved.

Measures

Phonological Awareness. We used the Blending Words subtest from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) to index phonemic awareness. Raw scores (of 20) were converted to standard scores to permit comparison of the present sample with a normative sample. Reliability (Cronbach's alpha) of this subtest is 0.88 (Wagner et al., 1999).

Rapid Naming. The Digit Naming subtest from the CTOPP, which comprises two parallel forms (A and B), was administered to provide an index of rapid serial naming. The total time in seconds required to name all of the digits was used in the analyses. We used the norms presented in the more recent second edition of the CTOPP to obtain standard scores for age. These norms are based on the time taken to name the digits on Form B. This step was taken because normative data are not provided for digit naming speed on the original CTOPP for children 6 years of age and younger.

Inattention. In the present study, we utilized the Strengths and Weaknesses of ADHD Symptoms and Normal Behaviors (SWAN; Swanson et al., 2006) rating scale to index children's strengths and weaknesses in attention. It indexes the nine DSM-IV symptoms of inattention associated with a clinical diagnosis of ADHD but respondents are able to rate each symptom from far above average to far below average with 0 representing average levels of behavior (Swanson et al., 2006). The SWAN assesses weaknesses in inattention as well as strengths in contrast to most ADHD rating scales (Arnett et al., 2013; Polderman et al., 2007). Although not developed to confirm to a particular theoretical model (Arnett et al., 2013; Hay, Bennett, Levy, Sergeant, & Swanson, 2007), the inattention items have been interpreted as an "attention/memory" factor in a previous study (Sáez et al., 2012) We created an average inattention score by summing the ratings on each of the nine SWAN inattention items and dividing by nine. Cronbach's alpha for the nine inattention items was 0.98 in this sample.

Word and Pseudoword Reading Ability. The Sight Word Efficiency and Phonetic Decoding Efficiency subtests from the TOWRE (Torgesen et al., 1999) were administered to assess word recognition and decoding, respectively. Raw scores were used in the analyses but were converted to age-based standard scores for purposes of sample description.

Data Analysis

Prior to conducting the analyses, we inspected each variable to ensure that it was normally distributed. The raw scores for the word and pseudoword reading measures were moderately positively skewed. A square root transformation was applied to each of these measures and these transformed variables were used in all subsequent analyses (Tabachnik & Fidell, 2007). The naming speed data were strongly positively skewed and was log transformed according to the guidelines put forth by Tabachnik and Fidell (2007). Prior to addressing our research questions, we present the descriptive data on each of the measures and the correlations among the measures.

To test our first hypothesis, we computed Spearman correlation coefficients to assess the relations among the measures. Next, we used Mplus (Muthén & Muthén, 1998–2012) to test our proposed mediation models. Mplus utilizes full information maximum likelihood (FIML) estimation to address missing data in the dependent variable. FIML uses all of the information that is available in the dataset to estimate the model; this approach to missing data is considered more appropriate than list-wise deletion (Enders, 2010). As a result, the sample size for this analysis was 79. As illustrated in Figs. 1 and 2, we conducted two parallel multiple mediation models in which both naming speed and phonemic awareness were included as mediators of the association between

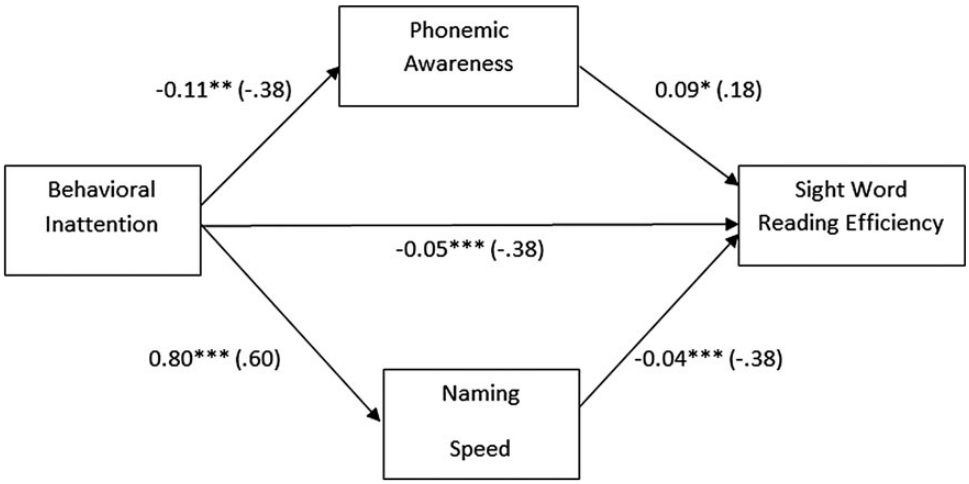

Fig. 1. Path analysis examining the direct and indirect effects of behavioral inattention on word reading efficiency. Unstandardized coefficients are reported for each pathway (standardized estimates in brackets). The direct effect of inattention on word reading controls for all remaining variables in the model. $*p < .05$, $**p < .01$, $***p < .001$.

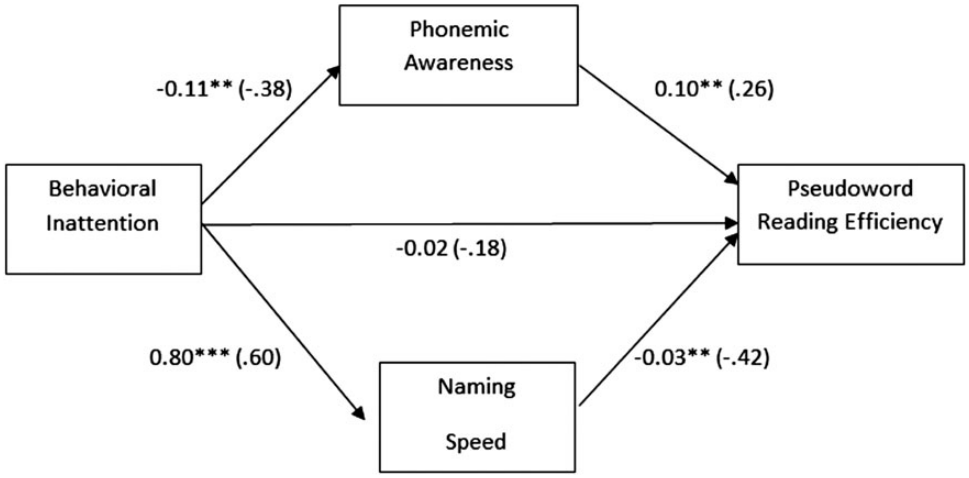

Fig. 2. Path analysis examining the direct and indirect effects of behavioral inattention on pseudoword reading efficiency. Unstandardized coefficients are reported for each pathway (standardized estimates in brackets). The direct effect of inattention on word reading controls for all remaining variables in the model. $*p < .05$, $**p < .01$, $***p < .001$.

teacher inattention ratings and word (or pseudoword) reading proficiency. Mplus provides both normal sampling and percentile bootstrapping approaches to test the significance of the specific indirect effects associated with each mediator (Geiser, 2013). Percentile bootstrapping approaches to testing the significance of the indirect effect are becoming more widely used in clinical (e.g., Graziano, McNamara, Geffken, & Reid, 2011; Hatch, Healey, & Halperin, 2013) and developmental studies (e.g., McMahon, & Meins, 2012) because they provide greater power than more traditional normal sampling methods, such as the Sobel test (Hayes & Scharkow, 2013; Mackinnon, Lockwood, & Williams, 2004), and do not require "the unrealistic assumption of normality of the sampling distribution of the specific indirect effect" (Hayes, 2013, p. 139). In a percentile bootstrapping approach, a large number of resamples (5,000 in the current study) are taken to create 95% bias-corrected confidence intervals around each estimate of the indirect effect (Preacher & Hayes, 2008). As noted by Hayes (2013), the indirect or mediated effect is considered significant if the confidence intervals surrounding the indirect estimate do not include 0.

To address our last objective, we conducted a hierarchical regression analysis to estimate the amount of unique variance in behavioral inattention accounted for by naming speed after controlling for word reading ability and phonemic awareness.

Results

Preliminary Analyses

Table 1 presents the descriptive characteristics of the sample by gender. To facilitate interpretation, the raw and untransformed means and *SDs* of the transformed variables are presented along with standard scores where available. The mean standard scores for phonemic awareness, naming speed, and both reading achievement measures were average or slightly above average. The mean inattention rating was close to 0 (average) which was anticipated as this sample was a community sample of children. Boys and girls did not differ significantly from each other on any of the measures; thus gender was not considered further in the analyses.

Table 2 presents the Spearman correlations among the measures. Age was not significantly correlated with the independent or dependent variables ($p > 01$). Phonemic awareness and naming speed were significantly correlated with each other and with the SWAN teacher attention ratings. Higher inattention scores were associated with lower scores on the sound blending task and slower digit naming speed. The word and pseudoword reading measures were significantly correlated with each of the remaining variables and with each other.

Path Analyses

The first path analysis examined the contributions of behavioral inattention, naming speed, and phonemic awareness to word reading proficiency and tested the significance of two indirect paths: inattention to word reading via naming speed and inattention to word reading via phonemic awareness. As shown in Fig. 1, the paths from inattention to each mediator were significant. Greater inattentiveness was associated with lower phonemic awareness scores and with slower naming speed. The paths from naming speed and phonemic awareness to word reading proficiency were also significant. Better phonemic awareness and faster naming speed were associated with more proficient word reading. Finally, the direct effect of inattention controlling for all

Table 1. Means and *SDs* of variables by gender and for the full sample

Measures	Boys ($n = 43$)		Girls ($n = 36$)			Full sample	
	M	*SD*	*M*	*SD*	*F*	*M*	*SD*
Age (years)	6.46	0.26	6.50	0.26	0.59	6.48	0.26
PA raw score[a]	9.91	3.60	10.58	3.12	0.78	10.22	3.38
PA standard score	11.33	2.28	11.50	1.91	0.13	11.41	2.10
Digit naming speed (s)	57.09	16.13	55.67	15.53	0.16	56.44	15.77
Digit naming standard score	9.93	1.61	9.97	1.65	0.01	9.95	1.62
Behavioral inattention[b]	−0.13	1.25	−0.42	1.40	0.97	−0.26	1.32
SWE raw score[a, c]	22.60	16.77	25.17	15.25	0.50	23.78	16.04
SWE standard score	101.38	13.36	101.92	11.57	0.04	101.63	12.49
PDE raw score[a, d]	10.78	8.37	11.46	9.49	0.11	11.09	8.85
PDE standard score	105.44	10.57	104.43	11.12	0.17	104.97	10.76

Notes: PA = phonemic awareness; SWE = sight word efficiency; PDE = phonemic decoding efficiency.
[a]Number of items correct.
[b]Average score based on nine inattention items on scale ranging from −3 to 3 with 0 as average.
[c]Missing data, $n = 78$.
[d]Missing data, $n = 76$.

Table 2. Correlations among the measures

Measure	1	2	3	4	5
1. Age (years)	–				
2. Phonemic awareness (items correct)	.15	–			
3. Digit naming speed (time in s)	−.04	−.36**	–		
4. Behavioral inattention (average rating)	−.27	−.36**	.58***	–	
5. Word reading (items correct)	.12	.50***	−.71***	−.69***	–
6. Pseudoword reading (items correct)	−.02	.51***	−.66***	−.52***	.85***

Notes: $^{**}p < .01$, $^{***}p < .001$.

Table 3. Hierarchical regression analysis examining the unique contribution of naming speed to behavioral attention ratings controlling for reading ability and phonemic awareness

Variables	Behavioral inattention	
	ΔR^2	Final β
Step 1	0.14**	
Phonemic awareness		−0.08
Step 2	0.32***	
Word reading proficiency		−0.44**
Step 3	0.04*	
Naming speed		0.27*

Notes: *$p < .05$, **$p < .01$, ***$p < .001$.

other variables in the model on word reading was significant. Higher scores on the SWAN (indicating greater attention problems) were associated with lower scores on the word reading subtest. Overall, 57.4% of the variance in word reading proficiency was explained by the variables in the model.

The second path analysis was conducted with pseudoword reading proficiency as the outcome variable. As illustrated in Fig. 2, inattention was significantly related to each mediating variable and each mediating variable was significantly associated with pseudoword reading proficiency. In contrast to the results for word reading, the direct path from inattention to pseudword reading was not significant. Overall, 44.9% of the variance in pseudoword reading was accounted for by the independent variables.

Testing the Significance of the Indirect Effects

The 95% bias-corrected confidence intervals were examined to determine the significance of each specific indirect effect. Phonemic awareness (estimate = −0.009, 95% CIs = −023, −0.002) and naming speed (estimate = −0.031, 95% CIs = −0.051, −0.016) were each significant mediators of the effect of inattention on word reading as the confidence intervals surrounding the estimate did not contain 0. The significance tests of the indirect effects for pseudoword reading also showed that there was a significant indirect effect from inattention through phonemic awareness (estimate = −0.011, 95% CIs = −0.023, −0.004) and from inattention through naming speed (estimate = −0.027, 95% CIs = −0.043, −0.015).

Naming Speed as a Predictor of Behavioral Inattention. The results of the hierarchical regression analysis showed that naming speed accounted for an additional 3.8% of variance in behavioral attention ratings when entered in the final step of the model after phonemic awareness and word reading proficiency (see Table 3). Only reading ability and naming speed accounted for a significant amount of unique variance in the attention ratings. The overall model accounted for a significant proportion of variance in behavioral inattention ratings, $R^2 = 49.4\%$, $F(3, 74) = 24.10$, $p < .001$.

Discussion

A primary aim of the present study was to determine whether individual differences in behavioral inattention in the classroom and reading proficiency are each uniquely associated with naming speed. A second and related objective was to assess whether phonemic awareness mediated the relationship between behavioral inattention and word and pseudoword reading achievement. As hypothesized, naming speed and phonemic awareness mediated the relationship between behavioral inattention and word and pseudoword reading. There was also a significant direct effect of inattention on word reading controlling for all other variables in the path analysis. As predicted, naming speed accounted for unique variance in behavioral inattention, controlling for reading proficiency and phonemic awareness. This pattern of findings provides further support for the argument that naming speed is a common cognitive risk factor for inattention and early reading difficulties (Willcutt et al., 2010). Below we discuss each of these findings in more detail.

Consistent with prior research, behavioral inattention was significantly associated with naming speed with slow naming speed related to greater attention problems (Sims & Lonigan, 2013; Willcutt, Betjemann, et al., 2007). In turn, naming speed was significantly related to word and pseudoword reading proficiency. Of particular relevance to the overall objective of this study was the finding that naming speed was a significant mediator of the association between behavioral inattention and word and pseudoword reading proficiency. Moreover, the regression analysis showed that naming speed also accounted for unique variance in behavioral attention controlling for reading proficiency and phonemic awareness. Overall, this pattern of results supports previous studies

with older children (e.g., Willcutt et al., 2010) showing that naming speed is a unique correlate of inattention as well as reading proficiency.

Similar to data reported in studies with preschool children (Sims & Lonigan, 2013; Walcott et al., 2010), first grade children with marked attention problems showed less proficient phonemic awareness. Moreover, consistent with our second hypothesis, the relationship between inattention and word and pseudoword reading proficiency was also mediated by phonemic awareness. Further research is needed to understand why young children who exhibit elevated attention problems do not acquire phonological and phonemic awareness skills at the same rate as their peers (Walcott et al., 2010). One possibility is that inattention may have a detrimental effect on children's level of classroom engagement in activities designed to foster phonemic awareness skills (Dally, 2006; Dittman, 2013). This hypothesis is consistent with evidence highlighting the importance of self-regulation to early academic achievement in reading (McClelland & Cameron, 2011).

Similar to the findings of Stephenson and colleagues (2008), the first path analysis showed that inattention had a direct effect on word reading. In contrast, the effect of inattention on pseudoword reading was only indirect through its association with phonemic awareness and naming speed. One explanation for this pattern of findings is that inattention may have more deleterious effects on the development of word recognition than decoding. Research with children diagnosed with ADHD indicates that they engage in less independent reading than their peers (Leonard, Lorch, Milich, & Hagans, 2009). As exposure to print is related to reading outcomes across grade levels (Mol & Bus, 2011) even after controlling for decoding proficiency (Cunningham & Stanovich, 1991), it is possible that young children who are inattentive engage with books less often than their peers and this lack of print exposure affects the development of word recognition skills.

Implications for Understanding the Role of Naming Speed in Word Reading Development

The present findings also inform our understanding of the relationship between naming speed and reading proficiency. Our findings, along with those of others (e.g., Arnett et al., 2012), suggest that naming speed shares a unique association with inattention controlling for individual differences in reading proficiency. Naming speed may account for unique variance in reading proficiency because it not only indexes proximal skills (e.g., speed of retrieval of lexical information) related to word reading acquisition but also processes that are more distal (e.g., executive control) processes (Cepeda, Blackwell, & Munakata, 2013). To better understand the role of naming speed in word reading acquisition, it may be helpful to examine the extent to which naming speed is related to reading outcomes independent of executive control processes such as inhibitory control as well as behavioral inattention (e.g., McGrath et al., 2011).

Limitations

Our findings must be considered in light of several limitations. First, specific casual relationships between inattention, phonemic awareness, naming speed, and reading proficiency cannot be made given the cross-sectional nature of the study. A second major limitation is that we used single measures to assess each construct. It would be important to replicate these findings using multiple indicators of each construct. A third factor to consider when interpreting our findings is that our study utilized a behavioral measure of inattention and thus the findings should not be generalized to other assessments of attention (e.g., cognitive assessments of sustained attention). In fact, recent evidence shows that cognitive measures of attention are not strongly correlated with teacher inattention ratings (e.g., $r = 15$; Sims & Lonigan, 2013) and each are uniquely related to emergent literacy skills. It would be important in future studies to include a broader range of attention measures to better delineate the role of attention in accounting for variability in word-level reading achievement.

Another key limitation of this study is that we did not include measures of processing speed. Given that both naming and processing speed are implicated in ADHD and RD (e.g., Shanahan et al., 2006) and are strongly associated ($r = .77$; McGrath et al., 2011), studies are needed that examine their separate and joint influence on reading proficiency and behavioral inattention. An additional limitation to consider is that we did not include a measure of IQ in our analyses. Previous findings, however, suggest that the relationship between inattention and reading achievement, as well as the association between naming speed and word reading ability, is significant even when nonverbal or verbal reasoning ability are included in the analyses (e.g., Bowers, Steffy, & Tate, 1988; Rabiner & Coie, 2000; Stephenson et al., 2008). It is also important to note that our reading achievement measures assessed children's word-level reading accuracy as well as fluency. Given that naming speed is known to share stronger associations with word reading fluency relative to accuracy (Georgiou, Parrila, & Liao, 2008), it would be important in future studies to clarify whether the findings remain when using accuracy-based assessment of word and pseudoword reading. Finally, it is important to note that our sample was relatively small, lacked diversity (i.e., participants were all Caucasian), and was drawn from one rural school district. Further research is needed with larger and more representative samples to confirm these findings.

Implications for Practice and Conclusion

From a practical perspective, our findings suggest that efforts to reduce reading failure in children displaying inattention in the classroom should address students' attention to task (Sáez et al., 2012) as well as enhance their emergent literacy skills (Deault, Savage, & Abrami, 2009). Given the stability of word reading achievement in the early grades in the absence of an intervention (Juel, 1988), our findings strongly suggest a need for effective preschool interventions designed to boost emergent literacy skills as well as self-regulatory capacity (e.g., Diamond, 2012). Our results also highlight the need to carefully monitor first grade children with attention problems for reading difficulties. Research suggests that children with attention plus early reading difficulties are particularly challenging to remediate in first grade (Rabiner & Malone, 2004). It may be necessary to provide more intensive interventions to this subgroup of children that simultaneously target attention and reading problems (Rabiner & Malone, 2004).

In summary, the present study contributes to the literature in several ways. First, our results demonstrate that inattention has both direct and indirect effects on word reading proficiency in first grade children. Second, our findings suggest that it may be important to explore the relationship of behavioral inattention with specific reading outcomes (e.g., decoding, word recognition) to better delineate its effects on reading acquisition. Third, our results show that naming speed is a unique correlate of behavioral inattention controlling for word reading and phonemic awareness. This latter finding, along with the results of the mediation analyses, provides further support for the hypothesis that naming speed weaknesses may contribute the development of attention problems as well as reading difficulties (Willcutt et al., 2010). Our findings also suggest that there is a need for interventions designed to promote self-regulatory capacity and reading success in children exhibiting inattentive behavior given the high risk of academic failure faced by many children with attention problems (e.g., Breslau, Miller, Chung, & Schweitzer, 2011; Holmberg & Bölte, 2012).

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Conflict of Interest

None declared.

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