THE ASSOCIATION BETWEEN BEHAVIORAL ATTENTION AND ACADEMIC ACHIEVEMENT: A META-ANALYSIS

by

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I dedicate this to my entire family, but especially my parents, who mean the world to me and have supported me every step of the way throughout this process.

ABSTRACT

Extant literature has found attention and academic achievement to be related at multiple levels throughout development (Macdonald et al., 2021; Rogers et al., 2011; Scholtens et al., 2013). Surprisingly, there are no comprehensive meta-analytic studies of the size of this effect. Therefore, the present study evaluates the relation between behavioral attention and academic achievement over 106 studies and 450 individual effect sizes, with moderators assessing: (1) study design type (group-based versus correlational); (2) type of attention (inattention versus hyperactivity); (3) academic domain (e.g., reading, writing, math) and subskills (e.g., decoding, fluency, comprehension); (4) rater (parent versus teacher); (5) gender; and (6) age. Included studies had: (1) students from Kindergarten to undergraduate level; (2) an ADHD group or behavioral attention rating measure; (3) an academic achievement measure; and (4) effect size availability (mean difference or correlation). All effect sizes were converted to pooled correlations, *r*. Analyses were conducted in R. The overall pooled correlation for behavioral attention and academic achievement was $r = -.25$ ($p < .001$). Meta-regression analyses were completed and significantly differed for the moderators of behavioral attention type (inattention $r = -.30$, hyperactivity/impulsivity $r = -.13$), and behavior attention rater (parent $r = -.19$, teacher $r = -.34$). There were no significant differences for the moderators of study type, academic domain or subskill, gender, or age. Post-hoc analyses found that higher academic level (e.g., combined reading comprehension, written expression, and math word problems) was more related to behavioral attention than low academic level (e.g., combined decoding, spelling, and math computation), $\beta = -.10$, $t = -3.21$, $p < .01$, 95% CI [-.17, -.04]. Overall, this meta-analysis quantified and systematized the sporadically known significant negative relation between behavioral attention and academic achievement using scientifically rigorous methodology. Results also highlight the importance

of inattention (relative to hyperactivity) and teacher ratings (relative to parents) for academic achievement. These findings can help inform how students can be most appropriately identified (i.e., teacher report), which students are at greater risk of achievement difficulties (i.e., inattentive students), and which academic areas (i.e., higher-level academics) are a potential target for intervention.

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Introduction

Overview

Attention and academic achievement are related throughout development (Barkley, 1991; Biederman et al., 1996; Fischer et al., 1993; Macdonald et al., 2021; Rogers et al., 2011; Scholtens et al., 2013; Spira & Fischel, 2005). Although there are several types of attention (e.g., internal, visual, and behavioral), behavioral attention ratings appear most frequently in neurodevelopmental literature likely due to the accessible method in which it is assessed (i.e., relative to performance-based measures). Additionally, behavioral attention has specific clinical relevance because its items comprise the clinical criteria for an Attention-Deficit/Hyperactivity Disorder (ADHD) diagnosis. Learning Disabilities (LD) and ADHD are commonly occurring neurodevelopmental disorders (American Psychiatric Association, 2013), and thus, academic achievement and behavioral attention are frequently examined together. Specifically, academic achievement is a major correlate and outcome of ADHD symptomatology, which has subtypes of inattention and hyperactivity/impulsivity (Jaekel et al., 2013; Massetti et al., 2008). Surprisingly, a meta-analytic review of the literature has not been done to determine: (1) whether the same pattern of relations occur between categorical behavioral attention (e.g., ADHD diagnosis) or continuously (e.g., behavioral attention symptomatology); (2) whether there is a differential effect between inattention and hyperactivity on academics; (3) which academic domains and subskills are more or less related to behavioral attention; (4) and the impact of other moderators on the relation of attention and achievement, including rater, gender, and age. The aim of this study is therefore to conduct a meta-analysis to address each of the above issues.

This study is important from empirical, practical/clinical, and theoretical perspectives. Empirically, this study addresses a critical gap in the literature regarding the relation between attention and academic outcomes. It is well known that ADHD is associated with shorter attention span during teaching (Rapport et al., 2009), less engagement in the learning environment (Junod et al., 2006), and less effortful learning strategies (Egeland, Johansen, & Ueland, 2010). Additional academic outcomes associated with children diagnosed with ADHD are low grades and increased risk of grade retention (Loe and Feldman, 2007). While such individual studies are useful, only three small-scale meta-analyses (reviewed below) have explicitly studied the relation between ADHD and academic achievement. Further, these studies only included ADHD as a diagnosis, rather than behavioral attention as a construct along a continuum, and they did not separately analyze subcomponents of ADHD symptomatology.

Clinical applications of the outcome of this study include addressing whether using categorical ADHD diagnoses or continuous attention symptomatology make a difference for academic outcomes. For example, if there is no difference in academic outcomes when assessing categorical versus continuous behavioral attention, it may illustrate that a categorical framework for ADHD is less necessary than previously thought, and a continuous spectrum of behavioral attention symptomatology can help address achievement concerns as effectively as a categorical framework. Although the DSM-5 is moving in the spectrum direction, ADHD is still considered a categorical diagnosis. An additional clinical question we are investigating is whether attention subtypes/symptomatology differentially affect academic achievement. If inattention is found to be more strongly related to academic achievement relative to hyperactivity, this can affect the extent and type of academic accommodations for children with inattention versus hyperactivity, and the way that they are used. Finally, evaluating the relative strength of behavioral attention for certain academic domains and subskills can have both theoretical and clinical applications. For example, if we find that behavioral attention is more related to reading than math and writing, it suggests that attentional strategies designed to ameliorate symptoms may be more effective in the reading domain. The current state of practice and applicability is that only a categorical distinction matters, with no differential effects; however, there is no meta-analytic support for such conjectures.

Although many studies document academic difficulties in children diagnosed with ADHD, the theoretical rationale for this relation is not always prevalent. However, one rationale is that attention difficulties are thought to directly impede the ability to focus and learn emerging language, math, and literacy (DuPaul et al., 2001; Lahey et al., 1998; Spira & Fischel, 2005). A second is somewhat indirect in that children with ADHD exhibit more off-task behaviors, leading to less time on academic skills, which, in turn, leads to insufficient skill development as compared to peers without ADHD (Barry et al., 2002). However, the effect of attentional difficulties appears to be more specific; in studies of both Conduct Disorder and ADHD, academic underachievement is much more associated with the latter relative to the former (Fergusson et al., 1993; Frick et al., 1991). Finally, a third rationale is even more indirect, with some studies suggesting that ADHD is associated with difficulties with problem-solving and executive functioning (Biederman et al., 2004), or memory and task engagement (Rapport et al., 1999), which *in turn* lead to difficulties in reading, math, and writing.

There is also specific theoretical and empirical support for the effect of attention on specific academic domains. For example, regarding reading, Barkley (1991) highlighted difficulties with (verbal) working memory in ADHD, which is important for deriving meaning from silent reading held in the mind. Numerous subsequent studies confirmed these findings (Arrington et al., 2014; Cirino et al., 2019; Kudo et al., 2015; Macdonald et al., 2021; Savage et al., 2006). For writing, inattention can lead to reduced learning in the classroom generally (Mayes & Calhoun, 2006), and there may be fewer opportunities to learn and improve writing skills (Posner & Rothbart, 2007). Additionally, executive function difficulties are common in children with ADHD and may disrupt writing processes (Eckrich et al., 2019). For example, working memory is implicated in spelling processes (Kroese et al., 2000), as well as in written expression, by helping to store syntactic and semantic information in the writing process (Olive, 2004; Olive, 2011) and to access information in short-term and long-term memory (Berninger & Amtmann, 2003; Kim & Schatschneider, 2017). For math, attention difficulties cause disruption in focus and impede independent work requirements (Tosto et al., 2015). Children with ADHD are also slower and less accurate in computational and problem-solving abilities relative to those without ADHD (Zentall et al., 1994).

Attention (Performance and Behavioral)

Attention can be considered a "hub" ability since it is involved in many other lower- and higher-level cognitive processes (Posner & Rothbart, 2007; Wass & Johnson, 2012). Attention can be measured in at least two ways – performance tests (i.e., tasks that have correct/incorrect answers, administered via paper and pencil or computer, standardized, norm-based or experimental tasks), and behavior ratings (e.g., questionnaire-based, no correct/incorrect answers, can be completed by multiple raters, standardized, and can be norm-referenced or not). Several models of attention are available, such as Mirsky et al.'s (1991), which discusses subfunctions of focusing, sustaining, shifting, and encoding. Others propose sensory selective attention and response selection/control (Cohen, 1993); selective, sustained, and divided attention (Cooley & Morris, 1990); and alerting, orienting, and executive control (Posner & Petersen, 1990). However, the differentiation of attentional subfunctions across these models heavily emphasizes performance-based measures of attention.

Regarding theories for the development of ADHD, behavioral disinhibition was proposed as the primary characteristic from Barkley's unifying model (Barkley, 1997). Due to the behavioral nature of an ADHD diagnosis, rating scales of behavioral attention can be an advantageous way to assess attention symptomatology, as it is time-efficient, cost-efficient, and assesses everyday functioning outside of an experimental setting (Bunger et al., 2019). Of the few studies that focus on the differences in rating-based and performance-based attention measures, only moderate correlations between .23 and .30 have been found between the two attention measure methodologies (Egeland et al., 2009; Macdonald et al., 2021; Sims & Lonigan, 2012). Additionally, findings have shown that both performance-based measures of attention as well as rating-based behavioral attention are associated with academic outcomes (Macdonald et al., 2021; Sims & Lonigan, 2012), specifically for multiple levels of reading. Further, Macdonald et al., (2021) found unique contributions of both behavioral and performance-based attention to reading comprehension, reflecting the multidimensional nature of attention, and a consideration of how different types of attention relate to academic achievement.

Over the past few decades, with regard to performance-based attention, visual attention has been commonly assessed with relation to reading, even though theories of visual attention are controversial as causal factors in reading difficulty (Skottun & Skoyles, 2006; Skoyles & Skottun, 2009; Stein & Walsh, 1997; Stein, 2014). There are five major visual attention paradigms that are represented in the literature with regard to reading (Antzaka et al., 2017; Facoetti et al., 2003; Facoetti et al., 2008; Franceschini et al., 2012; Lallier et al., 2010), primarily to word reading, many of which were evaluated empirically by our group (Cirino et al., 2022) and forming the hypotheses for a recent meta-analysis that our team is conducting quantifying the effect of visual attention on reading. The final studies are currently being coded, and so results are not yet available. Research focused on visual attention in math and writing is less obvious but has been evaluated. For example, visual search tasks, visuospatial attention, and visual attention span tasks are found to relate to math and writing at various levels (Kirk et al., 2017; Lourenco et al., 2018; Niolaki et al., 2013). Consequently, our team is currently completing a second meta-analysis on the relation of visual attention with math and writing, similar to the ongoing meta-analysis focused on reading. Investigation in these areas will allow for a comparison of effect sizes, which will be important for the specificity of visual attentional effects. Relevant to the present study, these meta-analyses will allow for a comparison of effect sizes across performance-based and behavioral types of attention for achievement.

Behavioral Attention (Categorical v. Continuous)

Behavioral attention is typically considered in the literature in two different ways – by assigning a categorical diagnosis of ADHD (since a portion of the diagnostic criteria are based on behavioral attention symptomatology) or continuously by measuring inattention and hyperactivity (McLennan, 2016). Assigning a diagnosis of ADHD is typically required for access to psycho-stimulant medication and school accommodations such as a 504 Plan or Individualized Education Program (IEP), and so is practically relevant. However, ADHD is likely to exist on a continuum rather than as an all-vs-none phenomenon (Frazier et al., 2007; Haslam et al., 2006); for example, the effect of stimulant medication is similar in both clinical and sub-clinical ADHD groups (Rapoport et al., 1980), and genetic links are similar in clinical and sub-threshold symptoms of ADHD (Larsson et al., 2011; Levy et al., 1997). Further, a continuous approach related to symptom severity can lend itself to more powerful methods of analysis whereas artificially dichotomizing continuous variables leads to a loss of power (Altman & Royston, 2006; Dawson & Weiss, 2012), which has been evidenced in behavioral disorders including ADHD (Fergusson & Horwood, 1995). Thus, it is important to understand whether the effect size for continuous behavioral attention on achievement is similar versus different to that of categorical behavioral attention. If it is similar, then clinical implications, such as changing the categorical classification of ADHD to a spectrum, could be considered, particularly if this can reach more at-risk students who would benefit from intervention/accommodations in school. Specifically, a tiered approach similar to the learning disability (Kurns & Tilly, 2008) literature can be applied so that the level of accommodations and support are related to severity of impact rather than the focus on a diagnosis of ADHD per se. Effect sizes from these two types of studies may be different if methodologically, categorical studies use an extreme groups approach (comparing children with severe difficulties to a group with minimal or no difficulties), relative to ascertaining a relationship across a continuum of functioning. Inclusion of extreme groups in study design can inflate effect sizes (Fisher et al., 2020; Preacher et al., 2005). Therefore, studies that utilize a categorical diagnosis of ADHD may show stronger effects than descriptive or correlational studies. Regardless of the findings, clarification between categorical and continuous methods of behavioral attention is important to advance understanding of the relation between behavioral attention and academic achievement. Interestingly, no meta-analyses have specifically investigated ADHD symptomatology continuously, which is crucial to explore to confirm whether categorical versus continuous study structures produce the same pattern of results.

Behavioral Attention (Inattention v. Hyperactivity/Impulsivity)

The majority of research on the relation of ADHD and academic achievement focuses on two areas – inattention and hyperactivity/impulsivity (or a comparison of inattention to a "combined" presentation due to the low incidence of hyperactive/impulsive symptoms in isolation from inattentive symptoms; Tucha et al., 2006). Several individual studies have found that children with ADHD where inattention is the primary consideration, relative to those with a combined inattentive/overactive presentation, have weaker academic outcomes in reading (Warner-Rogers et al., 2000; Willcutt & Pennington, 2000; Zendarski et al., 2017) or math (Marshall et al., 1997; Raghubar et al., 2009). Other studies show longitudinal effects of early behavioral inattention, but not hyperactivity (ages 4 to 6), on word reading, spelling, and math word problems at ages 11 and 13 (Jaekel et al., 2013; Massetti et al., 2008; Merell et al., 2017). Similar findings were obtained by Breslau et al. (2010), where increased problems with inattention at ages 6 or 11 yielded greater academic problems five years later.

There is theoretical support for the hypothesis that inattention has a stronger impact on academic achievement than does hyperactivity. For example, the highly metacognitive nature of inattentive symptoms (i.e., unable to focus on work, makes careless mistakes, difficulty in organizing tasks, forgetful) makes them naturally related to executive functioning, and to direct learning and production of academic work (Barkley, 1991; 1997). Although hyperactive/impulsive symptoms can impact academic achievement, the impacts may be less severe since the symptomology is less directly related to learning (e.g., fidgets/squirms, leaves seat, talks excessively, is “on the go”).

Although the evidence reviewed suggests that the inattentive subtype of ADHD would relate more strongly to academic achievement, no studies to date have quantitatively summarized this research through a meta-analysis. Thus, the conclusions of this study can show whether such findings are isolated to individual studies, versus more prevalent and wide-spread.

Academic Achievement (Reading, Writing, and Math)

Academic achievement in reading, writing, and math domains is critical for children’s success later in life. A majority of this literature focuses on the importance of the development of reading skills. However, literature on the development of writing and math skills, and difficulties in these areas has steadily increased, including their cognitive concomitants. Clarifying the relative nature and size of behavioral attention on achievement is critical given that learning difficulties and ADHD and attentional difficulties more generally, are commonly comorbid, which may amplify their negative consequences.

Behavioral attention has robust empirical relations with achievement, as earlier previewed (Jaekel et al., 2013). For example, a longitudinal study of 693 students found that behavioral ratings of attention problems at 6 years of age predict academic achievement, specifically reading and math, at 17 years of age (Breslau et al., 2009). Additionally, attention problems in Kindergarten significantly predicted reading achievement in 5^{th} grade in a sample of 387 students (Rabiner et al., 2000). Further, behavioral attention was found to be uniquely related to writing in children (Kent et al., 2013; Kim et al., 2013). Although individual studies investigating the relation between behavioral attention and academic achievement are important, they may vary in the scientific rigor of data collection, data analyses, etc., which is difficult to measure (Bauer, 2021; Eisner & Fearon, 2021). On the other hand, meta-analytic studies can provide a more comprehensive overview and include study bias indicators which may offer either confirmation or caution to results.

Although there are a number of studies of the relation of behavioral attention at the broad academic *domain* level, it is less clear whether behavioral attention relates differentially to various academic subskills within each domain. However, there are theoretical arguments for such differential effects. For example, in reading, at preschool ages, behavioral inattention interferes with word recognition and decoding processes since children with low behavioral inattention access books and reading at a lower rate (Martinussen et al., 2014). Additionally, for reading fluency, increased distractibility can lead to fewer words read correctly in a given amount of time (Pham, 2016). Further, given reading comprehension's higher order processing and integration of word reading, listening comprehension (Gough & Tunmer, 1986), and executive functioning (Barkley, 1991), attentional processes are posited to influence the focus of information in a passage leading to comprehension of the passage. Inattentive behaviors, not hyperactive/impulsive behaviors, were found to be significantly correlated to reading fluency and reading comprehension in children aged 8-11 years (Pham, 2016). Macdonald et al. (2021) supports findings of behavioral ratings of attention being more related to reading comprehension (r = -.42) compared to reading fluency (r = -.29) and word reading (r = -.19) in 4th and 5th grade struggling readers, though all three were significantly related to behavioral ratings of attention. Thus, due to the compounding effect of lower-order domains (e.g., word reading, listening comprehension) on reading comprehension, attention may be expected to impact reading comprehension more greatly than other reading subskills.

Less work has directly investigated the relation between attention and writing. The Not-So-Simple View of Writing consists of self-regulation, including attentional control, along with working memory, ideation, and transcription to explain the development of written composition skills (Ahmed et al., 2021; Berninger & Winn, 2006). The main bases for the involvement of attentional processes in writing comes from the empirical relation of attention and executive function, and the role that the latter plays in writing (Eckrich et al., 2019; Olive, 2004; Olive, 2011). Given the complexity of written expression and the high need for attentional and executive resources (e.g., planning and organizing thoughts on paper, inhibiting irrelevant information and including relevant information in writing), it is expected that attention will be most highly related to this writing subskill, relative to spelling. However, some empirical research has found that behavioral attention was uniquely related to both spelling and written expression, over and above language, in a sample of first grade students (Kim et al., 2013).

For math, inattentiveness can interfere with carefully monitoring performance for mistakes during math computational tasks (Raghubar et al., 2009) suggesting random errors due to monitoring weaknesses. Additionally, inattentiveness to switching from one type of task to another, such as addition to subtraction, could result in errors in math computation (Rourke, 1993). Further, attentional inhibition has been proposed to be related to word problem solving given that the success of math problem-solving requires attending to relevant information while inhibiting irrelevant information (Passolunghi et al., 1999). Moreover, switch errors and inhibition for irrelevant information are posited to negatively affect performance on math fluency suggesting that timed conditions can exacerbate the number of errors due to inattention (Lewandowski et al., 2007; Capodieci & Martinussen, 2017). Though studies have found that inattention is significantly related to calculation, math fluency, and applied problems in elementary-aged students (Fuchs et al., 2005; Gray et al., 2015; Sims et al., 2016), a number of studies support that the strongest relation between attention and math is with regard to math-fact fluency (Ackerman et al., 1986; Biederman et al., 2005; Bull & Johnston, 1997; Capodieci & Martinussen, 2017; Gray et al., 2015).

Investigating the magnitude of these relations is critical to the understanding of cognitive mechanisms that can potentially impact learning. For instance, if we found that behavioral attention was more related to reading comprehension than decoding, then this could inform ADHD as well as reading disability intervention targets. Specifically, more accommodations for reading comprehension may be necessary for children diagnosed with ADHD. Additionally, if we found that attention was more related to written expression, then intervention strategies, such as attention checks, may need to be implemented more often in written expression than in spelling. Further, if we found that attention was more related to math fluency, then we could also focus intervention targets on this math subskill.

Other Moderators

The above considerations are relevant to the relation of behavioral attention and academic achievement. However, a number of additional moderators to such relations are important to consider. Below we discuss why the following are the three most relevant based on the literature.

Raters

In addition to attention and academic subskills as moderators, research into differential reporting from raters of children's attention has been documented (Achenbach et al., 1987; Gomez, 2007; Narad et al., 2015). For instance, only moderate correlations have been found for parent-teacher concordance of inattention ($.24 < r < .34$) and hyperactivity/impulsivity ($.26 < r < .27$) in preschool children (Murray et al., 2007) and elementary-aged children (Wolraich et al., 2004) diagnosed with ADHD. Additionally, Cho et al. (2011) found consistent low to moderate concordance of parent and teacher ratings of attention in children with clinical levels and sub-clinical levels of ADHD ($.21 < r < .26$) but found a higher concordance between parent and teacher attention ratings in typically-developing children ($.31 < r < .41$). Further, in a longitudinal study assessing attention and academic achievement in children diagnosed with ADHD, parent ratings of inattention predicted later academic achievement, though teacher ratings were not included in this study (Lundervold et al., 2017). Additionally, using polynomial regression analyses, Saffer et al. (2021) found that parent-teacher concordance for ADHD symptoms was highest for children performing low in academic achievement domains. Further Breslau et al. (2010) found that increases in teacher-rated attention problems in elementary ages were related to difficulties in academic achievement in middle and high school, though parent ratings were not assessed. Thus, the critical aspect to investigate in our meta-analysis will be whether studies including teacher and/or parent report of attentional difficulties relate differently to academic achievement. We would expect teacher ratings to be more related to academic achievement since they are present and observe children's behavior solely in an academic setting. Moreover, the academic achievement of students may influence teachers' perception and ratings of behavioral attention compared to parents who see their children in multiple settings. However, specifically for categorical studies where an ADHD diagnosis is required in two settings (typically home and school), there is likely to be a more similar correlation between parent- and teacher-rated attention and academic achievement. If this is the case, and teacher ratings of attentional difficulties are more related to academic achievement overall, then this will be important clinically when weighing differential reporting between raters, especially when deciding if academic accommodations would be beneficial for the child.

Gender

In addition to raters, gender is found to be related to both behavioral attention and academic achievement. For instance, in a large study with 2200 children aged 5-7 years old, girls were reported to have higher rates of attention than boys (Naglieri & Rojahn, 2001). Mixed findings have been reported for academic achievement differences in boys and girls. For example, some studies have found that girls diagnosed with ADHD had higher levels of academic achievement than boys across studies (King, 2016; Kingdon et al., 2017; Velki & Vrdoljak, 2019); however, some studies have found no differences in academic achievement (Goni et al., 2015). Thus, the literature is clear that there are level differences between boys and girls in terms of achievement (King, 2016; Lester, 2016) and attention (Naglieri & Rojahn, 2001); however, the data is less clear regarding whether the effect is moderated by gender. Alavi et al. (2019) investigated whether gender moderated the relation between attention and academic achievement and found that although females had higher rated levels of attention, gender did not moderate the relation between attention and academic achievement. Additionally, a previous meta-analysis discussed below did not find gender differences in an ADHD sample when investigating the relation with academic achievement

(Frazier et al., 2007). Conversely, two population-based studies have found that girls with ADHD have a greater risk than boys for suffering from a comorbid reading or spelling disorder (Czamara et al., 2013; Yoshimasu et al., 2010, 2011). Additionally, Kerner auch Koerner et al. (2021) found girls with ADHD have a greater risk than boys in developing math difficulties, though did not find significant differences in reading and spelling. One possible theoretical explanation for these findings is that girls with inattentive symptoms may potentially be overlooked in the classroom and not receive accommodations and academic supports compared with inattentive and/or hyperactive boys, although this direct conjecture was not supported in the findings of Kerner auch Koerner et al. (2021). Given the controversial evidence from individual studies regarding gender moderating the effect of attention and academic achievement, it will be important to analyze this at a meta-analytical level. If results find that gender does moderate this relation, specifically that girls' attention problems are more significantly related to underachievement, then it will be important for clinical and intervention implications since implementing attentional strategies during academic learning may potentially be more important for females than males.

Age

Age plays an obvious role in the development of both attention and academic achievement (Cicchetti, 1990). In terms of level differences for age and attention, research has shown that behavioral attention symptomatology changes with age, such that the presentation of hyperactive/impulsive symptoms decrease with age, but inattention symptoms tend to persist in those diagnosed with ADHD (Schmidt & Petermann, 2009; Sobanski et al., 2008). Additionally, age is a critical factor in academic achievement since the consumption of information related to academic domains increases throughout school. In fact, studies have shown that differences at the month-level are evident in academic achievement in elementary and middle-school aged students (Bedard and Dhuey, 2006; Nam, 2014). Further, single studies have found that age moderates the relation between behavioral attention symptoms and academic achievement (Kawabata, Tseng, & Gau, 2012) such that the association was stronger for older children and adolescents than younger children. Additionally, Velki and Vrdoljak (2019) found that after considering age, relation between some aspects of self-report of behavioral attention symptoms with school success are not significant, specifically the correlation between hyperactivity and school success was not significant after accounting for age. Similar to Kawabata et al. (2012), this study also found that as age increased the correlation between inattention and school success weakened. Thus, this meta-analysis can help answer the question at a meta-analytic level whether age moderates the relation between behavioral attention and academic achievement. For instance, if attention symptoms are more related to academic achievement in older students, then this could inform intervention studies to implement more attention strategies in middle- and high-school aged students than younger students, if necessary.

Previous Meta-Analyses and Systematic Reviews

Several meta-analyses and systematic reviews include both ADHD samples and academic achievement (see Table 1 for more information); however, the aims of these works are not always directly related to measuring the relation between behavioral attention and academic achievement. Three systematic reviews of this nature were found. One of these discusses long-term academic achievement outcomes in students on and off treatment for ADHD (Arnold et al., 2020). Another reviewed the relation between cognition (including attention) and math in children with ADHD across four studies and concluded that there was a positive association between cognition (e.g., verbal/visuospatial short-term and working memory, central executive, inhibitory control, and processing speed) and math performance (Kanevski et al., 2021). The third reviewed academic outcomes related to ADHD medication type in children diagnosed with ADHD and Reading Disability and found inconsistent results between studies (Froehlich et al., 2018). Five meta-analyses of this nature were found, all of which included academic achievement in ADHD samples. Three measured the impact of ADHD medications on academic achievement; all showed improvement in math tasks, but with less conclusive results for reading and writing (Boland et al., 2020; Kortekaas-Rijlaarsdam et al., 2019; Prasad et al., 2013). Two other meta-analyses investigate the relation between working memory and processing speed, with academic achievement, in children diagnosed with ADHD (Cook et al., 2018; McDougal et al., 2022), finding medium effect sizes; however, only six studies were included in each of the two meta-analyses. Thus, all of the above systematic reviews and meta-analyses did not directly measure behavioral attention to academic achievement and included few studies.

More directly, we were able to identify only six total systematic reviews and meta-analyses where the goal is to address the specific relation of behavioral attention and academic achievement. However, none were comprehensive, and covered relatively few individual studies (median = 32.5, range 16 to 72).

We identified only three systematic reviews investigating behavioral attention symptomatology and academic achievement (Gray et al., 2017; Polderman et al., 2010; Tosto et al., 2015). Gray et al. (2017) and Polderman et al. (2010) both summarized results that were consistent with findings that inattentive symptoms were a stronger predictor of low academic achievement than hyperactive/impulsive symptoms. Specifically, Gray et al. (2017)

summarized findings from 27 articles and found that 7 articles with low-risk of bias reported teacher-rated inattention as significantly predictive of poor academic achievement. Additionally, Polderman et al. (2010) identified 16 studies measuring attention problems and academic achievement, though only 6 measured outcomes of achievement tests, and concluded that inattentive symptoms are a strong predictor of low academic achievement and hyperactive symptoms are a moderate predictor of academic achievement. Tosto et al. (2015) only reviewed studies including ADHD and math ability and concluded a negative association between ADHD symptoms and math ability, more so for the inattentive symptoms than hyperactivity/impulsivity symptoms. Although these studies review the literature regarding ADHD symptomatology, no quantitative methods were used to measure the effect of ADHD subtypes on academic achievement.

To our knowledge only three meta-analyses have examined the relation of behavioral attention to academic achievement, and all have done so only from the perspective of categorical diagnoses (Frazier et al., 2007; Fowler, 2015; Graham, 2016).

Graham (2016) only investigated writing, finding in 44 studies of group comparisons between ADHD and non-ADHD groups that there are moderate to large effect sizes with $d = -0.78$ ($p < .001$) for writing quality, $d = -0.64$ ($p < .001$) for writing output, $d = -0.80$ ($p < .001$) for spelling, and $d = -0.60$ ($p < .001$) for fluency. Although strong methods were utilized, this meta-analysis did not include other academic achievement areas, moderators such as age or gender, or behavioral attention symptomatology continuously.

Frazier et al. (2007) included 72 studies using a between-group design with age, gender, achievement area, sample type, and DSM type as moderators and found that children with ADHD performed significantly lower than non-ADHD individuals on academic performance (d = 0.71, p = .001) with reading having the greatest effect size (d = 0.73, p < .001) followed by math (d = 0.67, p < .001) and then spelling (d = 0.55, p < .001).

Fowler (2015) updated the Frazier et al. (2007) meta-analysis with additional moderators (e.g., IQ, assessment method, comorbid conditions, publications status), and included 31 studies. They found an overall large effect size for ADHD diagnosis and academic achievement (g = -0.90, p < .001), though they found the opposite effect with writing having the largest effect size (g = -1.38, p < .05) followed by math (g = -0.789, p < .05) and then reading (g = -0.601, p < .05). Although the above studies offer important information, several issues remain unresolved. Specifically, none evaluated the effect of behavioral attention problems defined *categorically as an ADHD diagnosis* AND *continuously as inattentive and/or hyperactive/impulsive symptomatology*. None of the studies differentiated the effect of achievement domains based on presentation/symptomatology (e.g., inattentive symptoms vs hyperactive/impulsive symptoms). None evaluated the differential presentation of behavioral attention in academic subskills (e.g., decoding vs reading comprehension, math calculation vs fluency, spelling vs written expression). And finally, none measured effect size differences according to rater (teacher vs parent).

Present Study

The present study is a comprehensive evaluation of the relation of behavioral attention to academic achievement. In light of the evidence reviewed above, we propose a number of hypotheses:

1. We expect that overall, behavioral attention and academic achievement to have a negative relation (approximately r = -.35) such that higher endorsement of behavioral

attention problems will lead to lower scores in academic achievement, collapsed across all types of behavioral attention and all types of achievement.

2. In terms of the relation of categorical behavioral attention (ADHD diagnosis) versus continuous behavioral attention to academic achievement, we expect larger effect sizes for the former versus the latter, collapsing across all domains of achievement.
3. We expect that inattention will be more related to academic achievement than hyperactivity/impulsivity, collapsing across all domains of academic achievement.
4. We expect that behavioral attention (collapsed across different types of attention) will differentially relate to achievement across and within domain.
    a. Across domains, there is not enough data to gauge whether behavioral attention ought to differentially relate to reading, writing, or math, as two more restrictive meta-analyses have come to opposite conclusions in this regard. The present study will add valuable data for this research question.
    b. Within reading, we expect behavioral attention to be more related to reading comprehension than decoding or reading fluency.
    c. Within writing, we expect behavioral attention to be more related to written expression than spelling or writing fluency.
    d. Within math, we expect behavioral attention to be more related to math fluency than math computation and math applications/word problems.
5. Raters: We expect behavioral attention raters to differentially predict academic achievement. Specifically, we expect teacher ratings to be more related to achievement than parent raters.

6. Gender: We expect gender to differentially predict academic achievement. Specifically, we expect girls' behavioral attention to be more related to achievement than boys' behavioral attention.
7. Age: We expect age to be a significant moderator of the relation between behavioral attention and academic achievement; although this has not been examined in detail, a few studies suggest that the relationship weakens with age.

Methods

Design Overview

This project uses a meta-analytic design to evaluate the role of types of behavioral attention to types of academic achievement outcomes, while considering several key moderators.

Inclusion/Exclusion Criteria

Inclusion: (1) All available types of empirical study reports, published or unpublished, including dissertations were included so as to minimize publication bias. (2) The study population included only students in Kindergarten through 12 settings, as well as secondary settings (undergraduate, not postgraduate). If school grade was not reported, the mean age of participants at the first time point in the study needed to fall between ages 5-25 to cover all educational settings (including undergraduate). (3) The study was published in 1990 or later. This ensures the most recent and relevant information is included. (4) Study reports were written in English; however, the study can be conducted in any location, and participants can speak any language. (5) The study measured and reported at least one of the following academic achievement variables: reading, writing, or math. For reading, measures of word reading, nonword reading, reading fluency, reading comprehension, or a composite of these measures were included. For writing, measures of spelling, writing fluency, written expression, or a composite of these measures were included. For math, measures of calculation/math computation, math fluency, math applications/math reasoning/word problems, or a composite of these measures were included. (6) All studies contained EITHER (a) a correlation between an academic outcome of interest and behavioral attention, OR (b) group comparisons defined by ADHD diagnosis (e.g., ADHD students versus typical students) on an academic achievement performance measure. For group comparisons, means and standard deviation or standard error of academic achievement measures were reported. (7) For the behavioral attention measure, “attention” included at least one of the following: (a) behavioral rating scale of attention by self or proxy (parent, teacher); (b) children categorized by behavioral criteria as having Attention-Deficit/Hyperactivity Disorder (ADHD). *Exclusion:* (1) Non-empirical publications, such as literature reviews, opinion pieces, corrections/errata, case studies, etc. (2) Pre-cursor achievement tasks (e.g., phonological awareness, counting tasks). (3a) For correlational studies, the primary study sample could not be individuals diagnosed with another disorder/medical condition (i.e., brain tumors, schizophrenia with comorbid ADHD). (3b) For group comparison studies, the control/comparison group could not be individuals diagnosed with another disorder (e.g., autism spectrum disorder, learning disability). (4) Any other study not meeting the specific inclusion criteria will be excluded.

Operationalization of Variables

We operationalized variables and collected codable data in the following way.

Study Type

ADHD was coded when the study reported a sample of individuals who met diagnostic criteria for any of the three presentations for ADHD. Clinically referred samples of children previously diagnosed with ADHD were included.

Inattention/Hyperactivity/Total Attention

Inattention and hyperactivity/impulsivity were operationalized in two ways. For categorical ADHD studies, inattention was operationalized as receiving a diagnosis of ADHD Primarily Inattentive Presentation and hyperactivity/impulsivity was operationalized as receiving a diagnosis of ADHD Primarily Hyperactive/Impulsive Presentation. For continuous studies, inattention and hyperactivity/impulsivity were operationalized through behavioral attention subscales that measure inattentive and hyperactivity/impulsivity symptomatology, respectively. Although not included in the hypotheses, total attention was included as part of the behavioral attention variable given that numerous studies did not categorize or include inattention or hyperactivity/impulsivity. Thus, for categorical ADHD studies, total attention was operationalized as receiving a diagnosis of ADHD Combined Presentation, when studies had mixed diagnoses that were not separated (e.g., all three presentations being grouped as one), or when the study did not specify the ADHD presentation. For continuous studies, total attention was operationalized as scales that consisted of "total attention" or items related to both inattention and hyperactivity/impulsivity.

Academic Achievement

As noted above, academic achievement was operationalized in four ways each for reading (e.g., word reading/decoding, reading fluency, reading comprehension, total reading), writing (e.g., spelling, writing fluency, written expression, total writing), and math (e.g., calculation, math fluency, word problems, total math). Of note, the "total" category for each academic domain was included to capture composite scores or tasks that encompassed more than one individual subskill and was included in post-hoc analyses. Raw and/or standard scores were used as available.

Raters

Raters were operationalized as parent or teacher ratings of a behavioral attention measure. In the circumstance that both parent and teacher ratings are combined, then a category for both raters was collected for the study. A fourth category for self-raters was included once coding began since several studies included self-ratings of behavioral attention.

Gender

Gender was operationalized as the percentage of male participants in the study. Although gender is meant to be a categorical variable, for the purposes of data analysis, gender was treated as a continuous variable.

Age

Age was operationalized continuously as mean age of the participants in the study.

Procedures

Aspects of the meta-analysis were managed by the study team including 14 trained undergraduate volunteer research assistants, 3 trained senior research assistants who had previously worked on another meta-analysis, and 3 current graduate students recruited by the Developmental Neuropsychology Lab. The meta-analysis was conducted uniformly and followed PRISMA protocol guidelines (Shamseer et al., 2015). Please refer to Figure 1 for a PRISMA flow diagram. Specific search criteria for the meta-analysis were obtained from the

UH Libraries databases: PsycINFO, ERIC, and MEDLINE, as these are the three most relevant databases that capture journal articles in educational psychology and developmental neuropsychology, and included dissertations and unpublished studies via ProQuest. The key search terms included are ‘behav* atten*’ OR ‘ADHD’ OR ‘inatt*’ OR ‘hyperact*’ OR ‘impulsiv*’ AND ‘academ* achiev*’ OR ‘read*’ OR ‘math*’ OR ‘writ*’.

The full search results (k = 6819) obtained in June 2021 were uploaded into Brown University’s beta version of an abstract coding program, *Abstrackr* (Rathbone et al., 2015). This system allows each specific abstract to be reviewed and coded as relevant or irrelevant by a member of the study team. Acceptable abstract criteria included: (1) study reported in English; (2) article reported empirical data; (3) article included attention/ADHD; (4) article included at least one domain of academic achievement (e.g., reading, writing, math). All study team members underwent training in *Abstrackr* and completed multiple rounds of pilot screening with all team members screening the same abstracts until high consensus greater than 85% occurred. After pilot screening, all abstracts were double-coded. All discrepancies were handled in weekly study group meetings by the senior study team where consensus was made.

Once the study team reviewed all abstracts, a full-text screening (FTS) review process for the abstracts (k = 1738) that passed criteria was completed. Specific criteria were recorded in individual excel sheets consisting of participant age, year article was published, measure of behavioral attention or ADHD group, academic achievement measure, and type of effect size between behavioral attention and academic achievement (e.g., correlation, group comparison) in addition to the criteria gathered in the abstract screening phase. Training and pilot screening were also completed until a high consensus was met. Double coding was completed for each FTS. All discrepancies went through a secondary full-text screening by the advanced study team (i.e., 3 senior RAs and/or first author). Of note, *k* = 327 studies were included after FTS; however, the study number was reduced for two reasons: (1) two other meta-analyses were completed on ADHD and academic achievement with articles reviewed from 1990 through 2005 (Frazier et al., 2007) and 2006 through 2014 (Fowler, 2015), and (2) the fact that the DSM-5 (American Psychiatric Association, 2013) was published in 2013. Thus, the study team decided to remove articles published prior to 2013 (*k* = 194) to ensure that this meta-analysis was making a new and unique contribution as opposed to including studies from the prior meta-analyses as well as including studies with the most updated criteria for a clinical diagnosis of ADHD. The full set of 327 FTS studies were however, retained, for a second, more restrictive future meta-analysis (one focused at the intersection of language and attention).

The qualifying articles (*k* = 133) of the FTS for the present meta-analysis underwent full coding. Training and pilot coding procedures as discussed above were applied to the coding phase. Team members coded detailed information about each article. Specifically, properties of the studies included publication year, publication type (peer-reviewed article, dissertation, etc.), country the study was conducted in, and number of studies included. Participant-level data included participant language, age, grade, and gender. Other relevant data included behavioral rating measures used, academic achievement measures used, *n*, effect sizes, etc. A subset of coding sheets (20%) were double-coded for quality assurance. The inter-rater agreement was calculated by dividing the number of agreements (numerator) by the sum of agreements and disagreements (denominator). This was calculated for all primary study variables (behavioral attention type, academic achievement type and subskill, N, effect size, etc.) and study characteristics (e.g., year, publication type, country, language) with results indicating a total agreement percentage of 94% ranging from 82% to 100% agreement for individual variables. After primary coding was completed, data cleaning occurred by the first author on a case-by-case basis before coding sheets were finalized and analyzed. After the data cleaning was completed, 27 of the fully-coded studies were determined to not have usable effect sizes. Thus, k = 106 studies were included in the analyses. These individual 106 study excel sheets were combined into one master excel sheet which was used to analyze the data.

Analyses

Preliminary analyses were conducted to identify studies identified as outliers or influential in the model (Viechtbauer & Cheung, 2010). Specifically, the data for the overall meta-analysis model was initially analyzed for outliers through evaluating study effect sizes that did not overlap with the confidence interval of the pooled effect. A number of effect sizes were identified and plotted; however, the outliers were uniformly distributed indicating no clear indication of bias. Additionally, a sensitivity analysis was performed by running the overall model with and without outliers. The pooled effect size was not significantly different between the removed outlier model (z = -0.27, 95% CI [-0.28, -0.25]) and the initial model (z = -0.26, 95% CI [-0.29, -0.22]) indicating that the outliers do not significantly bias the pooled effect. Thus, all studies were included in the planned analyses.

Planned analyses. We collected two types of effect sizes from studies: (1) effect sizes (Cohen's *d)* of academic achievement performance in reading, writing, and math from ADHD group comparisons (ADHD vs. typical students); and/or (2) correlational coefficients (r) between academic domains and behavioral attention ratings. To analyze the overall effect sizes of interest, the study team transformed all effect sizes using Fisher's *z* transformation (Borenstein et al., 2009) and analyzed the pooled effect sizes for correlational studies and categorical/standardized mean difference studies together. Ultimately back-transformation was performed to present effects sizes and confidence intervals in Pearson's *r*, for direct comparison of all effect sizes collected. We followed state of the art approaches (Quintana, 2015). Specifically, we utilized a random effects model since this assumes that there is a distribution of true effect sizes and accommodates for two sources of variation: within-study sampling error and between-studies variability (Mengersen et al., 2013) and used R software, specifically the *metafor* (Viechtbauer, 2010) and *robumeta* (Fisher & Tipton, 2015) packages. Specific study-level data was collected in an excel file and uploaded into R. In order to measure heterogeneity in our studies, a *Q*-statistic was obtained (Quintana, 2015; Higgins et al., 2003) as well as I^2 and τ^2 statistics of heterogeneity (Higgins & Thompson, 2002). The rationale for using multiple indicators of heterogeneity is that they have different parameters (e.g., false positive rates differ, conservative versus more liberal). Although we considered all three in our interpretation, τ^2, an estimate of between-study variance in a random effects model, is insensitive to the number of studies and has been found to be the more appropriate measure to interpret (Rucker et al., 2008).

Additionally, we used the robust variance estimation (Hedges et al., 2010) method since this allows the inclusion of all dependent effect sizes into a meta-regression model even when the exact form of dependence is unknown. The method utilizes a working model for dependence which approximates the dependence structure, which leads to coefficient estimates that are more precise and accurate. The working model used for this meta-analysis is the correlated effects model, which are estimated using weighted least squares (WLS) and assumes that dependence occurs due to effect sizes being estimated from the same sample, which is the case for this meta-analysis since multiple effect sizes are included from the same sample. This technique created clusters for nested effect sizes within samples and corrected standard error estimates to account for effect size correlations within samples. An estimate for the mean correlation (ρ) is required for effect sizes within a cluster to better estimate the between study sampling variance (τ^2), so we used $\rho = .80$ for all analyses as the results were robust during a sensitivity analysis across different ρ levels. Moreover, when interpreting and reporting the results, we used the PRISMA guidelines checklist (Moher et al., 2009). We initially conducted forest plots to display the effect sizes and confidence intervals for each study (Quintana, 2015); however, given the large number of studies included, the forest plots are not able to be presented.

Publication Analysis

Publication bias occurs due to a failure to publish results based on the direction or strength of findings (Dickersin & Min, 1993), with statistically significant studies typically being published more often than studies with non-significant findings, which can lead to incorrect or invalid meta-analytic estimates (DeVito & Goldacre, 2019). Since there is no gold standard for publication bias metrics, a sensitivity analysis using multiple methods is preferred. In terms of statistical tests of publication bias, contour-enhanced funnel plots were computed since this tool identifies the presence of, and sensitivity of results to, publication bias since it relates the estimates to a measure of precision via sample size or standard error (Egger et al., 1997). Publication bias is typically indicated when funnel plots are asymmetrical meaning that smaller studies have higher effect sizes. Egger's test of the intercept (Egger et al., 1997), which is a linear regression test of funnel plot asymmetry, and rank correlation test of funnel plot asymmetry (Begg & Mazumdar, 1994) were completed to quantify the asymmetry of the funnel plots.

Moderator Analyses

This study implemented two types of moderator analyses: subgroup/categorical moderator analysis and continuous moderator/covariate analysis. We ran weighted, random-effects meta-regression models through the *robumeta* package in R (Fisher & Tipton, 2015). The random-effect robust standard error estimation method was utilized to address statistical dependence when multiple effect sizes were used from the same sample by adjusting standard errors as mentioned above (Hedges et al., 2010). Subgroup analyses lend themselves to categorical moderator questions since one can compare the differential effect of attention on achievement (e.g., inattention over hyperactivity in relation to achievement). This then conforms to more "classical" definitions of moderation, where the relation between attention and achievement is altered according to a given level of the moderator. In the present study, categorical moderator analyses were used for Hypotheses 2 (categorical v. continuous), 3 (inattention vs. hyperactivity/impulsivity), 4 (reading v. writing v. math and their subcomponents), and 5 (raters) to compare Pearson's *r* for each moderator level. In the present study, continuous meta-regression was used for Hypotheses 6 (gender) and 7 (age). It is critical to understand that although we have hypotheses about girls having a stronger relation of attention and achievement than boys, it is not possible to run precise categorical subgroup analyses as with Hypotheses 2, 3, 4, and 5. This is because data in publications is usually not provided separately for girls versus boys. Instead, percentage of the sample being boys is a way to include gender as a continuous moderator within meta-regression. If the overall model is significant with the beta weight showing a significant difference from the intercept with positive directionality, then that would mean that the relation between attention and achievement is stronger for girls than boys.

To assess subset/group analyses through categorical moderators, we assessed the p-value, τ^2, and confidence interval (Cumming & Finch, 2005) through a random effects model to determine whether the outcome is significant. Non-overlapping confidence intervals between different levels of a moderator indicated a significant difference in outcomes. Additionally, all moderators/covariates were included in the same meta-regression model (Harrer et al., 2021). To assess moderator significance of the relation between behavioral attention and academic achievement, the meta-regression function in R runs t-tests of the beta weights with a p-value of < .05 to determine whether the moderator variable significantly predicts effect size differences in the regression model. To measure meta-regression variance, we used I^2 and τ^2 to measure overall variance in the effect sizes accounted for in the model.

Analytical Plan for Hypotheses

For this meta-analysis, H1 expected the correlational effect size between behavioral attention and academic achievement to be robust with a correlation of approximately $r = -.35$. This was assessed through analyzing the confidence intervals of the pooled effect size. If the confidence interval includes $r = .35$, then we can confirm this hypothesis (H1). Additionally, for H2, we categorized behavioral attention analyses in two ways: a) categorically via ADHD diagnosis and b) continuously via behavioral attention symptomatology. For this and all subsequent categorical moderators, differences between classes/levels of the moderator are tested by evaluation of the 95% confidence intervals formed around the point estimate for the pooled effect size; where confidence intervals overlap, the moderator levels are not significantly different from one another. Thus, for H3, the confidence intervals for inattention and hyperactivity/impulsivity (collapsed over study type and achievement type) were compared (with the former expected to be larger). H4 compared effect sizes between attention (collapsed over study type and symptom type) and each of reading, writing, and math (expecting similar and robust meta-analytic effect sizes). Hypotheses H4b, 4c, and 4d assessed effect sizes of behavioral attention (across study type and symptomatology type) for reading (4b, where we expect behavioral attention to be more related to reading comprehension than decoding and reading fluency), for writing (4c, where we expect behavioral attention to be more related to written expression than spelling and writing fluency), and for math (4d, where we expect behavioral attention to be more related to math fluency than math computation and applied/word problems. For H5, we compared confidence intervals of behavioral ratings (over study type and symptom type) with achievement (over academic domain) made by teachers versus parents, expecting the latter to be higher.

We assessed continuous moderators/covariates (H6, gender; H7, age) via continuous meta-regression. For H6, the t-test of the beta weight for the percent of boys indicates whether the relation of behavioral attention (over study type and symptom type) to achievement (over academic domains and subdomains) is significant; we expected a stronger relation for females, which would be indicated by a significant positive value. Similarly, as age was coded as the mean age for the study, when the beta weight was significant and positive, it would indicate that, as hypothesized, the relation of attention and achievement decreases with age.

After individually assessing these moderators via meta-regression, we included all moderators in the meta-regression analyses simultaneously to investigate their effects on the strength of the relations between behavioral attention and academic achievement outcomes. For categorical moderators, we created dummy coded variables to evaluate comparisons among categories.

Results

There were 106 studies with 135 independent samples and 450 effect sizes based on 46300 participants (range: 20 – 9182). Publication years ranged from 2013 to 2022. The majority of the studies were conducted in the US (56%, $k = 60$) with 75% of study participants speaking English ($k = 79$). Mean sample age was 9.92 (range from 5.13-21.64) with the mean study sample being 59% male. 265 effect sizes were from correlational analyses and 185 were from standardized mean difference analyses. The majority (94%, $k = 100$) were peer-reviewed publications and 6% ($k = 6$) were dissertations. All effect sizes and study-level information can be found in Supplementary Table 1.

Hypothesis 1 was that behavioral attention and academic achievement would have a strong negative relation (approximately $r = -.35$). The meta-analytic model evaluating the overall effect size between behavioral attention and academic achievement was $r = -.25$ (95% CI: -0.29, -0.22; $p < .01$). This correlation was significant and negative though lower than expected; however, the heterogeneity of the model was significant suggesting a high level of variability in the data. The moderator analyses thus may help explain some of the variability in effect sizes between behavioral attention and academic achievement.

Moderation Analyses

Hypothesis 2: Study Design. Hypothesis 2 regarding study design (ADHD grouping versus continuous) stated that effect sizes of the relation of attention and achievement would be larger for group studies (ADHD diagnosis versus not) compared to correlational studies. Results from the subgroup meta-analysis revealed no significant difference based on the pooled effect sizes and overlapping confidence intervals. Group comparison studies had an overall effect of r = -.24, 95% CI [-.29, -.19]. Correlational studies had an overall effect of r = -.27, 95% CI [-.31, -.22]. Thus, Hypothesis 2 was not supported given that the correlations between effect sizes were similar and did not significantly differ. Pooled moderator effect sizes for categorical moderators are presented in Table 2.

Hypothesis 3: Behavioral Attention Type: Hypothesis 3 stated that academic achievement would relate more to inattention than hyperactivity/impulsivity. Subgroup meta-analysis were collapsed across study design (group and correlational effect sizes), and compared with three types of behavioral attention with regard to achievement: Total (where group studies used ADHD Combined, or mixed inattention/hyperactive types, or where correlational studies used a total score and did not separate into inattention and hyperactivity); Inattentive (ADHD Inattentive type, or a rating scale of inattention only); and Hyperactivity/Impulsivity (ADHD hyperactive/impulsive type, or a rating scale of hyperactivity/impulsivity only). There were significant findings related to the moderator levels. The overall correlation for total/combined/mixed behavioral attention type with academic achievement was r = -.24, 95% CI [-.28, -.19]. The correlation for inattention was r = -0.30, 95% CI [-.35, -.24]. Finally, the correlation for hyperactivity/impulsivity type was r = -0.13, 95% CI [-.19, -.07]. Thus, hypothesis 3 was confirmed that inattention has a stronger relation with academic achievement than hyperactivity/impulsivity.

Hypothesis 4: Academic Achievement Domain. Prior literature did not provide clear evidence as to whether the relation of attention and achievement was differential by achievement domain, but a subgroup meta-analysis evaluated this. The relation with reading was *r* = -.24, 95% CI [-0.28, -0.20]. The correlation for math was *r* = -.28, 95% CI [-.34, -.22]. Finally, the correlation with writing was *r* = -.24, 95% CI [-.32, -.15]. Thus, findings were similar between domains and behavioral attention did not significantly vary by academic achievement domain.

Reading Subskill Moderator: Hypothesis 4b stated that behavioral attention would relate more to reading comprehension than decoding or reading fluency. To assess this, subgroup meta-analysis was completed for the reading subskills. There were not significant findings related to the moderator levels. The overall correlation for behavioral attention with word reading/decoding was *r* = -.22, 95% CI [-.28, -.16]. The correlation for behavioral attention and reading fluency was slightly higher, *r* = -.25, 95% CI [-.32, -0.18]. The correlation for behavioral attention and reading comprehension was *r* = -.26 95% CI [-.32, -.19]. The overall correlation for behavioral attention and total reading (i.e., composite reading scores;) was *r* = -.21, 95% CI [-0.27, -0.15]. Thus, although all had significant negative correlations, hypothesis 4b was not supported with no significant difference between reading subskills, though correlations were in the expected direction.

Writing Subskill Moderator: Hypothesis 4c stated that behavioral attention would relate more to written expression than spelling or writing fluency. To assess this, subgroup meta-analysis was completed for the writing subskill. There were not significant findings related to the moderator levels. The correlation for behavioral attention with spelling was *r* = -.23, 95% CI [-.35, -.12]. The correlation for behavioral attention and writing fluency was *r* = -.29, 95% CI [-.49, -.06]. The correlation for behavioral attention and written expression was *r* = -.36, 95% CI [-.43, -.29]. The correlation for behavioral attention and total writing was *r*

= -.23, 95% CI [-.41, -.03]. Thus, our hypothesis was not supported given that there was no significant difference between writing subskills; however, it is important to note that the number of studies (*k)* included in these analyses was lower than all other analyses (*k* ranging from 5 to 16), so a higher *k* would likely be necessary to detect a significant difference. Additionally, writing fluency had a small number of degrees of freedom (*df* = 3.94), so these results may not be valid and should be interpreted with caution (Tanner-Smith et al., 2016). Further, although not significant, it is important to acknowledge that written expression had the strongest correlation, which was consistent with our hypothesis.

Math Subskill Moderator: Hypothesis 4d stated that behavioral attention would relate more to math fluency than math computation or math applications/word problems. To assess this, subgroup meta-analysis was completed for the math subskill moderator. There were not significant findings related to the moderator levels. The correlation for behavioral attention with math computation was r = -.28, 95% CI [-.35, -.21]. The correlation for behavioral attention and math fluency was r = -.29, 95% CI [-.47, -.08]. The correlation for behavioral attention and math problem solving was r = -.45, 95% CI [-.60, -0.27]. The correlation for behavioral attention and total math was r = -.23, 95% CI [-.29, -.18]. Thus, hypothesis 4d was not supported; however, similar to the writing subskill meta-analysis above, the number of studies (*k*) was low, which may affect the power necessary to reach statistical significance.

Hypothesis 5: Raters. Hypothesis 5 stated that teacher ratings of attention would be more related to academic achievement than parent raters. The correlation for parent-rated behavioral attention and academic achievement was r = -.19, 95% CI [-0.24, -.14]. The correlation for teacher-rated behavioral attention and academic achievement was r = -.34, 95% CI [-.39, -.28]. Thus, hypothesis 5 was supported in that teacher ratings of attention were more related to academic achievement than parent ratings of attention.

Although self-rated behavioral attention was not included in our hypotheses, *k*=5 studies with 8 effect sizes were included in data collection so results are presented (though degrees of freedom were less than 4 so should be interpreted with caution). The correlation for self-rated behavioral attention and academic achievement was $r = -.05$, 95% CI [-.12, .01]. In addition, it was also the case that several studies did not differentiate between parents and teachers (*k*=25; 111 effect sizes), so another level for "both raters" was included. The correlation for both parent/teacher-rated behavioral attention with academic achievement was $r = -.27$, 95% CI [-.34, -.20].

Hypothesis 6: Gender. Hypothesis 6 stated that gender would differentially impact the relation between behavioral attention and academic achievement. However, the meta-regression did not yield a significant effect ($\beta = 0.09$, $t = 0.74$, $p > .05$), and thus hypothesis 6 was not supported.

Hypothesis 7: Age. Hypothesis 7 stated that older age would yield stronger relations between behavioral attention and academic achievement. The individual meta-regression analysis was significant ($\beta = -.015$, $t = 3.04$, $p < .01$), indicating that as age increases (i.e., children get older) the relation between behavioral attention and academic achievement decreases, supporting hypothesis 7.

Meta-regression analyses

Moderators were included in one model for meta-regression analysis. Table 3 shows achievement was more strongly associated with inattention than with hyperactivity/impulsivity, $\beta = -.17$, $t = -4.12$, $p < .001$, 95% CI [-.25, -.08]. Additionally, achievement was more related to teacher ratings of behavioral attention than with parent ratings of attention, $\beta = -.19$, $t = -3.66$, $p < .001$, 95% CI [-.34, -.06]. Age was not a significant moderator in the meta-regression model when all other moderators were included $\beta = -.002$, $t = -.44$, $p > .05$, 95% CI [-.02, .01]. Study design, achievement domain (and subdomains), and gender were also nonsignificant moderators. Moderator correlations are presented below.

Publication Bias

Egger's regression test and the rank correlation test indicated a potential publication bias for the overall and some moderator models (*p*s < .05; correlational data, total attention, writing, word reading/decoding, parent rater); however, all other moderator models were not significant (*p*s > .05). Additionally, the funnel plots suggested that missing studies were on the left side of the mean correlations indicating that the true effect sizes may be larger than reported here. In addition to these tests, selection models are a methodologically viable alternative since they make more flexible assumptions regarding heterogeneity and publication bias (Hedges, 1984, Maier et al., 2022) to determine whether there is overrepresentation of observed studies with significant p-values compared to observed studies with nonsignificant p-values. The model uses maximum likelihood estimation and is considered to be less biased than Egger's regression test. The *weightr* package in R (Coburn & Vevea, 2019) was used with non-significant findings ($\chi 2(1, N = 450) = 3.67$, $p > .05$ indicating there was not publication bias detected. Fail-safe N was also calculated to assess the number of additional studies to increase the findings to above $p > .05$ (Rosenthal, 1979) with a finding of 1,189,843 for the overall model and Ns ranging from 464 to 583,399 for the moderator models.

Post-Hoc Analyses

Given the significant difference between effect sizes in inattention and hyperactivity/impulsivity, post-hoc analyses were completed to analyze the relation between inattention and hyperactivity/impulsivity for specific academic domains with significant findings, which can be found in Table 4. To summarize, inattention was more strongly correlated with reading, *r* = -.29, 95% CI [-.35, -.22], and math, *r* = -.34, 95% CI [-.41, -.26] than hyperactivity was to reading, *r* = -.13, 95% CI [-.21, -.05], and math, *r* = -.13, 95% CI [-.22, -.04]; however, writing performance did not significantly differ between inattention, *r* = -.28, 95% CI [-.47, -.07], and hyperactivity, *r* = -.16, 95% CI [-.37, .06], though few studies were included in these analyses (*k*=8, *k* =5, respectively).

Additionally, given that inattention related more significantly to academic achievement than hyperactivity/impulsivity, we were interested in whether the level of subskill also differentially related; however, there were not enough studies to evaluate individual subskills, so the moderator for academic level was created. Low level academics consisted of decoding/word reading, spelling, and math computation, mid-level academics consisted of reading, writing, and math fluency, and high-level academics consisted of reading comprehension, written expression, and math words problems. Table 5 shows that lower academic levels were more strongly correlated to inattention, *r* = -.30, 95% CI [-.37, -.23] than hyperactivity/impulsivity, *r* = -.13, 95% CI [-.23, -.04]. A similar pattern followed with the relation between mid-academic levels and inattention, *r* = -.34, 95% CI [-.44, -.24] and hyperactivity/impulsivity, *r* = -.13, 95% CI [-.29, -.04]; as well as the relation between high academic levels and inattention, , *r* = -.30, 95% CI [-.37, -.23] and hyperactivity/impulsivity, *r* = -.13, 95% CI [-.23, -.04]; however, these were not significantly different given the overlapping confidence intervals. Additionally, Table 6 shows that when adding academic levels (low, mid, high) along with academic achievement domains (reading, math, and writing) in the full meta-regression model, the high academic level (i.e., combined reading comprehension, written expression, and math word problems) was more related to behavioral attention than low academic level, $\beta = -.10$, $t = -3.21$, $p < .01$, 95% CI [-.17, -.04].

Discussion

The goal of the present study was to evaluate the meta-analytic relation of behavioral attention with academic achievement, evaluating relevant moderators. Hypotheses received mixed support though were favorable. The overall relation was -.25, which was significant and in the expected direction, but smaller than expected. Significant moderators of this effect included behavioral attention type and behavioral attention rater. Specifically, inattention and teacher-rated behavioral attention had the strongest associations with academic achievement. Other moderators such as study design, academic achievement domains and subskills and gender were not found to be significant moderators; age (stronger relations for effect sizes generated from older students) was significant in individual analyses, though not in the meta-regression. However, each hypothesized effect was in the expected direction. Post-hoc analyses clarified that inattention was more strongly related than hyperactivity for reading and math though not writing outcomes; in addition, higher-level academic skills (reading comprehension, written expression, and math word problems) were more strongly associated with inattention than were lower-level achievement skills.

There is no denying that there is a significant relation between behavioral attention and academic achievement, specifically a small to medium negative effect indicating that greater attention problems are related to worse academic performance. This finding is consistent with the other meta-analyses discussed earlier, albeit our findings showed the relation to be somewhat weaker in all three academic areas than the three meta-analyses given that their findings ranged from Cohen's *d* = -.55 to Hedge's *g* = -1.38 across moderators. However, it is important to note that the Frazier et al. (2007) study had similar effect sizes with converted Pearson's *r* effect sizes ranging from -.26 to -.34. The Fowler (2015) dissertation had significantly higher effect sizes; however, it is important to note that the *k* was much lower (*k* = 31) and is not a peer-reviewed publication as opposed to the Frazier et al. (2007) study consisting of 72 studies. Additionally, Graham (2016) only investigated writing outcomes in children with ADHD and found effect sizes only slightly higher than our results with converted Pearson's *r* effect sizes from -.28 to -.37.

Overall, this consistent important finding has critical implications given that academic achievement is related to long-term outcomes such as graduating high school and adult occupational success, particularly those with diagnoses of ADHD (Barbaresi et al., 2007; Frazier et al., 2007; Kuriyan et al., 2013; Robb et al., 2011). The continued identification of the attention-achievement relation and its long-term effects is important to establish so that continued supports can be utilized for children with weaknesses in these areas. Below we discuss and interpret these other findings in the context of several moderators.

In terms of the findings related to study design, group comparison effect sizes (*r* = -.24) had similar findings to correlation effect sizes (*r* = -.27), which does not support Hypothesis 2. A primary reason this hypothesis was stated was due to the greater potential for inflated effect sizes due to extreme groups (ADHD versus control) relative to broader correlational data (Fisher et al., 2020; Preacher et al., 2005). This did not appear to be the case and the relations are similar despite the differences in research study design and format.

On the other hand, a potential explanation for the similar effect sizes could also be related to the fact that correlational studies sometimes included ADHD groups, typically-developing comparison groups, and combined groups, which could impact correlations. This is also a reassuring finding given the fact that most prior studies (particularly the Frazier et al., 2007 and Fowler, 2015 meta-analyses) implement a group comparisons format. Additionally, the finding of similar effect sizes potentially lends evidence to the argument that attention difficulties and ADHD diagnoses could be classified on a continuum instead of categorically. This type of framework has garnered more attention and is being increasingly studied in terms of mental health diagnoses through the Research Domain Criteria Initiative (RDoC; Cuthbert, 2022; Insel et al., 2010) to inform future classification schemes. Specifically, instead of categorizing mental diagnoses in specific categories, RDoC considers mental health and psychopathology within broad domains of functioning and investigates the varying degrees of dysfunction. Thus, since our findings (i.e., no difference between study design suggesting an attention continuum could be beneficial) did not find differences, this framework could be considered. This would allow assessment of the extent of the impairment (i.e., academic achievement impairment) and provide intervention options as opposed to determining this based on categorical thresholds (Haslam et al., 2006). An interesting follow-up study would be to conduct a quantile analysis based on children/adolescent's attention functioning and investigate whether achievement varies by "band." This would help those who experience sub-clinical levels of attention problems that could be impacting academic achievement.

The hypothesis related to the attention subtype category found that inattention is significantly more related to academic achievement than hyperactivity/impulsivity. This finding is novel at the meta-analytic level. Although other individual studies (Marshall et al., 1997; Raghubar et al., 2009; Warner-Rogers et al., 2000; Willcutt & Pennington, 2000; Zendarski et al., 2017) and systematic reviews (Gray et al., 2017; Polderman et al., 2010) have made conclusions that academic achievement is more related to inattention than hyperactivity/impulsivity, this is the first meta-analysis to confirm these findings. At a practical level, this finding helps clarify the functional impact that inattention exhibits in school, which could be due to several factors. First, ADHD medication typically works well in managing hyperactive/impulsive symptoms such as fidgeting and interruptive behavior (Advokat & Scheithauer, 2013) compared to inattentive symptoms. Thus, children who have already begun psychostimulant treatment of ADHD may be able to control these symptoms in a classroom setting so that the impact on academics is lessened. Second, children who are inattentive may be less behaviorally disruptive (Finn et al., 1995) compared to children exhibiting hyperactive/impulsive symptoms, and in turn, more difficult to "catch" in a classroom setting. This could lead to under-identification of children with inattentive symptoms which could have a detrimental impact on learning given the relation to lower academic performance. At a logistical and diagnostic level, although subtle changes in ADHD diagnosis criteria were implemented in the DSM-5 (i.e., change from "subtypes" to "presentations"; American Psychiatric Association, 1994; 2013) due to research showing that symptomatology can be fluid and less stable across the lifespan (Epstein & Loren, 2013; Hurtig et al., 2007), our findings indicate a continued differential impact in presentations. Theoretically, this finding is consistent with Barkley's (1991; 1997) work relating the metacognitive nature of inattentive symptoms (i.e., unable to focus on work, makes careless mistakes, difficulty in organizing tasks) to executive functioning and to direct learning of academics. Thus, further screening and identification of inattentive symptoms will aid in identifying children who could benefit from academic intervention. Specifically, incorporating meta-cognitive aspects (e.g., executive functioning and attentiveness) into intervention could prove beneficial in the academic setting for children with ADHD.

Given that all academic domains and subskills did not significantly differ within each domain, a broader interpretation can be discussed. As mentioned in our hypotheses, prior literature does not offer a solid conclusion for the relation between behavioral attention and reading, writing, and math with two prior meta-analyses having opposite findings (Frazier et al., 2007; Fowler, 2016). This meta-analysis lends more data to behavioral attention having a similar negative relation equally across academic domains. Currently, we can conclude that behavioral attention does impact academics, but that our meta-analysis did not find specific academic domains and subskills to differentially relate to overall behavioral attention.

However, this relation changes once we separate inattention and hyperactivity/impulsivity as noted above. Due to the significant finding between academics and inattention versus hyperactivity/impulsivity, post-hoc analyses were completed to compare specific academic domains to inattention and hyperactivity/impulsivity with findings showing that inattention was more related to reading and math compared to the relation between hyperactivity/impulsivity and reading and math. Although there were no differences when comparing academic domains with each other, it is important to note that the pooled effect size of behavioral attention appears to be "dampening" the effect between attention types, specifically inattention, and academic achievement domains. Additionally, given the lower study size for some of the writing and math subskills (writing fluency, math fluency, math problem solving), there may not have been enough power to detect differences between the subskills. Additionally, as mentioned earlier in the text, the literature has found that other cognitive skills such as executive function (Eckrich et al., 2019; Olive, 2004; Olive, 2011) and processing speed (Cook et al., 2018) are heavily related to these subskills, which may lower the effect sizes in this study. However, it is important to note that the models for all three subskills were significant indicating that behavioral attention has moderate relations with all reading, writing, and math subskills.

Given these findings at the academic domain and subskill level, post-hoc analyses were completed to compare academic groups based on complexity with low-level academics (word reading/decoding, spelling, math computation), mid-level academics (fluencies), and high-level academics (reading comprehension, written expression, math word problems). Once this moderator was added into the meta-regression model, high-level academics was significantly associated with behavioral attention compared to other academic levels. This is further solidified when analyzing the correlations given that the high-level academics had the strongest correlation with behavioral attention (r = -.31). These findings further support the theory that higher-level academic processes are more related to attention, which has been found in the literature (Kim et al., 2013; Macdonald et al., 2021, Passolunghi et al., 1999). Given that reading comprehension, written expression, and math word problems require higher order processing, attentional processes appear to be involved in the focus of information in a passage (Barkley, 1991), and attending to relevant information and inhibiting attention to irrelevant information in writing and word problem solving (Eckrich et al., 2019; Passolunghi et al., 1999). This is an important finding and could potentially indicate that more research should focus on the relation of behavioral attention *within* academic domains (lower versus higher-level) as opposed to *between* academic domains (reading versus math versus writing) when providing intervention given that children with attention difficulties may require greater support in higher-level academic tasks. Thus, further attention is needed to investigate the implementation of attentional resources in higher-level academic subskills given these findings.

Our hypothesis related to behavioral attention rater was supported indicating that teacher reports of behavioral attention are more related to academic achievement than parent reports of behavioral attention. Potential explanations for this finding include that teachers have a wider variety of student interactions compared to parents, so it may be easier for them to notice attention difficulties in the school setting. Additionally, it makes sense that teachers' attention ratings are more related to academic achievement than parents' ratings since teachers primary setting with the students are in an academic environment. Further, given the findings from Breslau et al. (2010) that increases in teacher-rated attention problems in elementary ages were related to later academic difficulties, it is critical to have teachers identify these attention changes as early as possible so that intervention or other supports can be implemented at a young age to potentially mitigate future academic difficulties. One caveat to this finding is that we are assuming temporal directionality, specifically that teachers are identifying attention difficulties which are leading to academic difficulties. However, we cannot rule out that teachers are noticing academic difficulties, which in turn, affect their attention ratings of the child. This is not to say that this changes our interpretations given that researchers have found that teachers have a high classification rating of ADHD diagnoses (Tripp et al., 2006) but it is important to note and consider differing views. Further, these findings suggest that teacher report of attention difficulties is helpful when assessing a child for ADHD or evaluating for other school supports since they clearly appear to have a better grasp on how attention is affecting their academics.

Although our hypothesis regarding gender expected a difference between boys and girls in the relation between attention and achievement, this difference was not found in our analyses. Specifically, these results did not find a difference between girls or boys on the relation between attention and academics. However, this is somewhat reassuring that the findings are not significantly different based on gender, particularly since the literature has found that girls with ADHD are at greater risk for difficulties in academic achievement, particularly math, than boys with ADHD (Kerner auch Koerner et al., 2021). On the other hand, gender may differentially impact the relation of attention in other functional domains (e.g., social outcomes, family relationships) that are outside of the achievement domain and, thus, not assessed in this meta-analysis. Given prior mixed findings on gender as a moderator of the relation between attention and achievement (Goni et al., 2015; King, 2016; Kingdon et al., 2017; Velki & Vrdoljak, 2019), our results are consistent with the Frazier et al. (2007) meta-analysis as well as aid in solidifying and confirming the results from Alavi et al.'s (2019) study that gender does not significantly moderate the relation between attention and achievement.

Although our hypothesis related to age being a significant moderator was ultimately not supported in the overall meta-regression, these results still have important implications. Specifically, these results show a trend suggesting that the relation between attention and academics decreases as children grow older. There are several factors that could affect this finding. Specifically, younger children have more difficulty regulating attention compared to older children (Hay et al., 2007; Holbrook et al., 2016; Lyon et al., 2022), which may lead attention difficulties to interfere with academics more directly than in older children. This could be due to younger children not having developed strategies related to attention regulation (i.e., taking breaks, working in an environment with less distractions) that older children are implementing. Additionally, older children with attention difficulties have had more time to begin receiving accommodations (i.e., psychostimulants or classroom supports) given that they have been in school for a longer period of time, which may impact the relation between attention and academics.

Limitations & Future Directions

The study team noted a few limitations to the current study. One obvious limitation is that there is less control over how individual study data is collected given the nature of meta-analyses. Specifically, the heterogeneity of the ADHD samples could not be controlled. For instance, some of the ADHD samples were referred. Although most studies provided descriptions on how the diagnoses were made, not all studies described this process. This could have influenced the results in the sense that less is known about the type of ADHD diagnoses given in those samples, so subtype analyses related to inattention were not able to be completed, which would have further helped clarify the differential role of ADHD presentations in academic achievement. Further, we were not able to account for whether any of the ADHD groups were taking medication or seeking other means of treatment (e.g., behavioral intervention) at the time of assessing academic achievement. This is an important factor to consider given that achievement scores may differ if children in the studies were taking a psychostimulant medication at the time of testing given its known benefits in focusing and learning (Powers et al., 2008). If medication was a factor, then we would expect the overall correlation to be lower in children prescribed psychostimulant medication compared to those who are not. Additionally, our team relied on data that was presented in articles so, as with all meta-analyses, it is important to assess publication bias. Although our study shows publication bias for some of the moderator models, it is important to note that the study team underwent a rigorous process of collecting data from all eligible studies to ensure the integrity of the study findings.

Additionally, in terms of theoretical limitations, although this was a large meta-analysis, other important moderators could have been included, specifically other cognitive moderators, such as language skills and pre-academic skills (i.e., phonological awareness), given that language is a known cognitive predictor of academic achievement (Gough & Tunmer, 1986; Kim et al., 2013; Peng et al., 2020) and due to both reading and writing being language-based tasks. Specifically, Gremillion and Martel (2012) found that semantic language fully mediated the relation between children with ADHD and reading achievement and partially mediated the relation between ADHD and math. A theoretical basis to include language as a moderator stems from developmental theory suggesting that language learning (e.g., semantic language/vocabulary) may aid in forming attentional skills in childhood which is then associated with learning academic skills (Gartstein et al., 2008). Thus, a future direction would be to include language as a moderator and potentially include it in a meta-SEM model to investigate the indirect or interactive effects of language and attention on academic achievement.

Based on the results of this meta-analysis, other future directions would be to investigate inattention and academics more directly at a meta-analytic level as well as other cognitive domains closely related to inattention such as executive functioning (Barkley, 1991; 1997) given that numerous studies have linked executive functioning with academic achievement (Eckrich et al., 2019; Olive, 2004; Olive, 2011). This could clarify the role that the metacognitive aspects of inattention and executive function are related to academic achievement outcomes, especially since verbal working memory has been associated with academic achievement (Gremillion and Martel, 2012; Gropper & Tannock, 2009; Thorell, 2007). Further, assessing the role of attention constructs outside of behavioral attention (e.g., external performance-based attention, internal "mind wandering" attention) and the relation to academic achievement through meta-regression techniques would be of interest to determine the differential impact of attention on academic achievement given that performance-based visual attention (Facoetti et al., 2003; Kirk et al., 2017; Lourenco et al., 2018) and mind wandering (Pereira et al., 2020; Wammes et al., 2016) have been associated with academic achievement.

Other methodological limitations include the small study size for some of the moderators (e.g., academic subskills), though all levels of moderators had at least 5 studies included (Higgins et al., 2022).

Summary

Overall, this meta-analysis further solidified the significant negative relation between behavioral attention and academic achievement using scientifically rigorous methodology. Further, it supports significant moderators in the relation between behavioral attention and academic achievement. Specifically, (1) this is the first meta-analysis indicating that inattention is significantly more related to academic achievement on a meta-analytic level than hyperactivity/impulsivity. This finding has significant implications for the importance of identifying students with inattention difficulties to mitigate the risk of developing academic achievement difficulties. Additionally, (2) similar findings related to study design indicate that attention difficulties based on a categorical or dimensional diagnosis may not be as important as previously thought and has potential implications for a continuum-based diagnosis for ADHD. (3) Post-hoc findings indicate that higher-order academic skills (e.g., reading comprehension, written expression, and math word problems) are more related to behavioral attention. This also provides implications for practice such that greater focus and additional intervention and supports may be warranted in these academic areas for children with attention difficulties. (4) Further, our findings indicate that multi-modal assessment of attention (e.g., parent AND teacher), particularly teacher ratings, will be important in identifying at-risk students for achievement difficulties. Overall, our study supports the moderate, significant relation between behavioral attention and academic achievement, and these findings help inform how students can be most appropriately identified (i.e., teacher report), which students are at greater risk of achievement difficulties (i.e., inattentive students), and which academic areas (i.e., higher-level academics) are a potential target for intervention.

References

Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin*, *101*(2), 213–232. https://doi.org/10.1037/0033-2909.101.2.213

Ackerman, P. T., Anhalt, J. M., & Dykman, R. A. (1986). Arithmetic Automatization Failure in Children with Attention and Reading Disorders: Associations and Sequela. *Journal of Learning Disabilities*, *19*(4), 222–232. https://doi.org/10.1177/002221948601900409

Advokat, C., & Scheithauer, M. (2013). Attention-deficit hyperactivity disorder (ADHD) stimulant medications as cognitive enhancers. *Frontiers in Neuroscience*, *7*, 82. https://doi.org/10.3389/fnins.2013.00082

Ahmed, Y., Kent, S., Cirino, P. T., & Keller-Margulis, M. (2021). The Not-So-Simple View of Writing in Struggling Readers/Writers. *Reading & Writing Quarterly*, *0*(0), 1–25. https://doi.org/10.1080/10573569.2021.1948374

Alavi, M., Seng, J. H., Mustaffa, M. S., Ninggal, M. T., Amini, M., & Latif, A. A. (2019). Attention, Impulsiveness, and Gender in Academic Achievement Among Typically Developing Children. *Perceptual and Motor Skills*, *126*(1), 5–24. https://doi.org/10.1177/0031512518809163

Altman, D. G., & Royston, P. (2006). The cost of dichotomising continuous variables. *BMJ*, *332*(7549), 1080. https://doi.org/10.1136/bmj.332.7549.1080

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV* (4th ed.). American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5.* (5th edition). American Psychiatric Association.

*Antonini, T. N., Narad, M. E., Langberg, J. M., & Epstein, J. N. (2013). Behavioral correlates of reaction time variability in children with and without ADHD. *Neuropsychology*, *27*(2), 201–209. https://doi.org/10.1037/a0032071

Antzaka, A., Lallier, M., Meyer, S., Diard, J., Carreiras, M., & Valdois, S. (2017). Enhancing reading performance through action video games: The role of visual attention span. *Scientific Reports*, *7*(1), 14563. https://doi.org/10.1038/s41598-017-15119-9

Arnold, L. E., Hodgkins, P., Kahle, J., Madhoo, M., & Kewley, G. (2020). Long-Term Outcomes of ADHD: Academic Achievement and Performance. *Journal of Attention Disorders*, *24*(1), 73–85. https://doi.org/10.1177/1087054714566076

Arrington, C. N., Kulesz, P. A., Francis, D. J., Fletcher, J. M., & Barnes, M. A. (2014). The Contribution of Attentional Control and Working Memory to Reading Comprehension and Decoding. *Scientific Studies of Reading*, *18*(5), 325–346. https://doi.org/10.1080/10888438.2014.902461

Barbaresi, W. J., Katusic, S. K., Colligan, R. C., Weaver, A. L., & Jacobsen, S. J. (2007). Long-term school outcomes for children with attention-deficit/hyperactivity disorder: A population-based perspective. *Journal of Developmental and Behavioral Pediatrics: JDBP*, *28*(4), 265–273. https://doi.org/10.1097/DBP.0b013e31811ff87d

Barkley, R. A. (1991). Diagnosis and assessment of attention deficit-hyperactivity disorder. *Comprehensive Mental Health Care*, *1*(1), 27–43.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, *121*(1), 65–94. https://doi.org/10.1037/0033-2909.121.1.65

Bauer, P. J. (2021). Why It Is Important to Know How the Sausage Is Made: Benefits, Risks, and Responsibilities of Using Third-Party Data. *Psychological Science*, *32*(6), 861–862. https://doi.org/10.1177/09567976211021594

Bedard, K., & Dhuey, E. (2006). The Persistence of Early Childhood Maturity: International Evidence of Long-Run Age Effects*. *The Quarterly Journal of Economics*, *121*(4), 1437–1472. https://doi.org/10.1093/qje/121.4.1437

Begg, C. B., & Mazumdar, M. (1994). Operating Characteristics of a Rank Correlation Test for Publication Bias. *Biometrics*, *50*(4), 1088–1101. https://doi.org/10.2307/2533446

*Berninger, V., Abbott, R., Cook, C. R., & Nagy, W. (2017). Relationships of Attention and Executive Functions to Oral Language, Reading, and Writing Skills and Systems in Middle Childhood and Early Adolescence. *Journal of Learning Disabilities*, *50*(4), 434–449. https://doi.org/10.1177/0022219415617167

Berninger, V. W., & Abbott, R. D. (2010). Listening comprehension, oral expression, reading comprehension, and written expression: Related yet unique language systems in grades 1, 3, 5, and 7. *Journal of Educational Psychology*, *102*(3), 635–651. https://doi.org/10.1037/a0019319

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In *Handbook of learning disabilities* (pp. 345–363). The Guilford Press.

Biederman, J., Faraone, S., Milberger, S., Guite, J., Mick, E., Chen, L., Mennin, D., Marrs, A., Ouellette, C., Moore, P., Spencer, T., Norman, D., Wilens, T., Kraus, I., & Perrin, J. (1996). A Prospective 4-Year Follow-up Study of Attention-Deficit Hyperactivity and

Related Disorders. *Archives of General Psychiatry*, *53*(5), 437–446. https://doi.org/10.1001/archpsyc.1996.01830050073012

Biederman, J., Mick, E., Fried, R., Aleardi, M., Potter, A., & Herzig, K. (2005). A Simulated Workplace Experience for Nonmedicated Adults With and Without ADHD. *Psychiatric Services*, *56*(12), 1617–1620. https://doi.org/10.1176/appi.ps.56.12.1617

Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., Ferrero, F., Morgan, C. L., & Faraone, S. V. (2004). Impact of executive function deficits and attention-deficit/hyperactivity disorder (ADHD) on academic outcomes in children. *Journal of Consulting and Clinical Psychology*, *72*(5), 757–766. https://doi.org/10.1037/0022-006X.72.5.757

*Birkett, E. E., & Talcott, J. B. (2013). Interval Timing in Children: Effects of Auditory and Visual Pacing Stimuli and Relationships with Reading and Attention Variables. *PLoS ONE*, *7*(8), e42820. https://doi.org/10.1371/journal.pone.0042820

Boland, H., DiSalvo, M., Fried, R., Woodworth, K. Y., Wilens, T., Faraone, S. V., & Biederman, J. (2020). A literature review and meta-analysis on the effects of ADHD medications on functional outcomes. *Journal of Psychiatric Research*, *123*, 21–30. https://doi.org/10.1016/j.jpsychires.2020.01.006

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. wiley. https://doi.org/10.1002/9780470743386

Breslau, J., Miller, E., Breslau, N., Bohnert, K., Lucia, V., & Schweitzer, J. (2009). The Impact of Early Behavior Disturbances on Academic Achievement in High School. *Pediatrics*, *123*(6), 1472–1476. https://doi.org/10.1542/peds.2008-1406

Breslau, N., Breslau, J., Peterson, E., Miller, E., Lucia, V. C., Bohnert, K., & Nigg, J. (2010). Change in teachers' ratings of attention problems and subsequent change in academic achievement: A prospective analysis. *Psychological Medicine*, *40*(1), 159–166. https://doi.org/10.1017/S0033291709005960

Bull, R., & Johnston, R. S. (1997). Children's Arithmetical Difficulties: Contributions from Processing Speed, Item Identification, and Short-Term Memory. *Journal of Experimental Child Psychology*, *65*(1), 1–24. https://doi.org/10.1006/jecp.1996.2358

Bünger, A., Urfer-Maurer, N., & Grob, A. (2019). Multimethod Assessment of Attention, Executive Functions, and Motor Skills in Children With and Without ADHD: Children's Performance and Parents' Perceptions. *Journal of Attention Disorders*, *25*, 108705471882498. https://doi.org/10.1177/1087054718824985

Burnham, K. P., & Anderson, D. R. (2004). Multimodel Inference: Understanding AIC and BIC in Model Selection. *Sociological Methods & Research*, *33*(2), 261–304. https://doi.org/10.1177/0049124104268644

Burnham, K. P., Anderson, D. R., & Burnham, K. P. (2002). *Model selection and multimodel inference: A practical information-theoretic approach* (2nd ed). Springer.

*Cain, K., & Bignell, S. (2014). Reading and listening comprehension and their relation to inattention and hyperactivity. *British Journal of Educational Psychology*, *84*(1), 108–124. https://doi.org/10.1111/bjep.12009

*Canu, W. H., Elizondo, M., & Broman-Fulks, J. J. (2017). History of ADHD traits related to general test and specific math anxiety in college students. *Learning and Individual Differences*, *58*, 56–63. https://doi.org/10.1016/j.lindif.2017.07.008

*Capodieci, A., & Martinussen, R. (2017). Math Error Types and Correlates in Adolescents with and without Attention Deficit Hyperactivity Disorder. *Frontiers in Psychology*, *8*, 1801. https://doi.org/10.3389/fpsyg.2017.01801

*Carrasco, K. D., Chuang, C.-C., & Tripp, G. (2022). Shared Predictors of Academic Achievement in Children with ADHD: A Multi-Sample Study. *Journal of Attention Disorders*.

*Chan, T., & Martinussen, R. (2016). Positive Illusions? The Accuracy of Academic Self-Appraisals in Adolescents With ADHD. *Journal of Pediatric Psychology*, *41*(7), 799–809. https://doi.org/10.1093/jpepsy/jsv116

*Child, A. E., Cirino, P. T., Fletcher, J. M., Willcutt, E. G., & Fuchs, L. S. (2019). A Cognitive Dimensional Approach to Understanding Shared and Unique Contributions to Reading, Math, and Attention Skills. *Journal of Learning Disabilities*, *52*(1), 15–30. https://doi.org/10.1177/0022219418775115

*Chimiklis, A. L. (2019). *Examining the Effects of a Multi-Component Neurocognitive Intervention for School-Aged Children with Co-Occurring ADHD and Reading Difficulties*.

*Cho, E., Compton, D. L., & Josol, C. K. (2020). Dynamic assessment as a screening tool for early identification of reading disabilities: A latent change score approach. *Reading and Writing*, *33*(3), 719–739. https://doi.org/10.1007/s11145-019-09984-1

Cho, S.-C., Kim, H.-W., Kim, B.-N., Shin, M.-S., Yoo, H. J., Kim, J.-W., Bhang, S.-Y., & Cho, I. H. (2011). Are Teacher Ratings and Parent Ratings Differently Associated with Children's Intelligence and Cognitive Performance? *Psychiatry Investigation*, *8*(1), 15–21. https://doi.org/10.4306/pi.2011.8.1.15

Cirino, P. T., Barnes, M. A., Roberts, G., Miciak, J., & Gioia, A. (2022). Visual attention and reading: A test of their relation across paradigms. *Journal of Experimental Child Psychology*, *214*, 105289. https://doi.org/10.1016/j.jecp.2021.105289

Cirino, P. T., Miciak, J., Ahmed, Y., Barnes, M. A., Taylor, W. P., & Gerst, E. H. (2019). Executive function: Association with multiple reading skills. *Reading and Writing*, *32*(7), 1819–1846. https://doi.org/10.1007/s11145-018-9923-9

Coburn, K. M., & Vevea, J. L. (2019). *weightr: Estimating Weight-Function Models for Publication Bias* (2.0.2) [Computer software]. https://cran.r-project.org/web/packages/weightr/index.html

Cohen, R. A. (2014). *The Neuropsychology of Attention*. Springer US. https://doi.org/10.1007/978-0-387-72639-7

Cook, N. E., Braaten, E. B., & Surman, C. B. H. (2018). Clinical and functional correlates of processing speed in pediatric Attention-Deficit/Hyperactivity Disorder: A systematic review and meta-analysis. *Child Neuropsychology*, *24*(5), 598–616. https://doi.org/10.1080/09297049.2017.1307952

Cooley, E. L., & Morris, R. D. (1990). Attention in children: A neuropsychologically based model for assessment. *Developmental Neuropsychology*, *6*(3), 239–274. https://doi.org/10.1080/87565649009540465

Counsell, C. (1997). Formulating Questions and Locating Primary Studies for Inclusion in Systematic Reviews. *Annals of Internal Medicine*, *127*(5), 380–387. https://doi.org/10.7326/0003-4819-127-5-199709010-00008

Cumming, G., & Finch, S. (2005). Inference by Eye: Confidence Intervals and How to Read Pictures of Data. *American Psychologist*, *60*(2), 170–180. https://doi.org/10.1037/0003-066X.60.2.170

*Cusick, C. N., Isaacson, P. A., Langberg, J. M., & Becker, S. P. (2018). Last night's sleep in relation to academic achievement and neurocognitive testing performance in adolescents with and without ADHD. *Sleep Medicine*, *52*, 75–79. https://doi.org/10.1016/j.sleep.2018.07.014

Cuthbert, B. N. (2022). Research Domain Criteria (RDoC): Progress and Potential. *Current Directions in Psychological Science*, *31*(2), 107–114. https://doi.org/10.1177/09637214211051363

Czamara, D., Tiesler, C. M. T., Kohlböck, G., Berdel, D., Hoffmann, B., Bauer, C.-P., Koletzko, S., Schaaf, B., Lehmann, I., Herbarth, O., Berg, A. von, Müller-Myhsok, B., Schulte-Körne, G., & Heinrich, J. (2013). Children with ADHD Symptoms Have a Higher Risk for Reading, Spelling and Math Difficulties in the GINIplus and LISAplus Cohort Studies. *PLOS ONE*, *8*(5), e63859. https://doi.org/10.1371/journal.pone.0063859

Dawson, N. V., & Weiss, R. (2012). Dichotomizing continuous variables in statistical analysis: A practice to avoid. *Medical Decision Making*, *32*(2), 225–226. https://doi.org/10.1177/0272989X12437605

DeShazo Barry, T., Lyman, R. D., & Klinger, L. G. (2002). Academic underachievement and attention-deficit/hyperactivity disorder: The negative impact of symptom severity on school performance. *Journal of School Psychology*, *40*(3), 259–283. https://doi.org/10.1016/S0022-4405(02)00100-0

DeVito, N. J., & Goldacre, B. (2019). Catalogue of bias: publication bias. *BMJ evidence-based medicine*, *24*(2), 53–54. https://doi.org/10.1136/bmjebm-2018-111107

Dickersin, K., & Min, Y. I. (1993). Publication bias: the problem that won't go away. *Annals of the New York Academy of Sciences*, *703*, 135–148. https://doi.org/10.1111/j.1749-6632.1993.tb26343.x

Dittman, C. K. (2016). Associations between inattention, hyperactivity and pre-reading skills before and after formal reading instruction begins. *Reading and Writing*, *29*(9), 1771–1791. https://doi.org/10.1007/s11145-016-9652-x

Dockrell, J. E., Lindsay, G., & Connelly, V. (2009). The Impact of Specific Language Impairment on Adolescents' Written Text. *Exceptional Children*, *75*(4), 427–446. https://doi.org/10.1177/001440290907500403

Dupaul, G. J., Mcgoey, K. E., Eckert, T. L., & Vanbrakle, J. (2001). Preschool Children With Attention-Deficit/Hyperactivity Disorder: Impairments in Behavioral, Social, and School Functioning. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(5), 508–515. https://doi.org/10.1097/00004583-200105000-00009

Eckrich, S. J., Rapport, M. D., Calub, C. A., & Friedman, L. M. (2019). Written expression in boys with ADHD: The mediating roles of working memory and oral expression. *Child Neuropsychology*, *25*(6), 772–794. https://doi.org/10.1080/09297049.2018.1531982

*Efron, D., Sciberras, E., Anderson, V., Hazell, P., Ukoumunne, O. C., Jongeling, B., Schilpzand, E. J., Bisset, M., & Nicholson, J. M. (2014). Functional Status in Children With ADHD at Age 6–8: A Controlled Community Study. *Pediatrics*, *134*(4), e992–e1000. https://doi.org/10.1542/peds.2014-1027

Egeland, J., Johansen, S. N., & Ueland, T. (2009). Differentiating between ADHD sub-types on CCPT measures of sustained attention and vigilance. *Scandinavian Journal of Psychology*, *50*(4), 347–354. https://doi.org/10.1111/j.1467-9450.2009.00717.x

Egeland, J., Johansen, S. N., & Ueland, T. (2010). Do low-effort learning strategies mediate impaired memory in adhd? *Journal of Learning Disabilities*, *43*(5), 430–440. https://doi.org/10.1177/0022219409355473

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, *315*(7109), 629–634. https://doi.org/10.1136/bmj.315.7109.629

*Ehm, J.-H., Kerner auch Koerner, J., Gawrilow, C., Hasselhorn, M., & Schmiedek, F. (2016). The association of ADHD symptoms and reading acquisition during elementary school years. *Developmental Psychology*, *52*(9), 1445–1456. https://doi.org/10.1037/dev0000186

Eisner, M., & Fearon, P. (2021). Pitfalls of Using Data Portals as Sources for Psychological Research: The Example of Cross-National Homicide Data. *Psychological Science*, *32*(6), 863–865. https://doi.org/10.1177/0956797621989967

Epstein, J. N., & Loren, R. E. A. (2013). Changes in the Definition of ADHD in DSM-5: Subtle but Important. *Neuropsychiatry*, *3*(5), 455–458. https://doi.org/10.2217/npy.13.59

Facoetti, A., Luisa Lorusso, M., Paganoni, P., Umiltà, C., & Gastone Mascetti, G. (2003). The role of visuospatial attention in developmental dyslexia: Evidence from a rehabilitation study. *Cognitive Brain Research*, *15*(2), 154–164. https://doi.org/10.1016/S0926-6410(02)00148-9

Facoetti, A., Ruffino, M., Peru, A., Paganoni, P., & Chelazzi, L. (2008). Sluggish engagement and disengagement of non-spatial attention in dyslexic children. *Cortex*, *44*(9), 1221–1233. https://doi.org/10.1016/j.cortex.2007.10.007

Fergusson, D. M., & Horwood, L. J. (1995). Predictive Validity of Categorically and Dimensionally Scored Measures of Disruptive Childhood Behaviors. *Journal of the American Academy of Child & Adolescent Psychiatry*, *34*(4), 477–487. https://doi.org/10.1097/00004583-199504000-00015

Fergusson, D. M., Horwood, L. J., & Lynskey, M. T. (1993). The Effects of Conduct Disorder and Attention Deficit in Middle Childhood on Offending and Scholastic Ability at Age 13. *Journal of Child Psychology and Psychiatry*, *34*(6), 899–916. https://doi.org/10.1111/j.1469-7610.1993.tb01097.x

Finn, J. D., Pannozzo, G. M., & Voelkl, K. E. (1995). Disruptive and Inattentive-Withdrawn Behavior and Achievement among Fourth Graders. *The Elementary School Journal*, *95*(5), 421–434. https://doi.org/10.1086/461853

Fischer, M., Barkley, R. A., Fletcher, K. E., & Smallish, L. (1993). The Adolescent Outcome of Hyperactive Children: Predictors of Psychiatric, Academic, Social, and Emotional Adjustment. *Journal of the American Academy of Child & Adolescent Psychiatry*, *32*(2), 324–332. https://doi.org/10.1097/00004583-199303000-00013

Fisher, J. E., Guha, A., Heller, W., & Miller, G. A. (2020). Extreme-groups designs in studies of dimensional phenomena: Advantages, caveats, and recommendations. *Journal of Abnormal Psychology*, *129*(1), 14–20. https://doi.org/10.1037/abn0000480

Fisher, Z., & Tipton, E. (2015). robumeta: An R-package for robust variance estimation in meta-analysis. *ArXiv:1503.02220 [Stat]*. http://arxiv.org/abs/1503.02220

Foorman, B. R., Petscher, Y., & Herrera, S. (2018). Unique and common effects of decoding and language factors in predicting reading comprehension in grades 1–10. *Learning and Individual Differences*, *63*, 12–23. https://doi.org/10.1016/j.lindif.2018.02.011

Franceschini, S., Gori, S., Ruffino, M., Pedrolli, K., & Facoetti, A. (2012). A Causal Link between Visual Spatial Attention and Reading Acquisition. *Current Biology*, *22*(9), 814–819. https://doi.org/10.1016/j.cub.2012.03.013

Frazier, T. W., Youngstrom, E. A., Glutting, J. J., & Watkins, M. W. (2007). ADHD and Achievement: Meta-Analysis of the Child, Adolescent, and Adult Literatures and a Concomitant Study With College Students. *Journal of Learning Disabilities*, *40*(1), 49–65. https://doi.org/10.1177/00222194070400010401

Frazier, T. W., Youngstrom, E. A., & Naugle, R. I. (2007). The latent structure of attention-deficit/hyperactivity disorder in a clinic-referred sample. *Neuropsychology*, *21*(1), 45–64. https://doi.org/10.1037/0894-4105.21.1.45

Frick, P. J., Kamphaus, R. W., Lahey, B. B., Loeber, R., Christ, M. A. G., Hart, E. L., & Tannenbaum, L. E. (1991). Academic underachievement and the disruptive behavior disorders. *Journal of Consulting and Clinical Psychology*, *59*(2), 289–294. https://doi.org/10.1037/0022-006X.59.2.289

*Friedman, L. M., Rapport, M. D., Orban, S. A., Eckrich, S. J., & Calub, C. A. (2018). Applied Problem Solving in Children with ADHD: The Mediating Roles of Working Memory and Mathematical Calculation. *Journal of Abnormal Child Psychology*, *46*(3), 491–504. https://doi.org/10.1007/s10802-017-0312-7

*Friedman, L. M., Rapport, M. D., Raiker, J. S., Orban, S. A., & Eckrich, S. J. (2017). Reading Comprehension in Boys with ADHD: The Mediating Roles of Working

Memory and Orthographic Conversion. *Journal of Abnormal Child Psychology*, *45*(2), 273–287. https://doi.org/10.1007/s10802-016-0171-7

Froehlich, T. E., Fogler, J., Barbaresi, W. J., Elsayed, N. A., Evans, S. W., & Chan, E. (2018). Using ADHD Medications to Treat Coexisting ADHD and Reading Disorders: A Systematic Review. *Clinical Pharmacology & Therapeutics*, *104*(4), 619–637. https://doi.org/10.1002/cpt.1192

Fuchs, L. S., Compton, D. L., Fuchs, D., Paulsen, K., Bryant, J. D., & Hamlett, C. L. (2005). The Prevention, Identification, and Cognitive Determinants of Math Difficulty. *Journal of Educational Psychology*, *97*(3), 493–513. https://doi.org/10.1037/0022-0663.97.3.493

*Fuchs, L. S., Schumacher, R. F., Long, J., Namkung, J., Hamlett, C. L., Cirino, P. T., Jordan, N. C., Siegler, R., Gersten, R., & Changas, P. (2013). Improving at-risk learners' understanding of fractions. *Journal of Educational Psychology*, *105*(3), 683–700. https://doi.org/10.1037/a0032446

Ganor-Stern, D., & Steinhorn, O. (2018). ADHD and math—The differential effect on calculation and estimation. *Acta Psychologica*, *188*, 55–64. https://doi.org/10.1016/j.actpsy.2018.05.013

Gartstein, M. A., Crawford, J., & Robertson, C. D. (2008). Early Markers of Language and Attention: Mutual Contributions and the Impact of Parent–Infant Interactions. *Child Psychiatry and Human Development*, *39*(1), 9–26. https://doi.org/10.1007/s10578-007-0067-4

*Geary, D. C., Hoard, M. K., Nugent, L., & Scofield, J. E. (2021). In-class attention, spatial ability, and mathematics anxiety predict across-grade gains in adolescents' mathematics achievement. *Journal of Educational Psychology*, *113*(4), 754–769. https://doi.org/10.1037/edu0000487

*Gibson, B. S., Gondoli, D. M., Ralph, K. J., & Sztybel, P. (2018). Application of the dual-component model of working memory to ADHD:Greater secondary memory deficit despite confounded cognitive differences. *Child Neuropsychology*, *24*(1), 61–81. https://doi.org/10.1080/09297049.2016.1225706

Gomez, R. (2007). Australian Parent and Teacher Ratings of the DSM-IV ADHD Symptoms: Differential Symptom Functioning and Parent-Teacher Agreement and Differences. *Journal of Attention Disorders*, *11*(1), 17–27. https://doi.org/10.1177/1087054706295665

Goni, U., wali S. B., Y., Ali, H. K., & Bularafa, M. W. (2015). Gender Difference in Students' Academic Performance in Colleges of Education in Borno State, Nigeria: Implications for Counselling. *Journal of Education and Practice*, *6*(32), 107–114.

Good, P. (2013). *Permutation Tests: A Practical Guide to Resampling Methods for Testing Hypotheses*. Springer Science & Business Media.

*Goradia, D. D., Vogel, S., Mohl, B., Khatib, D., Zajac-Benitez, C., Rajan, U., Robin, A., Rosenberg, D. R., & Stanley, J. A. (2016). Distinct differences in striatal dysmorphology between attention deficit hyperactivity disorder boys with and without a comorbid reading disability. *Psychiatry Research: Neuroimaging*, *258*, 30–36. https://doi.org/10.1016/j.pscychresns.2016.10.012

Gough, P. B., & Tunmer, W. E. (1986). Decoding, Reading, and Reading Disability. *Remedial and Special Education*, *7*(1), 6–10. https://doi.org/10.1177/074193258600700104

Graham, S., Fishman, E. J., Reid, R., & Hebert, M. (2016). Writing Characteristics of Students with Attention Deficit Hyperactive Disorder: A Meta-Analysis. *Learning Disabilities Research & Practice*, *31*(2), 75–89. https://doi.org/10.1111/ldrp.12099

Gray, S. A., Dueck, K., Rogers, M., & Tannock, R. (2017). Qualitative review synthesis: The relationship between inattention and academic achievement. *Educational Research*, *59*(1), 17–35. https://doi.org/10.1080/00131881.2016.1274235

Gray, S. A., Rogers, M., Martinussen, R., & Tannock, R. (2015). Longitudinal relations among inattention, working memory, and academic achievement: Testing mediation and the moderating role of gender. *PeerJ*, *3*, e939. https://doi.org/10.7717/peerj.939

Gremillion, M. L., & Martel, M. M. (2012). Semantic Language as a Mechanism Explaining the Association between ADHD Symptoms and Reading and Mathematics Underachievement. *Journal of Abnormal Child Psychology*, *40*(8), 1339–1349. https://doi.org/10.1007/s10802-012-9650-7

*Greven, C. U., Kovas, Y., Willcutt, E. G., Petrill, S. A., & Plomin, R. (2014). Evidence for shared genetic risk between ADHD symptoms and reduced mathematics ability: A twin study. *Journal of Child Psychology and Psychiatry*, *55*(1), 39–48. https://doi.org/10.1111/jcpp.12090

*Grills-Taquechel, A. E., Fletcher, J. M., Vaughn, S. R., Denton, C. A., & Taylor, P. (2013). Anxiety and inattention as predictors of achievement in early elementary school children. *Anxiety, Stress & Coping*, *26*(4), 391–410. https://doi.org/10.1080/10615806.2012.691969

Gropper, R. J., & Tannock, R. (2009). A pilot study of working memory and academic achievement in college students with ADHD. *Journal of Attention Disorders*, *12*(6), 574–581. https://doi.org/10.1177/1087054708320390

*Hansen, N., Jordan, N. C., Fernandez, E., Siegler, R. S., Fuchs, L., Gersten, R., & Micklos, D. (2015). General and math-specific predictors of sixth-graders' knowledge of fractions. *Cognitive Development*, *35*, 34–49. https://doi.org/10.1016/j.cogdev.2015.02.001

Harrer, M., Cuijpers, P., Furukawa, T. A., & Ebert, D. D. (2021). *Doing Meta-Analysis with R: A Hands-On Guide*. Chapman and Hall/CRC. https://doi.org/10.1201/9781003107347

Haslam, N., Williams, B., Prior, M., Haslam, R., Graetz, B., & Sawyer, M. (2006). The Latent Structure of Attention-Deficit/Hyperactivity Disorder: A Taxometric Analysis. *Australian & New Zealand Journal of Psychiatry*, *40*(8), 639–647. https://doi.org/10.1080/j.1440-1614.2006.01863.x

*Hassinger-Das, B., Jordan, N. C., Glutting, J., Irwin, C., & Dyson, N. (2014). Domain-general mediators of the relation between kindergarten number sense and first-grade mathematics achievement. *Journal of Experimental Child Psychology*, *118*, 78–92. https://doi.org/10.1016/j.jecp.2013.09.008

*Hawkins, E., Gathercole, S., Astle, D., The CALM Team, & Holmes, J. (2016). Language Problems and ADHD Symptoms: How Specific Are the Links? *Brain Sciences*, *6*(4), 50. https://doi.org/10.3390/brainsci6040050

Hay, D. A., Bennett, K. S., Levy, F., Sergeant, J., & Swanson, J. (2007). A Twin Study of Attention-Deficit/Hyperactivity Disorder Dimensions Rated by the Strengths and

Weaknesses of ADHD-Symptoms and Normal-Behavior (SWAN) Scale. *Biological Psychiatry*, *61*(5), 700–705. https://doi.org/10.1016/j.biopsych.2006.04.040

Hedges L. V. (1984). Estimation of effect size under nonrandom sampling: The effects of censoring studies yielding statistically insignificant mean differences. *Journal of Educational and Behavioral Statistics*, 9, 61–85.

Hedges, L. V., Tipton, E., & Johnson, M. C. (2010). Robust variance estimation in meta-regression with dependent effect size estimates. *Research Synthesis Methods*, *1*(1), 39–65. https://doi.org/10.1002/jrsm.5

*Heikkilä, R., Torppa, M., Aro, M., Närhi, V., & Ahonen, T. (2016). Double-Deficit Hypothesis in a Clinical Sample: Extension Beyond Reading. *Journal of Learning Disabilities*.

Higgins, J. P. T., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine*, *21*(11), 1539–1558. https://doi.org/10.1002/sim.1186

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ*, *327*(7414), 557–560. https://doi.org/10.1136/bmj.327.7414.557

Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). (2019). *Cochrane Handbook for Systematic Reviews of Interventions* (2nd ed.). John Wiley & Sons.

Holbrook, J. R., Cuffe, S. P., Cai, B., Visser, S. N., Forthofer, M. S., Bottai, M., Ortaglia, A., & McKeown, R. E. (2016). Persistence of Parent-Reported ADHD Symptoms From Childhood Through Adolescence in a Community Sample. *Journal of Attention Disorders*, *20*(1), 11–20. https://doi.org/10.1177/1087054714539997

*Holmes, J., Guy, J., Kievit, R. A., Bryant, A., Mareva, S., CALM Team, & Gathercole, S. E. (2021). Cognitive dimensions of learning in children with problems in attention, learning, and memory. *Journal of Educational Psychology*, *113*(7), 1454–1480. https://doi.org/10.1037/edu0000644

*Holmes, J., Hilton, K. A., Place, M., Alloway, T. P., Elliott, J. G., & Gathercole, S. E. (2014). Children with low working memory and children with ADHD: Same or different? *Frontiers in Human Neuroscience*, *8*. https://doi.org/10.3389/fnhum.2014.00976

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*, *2*(2), 127–160. https://doi.org/10.1007/BF00401799

Hurtig, T., Ebeling, H., Taanila, A., Miettunen, J., Smalley, S. L., McGough, J. J., Loo, S. K., Järvelin, M.-R., & Moilanen, I. K. (2007). ADHD symptoms and subtypes: Relationship between childhood and adolescent symptoms. *Journal of the American Academy of Child and Adolescent Psychiatry*, *46*(12), 1605–1613. https://doi.org/10.1097/chi.0b013e318157517a

*Iglesias-Sarmiento, V., Deaño, M., Alfonso, S., & Conde, Á. (2017). Mathematical learning disabilities and attention deficit and/or hyperactivity disorder: A study of the cognitive processes involved in arithmetic problem solving. *Research in Developmental Disabilities*, *61*, 44–54. https://doi.org/10.1016/j.ridd.2016.12.012

Insel, T., Cuthbert, B., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K., Sanislow, C., & Wang, P. (2010). Research domain criteria (RDoC): Toward a new classification framework for research on mental disorders. *The American Journal of Psychiatry*, *167*(7), 748–751. https://doi.org/10.1176/appi.ajp.2010.09091379

*Jacobson, L. A., Ryan, M., Denckla, M. B., Mostofsky, S. H., & Mahone, E. M. (2013). Performance Lapses in Children with Attention-Deficit/Hyperactivity Disorder Contribute to Poor Reading Fluency. *Archives of Clinical Neuropsychology*, *28*(7), 672–683. https://doi.org/10.1093/arclin/act048

Jaekel, J., Wolke, D., & Bartmann, P. (2013). Poor attention rather than hyperactivity/impulsivity predicts academic achievement in very preterm and full-term adolescents. *Psychological Medicine*, *43*(1), 183–196. https://doi.org/10.1017/S0033291712001031

*Jenkins, L. N., & Demaray, M. K. (2016). Teachers' Judgments of the Academic Achievement of Children With and Without Characteristics of Inattention, Impulsivity, and Hyperactivity. *Contemporary School Psychology*, *20*(2), 183–191. https://doi.org/10.1007/s40688-015-0073-7

*Jordan, N. C., Hansen, N., Fuchs, L. S., Siegler, R. S., Gersten, R., & Micklos, D. (2013). Developmental predictors of fraction concepts and procedures. *Journal of Experimental Child Psychology*, *116*(1), 45–58. https://doi.org/10.1016/j.jecp.2013.02.001

*Jones, D. (2015). *The relationship between performance-based and behavior rated measures of executive functioning and achievement in a clinical sample of children and adolescents with ADHD.* [Doctoral dissertation]. ProQuest.

Kanevski, M., Booth, J. N., Oldridge, J., McDougal, E., Stewart, T. M., McGeown, S., & Rhodes, S. M. (2021). The relationship between cognition and mathematics in children with attention-deficit/hyperactivity disorder: A systematic review. *Child Neuropsychology*, *0*(0), 1–33. https://doi.org/10.1080/09297049.2021.1985444

Kawabata, Y., Tseng, W.-L., & Gau, S. S.-F. (2012). Symptoms of Attention-Deficit/Hyperactivity Disorder and Social and School Adjustment: The Moderating Roles of Age and Parenting. *Journal of Abnormal Child Psychology*, *40*(2), 177–188. https://doi.org/10.1007/s10802-011-9556-9

*Keenan, J. M., & Meenan, C. E. (2014). Test Differences in Diagnosing Reading Comprehension Deficits. *Journal of Learning Disabilities*, *47*(2), 125–135. https://doi.org/10.1177/0022219412439326

Kelly, T. P. (2000). The Clinical Neuropsychology of Attention in School-Aged Children. *Child Neuropsychology*, *6*(1), 24–36. https://doi.org/10.1076/0929-7049(200003)6:1;1-B;FT024

*Kent, S., Wanzek, J., Petscher, Y., Al Otaiba, S., & Kim, Y.-S. (2014). Writing fluency and quality in kindergarten and first grade: The role of attention, reading, transcription, and oral language. *Reading and Writing*, *27*(7), 1163–1188. https://doi.org/10.1007/s11145-013-9480-1

Kerner auch Koerner, J., Visser, L., Rothe, J., Schulte-Körne, G., & Hasselhorn, M. (2021). Gender Differences in the Comorbidity of ADHD Symptoms and Specific Learning Disorders in a Population-Based Sample. *Sustainability*, *13*(15), 15. https://doi.org/10.3390/su13158440

*Kibby, M. Y., Dyer, S. M., Lee, S. E., & Stacy, M. (2020). Frontal volume as a potential source of the comorbidity between attention-deficit/hyperactivity disorder and reading disorders. *Behavioural Brain Research*, *381*, 112382. https://doi.org/10.1016/j.bbr.2019.112382

*Kibby, M. Y., Dyer, S. M., Vadnais, S. A., Jagger, A. C., Casher, G. A., & Stacy, M. (2015). Visual processing in reading disorders and attention-deficit/hyperactivity disorder and its contribution to basic reading ability. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.01635

*Kibby, M. Y., Lee, S. E., & Dyer, S. M. (2014). Reading performance is predicted by more than phonological processing. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00960

*Kim, Y. G. (2020). Structural relations of language and cognitive skills, and topic knowledge to written composition: A test of the direct and indirect effects model of writing. *British Journal of Educational Psychology*, *90*(4), 910–932. https://doi.org/10.1111/bjep.12330

Kim, Y.-S. (2015). Language and Cognitive Predictors of Text Comprehension: Evidence From Multivariate Analysis. *Child Development*, *86*(1), 128–144. https://doi.org/10.1111/cdev.12293

Kim, Y.-S., Al, O. S., Folsom, J. S., Greulich, L., & Puranik, C. (2014). Evaluating the Dimensionality of First-Grade Written Composition. *Journal of Speech, Language, and Hearing Research*, *57*(1), 199–211. https://doi.org/10.1044/1092-4388(2013/12-0152)

Kim, Y.-S., Al Otaiba, S., Puranik, C., Folsom, J. S., Greulich, L., & Wagner, R. K. (2011). Componential skills of beginning writing: An exploratory study. *Learning and Individual Differences*, *21*(5), 517–525. https://doi.org/10.1016/j.lindif.2011.06.004

*Kim, Y.-S., Al Otaiba, S., Sidler, J. F., & Gruelich, L. (2013). Language, literacy, attentional behaviors, and instructional quality predictors of written composition for first graders. *Early Childhood Research Quarterly*, *28*(3), 461–469. https://doi.org/10.1016/j.ecresq.2013.01.001

*Kim, Y.-S., Al Otaiba, S., Wanzek, J., & Gatlin, B. (2015). Toward an understanding of dimensions, predictors, and the gender gap in written composition. *Journal of Educational Psychology*, *107*(1), 79–95. https://doi.org/10.1037/a0037210

Kim, Y.-S., Apel, K., & Al, O. S. (2013). The Relation of Linguistic Awareness and Vocabulary to Word Reading and Spelling for First-Grade Students Participating in Response to Intervention. *Language, Speech, and Hearing Services in Schools*, *44*(4), 337–347. https://doi.org/10.1044/0161-1461(2013/12-0013)

*Kim, Y.-S. G., & Park, S.-H. (2019). Unpacking pathways using the direct and indirect effects model of writing (DIEW) and the contributions of higher order cognitive skills to writing. *Reading and Writing*, *32*(5), 1319–1343. https://doi.org/10.1007/s11145-018-9913-y

Kim, Y.-S. G., & Schatschneider, C. (2017). Expanding the developmental models of writing: A direct and indirect effects model of developmental writing (DIEW). *Journal of Educational Psychology*, *109*(1), 35–50. https://doi.org/10.1037/edu0000129

King, R. B. (2016). Gender differences in motivation, engagement and achievement are related to students' perceptions of peer—But not of parent or teacher—Attitudes toward school. *Learning and Individual Differences*, *52*, 60–71. https://doi.org/10.1016/j.lindif.2016.10.006

Kingdon, D., Serbin, L. A., & Stack, D. M. (2017). Understanding the gender gap in school performance among low-income children: A developmental trajectory analysis.

International Journal of Behavioral Development, *41*(2), 265–274. https://doi.org/10.1177/0165025416631836

Kirk, H. E., Gray, K., Riby, D. M., Taffe, J., & Cornish, K. M. (2017). Visual attention and academic performance in children with developmental disabilities and behavioural attention deficits. *Developmental Science*, *20*(6), e12468. https://doi.org/10.1111/desc.12468

*Kofler, M. J., Spiegel, J. A., Soto, E. F., Irwin, L. N., Wells, E. L., & Austin, K. E. (2019). Do Working Memory Deficits Underlie Reading Problems in Attention-Deficit/Hyperactivity Disorder (ADHD)? *Journal of Abnormal Child Psychology*, *47*(3), 433–446. https://doi.org/10.1007/s10802-018-0447-1

Koponen, T., Georgiou, G., Salmi, P., Leskinen, M., & Aro, M. (2017). A meta-analysis of the relation between RAN and mathematics. *Journal of Educational Psychology*, *109*(7), 977–992. https://doi.org/10.1037/edu0000182

*Kortekaas-Rijlaarsdam, A. F., Luman, M., Sonuga-Barke, E., Bet, P. M., & Oosterlaan, J. (2017). Short-Term Effects of Methylphenidate on Math Productivity in Children With Attention-Deficit/Hyperactivity Disorder are Mediated by Symptom Improvements: Evidence From a Placebo-Controlled Trial. *Journal of Clinical Psychopharmacology*, *37*(2), 210–219. https://doi.org/10.1097/JCP.0000000000000671

Kortekaas-Rijlaarsdam, A. F., Luman, M., Sonuga-Barke, E., & Oosterlaan, J. (2019). Does methylphenidate improve academic performance? A systematic review and meta-analysis. *European Child & Adolescent Psychiatry*, *28*(2), 155–164. https://doi.org/10.1007/s00787-018-1106-3

Kroese, J. M., Hynd, G. W., Knight, D. F., Hiemenz, J. R., & Hall, J. (2000). Clinical appraisal of spelling ability and its relationship to phonemic awareness (blending, segmenting, elision, and reversal), phonological memory, and reading in reading disabled, ADHD, and normal children. *Reading and Writing*, *13*(1), 105–131. https://doi.org/10.1023/A:1008042109851

Kudo, M. F., Lussier, C. M., & Swanson, H. L. (2015). Reading disabilities in children: A selective meta-analysis of the cognitive literature. *Research in Developmental Disabilities*, *40*, 51–62. https://doi.org/10.1016/j.ridd.2015.01.002

*Kuhn, J.-T., Ise, E., Raddatz, J., Schwenk, C., & Dobel, C. (2016). Basic numerical processing, calculation, and working memory in children with dyscalculia and/or ADHD symptoms. *Zeitschrift Für Kinder- Und Jugendpsychiatrie Und Psychotherapie*, *44*(5), 365–375. https://doi.org/10.1024/1422-4917/a000450

Kuriyan, A. B., Pelham, W. E., Molina, B. S. G., Waschbusch, D. A., Gnagy, E. M., Sibley, M. H., Babinski, D. E., Walther, C., Cheong, J., Yu, J., & Kent, K. M. (2013). Young adult educational and vocational outcomes of children diagnosed with ADHD. *Journal of Abnormal Child Psychology*, *41*(1), 27–41. https://doi.org/10.1007/s10802-012-9658-z

Kurns, S., & Tilly, W. D. (2008). Response to Intervention Blueprints: School Building Level Edition. In *National Association of State Directors of Special Education*. National Association of State Directors of Special Education.

*Kvande, M. N., Belsky, J., & Wichstrøm, L. (2018). Selection for special education services: The role of gender and socio-economic status. *European Journal of Special Needs Education*, *33*(4), 510–524. https://doi.org/10.1080/08856257.2017.1373493

Lahey, B. B., Pelham, W. E., Stein, M. A., Loney, J., Trapani, C., Nugent, K., Kipp, H., Schmidt, E., Lee, S., Cale, M., Gold, E., Hartung, C. M., Willcutt, E., & Baumann, B. (1998). Validity of DSM-IV Attention-Deficit/Hyperactivity Disorder for Younger Children. *Journal of the American Academy of Child & Adolescent Psychiatry*, *37*(7), 695–702. https://doi.org/10.1097/00004583-199807000-00008

Lallier, M., Donnadieu, S., & Valdois, S. (2010). Visual attentional blink in dyslexic children: Parameterizing the deficit. *Vision Research*, *50*(18), 1855–1861. https://doi.org/10.1016/j.visres.2010.06.006

*Langer, N., Benjamin, C., Becker, B. L. C., & Gaab, N. (2019). Comorbidity of reading disabilities and ADHD: Structural and functional brain characteristics. *Human Brain Mapping*, *40*(9), 2677–2698. https://doi.org/10.1002/hbm.24552

*Language and Reading Research Consortium, Jiang, H., & Farquharson, K. (2018). Are working memory and behavioral attention equally important for both reading and listening comprehension? A developmental comparison. *Reading and Writing*, *31*(7), 1449–1477. https://doi.org/10.1007/s11145-018-9840-y

Larsson, H., Dilshad, R., Lichtenstein, P., & Barker, E. D. (2011). Developmental trajectories of DSM-IV symptoms of attention-deficit/hyperactivity disorder: Genetic effects, family risk and associated psychopathology. *Journal of Child Psychology and Psychiatry*, *52*(9), 954–963. https://doi.org/10.1111/j.1469-7610.2011.02379.x

*Lee, J., & Zentall, S. S. (2017). Reading motivation and later reading achievement for students with reading disabilities and comparison groups (ADHD and typical): A 3-year longitudinal study. *Contemporary Educational Psychology*, *50*, 60–71. https://doi.org/10.1016/j.cedpsych.2015.11.001

*Lenartowicz, A., Truong, H., Salgari, G. C., Bilder, R. M., McGough, J., McCracken, J. T., & Loo, S. K. (2019). Alpha modulation during working memory encoding predicts neurocognitive impairment in ADHD. *Journal of Child Psychology and Psychiatry*, jcpp.13042. https://doi.org/10.1111/jcpp.13042

Levy, F., Hay, D. A., McSTEPHEN, M., Wood, C., & Waldman, I. (1997). Attention-Deficit Hyperactivity Disorder: A Category or a Continuum? Genetic Analysis of a Large-Scale Twin Study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *36*(6), 737–744. https://doi.org/10.1097/00004583-199706000-00009

*Lewandowski, L., Gathje, R. A., Lovett, B. J., & Gordon, M. (2013). Test-Taking Skills in College Students With and Without ADHD. *Journal of Psychoeducational Assessment*, *31*(1), 41–52. https://doi.org/10.1177/0734282912446304

Lewandowski, L. J., Lovett, B. J., Parolin, R., Gordon, M., & Codding, R. S. (2007). Extended Time Accommodations and the Mathematics Performance of Students With and Without ADHD. *Journal of Psychoeducational Assessment*, *25*(1), 17–28. https://doi.org/10.1177/0734282906291961

*Liang, H.-Y., & Kelsen, B. A. (2017). Gender differences in university EFL students' language proficiency corresponding to self-rated attention, hyperactivity and impulsivity. *Electronic Journal of Research in Educational Psychology*, *15*(1), 48–74. https://doi.org/10.14204/ejrep.41.16017

*Little, C. W., Hart, S. A., Schatschneider, C., & Taylor, J. (2016). Examining Associations Among ADHD, Homework Behavior, and Reading Comprehension: A Twin Study. *Journal of Learning Disabilities*, *49*(4), 410–423. https://doi.org/10.1177/0022219414555715

Loe, I. M., & Feldman, H. M. (2007). Academic and Educational Outcomes of Children With ADHD. *Journal of Pediatric Psychology*, *32*(6), 643–654. https://doi.org/10.1093/jpepsy/jsl054

Lourenco, S. F., Cheung, C.-N., & Aulet, L. S. (2018). Chapter 10 - Is Visuospatial Reasoning Related to Early Mathematical Development? A Critical Review. In A. Henik & W. Fias (Eds.), *Heterogeneity of Function in Numerical Cognition* (pp. 177–210). Academic Press. https://doi.org/10.1016/B978-0-12-811529-9.00010-8

*Lovett, B. J., & Leja, A. M. (2015). ADHD Symptoms and Benefit From Extended Time Testing Accommodations. *Journal of Attention Disorders*, *19*(2), 167–172. https://doi.org/10.1177/1087054713510560

Lovett, B. J., Lewandowski, L. J., & Carter, L. (2019). Separate Room Testing Accommodations for Students With and Without ADHD. *Journal of Psychoeducational Assessment*, *37*(7), 852–862. https://doi.org/10.1177/0734282918801420

Lundervold, A. J., Meza, J. I., Hysing, M., & Hinshaw, S. P. (2017). Parent Rated Symptoms of Inattention in Childhood Predict High School Academic Achievement Across Two Culturally and Diagnostically Diverse Samples. *Frontiers in Psychology*, *8*, 1436. https://doi.org/10.3389/fpsyg.2017.01436

Lyon, R. E., Rizeq, J., Flora, D. B., Martinussen, R., Andrade, B. F., & Toplak, M. E. (2022). Age-Related Variance in Performance versus Ratings of Attention and Impulse Regulation in Children: Implications for the Assessment of ADHD. *Brain Sciences*, *12*(8), 8. https://doi.org/10.3390/brainsci12081033

MacArthur, C. A., Graham, S., & Fitzgerald, J. (2008). *Handbook of Writing Research*. Guilford Press.

*Macdonald, K. T., Barnes, M. A., Miciak, J., Roberts, G., Halverson, K. K., Vaughn, S., & Cirino, P. T. (2021). Sustained Attention and Behavioral Ratings of Attention in Struggling Readers. *Scientific Studies of Reading*, *25*(5), 436–451. https://doi.org/10.1080/10888438.2020.1826950

*Mackenzie, M. (2019). Using the simple view of reading to examine reading comprehension proficiency in youth with and without attention deficit hyperactivity disorder (Publication No. 13419554) [Doctoral dissertation, University of Toronto]. ProQuest.

*Maehler, C., & Schuchardt, K. (2016). Working memory in children with specific learning disorders and/or attention deficits. *Learning and Individual Differences*, *49*, 341–347. https://doi.org/10.1016/j.lindif.2016.05.007

*Magnuson, K., Duncan, G. J., Lee, K. T. H., & Metzger, M. W. (2016). Early School Adjustment and Educational Attainment. *American Educational Research Journal*, *53*(4), 1198–1228. https://doi.org/10.3102/0002831216634658

Maier, M., VanderWeele, T. J., & Mathur, M. B. (2022). Using selection models to assess sensitivity to publication bias: A tutorial and call for more routine use. *Campbell systematic reviews*, *18*(3), e1256. https://doi.org/10.1002/cl2.1256

*Malone, A. & Fuchs, L. (2014) Comparing the contribution of teacher versus tutor ratings of inattentive behavior in predicting mathematics achievement. Remedial and Special Educatiion, 35(6), 378-396. doi:10.1177/0741932514539855

*Mano, Q. R., Jastrowski Mano, K. E., Denton, C. A., Epstein, J. N., & Tamm, L. (2017). GENDER MODERATES ASSOCIATION BETWEEN EMOTIONAL-BEHAVIORAL PROBLEMS AND TEXT COMPREHENSION IN CHILDREN WITH BOTH

READING DIFFICULTIES AND ADHD: Emotional-Behavioral Problems and Reading. *Psychology in the Schools*, *54*(5), 504–518. https://doi.org/10.1002/pits.22011

Marshall, R. M., Hynd, G. W., Handwerk, M. J., & Hall, J. (1997). Academic Underachievement in ADHD Subtypes. *Journal of Learning Disabilities*, *30*(6), 635–642. https://doi.org/10.1177/002221949703000607

*Martin, R. B., Cirino, P. T., Barnes, M. A., Ewing-Cobbs, L., Fuchs, L. S., Stuebing, K. K., & Fletcher, J. M. (2013). Prediction and Stability of Mathematics Skill and Difficulty. *Journal of Learning Disabilities*, *46*(5), 428–443. https://doi.org/10.1177/0022219411436214

*Martinussen, R., Grimbos, T., & Ferrari, J. L. S. (2014). Word-Level Reading Achievement and Behavioral Inattention: Exploring Their Overlap and Relations with Naming Speed and Phonemic Awareness in a Community Sample of Children. *Archives of Clinical Neuropsychology*, *29*(7), 680–690. https://doi.org/10.1093/arclin/acu040

*Martinussen, R., & Mackenzie, G. (2015). Reading comprehension in adolescents with ADHD: Exploring the poor comprehender profile and individual differences in vocabulary and executive functions. *Research in Developmental Disabilities*, *38*, 329–337. https://doi.org/10.1016/j.ridd.2014.12.007

Massetti, G. M., Lahey, B. B., Pelham, W. E., Loney, J., Ehrhardt, A., Lee, S. S., & Kipp, H. (2008). Academic Achievement Over 8 Years Among Children Who Met Modified Criteria for Attention-deficit/Hyperactivity Disorder at 4–6 Years of Age. *Journal of Abnormal Child Psychology*, *36*(3), 399–410. https://doi.org/10.1007/s10802-007-9186-4

May, T., Rinehart, N., Wilding, J., & Cornish, K. (2013). The role of attention in the academic attainment of children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *43*(9), 2147–2158. https://doi.org/10.1007/s10803-013-1766-2

Mayes, S. D., & Calhoun, S. L. (2006). Frequency of reading, math, and writing disabilities in children with clinical disorders. *Learning and Individual Differences*, *16*(2), 145–157. https://doi.org/10.1016/j.lindif.2005.07.004

McDougal, E., Gracie, H., Oldridge, J., Stewart, T. M., Booth, J. N., & Rhodes, S. M. (n.d.). Relationships between cognition and literacy in children with attention-deficit/hyperactivity disorder: A systematic review and meta-analysis. *British Journal of Developmental Psychology*, *n/a*(n/a). https://doi.org/10.1111/bjdp.12395

McLennan, J. D. (2016). Understanding attention deficit hyperactivity disorder as a continuum. *Canadian Family Physician*, *62*(12), 979–982.

Mengersen, K., Gurevitch, J., & Schmid, C. H. (2013). 18. Meta-analysis of Primary Data. In *18. Meta-analysis of Primary Data* (pp. 300–312). Princeton University Press. https://doi.org/10.1515/9781400846184-020

Merrell, C., Sayal, K., Tymms, P., & Kasim, A. (2017). A longitudinal study of the association between inattention, hyperactivity and impulsivity and children's academic attainment at age 11. *Learning and Individual Differences*, *53*, 156–161. https://doi.org/10.1016/j.lindif.2016.04.003

*Miller, A. C., Keenan, J. M., Betjemann, R. S., Willcutt, E. G., Pennington, B. F., & Olson, R. K. (2013). Reading Comprehension in Children with ADHD: Cognitive

Underpinnings of the Centrality Deficit. *Journal of Abnormal Child Psychology*, *41*(3), 473–483. https://doi.org/10.1007/s10802-012-9686-8

*Miller, L. A., Lewandowski, L. J., & Antshel, K. M. (2015). Effects of Extended Time for College Students With and Without ADHD. *Journal of Attention Disorders*, *19*(8), 678–686. https://doi.org/10.1177/1087054713483308

*Miranda, A., Mercader, J., Fernández, M. I., & Colomer, C. (2017). Reading Performance of Young Adults With ADHD Diagnosed in Childhood: Relations With Executive Functioning. *Journal of Attention Disorders*, *21*(4), 294–304. https://doi.org/10.1177/1087054713507977

Mirsky, A. F., Anthony, B. J., Duncan, C. C., Ahearn, M. B., & Kellam, S. G. (1991). Analysis of the elements of attention: A neuropsychological approach. *Neuropsychology Review*, *2*(2), 109–145. https://doi.org/10.1007/BF01109051

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Group, T. P. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLOS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

*Mohl, B., Ofen, N., Jones, L. L., Casey, J. E., & Stanley, J. A. (2018). Novel reading index for identifying disordered reading skill development: A preliminary study. *Applied Neuropsychology: Child*, *7*(4), 287–297. https://doi.org/10.1080/21622965.2017.1328681

Murray, D. W., Kollins, S. H., Hardy, K. K., Abikoff, H. B., Swanson, J. M., Cunningham, C., Vitiello, B., Riddle, M. A., Davies, M., Greenhill, L. L., McCracken, J. T., McGough, J. J., Posner, K., Skrobala, A. M., Wigal, T., Wigal, S. B., Ghuman, J. K., & Chuang, S. Z. (2007). Parent versus Teacher Ratings of Attention-Deficit/Hyperactivity

Disorder Symptoms in the Preschoolers with Attention-Deficit/Hyperactivity Disorder Treatment Study (PATS). *Journal of Child and Adolescent Psychopharmacology*, *17*(5), 605–619. https://doi.org/10.1089/cap.2007.0060

Naglieri, J. A., & Rojahn, J. (2001). Gender differences in planning, attention, simultaneous, and successive (PASS) cognitive processes and achievement. *Journal of Educational Psychology*, *93*(2), 430–437. https://doi.org/10.1037/0022-0663.93.2.430

Nam, K. (2014). Until when does the effect of age on academic achievement persist? Evidence from Korean data. *Economics of Education Review*, *40*, 106–122. https://doi.org/10.1016/j.econedurev.2014.02.002

Namkung, J. M., & Fuchs, L. S. (2016). Cognitive predictors of calculations and number line estimation with whole numbers and fractions among at-risk students. *Journal of Educational Psychology*, *108*(2), 214–228. https://doi.org/10.1037/edu0000055

Narad, M. E., Garner, A. A., Peugh, J. L., Tamm, L., Antonini, T. N., Kingery, K. M., Simon, J. O., & Epstein, J. N. (2015). Parent–teacher agreement on ADHD symptoms across development. *Psychological Assessment*, *27*(1), 239–248. https://doi.org/10.1037/a0037864

Niolaki, G. Z., Masterson, J., & Terzopoulos, A. R. (2013). Association of single word spelling with visual attention span and phonological ability in monolingual English-and Greek-speaking children. *13th European Congress of Psychology, Stockholm, Sweden*.

*NoackLeSage, F., Shaheen, G. L., Davis, T. E., Castagna, P. J., Kaskas, M. M., Ryan, P., & Lilly, M. E. (2019). Predicting Reading, Writing, and Mathematics Achievement: Do Anxiety and ADHD Symptoms Add to the Variance Explained by Working Memory and Verbal Reasoning Alone? *Current Psychology*, *38*(3), 792–802. https://doi.org/10.1007/s12144-017-9649-x

*Noda, W., Ito, H., Fujita, C., Ohnishi, M., Takayanagi, N., Someki, F., Nakajima, S., Ohtake, S., Mochizuki, N., & Tsujii, M. (2013). Examining the relationships between attention deficit/hyperactivity disorder and developmental coordination disorder symptoms, and writing performance in Japanese second grade students. *Research in Developmental Disabilities*, *34*(9), 2909–2916. https://doi.org/10.1016/j.ridd.2013.05.023

Olinghouse, N. G. (2008). Student- and instruction-level predictors of narrative writing in third-grade students. *Reading and Writing*, *21*(1), 3–26. https://doi.org/10.1007/s11145-007-9062-1

Olive, T. (2004). Working Memory in Writing: Empirical Evidence From the Dual-Task Technique. *European Psychologist*, *9*(1), 32–42. https://doi.org/10.1027/1016-9040.9.1.32

Olive, T. (2011). Working memory in writing. In *Past, Present, and Future Contributions of Cognitive Writing Research to Cognitive Psychology* (pp. 485–503).

*Öner, Ö., Vatanartiran, S., & Karadeniz, Ş. (2019). Relationships between teacher-reported ADHD symptom profiles and academic achievement domains in a nonreferred convenience sample of first- to fourth-grade students. *Psychiatry and Clinical Psychopharmacology*, *29*(4), 502–508. https://doi.org/10.1080/24750573.2018.1457488

*Orbach, L., Herzog, M., & Fritz, A. (2020). State- and trait-math anxiety and their relation to math performance in children: The role of core executive functions. *Cognition*, *200*, 104271. https://doi.org/10.1016/j.cognition.2020.104271

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ (Clinical research ed.)*, *372*, n71. https://doi.org/10.1136/bmj.n71

*Pagirsky, M. S., Koriakin, T. A., Avitia, M., Costa, M., Marchis, L., Maykel, C., Sassu, K., Bray, M. A., & Pan, X. (2017). Do the Kinds of Achievement Errors Made by Students Diagnosed With ADHD Vary as a Function of Their Reading Ability? *Journal of Psychoeducational Assessment*, *35*(1–2), 124–137. https://doi.org/10.1177/0734282916669020

*Papaioannou, S., Mouzaki, A., Sideridis, G. D., Antoniou, F., Padeliadu, S., & Simos, P. G. (2016). Cognitive and academic abilities associated with symptoms of attention-deficit/hyperactivity disorder: A comparison between subtypes in a Greek non-clinical sample. *Educational Psychology*, *36*(1), 138–158. https://doi.org/10.1080/01443410.2014.915931

Pasolunghi, M. C., Cornoldi, C., & De Liberto, S. (1999). Working memory and intrusions of irrelevant information in a group of specific poor problem solvers. *Memory & Cognition*, *27*(5), 779–790. https://doi.org/10.3758/BF03198531

Peng, P., Lin, X., Ünal, Z. E., Lee, K., Namkung, J., Chow, J., & Sales, A. (2020). Examining the mutual relations between language and mathematics: A meta-analysis. *Psychological Bulletin*, *146*(7), 595–634. https://doi.org/10.1037/bul0000231

Pereira, E. J., Gurguryan, L., & Ristic, J. (2020). Trait-Level Variability in Attention Modulates Mind Wandering and Academic Achievement. *Frontiers in Psychology*, *11*. https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00909

*Pham, A. V. (2016). Differentiating Behavioral Ratings of Inattention, Impulsivity, and Hyperactivity in Children: Effects on Reading Achievement. *Journal of Attention Disorders*, *20*(8), 674–683. https://doi.org/10.1177/1087054712473833

*Plamondon, A., & Martinussen, R. (2019). Inattention Symptoms Are Associated With Academic Achievement Mostly Through Variance Shared With Intrinsic Motivation and Behavioral Engagement. *Journal of Attention Disorders*, *23*(14), 1816–1828. https://doi.org/10.1177/1087054715587098

Polderman, T. J. C., Boomsma, D. I., Bartels, M., Verhulst, F. C., & Huizink, A. C. (2010). A systematic review of prospective studies on attention problems and academic achievement. *Acta Psychiatrica Scandinavica*, *122*(4), 271–284. https://doi.org/10.1111/j.1600-0447.2010.01568.x

Posner, M. I., & Petersen, S. E. (1990). The Attention System of the Human Brain. *Annual Review of Neuroscience*, *13*(1), 25–42. https://doi.org/10.1146/annurev.ne.13.030190.000325

Posner, M. I., & Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annual Review of Psychology*, *58*, 1–23. https://doi.org/10.1146/annurev.psych.58.110405.085516

Prasad, V., Brogan, E., Mulvaney, C., Grainge, M., Stanton, W., & Sayal, K. (2013). How effective are drug treatments for children with ADHD at improving on-task behaviour and academic achievement in the school classroom? A systematic review and meta-analysis. *European Child & Adolescent Psychiatry*, *22*(4), 203–216. https://doi.org/10.1007/s00787-012-0346-x

Preacher, K. J., Rucker, D. D., MacCallum, R. C., & Nicewander, W. A. (2005). Use of the Extreme Groups Approach: A Critical Reexamination and New Recommendations. *Psychological Methods*, *10*(2), 178–192. https://doi.org/10.1037/1082-989X.10.2.178

Quintana, D. S. (2015). From pre-registration to publication: A non-technical primer for conducting a meta-analysis to synthesize correlational data. *Frontiers in Psychology*, *6*, 1549. https://doi.org/10.3389/fpsyg.2015.01549

Rabiner, D., & Coie, J. D. (2000). Early Attention Problems and Children's Reading Achievement: A Longitudinal Investigation. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*(7), 859–867. https://doi.org/10.1097/00004583-200007000-00014

*Rabiner, D. L., Godwin, J., & Dodge, K. A. (2016). Predicting Academic Achievement and Attainment: The Contribution of Early Academic Skills, Attention Difficulties, and Social Competence. *School Psychology Review*, *45*(2), 250–267. https://doi.org/10.17105/SPR45-2.250-267

Raghubar, K., Cirino, P., Barnes, M., Ewing-Cobbs, L., Fletcher, J., & Fuchs, L. (2009). Errors in Multi-Digit Arithmetic and Behavioral Inattention in Children With Math Difficulties. *Journal of Learning Disabilities*, *42*(4), 356–371. https://doi.org/10.1177/0022219409335211

Rapoport, J. L., Buchsbaum, M. S., Weingartner, H., Zahn, T. P., Ludlow, C., & Mikkelsen, E. J. (1980). Dextroamphetamine: Its Cognitive and Behavioral Effects in Normal and

Hyperactive Boys and Normal Men. *Archives of General Psychiatry*, *37*(8), 933–943. https://doi.org/10.1001/archpsyc.1980.01780210091010

Rapport, M. D., Kofler, M. J., Alderson, R. M., Timko, T. M., & DuPaul, G. J. (2009). Variability of Attention Processes in ADHD: Observations From the Classroom. *Journal of Attention Disorders*, *12*(6), 563–573. https://doi.org/10.1177/1087054708322990

Rapport, M. D., Scanlan, S. W., & Denney, C. B. (1999). Attention-Deficit/Hyperactivity Disorder and Scholastic Achievement: A Model of Dual Developmental Pathways. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *40*(8), 1169–1183. https://doi.org/10.1111/1469-7610.00534

Rathbone, J., Hoffmann, T., & Glasziou, P. (2015). Faster title and abstract screening? Evaluating Abstrackr, a semi-automated online screening program for systematic reviewers. *Systematic Reviews*, *4*(1), 80. https://doi.org/10.1186/s13643-015-0067-6

*Re, A. M., & Cornoldi, C. (2015). Spelling Errors in Text Copying by Children With Dyslexia and ADHD Symptoms. *Journal of Learning Disabilities*, *48*(1), 73–82. https://doi.org/10.1177/0022219413491287

*Re, A. M., Lovero, F., Cornoldi, C., & Passolunghi, M. C. (2016). Difficulties of children with ADHD symptoms in solving mathematical problems when information must be updated. *Research in Developmental Disabilities*, *59*, 186–193. https://doi.org/10.1016/j.ridd.2016.09.001

*Rennie, B., Beebe-Frankenberger, M., & Swanson, H. L. (2014). A longitudinal study of neuropsychological functioning and academic achievement in children with and without signs of attention-deficit/hyperactivity disorder. *Journal of Clinical and Experimental Neuropsychology*, *36*(6), 621–635. https://doi.org/10.1080/13803395.2014.921284

*Rezende, A. R. T., Pacheco, S. P., Branco, S. C. C., Fernandes, R. D. C., Boldrini, C. R., Doria Filho, U., Bazán, P. R., Amaro Junior, E., Reed, U. C., & Casella, E. B. (2020). Combining neuropsychological tests to improve the assessment of arithmetic difficulties in children with ADHD. *Arquivos de Neuro-Psiquiatria*, *78*(4), 193–198. https://doi.org/10.1590/0004-282x20190178

Robb, J. A., Sibley, M. H., Pelham, W. E., Foster, E. M., Molina, B. S. G., Gnagy, E. M., & Kuriyan, A. B. (2011). The Estimated Annual Cost of ADHD to the U.S. Education System. *School Mental Health*, *3*(3), 169–177. https://doi.org/10.1007/s12310-011-9057-6

*Rodríguez, C., Grünke, M., González-Castro, P., García, T., & Álvarez-García, D. (2015). How Do Students With Attention-Deficit/ Hyperactivity Disorders and Writing Learning Disabilities Differ From Their Nonlabeled Peers in the Ability to Compose Texts? *Learning Disabilities*.

*Rodríguez, C., Torrance, M., Betts, L., Cerezo, R., & García, T. (2020). Effects of ADHD on Writing Composition Product and Process in School-Age Students. *Journal of Attention Disorders*, *24*(12), 1735–1745. https://doi.org/10.1177/1087054717707048

Rogers, M., Hwang, H., Toplak, M., Weiss, M., & Tannock, R. (2011). Inattention, working memory, and academic achievement in adolescents referred for attention deficit/hyperactivity disorder (ADHD). *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence*, *17*(5), 444–458. https://doi.org/10.1080/09297049.2010.544648

Rolf, J., Masten, A. S., Cicchetti, D., & Nüchterlein, K. H. (1992). *Risk and Protective Factors in the Development of Psychopathology*. Cambridge University Press.

Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin*, *86*, 638-641.

Rourke, B. P. (1993). Arithmetic Disabilities, Specific and Otherwise: A Neuropsychological Perspective. *Journal of Learning Disabilities*, *26*(4), 214–226. https://doi.org/10.1177/002221949302600402

Rücker, G., Schwarzer, G., Carpenter, J. R., & Schumacher, M. (2008). Undue reliance on I2 in assessing heterogeneity may mislead. *BMC Medical Research Methodology*, *8*(1), 79. https://doi.org/10.1186/1471-2288-8-79

*Ryan, M., Jacobson, L. A., Hague, C., Bellows, A., Denckla, M. B., & Mahone, E. M. (2017). Rapid automatized naming (RAN) in children with ADHD: An ex-Gaussian analysis. *Child Neuropsychology*, *23*(5), 571–587. https://doi.org/10.1080/09297049.2016.1172560

Saffer, B. Y., Mikami, A. Y., Qi, H., Owens, J. S., & Normand, S. (2021). Factors Related to Agreement between Parent and Teacher Ratings of Children's ADHD Symptoms: An Exploratory Study Using Polynomial Regression Analyses. *Journal of Psychopathology and Behavioral Assessment*, *43*(4), 793–807. https://doi.org/10.1007/s10862-021-09892-1

Savage, R., Cornish, K., Manly, T., & Hollis, C. (2006). Cognitive processes in children's reading and attention: The role of working memory, divided attention, and response inhibition. *British Journal of Psychology*, *97*(3), 365–385. https://doi.org/10.1348/000712605X81370

Schatschneider, C., Carlson, C. D., Francis, D. J., Foorman, B. R., & Fletcher, J. M. (2002). Relationship of Rapid Automatized Naming and Phonological Awareness in Early

Reading Development: Implications for the Double-Deficit Hypothesis. *Journal of Learning Disabilities*, *35*(3), 245–256. https://doi.org/10.1177/002221940203500306

Schmidt, S., & Petermann, F. (2009). Developmental psychopathology: Attention Deficit Hyperactivity Disorder (ADHD). *BMC Psychiatry*, *9*(1), 58. https://doi.org/10.1186/1471-244X-9-58

Scholtens, S., Rydell, A.-M., & Yang-Wallentin, F. (2013). ADHD symptoms, academic achievement, self-perception of academic competence and future orientation: A longitudinal study. *Scandinavian Journal of Psychology*, *54*(3), 205–212. https://doi.org/10.1111/sjop.12042

*Sciberras, E., Mueller, K. L., Efron, D., Bisset, M., Anderson, V., Jongeling, B., & Nicholson, J. M. (2014). *Language Problems in Children With ADHD: A Community-Based Study*. *133*(5).

*Sella, F., Re, A. M., Lucangeli, D., Cornoldi, C., & Lemaire, P. (2019). Strategy Selection in ADHD Characteristics Children: A Study in Arithmetic. *Journal of Attention Disorders*, *23*(1), 87–98. https://doi.org/10.1177/1087054712438766

*Sellers, R., Harold, G. T., Smith, A. F., Neiderhiser, J. M., Reiss, D., Shaw, D., Natsuaki, M. N., Thapar, A., & Leve, L. D. (2021). Disentangling nature from nurture in examining the interplay between parent–child relationships, ADHD, and early academic attainment. *Psychological Medicine*, *51*(4), 645–652. https://doi.org/10.1017/S0033291719003593

Shamseer, L., Moher, D., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., & Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: Elaboration and explanation. *BMJ*, *349*, g7647. https://doi.org/10.1136/bmj.g7647

Simonsohn, U., Nelson, L. D., & Simmons, J. P. (2014). P-curve: A key to the file-drawer. *Journal of Experimental Psychology: General*, *143*(2), 534–547. https://doi.org/10.1037/a0033242

Sims, D. M., & Lonigan, C. J. (2012). Multi-method assessment of ADHD characteristics in preschool children: Relations between measures. *Early Childhood Research Quarterly*, *27*(2), 329–337. https://doi.org/10.1016/j.ecresq.2011.08.004

Sims, D. M., Purpura, D. J., & Lonigan, C. J. (2016). The Relation Between Inattentive and Hyperactive/Impulsive Behaviors and Early Mathematics Skills. *Journal of Attention Disorders*, *20*(8), 704–714. https://doi.org/10.1177/1087054712464390

Skottun, B. C., & Skoyles, J. (2007). Dyslexia: Sensory Deficits or Inattention? *Perception*, *36*(7), 1084–1088. https://doi.org/10.1068/p5468

Skottun, B. C., & Skoyles, J. R. (2006). Attention, reading and dyslexia. *Clinical and Experimental Optometry*, *89*(4), 241–245. https://doi.org/10.1111/j.1444-0938.2006.00052.x

SKOTTUN, B. C., & SKOYLES, J. R. (2008). Coherent Motion, Magnocellular Sensitivity and the Causation of Dyslexia. *International Journal of Neuroscience*, *118*(1), 185–190. https://doi.org/10.1080/00207450601041872

Skoyles, J. R., & Skottun, B. C. (2009). Conflicting Data About Dyslexia's Cause. *Science*, *326*(5950), 228–229. https://doi.org/10.1126/science.326_228b

Sobanski, E., Brüggemann, D., Alm, B., Kern, S., Philipsen, A., Schmalzried, H., Heßlinger, B., Waschkowski, H., & Rietschel, M. (2008). Subtype differences in adults with attention-deficit/hyperactivity disorder (ADHD) with regard to ADHD-symptoms, psychiatric comorbidity and psychosocial adjustment. *European Psychiatry*, *23*(2), 142–149. https://doi.org/10.1016/j.eurpsy.2007.09.007

*Spiel, C. F. (2016). *Is Reading Tests Aloud an Accommodation for Youth With or at Risk for ADHD?* [Doctoral dissertation]. ProQuest.

*Spiel, C. F., Mixon, C. S., Holdaway, A. S., Evans, S. W., Harrison, J. R., Zoromski, A. K., & Yost, J. S. (2016). Is Reading Tests Aloud an Accommodation for Youth With or at Risk for ADHD? *Remedial and Special Education*, *37*(2), 101–112. https://doi.org/10.1177/0741932515619929

Spira, E. G., & Fischel, J. E. (2005). The impact of preschool inattention, hyperactivity, and impulsivity on social and academic development: A review. *Journal of Child Psychology and Psychiatry*, *46*(7), 755–773. https://doi.org/10.1111/j.1469-7610.2005.01466.x

Stein, J. (2001). The magnocellular theory of developmental dyslexia. *Dyslexia (Chichester, England)*, *7*(1), 12–36. https://doi.org/10.1002/dys.186

Stein, J. (2014). Dyslexia: The Role of Vision and Visual Attention. *Current Developmental Disorders Reports*, *1*(4), 267–280. https://doi.org/10.1007/s40474-014-0030-6

Stein, J., & Walsh, V. (1997). To see but not to read; the magnocellular theory of dyslexia. *Trends in Neurosciences*, *20*(4), 147–152. https://doi.org/10.1016/s0166-2236(96)01005-3

*Tamm, L., Epstein, J. N., Denton, C. A., Vaughn, A. J., Peugh, J., & Willcutt, E. G. (2014). Reaction Time Variability Associated with Reading Skills in Poor Readers with ADHD.

Journal of the International Neuropsychological Society, *20*(3), 292–301. https://doi.org/10.1017/S1355617713001495

*Tang, X., & Dai, T. (2021). How do classroom behaviors predict longitudinal reading achievement? A conditional autoregressive latent growth analysis. *Early Childhood Research Quarterly*, *54*, 239–251. https://doi.org/10.1016/j.ecresq.2020.09.007

Tanner-Smith, E. E., Tipton, E., & Polanin, J. R. (2016). Handling Complex Meta-analytic Data Structures Using Robust Variance Estimates: A Tutorial in R. *Journal of Developmental and Life-Course Criminology*, *2*(1), 85–112. https://doi.org/10.1007/s40865-016-0026-5

The relationship between performance-based and behavior rated measures of executive functioning and achievement in a clinical sample of children and adolescents with ADHD - ProQuest. (n.d.). Retrieved July 6, 2023, from https://www.proquest.com/openview/3c04361880b5c8f0a3b254648555c127/1?pq-origsite=gscholar&cbl=18750

Thorell, L. B. (2007). Do delay aversion and executive function deficits make distinct contributions to the functional impact of ADHD symptoms? A study of early academic skill deficits. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *48*(11), 1061–1070. https://doi.org/10.1111/j.1469-7610.2007.01777.x

Tosto, M. G., Momi, S. K., Asherson, P., & Malki, K. (2015a). A systematic review of attention deficit hyperactivity disorder (ADHD) and mathematical ability: Current findings and future implications. *BMC Medicine*, *13*(1), 204. https://doi.org/10.1186/s12916-015-0414-4

Tosto, M. G., Momi, S. K., Asherson, P., & Malki, K. (2015b). A systematic review of attention deficit hyperactivity disorder (ADHD) and mathematical ability: Current findings and future implications. *BMC Medicine*, *13*(1), 204. https://doi.org/10.1186/s12916-015-0414-4

Trautman, R. C., Giddan, J. J., & Jurs, S. G. (1990). Language Risk Factor in Emotionally Disturbed Children Within a School and Day Treatment Program. *Journal of Childhool Communication Disorders*, *13*(2), 123–133. https://doi.org/10.1177/152574019001300201

Tripp, G., Schaughency, E. A., & Clarke, B. (2006). Parent and Teacher Rating Scales in the Evaluation of Attention-deficit Hyperactivity Disorder: Contribution to Diagnosis and Differential Diagnosis in Clinically Referred Children. *Journal of Developmental & Behavioral Pediatrics*, *27*(3), 209.

*Tsujimoto, K. C., Boada, R., Gottwald, S., Hill, D., Jacobson, L. A., Lovett, M., Mahone, E. M., Willcutt, E., Wolf, M., Bosson-Heenan, J., Gruen, J. R., & Frijters, J. C. (2019). Causal Attribution Profiles as a Function of Reading Skills, Hyperactivity, and Inattention. *Scientific Studies of Reading*, *23*(3), 254–272. https://doi.org/10.1080/10888438.2018.1529767

*Turker, S., Seither-Preisler, A., Reiterer, S. M., & Schneider, P. (2019). Cognitive and Behavioural Weaknesses in Children with Reading Disorder and AD(H)D. *Scientific Reports*, *9*(1), 15185. https://doi.org/10.1038/s41598-019-51372-w

Using the Simple View of Reading to Examine Reading Comprehension Proficiency in Youth With and Without Attention Deficit Hyperactivity Disorder—ProQuest. (n.d.). Retrieved July 6, 2023, from https://www.proquest.com/openview/1eb4e3cbb45f12ee14b29eeb1f80927a/1?pq-origsite=gscholar&cbl=18750&diss=y

Velki, T., & Gabrijela, V. (2019). GENDER AS MODERATOR AND AGE AS MEDIATOR VARIABLES IN PREDICTION OF SCHOOL ADJUSTMENT BY SELF-EVALUTED SYMPTOMS OF ADHD 2. *Primenjena Psihologija*, *12*, 65–83. https://doi.org/10.19090/pp.2019.1.65-83

*Vicente, M. M., & Riveiro, J. M. S. (2019). Executive functioning and learning in primary school students. *Electronic Journal of Research in Educational Psychology*, *47*.

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, *36*(3), 1–48. https://doi.org/10.18637/jss.v036.i03

Viechtbauer, W., & Cheung, M. W.-L. (2010). Outlier and influence diagnostics for meta-analysis. *Research Synthesis Methods*, *1*(2), 112–125. https://doi.org/10.1002/jrsm.11

Vile Junod, R. E., DuPaul, G. J., Jitendra, A. K., Volpe, R. J., & Cleary, K. S. (2006). Classroom observations of students with and without ADHD: Differences across types of engagement. *Journal of School Psychology*, *44*(2), 87–104. https://doi.org/10.1016/j.jsp.2005.12.004

*von Wirth, E., Kujath, K., Ostrowski, L., Settegast, E., Rosarius, S., Döpfner, M., Schwenk, C., & Kuhn, J.-T. (2021). The co-occurrence of Attention-Deficit/Hyperactivity Disorder and mathematical difficulties: An investigation of the role of basic numerical skills. *Research in Developmental Disabilities*, *112*, 103881. https://doi.org/10.1016/j.ridd.2021.103881

*Vukovic, R. K., Fuchs, L. S., Geary, D. C., Jordan, N. C., Gersten, R., & Siegler, R. S. (2014). Sources of Individual Differences in Children's Understanding of Fractions. *Child Development*, *85*(4), 1461–1476. https://doi.org/10.1111/cdev.12218

*Wadley, M. N., & Liljequist, L. (n.d.). *The Effect of Extended Test Time for Students with Attention-Deficit Hyperactivity Disorder*.

Wammes, J. D., Boucher, P. O., Seli, P., Cheyne, J. A., & Smilek, D. (2016). Mind wandering during lectures I: Changes in rates across an entire semester. *Scholarship of Teaching and Learning in Psychology*, *2*(1), 13–32. https://doi.org/10.1037/stl0000053

Warner-Rogers, J., Taylor, A., Taylor, E., & Sandberg, S. (2000). Inattentive Behavior in Childhood: Epidemiology and Implications for Development. *Journal of Learning Disabilities*, *33*(6), 520–536. https://doi.org/10.1177/002221940003300602

Wass, S. V., Scerif, G., & Johnson, M. H. (2012). Training attentional control and working memory – Is younger, better? *Developmental Review*, *32*(4), 360–387. https://doi.org/10.1016/j.dr.2012.07.001

Willcutt, E. G., & Pennington, B. F. (2000). Comorbidity of Reading Disability and Attention-Deficit/ Hyperactivity Disorder: Differences by Gender and Subtype. *Journal of Learning Disabilities*, *33*(2), 179–191. https://doi.org/10.1177/002221940003300206

Wolraich, M. L., Lambert, E. W., Bickman, L., Simmons, T., Doffing, M. A., & Worley, K. A. (2004). Assessing the Impact of Parent and Teacher Agreement on Diagnosing Attention-Deficit Hyperactivity Disorder. *Journal of Developmental & Behavioral Pediatrics*, *25*(1), 41–47.

*Yeari, M., Avramovich, A., & Schiff, R. (2017). Online inferential and textual processing by adolescents with attention-deficit/hyperactivity disorder during reading comprehension: Evidence from a probing method. *Journal of Clinical and Experimental Neuropsychology*, *39*(5), 485–501. https://doi.org/10.1080/13803395.2016.1236906

Yeari, M., & Lavie, A. (2021). The Role of Surface Text Processing in Centrality Deficit and Poor Text Comprehension of Adolescents with Attention Deficit Hyperactivity Disorder: A Think-Aloud Study. *Learning Disabilities Research & Practice*, *36*(1), 40–55. https://doi.org/10.1111/ldrp.12237

Yoshimasu, K., Barbaresi, W. J., Colligan, R. C., Killian, J. M., Voigt, R. G., Weaver, A. L., & Katusic, S. K. (2010). Gender, Attention-Deficit/Hyperactivity Disorder, and Reading Disability in a Population-Based Birth Cohort. *Pediatrics*, *126*(4), e788–e795. https://doi.org/10.1542/peds.2010-1187

Yoshimasu, K., Barbaresi, W. J., Colligan, R. C., Killian, J. M., Voigt, R. G., Weaver, A. L., & Katusic, S. K. (2011). Written-Language Disorder Among Children With and Without ADHD in a Population-Based Birth Cohort. *Pediatrics*, *128*(3), e605–e612. https://doi.org/10.1542/peds.2010-2581

Young, A. R., Beitchman, J. H., Johnson, C., Douglas, L., Atkinson, L., Escobar, M., & Wilson, B. (2002). Young adult academic outcomes in a longitudinal sample of early identified language impaired and control children. *Journal of Child Psychology and Psychiatry*, *43*(5), 635–645. https://doi.org/10.1111/1469-7610.00052

*Zajic, M. C., McIntyre, N., Swain-Lerro, L., Novotny, S., Oswald, T., & Mundy, P. (2018). Attention and written expression in school-age, high-functioning children with autism spectrum disorders. *Autism*, *22*(3), 245–258. https://doi.org/10.1177/1362361316675121

*Zajic, M. C., Solari, E. J., McIntyre, N. S., Lerro, L., & Mundy, P. C. (2020). Task engagement during narrative writing in school-age children with autism spectrum disorder compared to peers with and without attentional difficulties. *Research in Autism Spectrum Disorders*, *76*, 101590. https://doi.org/10.1016/j.rasd.2020.101590

*Zendarski, N., Sciberras, E., Mensah, F., & Hiscock, H. (2017). Academic Achievement and Risk Factors for Adolescents with Attention-Deficit Hyperactivity Disorder in Middle School and Early High School. *Journal of Developmental & Behavioral Pediatrics*, *38*(6), 358–368. https://doi.org/10.1097/DBP.0000000000000460

Zentall, S. S., Smith, Y. N., Lee, Y. B., & Wieczorek, C. (1994). Mathematical Outcomes of Attention-Deficit Hyperactivity Disorder. *Journal of Learning Disabilities*, *27*(8), 510–519. https://doi.org/10.1177/002221949402700806

Tables

Table 1. *Prior Systematic Reviews/Meta-Analyses*

Study	Article Type	Aim	Relation to Behavioral Attention and Achievement	# Studies	Moderators	Overall effect sizes
Arnold et al., 2020	Systematic Review	long-term academic achievement outcomes in students on and off treatment for ADHD	Direct	176	ADHD medication	--
Kanevski et al., 2021	Systematic Review	the relation between cognition and math in children with ADHD	Indirect	4	verbal/visuospatial short-term and working memory, central executive, inhibitory control, and processing speed	--
Froehlich et al., 2018	Systematic Review	academic outcomes related to ADHD medication type in children diagnosed with ADHD and Reading Disability	Direct	14	ADHD medication	--
Boland et al., 2020	Meta-analysis	impact of ADHD medications on academic outcomes	Indirect	40	ADHD medication	Academic Outcomes = .80 (OR)
Kortekaas-Rijlaarsdam et al., 2019	Meta-analysis	impact of ADHD medications on academic achievement	Direct	34	ADHD medication (methylphenidate); achievement type	Math accuracy = .030 (RR) Math productivity = .078 (RR) Reading accuracy = .062 (RR) Reading attempted = .47 (*d*)
Prasad et al., 2013	Meta-analysis	impact of ADHD medications on academic achievement	Direct	14	ADHD medication	% seatwork correct = 1.66 (Mean Difference)
Cook et al., 2018	Meta-analysis	relation between processing speed with academic achievement, in	Indirect	8	--	Processing speed and reading skills $r = .33$

		children diagnosed with ADHD				
McDougal et al., 2022	Meta-analysis	relation between working memory and processing speed with academic achievement, in children diagnosed with ADHD	Indirect	6	Reading type	Working memory and reading achievement $r = .53$ Working memory and word reading $r = .49$ Processing speed and word reading $r = .29$ Processing speed and reading comprehension = .35
Gray et al., 2017	Systematic Review	inattentive symptoms were a stronger predictor of low academic achievement than hyperactive/impulsive symptoms	Direct	27	Attention type (inattention, hyperactivity/impulsivity), teacher ratings	--
Polderman et al., 2010	Systematic Review	inattentive symptoms are a strong predictor of low academic achievement and hyperactive symptoms are a moderate predictor of academic achievement	Direct	16	Attention type	--
Tosto et al., 2015	Systematic Review	ADHD and math ability	Direct	34	Attention type	--
Graham, 2016	Meta-analysis	Writing outcomes in children with ADHD	Direct	44	Type of writing skill	$d = -0.78$ ($p < .001$) for writing quality, $d = -0.64$ ($p < .001$) for writing output, $d = -0.80$ ($p < .001$) for spelling, and $d = -0.60$ ($p < .001$) for fluency
Frazier et al., 2007	Meta-analysis	Academic achievement outcomes in children with and without ADHD	Direct	72	age, gender, achievement area, sample type, and DSM type	ADHD performed significantly lower than non-ADHD individuals on academic performance ($d = 0.71$, $p = .001$) with reading

						having the greatest effect size (d = 0.73, p < .001) followed by math (d = 0.67, p < .001) and then spelling (d = 0.55, p < .001).
Fowler, 2015	Meta-analysis	Updated meta-analysis on academic achievement outcomes in children with and without ADHD	Direct	31	IQ, assessment method, comorbid conditions, publications status	ADHD diagnosis and academic achievement (g = -0.90, p < .001), writing having the largest effect size (g = -1.38, p < .05) followed by math (g = -0.789, p < .05) and then reading (g = -0.601, p < .05).

Note: Articles are listed from least similar (top) to most similar (bottom) to the current meta-analysis; Relation to Behavioral Attention and Achievement: Direct = direct analysis (qualitative/quantitative) of behavioral attention and achievement; OR = Odds Ratio; RR = Relative Risk; d = Cohen's d; r = Pearson's correlation coefficient; g = Hedge's g.

Table 2. *Correlations Between Behavioral Attention and Academic Achievement*

Measure	*K*/ES	*r*	95% CI of *r*	τ^2
Main average correlation	106/450	-.25	[-.29, -.22]	.02
Study Design				
1. Group Comparison	57/185	-.24	[-.29, -.19]	.05
2. Correlation	57/265	-.27	[-.31, -.22]	.02
Behavioral Attention Type				
1. Total/Combined	69/227	-.24	[-.28, -.19]	.04
2. Inattention	44/146	-.30	[-.35, -.24]	.02
3. Hyperactive/Impulsive	25/77	-.13	[-.19, -.07]	.02
Achievement Type				
1. Reading	83/258	-.24	[-.28, -.20]	.02
2. Writing	25/79	-.24	[-.32, -.15]	.06
3. Math	50/113	-.28	[-.34, -.22]	.03
Reading Subskills				
1. Decoding/Word Reading	48/99	-.22	[-.28, -.16]	.03
2. Reading Fluency	33/59	-.25	[-.32, -.18]	.04
3. Reading Comprehension	34/79	-.26	[-.32, -.19]	.03
4. Total Reading	16/21	-.21	[-.27, -.15]	.01
Writing Subskills				
1. Spelling	16/33	-.23	[-.35, -.12]	.08
2. Writing Fluency*	5/8	-.29	[-.49, -.06]	.02
3. Written Expression	10/24	-.36	[-.43, -.29]	.01
4. Total Writing	7/14	-.23	[-.41, -.03]	.03
Math Subskills				
1. Math Computation	32/63	-.28	[-.35, -.21]	.05
2. Math Fluency	9/12	-.29	[-.47, -.08]	.05
3. Word Problems	8/10	-.45	[-.60, -.27]	.06
4. Total Math	15/28	-.23	[-.29, -.18]	.01
Behavioral Attention Rater				
1. Both Parent/Teacher	25/111	-.27	[-.34, -.20]	.03
2. Parent	35/110	-.19	[-.24, -.14]	.02
3. Teacher	33/187	-.34	[-.39, -.28]	.03
4. Self*	5/8	-.05	[-.12, .01]	.01

Note. *K* = number of studies; ES = number of effect sizes; *r* = Pearson's correlation coefficient; CI = Confidence Interval; τ^2 = between-study sampling variance; *****Caution with interpretation due to degrees of freedom (*df)* < 4.

Table 3. *Moderations on Correlations Between Behavioral Attention and Academic Achievement*

Correlation	β	*SE*	*t*	95% CI	*p* value
Age	-.002	.008	-.44	[-.02, .01]	.81
Gender	.09	.12	.74	[-.17, .35]	.47
Study Design					
Correlation vs. Group Comparison	-.02	.06	-.37	[-.16, .11]	.72
Behavioral Attention Type					
Inattention vs. Hyperactive/Impulsive	**-.17**	**.04**	**-4.12**	**[-.25, -.08]**	**<.001**
Total/Combined vs. Hyperactive/Impulsive	**-.14**	**.06**	**-2.59**	**[-.26, -.03]**	**.02**
Behavioral Attention Rater					
Both Parent/Teacher vs. Parent	-.11	.06	-1.77	[-.23, .02]	.09
Teacher vs. Parent	**-.19**	**.05**	**-3.66**	**[-.30, -.09]**	**<.001**
Self vs. Parent	.15	.09	1.70	[-.06, .37]	.14
Academic Achievement					
Math vs. Reading	-.05	.04	-1.32	[-.12, .02]	.19
Writing vs. Reading	-.04	.04	-.90	[-.13, .05]	.38

Note. All moderators were entered in one model. Several models were run for thorough subgroup comparisons among moderators with more than two categories. Subgroup comparisons within categorical moderators are all listed in the model. CI= confidence interval. The second group in each group comparison variable is the reference group (e.g., in Inattention vs. Hyperactive/Impulsive, Hyperactive/Impulsive is the reference group in the dummy coding of Behavioral Attention Type). There are 368 correlations and 83 studies. Between-study sampling variance (τ^2) is .03 for the model. The bold variables are significant moderators

Table 4. *Post-hoc Correlational Analyses for Academic Achievement Domain and Attention Type*

Measure	*K*/ES	*r*	95% CI of *r*	τ^2
Reading				
1. Inattention	37/89	-.29	[-.35, -.22]	.02
2. Hyperactive/Impulsive	21/48	-.13	[-.21, -.05]	.02
Writing				
1. Inattention	8/16	-.28	[-.47, -.07]	.03
2. Hyperactive/Impulsive*	5/10	-.16	[-.37, .06]	.02
Math				
1. Inattention	23/41	-.34	[-.41, -.26]	.02
2. Hyperactive/Impulsive	12/19	-.13	[-.22, -.04]	.02

Note. *K* = number of studies; ES = number of effect sizes; *r* = Pearson's correlation coefficient; CI = Confidence Interval; τ^2 = between-study sampling variance; *****Caution with interpretation due to degrees of freedom (*df)* < 4.

Table 5. *Post-hoc Correlational Analyses for Academic Achievement Level and Attention Type*

Measure	*K*/ES	*r*	95% CI of *r*	τ^2
Low-Level Academics	73/195	-.24	[-.29, -.20]	.04
1. Inattention	31/70	-.30	[-.37, -.23]	.04
2. Hyperactive/Impulsive	16/35	-.13	[-.23, -.04]	.02
Mid-Level Academics	40/79	-.27	[-.33, -.20]	.04
1. Inattention	15/23	-.34	[-.44, -.24]	.04
2. Hyperactive/Impulsive	6/9	-.13	[-.29, .04]	.03
High-Level Academics	47/113	-.31	[-.36, -.25]	.03
1. Inattention	17/31	-.36	[-.45, -.26]	.03
2. Hyperactive/Impulsive	8/17	-.17	[-.28, -.05]	.02

Note. Low-level academics consisted of decoding/word reading, spelling, math computation; Mid-level academics consisted of reading fluency, writing fluency, math fluency; High-level academics consisted of reading comprehension, written expression, math word problems; *K* = number of studies; ES = number of effect sizes; *r* = Pearson's correlation coefficient; CI = Confidence Interval; τ^2 = between-study sampling variance.

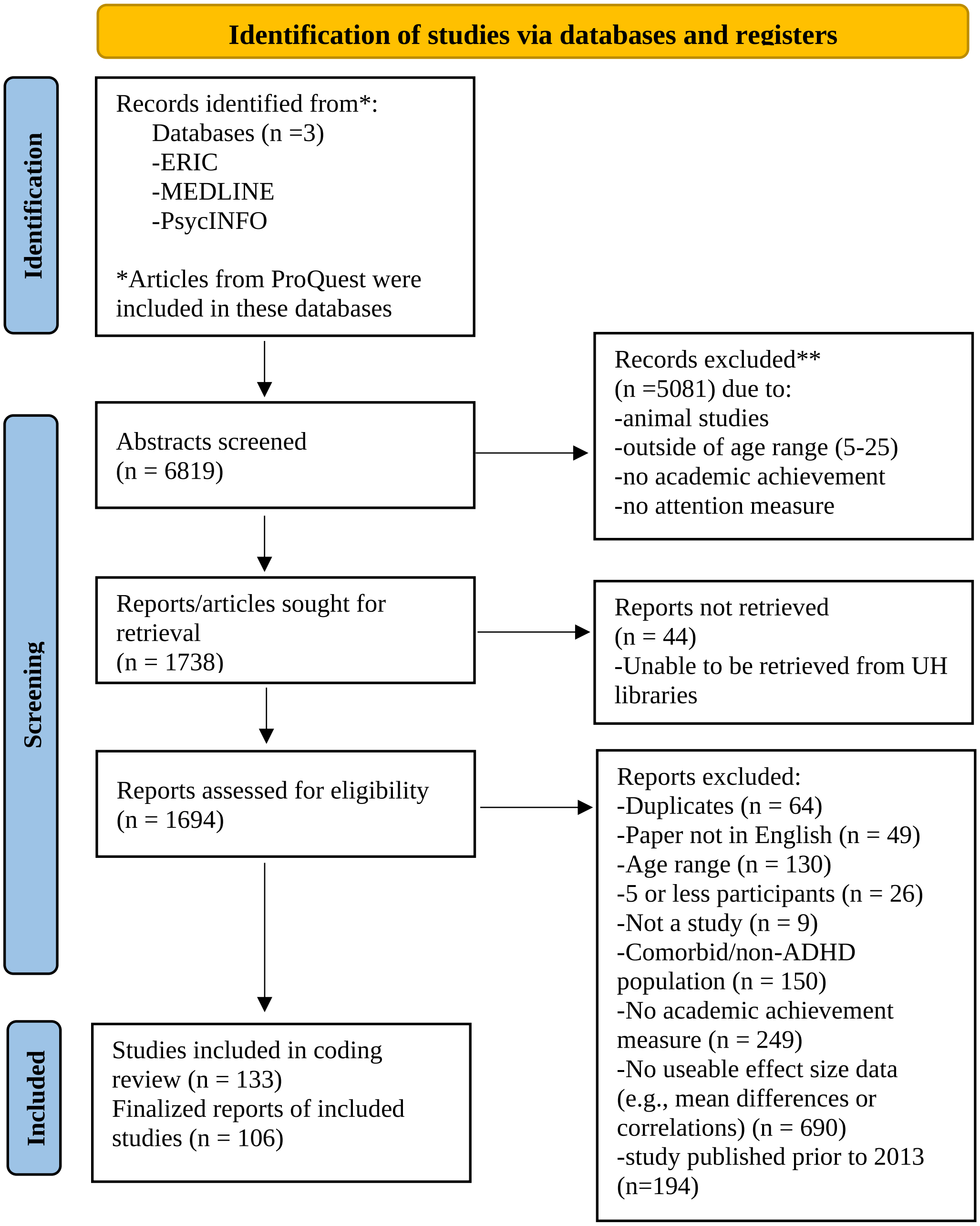
Table 6. *Moderations on Correlations Between Behavioral Attention and Academic Achievement, Model 2 with Academic Levels*

Correlation	β	*SE*	*t*	95% CI	*p* value
Age	-.001	.008	-.09	[-.02, .02]	.93
Gender	.08	.11	.67	[-.16, .32]	.51
Study Design					
Correlation vs. Group Comparison	-.04	.06	-.68	[-.18, .09]	.50
Behavioral Attention Type					
Inattention vs. Hyperactive/Impulsive	**-.16**	**.04**	**-4.38**	**[-.24, -.09]**	**<.001**
Total/Combined vs. Hyperactive/Impulsive	**-.12**	**.05**	**-2.28**	**[-.23, -.01]**	**.03**
Behavioral Attention Rater					
Both Parent/Teacher vs. Parent	-.10	.06	-1.72	[-.21, .02]	.09
Teacher vs. Parent	**-.19**	**.05**	**-3.72**	**[-.29, -.09]**	**<.001**
Self vs. Parent	.15	.09	1.62	[-.07, .36]	.15
Academic Achievement					
Reading vs. Writing	.05	.04	1.10	[-.04, .13]	.28
Math vs. Writing	-.02	.05	-.51	[-.12, .07]	.61
Academic Levels					
Mid-Level vs. Low-Level	-.06	.05	-1.24	[-.15, .04]	.22
High-Level vs. Low-Level	**-.10**	**.03**	**-3.21**	**[-.17, -.04]**	**.002**
Composite vs. Low-Level	.01	.04	.23	[-.07, .09]	.82

Note. All moderators were entered in one model. Several models were run for thorough subgroup comparisons among moderators with more than two categories. Subgroup comparisons within categorical moderators are all listed in the model. CI= confidence interval. The second group in each group comparison variable is the reference group (e.g., in Inattention vs. Hyperactive/Impulsive, Hyperactive/Impulsive is the reference group in the dummy coding of Behavioral Attention Type). There are 368 correlations and 83 studies. Between-study sampling variance (τ^2) is .03 for the model. The bold variables are significant moderators.

Figures

Figure 1. *PRISMA Flow Diagram*



Note: Article selection process for the current study. Adapted from Page et al., (2021).

Supplementary Table 1. *Study-Level Effect Size Data*

Citation	Corr	N	Pub Type	Country	Language	Age (*M*)	Male (%)	Study Design	Attention Type	Rater	Academic Achieve
Antonini et al., (2013)	-0.46	94	1	1	1	8.20	0.76	2	1	1	2
Antonini et al., (2013)	-0.42	98	1	1	1	8.20	0.68	2	2	1	2
Berninger et al., (2017)	0.30	88	1	1	1	12.30	0.67	1	2	2	3
Berninger et al., (2017)	-0.32	88	1	1	1	12.30	0.67	1	2	2	1
Birkett & Talcott (2013)	-0.20	21	1	2	1	9.58	0.48	1	2	3	1
Birkett & Talcott (2013)	-0.32	21	1	2	1	9.58	0.48	1	2	3	3
Birkett & Talcott (2013)	-0.14	21	1	2	1	9.58	0.48	1	3	3	1
Birkett & Talcott (2013)	-0.14	21	1	2	1	9.58	0.48	1	3	3	3
Cain & Bignell (2014)	-0.71	22	1	2	1	9.31	0.82	2	1	3	1
Cain & Bignell (2014)	-0.52	22	1	2	1	9.31	0.82	2	1	3	1
Cain & Bignell (2014)	-0.18	22	1	2	1			2	3	3	1
Cain & Bignell (2014)	0.05	22	1	2	1			2	3	3	1
Cain & Bignell (2014)	-0.70	22	1	2	1			2	2	3	1
Cain & Bignell (2014)	-0.80	22	1	2	1			2	2	3	1
Cain & Bignell (2014)	-0.76	32	1	2	1	10.74	0.91	2	1	3	1
Cain & Bignell (2014)	0.53	32	1	2	1	10.74	0.91	2	1	3	1
Cain & Bignell (2014)	-0.46	32	1	2	1	9.18	0.73	2	1	3	1
Cain & Bignell (2014)	-0.15	32	1	2	1	9.18	0.73	2	3	3	1
Cain & Bignell (2014)	0.12	32	1	2	1	9.52		2	3	3	1
Cain & Bignell (2014)	-0.11	32	1	2	1	9.52		2	3	3	1
Cain & Bignell (2014)	-0.68	32	1	2	1	9.52		2	2	3	1
Cain & Bignell (2014)	0.63	32	1	2	1	9.46		2	2	3	1
Cain & Bignell (2014)	-0.51	32	1	2	1	9.46		2	2	3	1
Cain & Bignell (2014)	-0.14	66	1	2	1	9.46		1	3	3	1
Cain & Bignell (2014)	-0.10	66	1	2	1	9.48		1	3	3	1
Cain & Bignell (2014)	-0.70	66	1	2	1	9.48		1	2	3	1
Cain & Bignell (2014)	-0.62	66	1	2	1	9.48		1	2	3	1
Canu et al., (2017)	0.01	203	1	1	1	19.75	0.33	2	1	4	2
Capodieci & Martinussen (2017)	-0.22	69	1	7	1	15.45	0.57	2	1	2	2

Capodieci & Martinussen (2017)	-0.51	69	1	7	1	15.45	0.57	2	1	2	2
Carrasco et al., (2022)	-0.02	88	1	18	1	8.35	0.74	1	2	1	1
Carrasco et al., (2022)	-0.03	88	1	18	1	8.35	0.74	1	2	1	2
Carrasco et al., (2022)	-0.09	88	1	18	1	8.35	0.74	1	2	1	3
Carrasco et al., (2022)	0.01	88	1	18	1	8.35	0.74	1	3	1	1
Carrasco et al., (2022)	0.08	88	1	18	1	8.35	0.74	1	3	1	2
Carrasco et al., (2022)	0.00	88	1	18	1	8.35	0.74	1	3	1	3
Carrasco et al., (2022)	-0.09	121	1	18	1	8.79	0.74	1	2	1	1
Carrasco et al., (2022)	-0.16	121	1	18	1	8.79	0.74	1	2	1	2
Carrasco et al., (2022)	-0.22	121	1	18	1	8.79	0.74	1	2	1	3
Carrasco et al., (2022)	0.00	121	1	18	1	8.79	0.74	1	3	1	1
Carrasco et al., (2022)	-0.04	121	1	18	1	8.79	0.74	1	3	1	2
Carrasco et al., (2022)	-0.06	121	1	18	1	8.79	0.74	1	3	1	3
Carrasco et al., (2022)	-0.04	111	1	18	1	9.14	0.74	1	2	1	1
Carrasco et al., (2022)	-0.05	111	1	18	1	9.14	0.74	1	2	1	2
Carrasco et al., (2022)	-0.03	111	1	18	1	9.14	0.74	1	2	1	3
Carrasco et al., (2022)	0.21	111	1	18	1	9.14	0.74	1	3	1	1
Carrasco et al., (2022)	0.18	111	1	18	1	9.14	0.74	1	3	1	2
Carrasco et al., (2022)	0.12	111	1	18	1	9.14	0.74	1	3	1	3
Carrasco et al., (2022)	-0.04	114	1	18	1	9.10	0.74	1	2	1	1
Carrasco et al., (2022)	-0.09	114	1	18	1	9.10	0.74	1	2	1	2
Carrasco et al., (2022)	-0.08	114	1	18	1	9.10	0.74	1	2	1	3
Carrasco et al., (2022)	0.01	114	1	18	1	9.10	0.74	1	3	1	1
Carrasco et al., (2022)	0.05	114	1	18	1	9.10	0.74	1	3	1	2
Carrasco et al., (2022)	0.06	114	1	18	1	9.10	0.74	1	3	1	3
Chan & Martinussen (2016)	-0.36	96	1	7	1	15.39	0.52	2	1	2	2
Child et al., (2019)	-0.45	233	1	1	1	7.58	0.52	1	2	3	1
Child et al., (2019)	-0.44	233	1	1	1	7.58	0.52	1	2	3	2
Child et al., (2019)	-0.44	233	1	1	1	7.58	0.52	1	2	3	1
Child et al., (2019)	-0.40	233	1	1	1	7.58	0.52	1	2	3	2
Child et al., (2019)	-0.32	233	1	1	1	7.58	0.52	1	3	3	1
Child et al., (2019)	-0.22	233	1	1	1	7.58	0.52	1	3	3	2

Child et al., (2019)	-0.24	233	1	1	1	7.58	0.52	1	3	3	1
Child et al., (2019)	-0.22	233	1	1	1	7.58	0.52	1	3	3	2
Chimiklis (2019)	0.24	20	2	1	1	8.40	0.75	1	2	2	1
Chimiklis (2019)	-0.14	20	2	1	1	8.40	0.75	1	2	2	1
Chimiklis (2019)	0.20	20	2	1	1	8.40	0.75	1	3	2	1
Chimiklis (2019)	0.03	20	2	1	1	8.40	0.75	1	3	2	1
Cho et al. (2019)	-0.45	104	1	1	1		0.55	1	1	3	1
Cusick et al., (2018)	-0.21	300	1	1	1		0.55	1	1	2	1
Cusick et al., (2018)	-0.34	300	1	1	1		0.55	1	1	2	2
Cusick et al., (2018)	-0.31	300	1	1	1		0.55	1	1	2	2
Efron et al., (2014)	-0.42	391	1	8	1	7.30	0.66	2	1	1	1
Efron et al., (2014)	-0.41	391	1	8	1	7.30	0.66	2	1	1	2
Ehm et al., (2016)	-0.31	1706	1	3	4	8.33	0.51	1	1	3	1
Ehm et al., (2016)	-0.32	1706	1	3	4	8.33	0.51	1	1	3	1
Friedman et al., (2017)	-0.45	61	1	1	1	9.64	1.00	2	1	1	1
Friedman et al., (2017)	-0.45	61	1	1	1	9.64	1.00	1	1	1	1
Friedman et al., (2018)	-0.44	69	1	1	1	9.69	1.00	2	1	1	2
Friedman et al., (2018)	-0.37	69	1	1	1	9.69	1.00	2	1	1	2
Friedman et al., (2018)	-0.38	69	1	1	1	9.69	1.00	1	1	1	2
Friedman et al., (2018)	-0.44	69	1	1	1	9.69	1.00	1	1	1	2
Fuchs et al., (2013)	-0.30	541	1	1	1		0.52	1	2	3	2
Fuchs et al., (2013)	-0.32	541	1	1	1		0.52	1	2	3	2
Fuchs et al., (2013)	-0.17	541	1	1	1		0.52	1	2	3	2
Ganor-Stern et al. (2018)	0.37	34	1	17	6	24.06	0.24	2	1		2
Ganor-Stern et al. (2018)	0.10	34	1	17	6	24.06	0.24	2	1		2
Ganor-Stern et al. (2018)	-0.06	34	1	17	6	24.06	0.24	2	1		2
Ganor-Stern et al. (2018)	0.32	34	1	17	6	24.06	0.24	2	1		2
Ganor-Stern et al. (2018)	0.29	34	1	17	6	24.06	0.24	2	1		2
Geary et al., (2021)	-0.56	317	1	1	1	13.00	0.49	1	2	3	2
Geary et al., (2021)	-0.54	317	1	1	1	13.00	0.49	1	2	3	2
Geary et al., (2021)	-0.36	317	1	1	1	13.00	0.49	1	2	3	1
Gibson et al., (2018)	-0.50	77	2	1	1	12.53	0.59	2	1	1	1

Gibson et al., (2018)	-0.48	77	2	1	1	12.53	0.59	1	1	1	1
Goradia et al., (2016)	0.00	44	1	19	1	10.49	1.00	2	1	1	1
Goradia et al., (2016)	0.14	44	1	19	1	10.49	1.00	2	1	1	1
Goradia et al., (2016)	-0.04	44	1	19	1	10.49	1.00	2	1	1	3
Greven et al., (2014)	-0.18	6121	1	2	1	12.00	0.30	1	3	2	1
Greven et al., (2014)	-0.18	6121	1	2	1	12.00	0.30	1	3	2	2
Greven et al., (2014)	-0.27	6121	1	2	1	12.00	0.30	1	2	2	1
Greven et al., (2014)	-0.26	6121	1	2	1	12.00	0.30	1	2	2	2
Grills-Taquechel et al., (2013)	-0.46	161	1	1	1	7.30	0.57	1	2	3	1
Grills-Taquechel et al., (2013)	-0.46	161	1	1	1	7.30	0.57	1	2	3	1
Grills-Taquechel et al., (2013)	-0.39	161	1	1	1	7.30	0.57	1	2	3	2
Grills-Taquechel et al., (2013)	-0.49	161	1	1	1	7.30	0.57	1	2	3	1
Grills-Taquechel et al., (2013)	-0.49	161	1	1	1	7.30	0.57	1	2	3	1
Grills-Taquechel et al., (2013)	-0.47	161	1	1	1	7.30	0.57	1	2	3	1
Grills-Taquechel et al., (2013)	-0.35	161	1	1	1	7.30	0.57	1	2	3	2
Grills-Taquechel et al., (2013)	-0.51	161	1	1	1	7.30	0.57	1	2	3	1
Hansen et al., (2015)	-0.34	334	1	1	1	10.82	0.46	1	2	3	1
Hansen et al., (2015)	-0.44	334	1	1	1	10.82	0.46	1	2	3	2
Hansen et al., (2015)	-0.47	334	1	1	1	10.82	0.46	1	2	3	2
Hansen et al., (2015)	-0.50	334	1	1	1	10.82	0.46	1	2	3	2
Hassinger-Das et al., (2013)	-0.46	107	1	1	1	5.46	0.48	1	2	3	1
Hassinger-Das et al., (2013)	-0.41	107	1	1	1	5.46	0.48	1	2	3	2
Hassinger-Das et al., (2013)	-0.57	107	1	1	1	5.46	0.48	1	2	3	2
Hassinger-Das et al., (2013)	-0.38	107	1	1	1	5.46	0.48	1	3	3	1
Hassinger-Das et al., (2013)	-0.38	107	1	1	1	5.46	0.48	1	3	3	2
Hassinger-Das et al., (2013)	-0.46	107	1	1	1	5.46	0.48	1	3	3	2
Hawkins et al. (2016)	0.01	253	1	2	1	9.40	0.66	1	2	2	1
Hawkins et al. (2016)	-0.02	253	1	2	1	9.40	0.66	1	3	2	1
Heikkila et al., (2016)	0.20	205	1	14	3	10.33	0.62	1	1	1	1
Heikkila et al., (2016)	0.01	205	1	14	3	10.33	0.62	1	1	1	1
Heikkila et al., (2016)	0.08	205	1	14	3	10.33	0.62	1	1	1	1
Heikkila et al., (2016)	0.03	205	1	14	3	10.33	0.62	1	1	1	3

Heikkila et al., (2016)	0.05	205	1	14	3	10.33	0.62	1	1	1	2
Holmes et al., (2014)	-0.45	133	1	2	1	9.77	0.77	2	1	2	2
Holmes et al., (2014)	-0.42	133	1	2	1	9.77	0.77	2	1	2	2
Holmes et al., (2014)	-0.32	133	1	2	1	9.77	0.77	2	1	2	1
Holmes et al., (2014)	-0.43	133	1	2	1	9.77	0.77	2	1	2	3
Holmes et al., (2014)	-0.52	133	1	2	1	9.77	0.77	2	1	2	1
Holmes et al., (2021)	0.09	785	1	2	1	9.48	0.69	2	1	2	1
Holmes et al., (2021)	0.08	778	1	2	1	9.48	0.69	2	1	2	3
Holmes et al., (2021)	0.06	789	1	2	1	9.48	0.69	2	1	2	2
Iglesias-Sarmiento et al., (2017)	-0.68	60	1	10	11	10.46	0.59	2	1		2
Jacobson et al., (2013)	-0.35	67	1	1	1	11.21	0.55	2	1	1	1
Jacobson et al., (2013)	-0.27	67	1	1	1	11.21	0.55	2	1	1	1
Jacobson et al., (2013)	-0.32	67	1	1	1	11.21	0.55	2	1	1	1
Jenkins & Demaray (2015)	-0.44	72	1	1	1		0.49	2	1	2	1
Jenkins & Demaray (2015)	-0.13	72	1	1	1		0.49	2	1	2	2
Jenkins & Demaray (2015)	-0.50	71	1	1	1		0.49	2	1	2	3
Jiang & Farquharson (2018)	-0.32	125	1	1	1	6.56	0.43	1	2	3	1
Jiang & Farquharson (2018)	-0.38	125	1	1	1	6.56	0.43	1	2	3	1
Jiang & Farquharson (2018)	-0.29	125	1	1	1	6.56	0.43	1	2	2	1
Jiang & Farquharson (2018)	-0.32	125	1	1	1	6.56	0.43	1	2	2	1
Jiang & Farquharson (2018)	-0.42	123	1	1	1	7.53	0.52	1	2	3	1
Jiang & Farquharson (2018)	-0.46	123	1	1	1	7.53	0.52	1	2	3	1
Jiang & Farquharson (2018)	-0.07	123	1	1	1	7.53	0.52	1	2	2	1
Jiang & Farquharson (2018)	-0.34	123	1	1	1	7.53	0.52	1	2	2	1
Jiang & Farquharson (2018)	-0.21	122	1	1	1	8.58	0.46	1	2	3	1
Jiang & Farquharson (2018)	-0.34	122	1	1	1	8.58	0.46	1	2	3	1
Jiang & Farquharson (2018)	-0.11	122	1	1	1	8.58	0.46	1	2	2	1
Jiang & Farquharson (2018)	-0.24	122	1	1	1	8.58	0.46	1	2	2	1
Jones (2014)	-0.04	134	2	1	1	10.75	0.74	1	2	2	1
Jones (2014)	0.01	119	2	1	1	10.75	0.74	1	2	2	2
Jordan et al., (2013)	-0.45	357	1	1	1	8.83	0.47	1	2	3	1
Jordan et al., (2013)	-0.34	357	1	1	1	8.83	0.47	1	2	3	2

Jordan et al., (2013)	-0.36	357	1	1	1	8.83	0.47	1	2	3	2
Jordan et al., (2013)	-0.49	357	1	1	1	8.83	0.47	1	2	3	2
Keenan & Meenan (2014)	-0.21	995	1	1	1	11.17		1	1	1	1
Keenan & Meenan (2014)	-0.13	995	1	1	1	11.17		1	1	1	1
Keenan & Meenan (2014)	-0.22	995	1	1	1	11.17		1	1	1	1
Keenan & Meenan (2014)	-0.17	995	1	1	1	11.17		1	1	1	1
Kent et al., (2014)	-0.46	214	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.32	214	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.37	214	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.54	232	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.38	232	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.44	232	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.44	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.32	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.31	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.47	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.38	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.37	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.42	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.33	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.31	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.40	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.34	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.31	249	1	1	1	5.13	0.54	1	1	3	1
Kent et al., (2014)	-0.44	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.41	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.39	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.42	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.37	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.39	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.42	249	1	1	1	5.13	0.54	1	1	3	3
Kent et al., (2014)	-0.36	249	1	1	1	5.13	0.54	1	1	3	3

Kent et al., (2014)	-0.38	249	1	1	1	5.13	0.54	1	1	3	3
Kibby et al., (2014)	-0.04	182	1	1	1	9.55	0.54	1	2	2	1
Kibby et al., (2014)	0.00	182	1	1	1	9.55	0.54	1	2	2	1
Kibby et al., (2014)	-0.14	182	1	1	1	9.55	0.54	1	2	2	1
Kibby et al., (2014)	-0.06	182	1	1	1	9.55	0.54	1	2	2	1
Kibby et al., (2015)	-0.14	162	1	1	1	9.65	0.51	2	1	1	1
Kibby et al., (2015)	-0.12	162	1	1	1	9.65	0.51	2	1	1	1
Kibby et al., (2020)	-0.19	103	1	1	1	9.60	0.48	2	1	2	1
Kim & Park (2018)	-0.22	201	1	13	9	6.84	0.56	1	1	3	3
Kim & Park (2018)	-0.36	201	1	13	9	6.84	0.56	1	1	3	3
Kim (2020)	-0.42	132	1	1	1	9.39	0.50	1	1	3	3
Kim (2020)	-0.44	132	1	1	1	9.39	0.50	1	1	3	3
Kim (2020)	-0.45	132	1	1	1	9.39	0.50	1	1	3	3
Kim (2020)	-0.42	132	1	1	1	9.39	0.50	1	1	3	3
Kim (2020)	-0.48	132	1	1	1	9.39	0.50	1	1	3	3
Kim et al., (2013)	-0.39	527	1	1	1	6.21	0.55	1	2	3	3
Kim et al., (2013)	-0.29	527	1	1	1	6.21	0.55	1	3	3	3
Kim et al., (2013)	-0.54	527	1	1	1	6.21	0.55	1	2	3	1
Kim et al., (2013)	-0.41	527	1	1	1	6.21	0.55	1	3	3	1
Kim et al., (2013)	-0.54	527	1	1	1	6.21	0.55	1	2	3	3
Kim et al., (2013)	-0.42	527	1	1	1	6.21	0.55	1	3	3	3
Kim et al., (2013)	-0.42	527	1	1	1	6.21	0.55	1	2	3	3
Kim et al., (2013)	-0.35	527	1	1	1	6.21	0.55	1	3	3	3
Kim et al., (2015)	-0.36	494	1	1	1	8.31	0.51	1	2	3	3
Kim et al., (2015)	-0.43	494	1	1	1	8.31	0.51	1	2	3	1
Kim et al., (2015)	-0.44	494	1	1	1	8.31	0.51	1	2	3	1
Kim et al., (2015)	-0.44	494	1	1	1	8.31	0.51	1	2	3	1
Kim et al., (2015)	-0.26	494	1	1	1	8.31	0.51	1	2	3	3
Kim et al., (2015)	-0.47	494	1	1	1	8.31	0.51	1	2	3	3
Kim et al., (2015)	-0.27	494	1	1	1	8.31	0.51	1	2	3	3
Kim et al., (2015)	-0.52	494	1	1	1	8.31	0.51	1	2	3	1
Kim et al., (2015)	-0.59	494	1	1	1	8.31	0.51	1	2	3	1

Kofler et al., (2019)	-0.46	78	1	1	1	10.50	0.63	2	1	1	1
Kofler et al., (2019)	-0.26	78	1	1	1	10.50	0.63	2	1	1	1
Kofler et al., (2019)	-0.37	78	1	1	1	10.50	0.63	2	1	1	1
Kofler et al., (2019)	-0.39	78	1	1	1	10.50	0.63	2	1	1	1
Kofler et al., (2019)	-0.21	78	1	1	1	10.50	0.63	2	1	1	1
Koltermann et al., (2020)	-0.05	179	1	12		8.94	0.47	2	1		1
Kortekaas-Rijlaarsdam et al., (2017)	-0.31	130	1	4	2	10.33	0.64	2	1	1	2
Kortekaas-Rijlaarsdam et al., (2017)	-0.18	130	1	4	2	10.33	0.64	2	1	1	2
Kortekaas-Rijlaarsdam et al., (2017)	-0.03	130	1	4	2	10.33	0.64	2	1	1	2
Kortekaas-Rijlaarsdam et al., (2017)	-0.20	130	1	4	2	10.33	0.64	2	1	1	2
Kortekaas-Rijlaarsdam et al., (2017)	-0.11	130	1	4	2	10.33	0.64	2	1	1	1
Kortekaas-Rijlaarsdam et al., (2017)	-0.11	130	1	4	2	10.33	0.64	2	1	1	3
Kuhn et al., (2016)	-0.02	56	1	3	4	8.98	0.39	2	1	2	1
Kuhn et al., (2016)	-0.33	56	1	3	4	8.98	0.39	2	1	2	2
Kvande & Wichstrom (2018)	-0.24	1232	1	11			0.50	1	1	2	1
Kvande & Wichstrom (2018)	-0.31	1232	1	11			0.50	1	1	2	2
Langer et al., (2019)	-0.27	30	1	1	1	10.09	0.65	2	2	1	1
Langer et al., (2019)	-0.37	30	1	1	1	10.09	0.65	2	2	1	1
Langer et al., (2019)	-0.25	30	1	1	1	10.09	0.65	2	2	1	1
Langer et al., (2019)	-0.40	30	1	1	1	10.09	0.65	2	2	1	1
Lee & Zentall (2017)	-0.10	47	1	1	1	12.39	0.53	2	3	3	1
Lenartowicz et al., (2019)	0.09	85	1	1	1	10.32	0.69	1	2	1	1
Lenartowicz et al., (2019)	-0.10	119	1	1	1	10.32	0.69	2	1	1	1
Lenartowicz et al., (2019)	0.05	85	1	1	1	10.32	0.69	1	3	1	1
Lenartowicz et al., (2019)	-0.07	119	1	1	1	10.32	0.69	2	1	1	1
Lenartowicz et al., (2019)	-0.15	119	1	1	1	10.32	0.69	2	1	1	3
Lenartowicz et al., (2019)	-0.26	119	1	1	1	10.32	0.69	2	1	1	2
Lewandowski et al., (2013)	-0.09	220	1	1	1	19.42	0.39	2	1		1

Lewandowski et al., (2013)	-0.04	220	1	1	1	19.42	0.39	2	1		1
Lewandowski et al., (2013)	-0.04	220	1	1	1	19.42	0.39	2	1		1
Liang & Kelsen (2017)	-0.07	229	1	5	1	20.66	0.39	2	1	4	1
Little et al., (2016)	-0.33	820	1	1	1	11.72	0.48	1	2	2	1
Little et al., (2016)	-0.24	820	1	1	1	11.72	0.48	1	3	2	1
Little et al., (2016)	-0.28	820	1	1	1	11.72	0.48	1	2	2	1
Little et al., (2016)	-0.18	820	1	1	1	11.72	0.48	1	3	2	1
Little et al., (2016)	-0.40	865	1	1	1	11.72	0.48	1	2	2	1
Little et al., (2016)	-0.30	865	1	1	1	11.72	0.48	1	3	2	1
Little et al., (2016)	-0.32	865	1	1	1	11.72	0.48	1	2	2	1
Little et al., (2016)	-0.17	865	1	1	1	11.72	0.48	1	3	2	1
Lovett et al., (2015)	0.01	141	1	1	1	19.38	0.41	1	1	4	1
Lovett et al., (2015)	-0.15	141	1	1	1	19.38	0.41	1	1	4	1
Lovett et al., (2019)	-0.09	69	1	1	1	20.76	0.29	2	1		1
Macdonald et al., (2021)	-0.16	245	1	1	1	10.30	0.52	1	2	3	1
Macdonald et al., (2021)	-0.28	245	1	1	1	10.30	0.52	1	2	3	1
Macdonald et al., (2021)	-0.28	245	1	1	1	10.30	0.52	1	2	3	1
Mackenzie (2019)	-0.11	98	2	7	1	15.54	0.54	2	1	2	1
Mackenzie (2019)	-0.41	98	2	7	1	15.54	0.54	2	1	2	1
Mackenzie (2019)	-0.17	98	2	7	1	15.54	0.54	2	1	2	1
Mackenzie (2019)	-0.06	98	2	7	1	15.54	0.54	2	1	2	1
Maehler & Schuchardt (2016)	-0.41	65	1	3	4	8.86	0.57	2	1	1	3
Maehler & Schuchardt (2016)	-0.11	65	1	3	4	8.86	0.57	2	1	1	1
Maehler & Schuchardt (2016)	-0.11	65	1	3	4	8.86	0.57	2	1	1	2
Magnuson et al., (2016)	-0.31	9182	1	1	1		0.51	1	3	2	2
Magnuson et al., (2016)	-0.32	9182	1	1	1		0.51	1	3	2	1
Malone & Fuchs (2014)	-0.23	139	1	1	1	9.49	0.42	1	2	3	2
Malone & Fuchs (2014)	-0.32	139	1	1	1	9.49	0.42	1	2	3	2
Malone & Fuchs (2014)	-0.36	139	1	1	1	9.49	0.42	1	2	3	2
Malone & Fuchs (2014)	-0.15	139	1	1	1	9.49	0.42	1	2	3	2
Malone & Fuchs (2014)	-0.25	139	1	1	1	9.49	0.42	1	2	3	2
Mano et al., (2017)	0.12	115	1	1	1	9.00	1.00	1	1	2	1

Mano et al., (2017)	0.10	115	1	1	1	9.00	1.00	1	1	2	1
Mano et al., (2017)	-0.19	72	1	1	1	9.50	0.00	1	1	2	1
Mano et al., (2017)	-0.06	72	1	1	1	9.50	0.00	1	1	2	1
Martin et al., (2013)	-0.32	144	1	1	1	9.53	0.51	1	2	3	1
Martin et al., (2013)	-0.57	144	1	1	1	9.53	0.51	1	2	3	2
Martin et al., (2013)	-0.51	144	1	1	1	9.53	0.51	1	2	3	2
Martínez-Vicente et al., (2019)	0.05	519	1	10	11	10.74	0.54	1	3	3	2
Martínez-Vicente et al., (2019)	-0.17	519	1	10	11	10.74	0.54	1	3	3	2
Martínez-Vicente et al., (2019)	-0.46	519	1	10	11	10.74	0.54	1	2	3	2
Martínez-Vicente et al., (2019)	-0.31	519	1	10	11	10.74	0.54	1	1	3	2
Martinussen & Mackenzie (2015)	-0.04	44	1	7	1	15.50		2	1	2	1
Martinussen & Mackenzie (2015)	-0.35	44	1	7	1	15.50		2	1	2	1
Martinussen et al., (2014)	-0.69	79	1	7	1	6.48	0.54	1	2	3	1
Martinussen et al., (2014)	-0.52	79	1	7	1	6.48	0.54	1	2	3	1
May et al., (2013)	0.26	60	1	8	1	9.32	0.50	1	2	2	1
May et al., (2013)	-0.14	60	1	8	1	9.32	0.50	1	2	2	2
May et al., (2013)	0.24	60	1	8	1	9.32	0.50	1	3	2	1
May et al., (2013)	-0.07	60	1	8	1	9.32	0.50	1	3	2	2
McIntyre (2015)	-0.25	83	2	1	1	11.50	0.75	2	1	2	1
McIntyre (2015)	-0.17	83	2	1	1	11.50	0.75	2	1	2	1
McIntyre (2015)	-0.27	83	2	1	1	11.50	0.75	2	1	2	1
McIntyre (2015)	-0.33	83	2	1	1	11.50	0.75	2	1	2	1
McIntyre (2015)	-0.34	83	2	1	1	11.50	0.75	2	1	2	1
McIntyre (2015)	-0.21	83	2	1	1	11.50	0.75	2	1	2	1
McIntyre (2015)	-0.24	83	2	1	1	11.50	0.75	2	1	2	1
Miller et al., (2013)	-0.10	27	1	1	1	9.78	0.74	1	3	1	1
Miller et al., (2013)	-0.21	27	1	1	1	9.78	0.74	1	2	1	1
Miller et al., (2013)	0.02	54	1	1	1	9.84	0.74	2	1	1	1
Miller et al., (2015)	0.01	76	1	1	1	19.94	0.45	2	1	4	1
Miranda et al., (2017)	-0.30	60	1	19	11	19.44	1.00	2	1	1	1
Miranda et al., (2017)	-0.27	60	1	19	11	19.44	1.00	2	1	1	1
Miranda et al., (2017)	-0.58	60	1	19	11	19.44	1.00	2	1	1	1

Miranda et al., (2017)	-0.28	60	1	19	11	19.44	1.00	2	1	1	1
Miranda et al., (2017)	-0.41	60	1	19	11	19.44	1.00	2	1	1	1
Miranda et al., (2017)	-0.26	60	1	19	11	19.44	1.00	2	1	1	1
Miranda et al., (2017)	-0.48	60	1	19	11	19.44	1.00	2	1	1	1
Mohl et al., (2018)	0.00	29	1	17	1	12.03	1.00	2	1	2	1
Mohl et al., (2018)	0.17	29	1	17	1	12.03	1.00	2	1		1
Mohl et al., (2018)	0.00	29	1	17	1	12.03	1.00	2	1		3
Mohl et al., (2018)	0.06	29	1	17	1	12.03	1.00	2	1		1
Mohl et al., (2018)	0.07	29	1	17	1	12.03	1.00	2	1		1
NoackLeSage et al., (2019)	-0.38	383	1	1	1	11.00	0.57	1	2	3	1
NoackLeSage et al., (2019)	-0.06	383	1	1	1	11.00	0.57	1	3	3	1
NoackLeSage et al., (2019)	-0.41	383	1	1	1	10.52	0.60	1	2	3	3
NoackLeSage et al., (2019)	-0.07	383	1	1	1	10.52	0.60	1	3	3	3
NoackLeSage et al., (2019)	-0.35	383	1	1	1	10.57	0.59	1	2	3	2
NoackLeSage et al., (2019)	-0.17	383	1	1	1	10.57	0.59	1	3	3	2
Noda et al., (2013)	-0.29	768	1	6	8		0.46	1	2	2	3
Noda et al., (2013)	-0.19	773	1	6	8		0.46	1	3	2	3
Noda et al., (2013)	0.26	758	1	6	8		0.46	1	1	2	3
Orbach et al., (2020)	-0.23	646	1	3	4	10.01	0.57	1	2	4	2
Orbach et al., (2020)	-0.06	646	1	3	4	10.01	0.57	1	3	4	2
Orbach et al., (2020)	0.01	646	1	3	4	10.01	0.57	1	3	4	2
Ozgur Oner et al., (2019)	0.04	2167	1	9	12		0.55	2	3	3	1
Ozgur Oner et al., (2019)	-0.06	2213	1	9	12		0.55	2	2	3	1
Ozgur Oner et al., (2019)	-0.04	2223	1	9	12		0.55	2	1	3	1
Ozgur Oner et al., (2019)	0.02	2167	1	9	12		0.55	2	3	3	2
Ozgur Oner et al., (2019)	-0.22	2213	1	9	12		0.55	2	2	3	2
Ozgur Oner et al., (2019)	-0.13	2223	1	9	12		0.55	2	1	3	2
Pagirsky et al. (2017)	-0.16	109	1	1	1	11.63	0.57	2	1		1
Pagirsky et al. (2017)	0.13	109	1	1	1	11.63	0.57	2	1		1
Pagirsky et al. (2017)	-0.17	109	1	1	1	11.63	0.57	2	1		1
Pagirsky et al. (2017)	-0.09	109	1	1	1	11.63	0.57	2	1		1
Pagirsky et al. (2017)	-0.20	109	1	1	1	11.63	0.57	2	1		1

Pagirsky et al. (2017)	0.02	109	1	1	1	11.63	0.57	2	1		1
Pagirsky et al. (2017)	-0.14	109	1	1	1	11.63	0.57	2	1		3
Pagirsky et al. (2017)	-0.12	109	1	1	1	11.63	0.57	2	1		3
Pagirsky et al. (2017)	0.07	109	1	1	1	11.63	0.57	2	1		3
Pagirsky et al. (2017)	-0.27	109	1	1	1	11.63	0.57	2	1		2
Pagirsky et al. (2017)	-0.14	109	1	1	1	11.63	0.57	2	1		2
Papaioannou et al., (2016)	-0.21	859	1	15	5	8.67	0.50	2	1	3	1
Papaioannou et al., (2016)	-0.13	859	1	15	5	8.67	0.50	2	1	3	1
Papaioannou et al., (2016)	-0.15	859	1	15	5	8.67	0.50	2	1	3	1
Papaioannou et al., (2016)	-0.11	859	1	15	5	8.67	0.50	2	1	3	1
Papaioannou et al., (2016)	-0.15	859	1	15	5	8.67	0.50	2	1	3	2
Papaioannou et al., (2016)	-0.03	866	1	15	5	8.65	0.50	2	3	3	1
Papaioannou et al., (2016)	-0.02	866	1	15	5	8.65	0.50	2	3	3	1
Papaioannou et al., (2016)	-0.02	866	1	15	5	8.65	0.50	2	3	3	1
Papaioannou et al., (2016)	-0.03	866	1	15	5	8.65	0.50	2	3	3	1
Papaioannou et al., (2016)	-0.06	866	1	15	5	8.65	0.50	2	3	3	2
Papaioannou et al., (2016)	-0.17	868	1	15	5	8.65	0.50	2	2	3	1
Papaioannou et al., (2016)	-0.15	868	1	15	5	8.65	0.50	2	2	3	1
Papaioannou et al., (2016)	-0.15	868	1	15	5	8.65	0.50	2	2	3	1
Papaioannou et al., (2016)	-0.15	868	1	15	5	8.65	0.50	2	2	3	1
Papaioannou et al., (2016)	-0.17	868	1	15	5	8.65	0.50	2	2	3	2
Pham (2016)	-0.37	131	1	1	1	9.13	0.50	1	2	2	1
Pham (2016)	-0.32	131	1	1	1	9.13	0.50	1	2	2	1
Pham (2016)	-0.20	131	1	1	1	9.13	0.50	1	3	2	1
Pham (2016)	-0.18	131	1	1	1	9.13	0.50	1	3	2	1
Pham (2016)	0.01	131	1	1	1	9.13	0.50	1	3	2	1
Pham (2016)	-0.05	131	1	1	1	9.13	0.50	1	3	2	1
Pham (2016)	-0.31	131	1	1	1	9.13	0.50	1	2	3	1
Pham (2016)	-0.32	131	1	1	1	9.13	0.50	1	2	3	1
Pham (2016)	-0.15	131	1	1	1	9.13	0.50	1	3	3	1
Pham (2016)	-0.13	131	1	1	1	9.13	0.50	1	3	3	1
Pham (2016)	-0.09	131	1	1	1	9.13	0.50	1	3	3	1

Pham (2016)	0.03	131	1	1	1	9.13	0.50	1	3	3	1
Plamondon et al., (2019)	-0.45	92	1	7	1	8.21	0.66	1	2	1	1
Plamondon et al., (2019)	-0.46	92	1	7	1	8.21	0.66	1	2	1	3
Plamondon et al., (2019)	-0.54	92	1	7	1	8.21	0.66	1	2	1	2
Rabiner et al., (2016)	-0.16	386	1	1	1	6.50	0.51	1	2	3	1
Rabiner et al., (2016)	-0.08	386	1	1	1	6.50	0.51	1	2	3	2
Re et al., (2015)	-0.09	57	1	16	7	9.50	0.91	2	1		1
Re et al., (2016)	-0.60	28	1	16	7	11.04	0.71	2	1	3	2
Rennie et al., (2014)	-0.49	51	1	1	1	7.74	0.50	2	1	3	1
Rennie et al., (2014)	-0.46	51	1	1	1	7.74	0.50	2	1	3	2
Rennie et al., (2014)	-0.39	51	1	1	1	7.74	0.50	1	1	3	2
Rennie et al., (2014)	-0.30	51	1	1	1	7.74	0.50	1	1	3	2
Rennie et al., (2014)	-0.25	51	1	1	1	7.74	0.50	1	1	3	2
Rennie et al., (2014)	-0.56	51	1	1	1	7.74	0.50	1	1	3	1
Rennie et al., (2014)	-0.20	51	1	1	1	7.74	0.50	1	1	3	1
Rennie et al., (2014)	-0.46	51	1	1	1	7.74	0.50	1	1	3	1
Rennie et al., (2014)	-0.43	51	1	1	1	7.74	0.50	1	1	3	2
Rezende et al., (2020)	-0.40	42	1	12	10	9.90		2	1	1	2
Rezende et al., (2020)	-0.23	42	1	12	10	9.90		2	1	1	2
Rodríguez et al., (2015)	-0.42	164	1	10	11	11.03	0.64	2	1	1	3
Rodríguez et al., (2015)	-0.38	164	1	10	11	11.03	0.64	2	1	1	3
Rodríguez et al., (2015)	-0.28	164	1	10	11	11.03	0.64	2	1	1	3
Rodríguez et al., (2015)	-0.34	164	1	10	11	11.03	0.64	2	1	1	3
Rodríguez et al., (2015)	-0.41	164	1	10	11	11.03	0.64	2	1	1	3
Rodríguez et al., (2015)	-0.35	164	1	10	11	11.03	0.64	2	1	1	3
Rodriguez et al., (2020)	-0.37	219	1	10	11	11.25	0.80	2	1	2	3
Rodriguez et al., (2020)	-0.31	219	1	10	11	11.25	0.80	2	1	2	3
Rodriguez et al., (2020)	-0.21	219	1	10	11	11.25	0.80	2	1	2	3
Ryan et al., (2017)	-0.40	80	1	1	1	11.26	0.52	2	1	1	1
Ryan et al., (2017)	-0.44	80	1	1	1	11.26	0.52	2	1	1	1
Ryan et al., (2017)	-0.24	80	1	1	1	11.26	0.52	2	1	1	1
Ryan et al., (2017)	-0.20	80	1	1	1	11.26	0.52	2	1	1	1

Sciberras et al., (2014)	-0.39	178	1	8	1	7.30	0.66	2	1	1	1
Sciberras et al., (2014)	-0.12	178	1	8	1	7.30	0.66	2	1	1	2
Sella et al., (2019)	0.02	38	1	16	7	10.21	0.74	2	1	3	2
Sella et al., (2019)	0.25	38	1	16	7	10.21	0.74	2	1	3	2
Sellers et al., (2019)	-0.11	361	1	1	1			1	1	2	1
Sellers et al., (2019)	-0.22	361	1	1	1			1	1	2	2
Spiel (2016)	-0.45	45	2	1	1	11.70	0.73	2	1	1	1
Spiel et al., (2016)	0.05	36	1	1	1	11.50	0.68	2	1	2	1
Tamm et al., (2014)	0.06	65	1	1	1	9.10	0.60	1	2	1	1
Tamm et al., (2014)	-0.06	65	1	1	1	9.10	0.60	1	3	1	1
Tamm et al., (2014)	0.02	65	1	1	1	9.10	0.60	1	2	1	1
Tamm et al., (2014)	-0.08	65	1	1	1	9.10	0.60	1	3	1	1
Tamm et al., (2014)	-0.11	65	1	1	1	9.10	0.60	1	2	1	1
Tamm et al., (2014)	-0.13	65	1	1	1	9.10	0.60	1	3	1	1
Tang & Dai (2021)	-0.30	6491	1	1	1	5.68	0.51	1	2	3	1
Tsujimoto et al., (2019)	-0.27	1315	1	17	1	11.09	0.52	1	2	2	1
Tsujimoto et al., (2019)	-0.24	1315	1	17	1	11.09	0.52	1	2	2	1
Tsujimoto et al., (2019)	-0.22	1315	1	17	1	11.09	0.52	1	3	2	1
Tsujimoto et al., (2019)	-0.23	1315	1	17	1	11.09	0.52	1	3	2	1
Turker et al., (2019)	-0.14	37	1	3	4	14.30	0.61	1	2	2	2
Turker et al., (2019)	-0.05	126	1	3	4	14.30	0.61	2	1	2	2
Turker et al., (2019)	-0.11	37	1	3	4	14.30	0.61	1	3	2	2
Turker et al., (2019)	0.16	126	1	3	4	14.30	0.61	2	1	2	2
von Wirth et al., (2021)	-0.05	51	1	3	4	9.10		2	1	2	1
von Wirth et al., (2021)	-0.14	51	1	3	4	9.10		2	1	2	2
Vukovic et al., (2014)	-0.55	163	1	1	1	6.50	0.53	1	2	3	1
Vukovic et al., (2014)	-0.66	163	1	1	1	6.50	0.53	1	2	3	2
Wadley & Liljequist (2013)	-0.24	129	1	1	1	21.64	0.33	2	1		2
Wadley & Liljequist (2013)	-0.40	129	1	1	1	21.64	0.33	2	1		2
Yeari & Lavie (2021)	-0.56	60	1	17	6	16.60	0.45	2	1		1
Yeari & Lavie (2021)	-0.42	60	1	17	6	16.60	0.45	2	1		1
Yeari et al., (2017)	-0.46	91	1		1	15.08	0.24	2	1		1

Yeari et al., (2017)	0.15	91	1		1	15.08	0.24	2	1		1
Yeari et al., (2017)	-0.19	91	1		1	15.08	0.24	2	1		1
Zajic et al., (2018)	-0.41	78	1	1	1	11.69	0.18	2	1	2	3
Zajic et al., (2018)	-0.40	78	1	1	1	11.69	0.18	2	1	2	3
Zajic et al., (2018)	-0.33	78	1	1	1	11.69	0.18	2	1	2	3
Zajic et al., (2020)	-0.30	61	1	1	1	12.97	0.71	2	1	2	3
Zajic et al., (2020)	-0.35	61	1	1	1	12.97	0.71	2	1	2	3
Zajic et al., (2020)	-0.43	61	1	1	1	12.97	0.71	2	1	2	3
Zendarski et al., (2017)	-0.19	130	1	8	1	13.70	0.89	1	2	2	1

Note. Corr = Correlation; Pub type = Publication Type; For Publication Type: 1= Journal Article, 2- Dissertation; For Country: 1=USA, 2=UK, 3=Germany, 4=Netherlands, 5=Taiwan, 6=Japan, 7=Canada, 8=Australia, 9=Turkey, 10=Spain, 11=Norway, 12=Brazil, 13=South Korea, 14=Finland, 15=Greece, 16=Italy, 17=Israel, 18=New Zealand, 19=Multiple; For Language: 1=English, 2=Dutch, 3=Finnish, 4=German, 5=Greek, 6=Hebrew, 7=Italian, 8=Japanese, 9=Korean, 10=Portuguese, 11=Spanish, 12=Turkish; For Study Design: 1=Correlation, 2= Group Comparisons; For Attention Type: 1=Total Attention/Combined/Mixed, 2=Inattentive, 3=Hyperactive/Impulsive; For Rater: 1=Both Parent/Teacher, 2=Parent, 3=Teacher, 4=Self; Academic Achieve = Academic Achievement; For Academic Achievement: 1=Reading, 2=Math, 3=Writing.