Parent Reports of Executive Functions in Students With Learning Disability

Jane Roitsch
Old Dominion University, jroitsch@odu.edu

Annemarie L. Horn
Old Dominion University, ahorn@odu.edu

Lisa Morin
Old Dominion University, lmorin@odu.edu

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Parent Reports of Executive Functions in Students with Learning Disability

Jane Roitsch[a], Annemarie L. Horn[b], Lisa Morin[c]

[a-c]Old Dominion University

Jane Roitsch is currently an Assistant Professor in the Department of Communication Disorders and Special Education at Old Dominion University. She has been an adjunct instructor at the University of Nebraska-Kearney and will be joining UNK as a full-time assistant professor in the Fall of 2022. She has taught anatomy and physiology, voice and voice disorders, phonetics and articulation disorders, speech science and dysphagia. Her research interests include executive functions, cognition, anatomy, dysphagia, voice and fluency disorders.
jroitsch@odu.edu | ORCID: https://orcid.org/0000-0003-1424-6610

Annemarie L. Horn is an Assistant Professor in the Department of Communication Disorders and Special Education at Old Dominion University. She is currently serving as the Program Coordinator for the MSED Adapted Curriculum Program. Research interests include eCoaching and teacher preparation, as it relates to improving postsecondary outcomes for youth with disabilities.
ahorn@odu.edu | ORCID: https://orcid/org/0000-0002-9595-9075

Lisa L. Morin is a lecturer of special education in the Department of Communication Disorders and Special Education at Old Dominion University. She is currently the Research Coordinator for Project Prepare!, the focus of which is to provide training for preschool teachers who teach children considered at risk. Her research interests include learning disabilities, evidence-based math and reading strategies, and inclusive practices.
lmorin@odu.edu | ORCID: https://orcid.org/0000-0002-2189-9399

Abstract

This study examines the results of the Behavior Rating Inventory of Executive Function (BRIEF-2) (Gioia et al., 2015) reported by parents of children with Specific Learning Disability (LD) and/or other comorbid disabilities. LD is most notably associated with comorbid attention deficit hyperactivity disorder (ADHD) (Alloway & Stein, 2014; Westby &Watson, 2004; Willcutt et al., 2013). A total of 43 parents completed the BRIEF-2 rating scale. Findings suggest children with LD and ADHD display greater challenges with inhibition, working memory, planning, along with greater challenges in organization and metacognition. Parents of children with LD reported their children have greater levels of executive function difficulties in comparison to children with LD who do not have a secondary diagnosis of ADHD.

Keywords: learning disability, attention deficit hyperactivity disorder, Behavior Rating Inventory of Executive Function, learning, cognition

Introduction

Students identified with a specific learning disability (LD) comprise the largest individual disability population served under the Individuals with Disabilities Improvement Education Act (IDEIA) (Irwin et al., 2021). Students with a LD provide 4.6% of the entire K-12 school population (National Center for Education Statistics, 2020); however, if students at risk of LD are included, the percentage would be much higher (Geary et al., 2020). Converging evidence points to the notion that LD is a neurological disorder that results in difficulties acquiring basic and more complex academic skills (Fletcher & Grigorenko, 2017; Pennington et al., 2019). Cognitive abilities (e.g., working memory [WM]) consistently correlate with the different academic competencies in the areas of LD, as it is reflected in the LD definition in IDEIA and in the Diagnostic and Statistical Manual-5 (DSM-5) (American Psychiatric Association, 2013).

Representing a heterogeneous population, students with LD exhibit individual differences in academic achievement, growth in skills development, visuospatial memory, verbal WM, intelligence, executive functions, and other cognitive correlates (Fletcher et al., 2013; Geary et al., 2012; Geary et al., 2020; Grigorenko et al., 2020; Lee et al., 2017; Swanson et al., 2009). LD is often associated with comorbidity with other disorders, such as attention deficit hyperactivity disorder (ADHD) (Alloway & Stein, 2014; Miller et al., 2012; Westby &Watson, 2004, 2021; Willcutt et al., 2013). Not surprisingly, underlying academic (e. g., reading), behavioral (e.g., attention), and cognitive (e.g., WM) deficits of LD and ADHD account for their comorbidity. ADHD can be briefly described as deficits in executive functions.

Geary and colleagues (2020) found that specific cognitive abilities directly correlate with academic achievement (e.g., verbal short-term memory was critical for reading accuracy and fluency, whereas spatial ability was important for mathematics). However, poor in-class attentive behavior correlates with learning difficulties. The ability to control one's attention is a cognitive skill included in the umbrella term executive function. Similar to Geary et al. (2020), other researchers identified deficits in students with LD and ADHD related to executive functions, such as inhibition, cognitive flexibility, and WM (Faedda et al., 2019; Mattison & Mayes, 2012). For example, Faedda et al. (2019) identified differences and similarities in intellectual functioning and executive functions between children and adolescents with ADHD and LD. Both groups had deficits in executive functions, with the ADHD group being more impaired particularly in cognitive inhibition, cognitive flexibility, verbal memory, WM, and intellectual functioning. Mattison and Mayes (2012) observed that those students with comorbid ADHD and LD seemed to have more executive dysfunctions than those with ADHD only. What is known in the field related to executive functions (EF) for persons with ADHD and LD appears limited to the aforementioned studies, although the associations between EF difficulties in students with ADHD and students with LD have been well-identified (Biederman et al., 2008). To demonstrate, El Wafa et al. (2020) compared the EF skills of four groups of children between the ages of six and 13 (i.e., one group of students with ADHD only, another group of children with LD only; a third group of children with ADHD and LD; and a control group). Findings revealed the first three groups evidenced greater EF difficulties, suggesting EF assessments for these three groups of students (i.e., those with ADHD, LD, and ADHD with LD) require intervention plans designed to optimize outcomes.

Executive Functions

EFs are high-level cognitive functions that enable humans to accomplish goals, regulate their behaviors, manage their emotions, monitor their thoughts, resist distractions, plan activities, and persist to complete them to reach their goals (Barkley, 2015; Denckla & Mahone, 2018). The multidimensional nature of EFs includes several cognitive processes and skills, such as working memory operations (e.g., updating), sustained attention, self-regulatory processes (e.g., self-monitoring), cognitive flexibility, metacognition (i.e., knowledge of one's own thinking), task initiation, planning, and goal-directed persistence (Dawson & Guare, 2018; Watson et al., 2016).

The developmental context of EFs must be understood to account for individual differences since most EF processes and skills are linked to the brain's frontal cortex. The course of brain networks from childhood to adulthood becomes better established during the evolution of networks that occur during development (Bernstein & Weber, 2018). Improvement of EFs is associated with maturation of the frontal lobes (Anderson, 2002). One standardized assessment commonly used to measure EFs in students is the Behavior Rating Inventory of Executive Function (BRIEF-2) (Gioia et al., 2015). Along with a student self-reporting scale, the BRIEF-2 includes a parent/teacher report rating scale for students between the ages of 11-18 years old.

Although developmental knowledge of EFs is critical to determining what tasks students can perform and those that need to be taught (Dawson & Guare, 2018), there is limited research investigating the relationships between EFs and other factors (e.g., age, comorbidities) in students with LD (i.e., Faedda et al., 2019; Geary et al., 2020; Mattison & Mayes, 2012). As the academic demands of a student's curriculum must match developmental changes of EFs, the need to further explore these relationships can provide critical information to drive educational supports and curriculum design.

In response to the aforementioned needs, this study examines the results of the BRIEF-2 as reported by parents of children between the ages of 11 and 18, all of whom had a diagnosis of LD, and some had comorbid disabilities, including ADHD. The specific question this study sought to answer is the following: What relationship(s), if any, exist between parent reports of children's EFs and other variables (i.e., age, severity of condition, comorbid conditions, household income, parent education, parent race, presence of autism, or presence of emotional/behavioral problem)?

Method

Participants

A total of 43 parents of children with LD enrolled in this study by responding to an online invitation to participate in a research study and volunteering to complete the BRIEF-2 rating scale. Inclusion criteria required participants to be at least 18 years old and self-identify as being the parent of at least one child with a diagnosis of LD. Comorbid diagnoses (e.g., ASD, ADHD) in children did not exclude their participation. Participants were informed their enrollment was voluntary, and all data would remain anonymous. According to parent reports, all students with LD were enrolled in school within the United States, where they received special education services under the primary disability diagnosis of LD. Table 1 includes participant demographic information.

Participants completed a short online demographic questionnaire and then, proceeded to a link to the BRIEF-2 parent questionnaire. The BRIEF-2 parent report included 86 statements regarding behavior rated on a 3-point Likert scale (i.e., 1 = never; 2 = sometimes; 3 = often). Raw subscale scores were calculated for eight subscales (i.e, inhibit, working memory, shift, emotional control, initiate, plan/organize, organization of materials, and monitoring) (Gioia et al, 2015). Next, aggregated subscales were tallied into three index scores: (1) the Behavior Regulation Index (which includes the inhibit, shift, and emotional control subscales); (2) the Metacognition Index (which consists of the working memory, initiate, plan/organize, organization of materials, and monitoring subscales); and (3) a Total Score (a composite of all subscales). For all the scores, an elevated score suggests greater EF difficulties. This study employed the computerized version of the BRIEF-2 due to the face-to-face constraints of the global COVID-19 pandemic. Therefore, an email link was sent to interested participants who met inclusion criteria.

This survey study utilized descriptive statistics and correlations analysis to determine what relationships, if any, existed between variables (i.e., demographic questions and responses to the BRIEF-2 parent report). The first author confirmed collection and scoring accuracy, and reliability was ensured through independent statistical analyses performed by a trained master's degree student studying speech-language pathology. No discrepancies between data analysis were found; thus, results were determined to be reliable.

Materials and Procedures

After obtaining consent from the University Institutional Review Board (IRB), flyers including a Qualtrics link to the survey were disseminated on approved websites and social media platforms for a two-month period. Due to the nature of dissemination, researchers were unable to track the total number of qualifying individuals who may have seen the survey invitation and declined to participate. The invitation included a Qualtrics link to a demographic questionnaire, and the BRIEF-2 survey immediately followed. Prior to the BRIEF-2 survey questions appearing, participants were asked if they had a child with a primary diagnosis of LD. Only survey data from those who self-reported being the parent of a child with LD were included in this current research. Further, all survey questions had to be answered in order for data to be analyzed and reported.

Survey responses were anonymous, yet still kept confidential through the secure, university-owned and faculty-operated Qualtrics account. Data were imported into SAS version 9.4 (SAS Institute Inc., 2014) for management and analysis. The BRIEF survey responses were scored according to previously published manual guidelines. Higher scores indicate that the child has *greater* problems with the behaviors. Descriptive analyses were used to understand the level of missing data, sample socio-demographics, and BRIEF scale raw scores. Means and standard deviations were reported for continuous variables while frequencies and percentages were reported for binary/categorical variables. A multivariate analysis of variance (MANOVA) was used to examine differences in the BRIEF scale raw scores between parent education, parent race, household income, parent age, child age, child diagnosis severity, presence of other child diagnoses, child ADHD diagnosis, child ASD diagnosis, and child emotional/behavioral problem diagnosis. A *p*-value < 0.05 was used to determine statistical significance.

Results

In all, 96 subjects were enrolled in this survey study. A total of 52 subjects (54.2%) did not complete any of the BRIEF questions and 1 (1.0%) completed only 33 of the 86 BRIEF questions, leaving an analytic same of 43 participants. Table 1 displays the sample characteristics. Among the parent respondents, 31 (72.1%) had at least a college degree, 33 (76.7%) were White, 40 (93%) were female, 19 (45.2%) made over $100,000, and 22 (51.2%) were between the ages of 25 and 44 years. Among the children discussed in the BRIEF questionnaire, 14 (32.6%) were between the ages of 13 and 18, 28 (70%) exhibited a mild learning disability, six (15%) represented a moderate learning disability, six (15%) demonstrated a severe learning disability; 32 (76.2%) indicated another diagnosis, with 24 (55.8%) having ADHD, 13 (30.2%) having an Autism Spectrum Disorder, and eight (18.6%) evidencing an emotional or behavioral disorder.

Table 2 displays the descriptive statistics for the BRIEF scale raw scores. There was no main effect of child age (Wilk's Lambda=0.57, $F(24, 93.41)=0.82$, $p = 0.70$). Similarly, there was no main effect of severity (Wilk's Lambda=0.72, $F(16, 60)=0.68$, $p = 0.80$), presence of another diagnosis (Wilk's Lambda=0.73, $F(8, 33)=1.56$, $p = 0.18$), household income (Wilk's Lambda=0.67, $F(16, 64)=0.89$, $p = 0.59$), parent education (Wilk's Lambda=0.58, $F(16, 66)=1.29$, $p = 0.23$), parent race (Wilk's Lambda=0.88, $F(8, 34)=0.60$, $p = 0.77$), presence of autism (Wilk's Lambda=0.84, $F(8, 34)=0.84$, $p = 0.58$), or presence of emotional/behavioral problem (Wilk's Lambda=0.75, $F(8, 34)=1.40$, p = 0.23).

There was a main effect of the presence of ADHD (Wilk's Lambda=0.60, $F(8, 34)=2.86$, $p = 0.02$). When looking at the individual components, we identified 11 key findings:

> (1) there was no difference in emotional control between children with and without ADHD (Mean (SD)=18.42 (5.47) vs. 18.63 (5.72), $F(1, 41)=0.01$, $p = 0.91$);
>
> (2) those with ADHD had elevated inhibition problems (Mean (SD) of children without ADHD=16.21 (4.89) vs. Mean (SD) of children with ADHD =19.75 (5.78), $F(1, 41)=4.53$, $p=0.04$) than those without ADHD;
>
> (3) there was no difference in shift between children with and without ADHD (Mean (SD)=15.53 (4.10) vs. 16.54 (2.95), $F(1, 41)=0.89$, $p = 0.35$);
>
> (4) there was no difference in initiation between children with and without ADHD (Mean (SD)=15.84 (3.80) vs. 17.71 (3.22), F(1, 41)=0.09, p=0.09);

(5) children with ADHD had elevated working memory problems than those without ADHD (Mean (SD) of children without ADHD=21.47 (5.23) vs. children with ADHD = 24.54 (3.90), $F(1, 41)=4.86$, $p = 0.03$);

(6) children with ADHD had elevated plan/organize problems than those without ADHD (Mean (SD) of children without ADHD=23.84 (5.63) vs. children with ADHD = 28.63 (5.03), $F(1, 41)=8.63$, $p = 0.01$);

(7) children with ADHD had elevated organization of materials problems than those without ADHD (Mean (SD) of children without ADHD=11.05 (3.94) vs. children with ADHD=14.58 (3.37), $F(1, 41)=10.02$, $p= 0.003$);

(8) there was no difference in monitor scores between children with and without ADHD (Mean (SD)=16.58 (3.92) vs. 18.08 (3.68), $F(1, 41)=1.67$, $p = 0.20$);

(9) there was no difference in behavioral regulation index between children with and without ADHD (Mean (SD)=50.16 (12.82) vs. 54.92 (13.29), $F(1, 41)=1.40$, $p = 0.24$);

(10) children with ADHD had an elevated metacognitive index than those without ADHD (Mean (SD) children without ADHD=72.95 (16.01) vs. children with ADHD = 85.83 (13.91), $F(1, 41)=7.96$, $p = 0.01$); and

(11) children with ADHD had higher total scores than those without ADHD (Mean (SD) children without ADHD=138.95 (28.21) vs. children with ADHD = 158.66 (27.14), $F(1, 41)=5.29$, $p = 0.03$).

Discussion

This survey study examines the results of the BRIEF-2 reports provided by parents of children between the ages of 11 and 18 with a primary diagnosis of LD, and some of whom had a secondary diagnosis (e.g., ADHD). This study sought to discover what relationship(s) exist between parent reports of EFs and other variables (i.e., age, severity of condition, comorbid conditions, household income, parent education, parent race, presence of autism, or presence of emotional/behavioral problem). The findings extend the extant literature in several ways.

The comorbid diagnosis of ADHD demonstrated a significant relationship to the EFs of children with LD, as reported by their parents. That is, children with LD and ADHD were reported to have greater challenges with the following EFs: (a) inhibition, (b) working memory, (c) planning/organization, (d) organization of materials, and (e) metacognition abilities. Notably, this subgroup (i.e., LD and ADHD) had higher overall total scores compared to children with LD only. These findings are significant and warrant further discussion.

Inhibition is defined as “the ability to suppress a dominant response in favor of another or no response” (van der Ven et al., 2013, p. 71). Barkley (1997) defined inhibition difficulties as a failure to: (1) delay a response for which immediate reinforcement is available, (2) stop an ongoing response, or (3) protect from competing events and responses (i.e., interference control). DeWeerdt et al. (2013) found listening recall, often used as a measure of inhibition, to be a particular deficit in students with LD. Barkley's (1997) assertion that behavioral inhibition is a core deficit associated with ADHD was backed by the findings of Willcutt et al. (2001) that behavioral inhibition deficits were strongest in students with ADHD. One example of this type of difficulty with inhibition includes rushing through academic assignments without taking time to carefully consider the instructions provided. This current study supports the importance of considering inhibition as a challenging impediment to the academic success of students with LD and underlying ADHD.

These data indicate WM issues were noticed by parents of children with ADHD and LD. By definition, WM can be described as the concurrent storage and processing of information (Baddeley, 1992; Watson & Gable, 2010). Similar to this study, research indicates students with LD can experience deficits in WM areas controlled by the phonological loop and central executive, manifesting in domain-general working memory difficulties in academics, typically in reading, mathematics, and writing (De Weerdt et al., 2013; Swanson & Siegel, 2001). However, by definition, WM involves attentional control (Martinussen & Major, 2011). Students with ADHD often exhibit higher levels of inattentive behavior when presented with tasks that place high demands on WM which, in turn, leads to poor academic performance across subjects (Martinussen & Major, 2011). Thus, DuPaul et al. (2013) suggests that while students with LD may receive interventions in one specific setting, students with comorbid LD and ADHD should receive interventions to address deficits across many settings, suggesting the critical importance of "cross-setting collaboration" (p. 48). These current findings support this assertation, as they highlight WM difficulties that have been observed by parents of students with LD and ADHD.

Planning and organization involve strategizing about how to complete a task or assignment, or a reach a goal successfully (Kaufman, 2010). For students with LD, planning and organization deficits often appear as deficits in reading comprehension, including the ability to read with a specific purpose in mind, or to answer a specific question (Kaufman, 2010). Students with LD can struggle with writing tasks that require planning and organization of a multi-step process (Graham & Harris, 1993; Watson et al., 2016). Similarly, Jacobson and Reid (2010) reported students with ADHD do not spend time planning before writing, despite being reminded to do so and provided with required components of an essay. Heavily related to planning and organization is material organization, which can be described as the hands-on, physical organization of materials necessary to carry out a plan (Kaufman, 2010). This is a deficit shared by students with LD and ADHD (Langberg et al., 2013; Meltzer & Krishnan, 2007). As the importance of planning and organizing only increases as students progress through academic courses, the need to investigate how to best support the needs of students with LD and underlying ADHD becomes of growing importance. These findings were underlined by the reports of parents who participated in this current study. Parents felt that their children had less-than-optimal planning and organization skills.

Metacognitive difficulties (i.e., deficits in awareness about thinking and regulating thinking) have been identified in students with LD, often manifesting in poor planning skills, ineffective self-monitoring of their own learning, and challenges in identifying and correcting their own errors (Mason et al., 2011). Students with ADHD have also been identified as having metacognitive difficulties that can ultimately impact their abilities to regulate behaviors and focus on tasks (Capodieci et al., 2019). Perhaps it is not surprising that when these two conditions are compounded (i.e., LD and ADHD), greater metacognitive challenges are observed in comparison to parental reports of children with LD who do not also have ADHD. Nonetheless, there is a paucity of research specifically focusing on how metacognitive deficits can be compounded in students with LD and ADHD. The importance of acknowledging this increase in metacognitive challenges for students with both LD and ADHD cannot be understated. Working with students with compounding diagnoses should be not only considered, but also adjusted for an individual student basis.

Limitations

These findings should be interpreted within the context of several limitations. First, the use of a survey tool to gather data has inherent limitations, as does the selection of what demographic questions and which survey tool is used. The BRIEF-2 Parent report is a valid and reliable means of reporting EF perceptions (BRIEF-2; Gioia et al., 2015) and administration of this tool was relevant and appropriate due to current COVID-19 global pandemic restrictions. Nonetheless, since data were self-reported, there is no guarantee that respondents provided accurate information (Wright, 2005). Secondly, sample bias is a possible limitation, since the nature of the survey may have excluded parents who do not have access to the Internet or who have difficulty reading, possibly excluding parents of students who live in rural locations, represent lower socio-economic groups, or have a reading disability (Coughlan et al., 2009). The third limitation relates to the sample size. That is, our sample was small and only included parents of children with a diagnosis of LD, or comorbid conditions that include LD. Parents of children with other disability diagnoses (e.g., intellectual disability) were not included in this investigation; thus, generalization of these current findings should be analyzed within this context. Finally, the fourth limitation centers on the variability of reported disability diagnoses. That is, some children had LD only (i.e., no reported secondary diagnosis), whereas other children had a primary diagnosis of LD as well as a secondary disability diagnosis (e.g., ADHD). Varying disability diagnoses could limit generalization of reported findings.

Implications for Research

Based on findings from this survey study, coupled with the paucity of literature related to measuring EFs in children with LD, findings suggest several implications. First, it is recommended researchers consider conducting a similar study that uses methods other than parent reports to assess EFs in children with LD. Second, researchers should utilize methods other than the internet to disseminate flyers to potential participants. Similarly, the third recommendation relates to sample size. It is recommended researchers aim to sample a larger sample to enhance generalizability of findings. The fourth recommendation for research relates to variability in disability diagnosis. In a larger-scale study, it is recommended researchers tease out disability diagnoses and do more thorough comparative analyses between subgroups of children with LD.

Implications for Practice

There is substantial research connecting EFs and LD (Alloway & Stein, 2014; Cain et al., 2004; Geary et al., 2020; Mattison & Mayes, 2012; Toll et al., 2011). The negative effects of EF weaknesses have been observed in specific academic domains, such as reading comprehension (Spencer et al., 2020), mathematics (van der Ven et al., 2012), and written language (Drijbooms et al., 2017). Conversely, different EF processes contribute to distinct academic areas.

Acknowledging that EF processes are developmental and have been associated with student academic performance is the first step to intervention. Evidence from few studies suggests that EFs are malleable and deficits in EFs can be enhanced through specific interventions (Diamond & Lee, 2011; Diamond & Ling, 2016; Espinet et al., 2013). The second and critical step is to understand how EFs, such as working memory, inhibition control, and cognitive flexibility, affect academic performance. This is essential to designing classroom instruction and to teaching students specific compensatory strategies. For example, to address poor inhibition, students should be taught self-regulation strategies within the academic area, such as the Self-Regulated Strategy Development (SRSD) for writing (Harris et al., 2008). Teaching students how to use graphic organizers (e.g., Story Mapping) can support working memory.

As mentioned earlier, DuPaul et al. (2013) suggested that while students with LD may receive interventions in one specific setting, students with comorbid LD and ADHD should receive interventions to address deficits across many settings, suggesting the critical importance of "cross-setting collaboration" (p. 48). There is, then, a critical need to understand the deficits and needs of students with LD and comorbid ADHD, not only in one area on which an IEP team and a student's teachers might focus for a student with LD in reading or in math, but across all settings. For example, students with metacognitive deficits often have difficulty distinguishing between reality versus what is not realistic (Yong & Kiong, 2005). Thus, it is more likely that a student who has difficulty with inhibition will rush through academic assignments without taking time to carefully consider the instructions provided to complete the task.

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