MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Psychology & Psychological Research International Journal
ISSN: 2576-0319

A Short Report of Parent Reports on Executive Functions

Roitsch J, Horn AL and Morin LL*

Department of Communication Disorders and Special Education, University of Nebraska-Kearney, USA

***Corresponding author:** Lisa L Morin, Department of Communication Disorders and Special Education, Old Dominion University, 116 Lion's Child Study Center Norfolk, VA 23529, USA, Email: lmorin@odu.edu

Research Article

Volume 8 Issue 1

Received Date: January 24, 2023

Published Date: March 01, 2023

DOI: 10.23880/pprij-16000322

Abstract

Results from 45 parent respondents indicated a near-significant relationship between children with intellectual disability (ID) and comorbid autism spectrum disorder (ASD) and the Behavior Rating Inventory of Executive Function (BRIEF-2; Gioia et al., 2015) scale raw scores, emotional control scale and the behavioral regulation index. The manuscript raises an important message about the necessity to better understand the executive functioning and cognitive processes in children with ID, especially those children with comorbid ASD.

Keywords: Autism Spectrum Disorder; Intellectual Disability; Behavior Rating Inventory of Executive Function; Learning; Cognitive Ability

Abbreviations: DSM: Diagnostic and Statistical Manual of Mental Disorders; ID: Intellectual Disability; IDEA: Individuals with Disabilities Education Act; ADHD: Attention Deficit Hyperactivity Disorder; ERI: Emotional Regulation Index; BRI: Behavioral Regulation Index; CRI: Cognitive Regulation Index; BRIEF: Behavior Rating Inventory of Executive Function; ASD: Autism Spectrum Disorder.

Introduction

In accordance with the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), an individual with a diagnosis of intellectual disability (ID) has deficits in intellectual (e.g., reasoning, problem solving, planning, abstract thinking, judgment), and adaptive (e.g., independent functioning, communication, social skills) functioning [1,2]. These deficits occur during the developmental period. In the United States, federal mandates, such as the Individuals with Disabilities Education Act (IDEA, 2004), ensure students with ID receive special education services [3-6]. Correspondingly, special education teachers provide individualized instruction to optimize learning and meet the unique educational, social/emotional, and behavioral needs of students with ID. To better understand success or failure in school, research has focused on a) socio-environmental, institutional and instructional variables and b) cognitive and motivational variables [7]. However, research indicates that traditional intelligence measures are not always reliable and precise, nor do they reliably capture strengths and weaknesses and of students with ID Sansone, et al. [8]. For that reason, professionals have sought other ways to determine cognitive ability in individuals with ID.

Understanding executive functions EFs helps researchers and practitioners to better understand cognitive processes and abilities overall. Although several different definitions exist, EFs are generally considered a group of skills that include working memory, inhibition, interference control, cognitive flexibility, organization, and planning [8-10]. EF deficits have been identified in students with developmental

and intellectual disorders [11], as well as in children with attention deficit hyperactivity disorder (ADHD) [12], autism spectrum disorder (ASD) [13] and language-based learning disabilities [14]. For students with ID, EF difficulties (e.g., working memory) and strengths (e.g., emotional control) have been identified, but overall results vary based on age and severity of intellectual impairment [15]. To date, few studies have sought to examine which specific EFs are related to performance and how or if variables such as age, co-morbid conditions, and other factors play a role in overall outcomes in students with ID. Thus, the nature of the relationship between EFs and the academic outcomes of students with ID remains underspecified at best. Having a better understanding of EFs in students with ID may lend insight into effective learning processes and ways to promote learning acquisition. In examining EFs, it is important to consider a) the relationship between EFs and academic performance, and 2) how other conditions (i.e, compounding or comorbid conditions) may impact performance.

One means of determining EFs involves rating scales. Self-assessments of EFs are available, yet students with ID often struggle with metacognition (i.e., the ability to think about how they are able to think and process) [16]. The accuracy of self-reporting in students with ID has come into question due to limited comprehension [17]. In other words, students with ID may overrate their competence in areas due to cognitive immaturity [18]. For these reasons, validated checklists (e.g., the BASC-2/3 have been developed to query parents and teachers on their perceptions of students' EFs, as these measures more accurately depict everyday, real-world EF abilities and deficits [19-22].

A standardized assessment commonly used to measure EFs in students is the Behavior Rating Inventory of Executive Function [23,24]. Along with a self-reporting scale for students aged 11-18, the BRIEF-2 includes a parent and a teacher report rating scale for students aged 5-18 years of age. This report, which takes about 10 minutes to complete (BRIEF-2), includes statements regarding behavior rated on a 3-point Likert scale (i.e., 1 = never; 2 = sometimes; 3 = often).

The BRIEF-2 is considered a reliable test with high internal consistency. Parent forms report coefficients ranging from .76 to .97, with index and composite scores ranging from .90 to .97 [23,24]. Specific to validity, correlations revealed moderate to strong membership, with correlation coefficients ranging from .44 to .77 for parents [23,24]. On the BRIEF-2 Parent Report form, there are 63 items divided into nine clinical scales. Specifically, they are the inhibit, self-monitor, shift, emotional control, initiate, working memory, plan/organize, task-monitor, and organization of materials. From these, three composite or index scores are derived, including the Behavioral Regulation Index (BRI), Emotional Regulation Index (ERI), and the Cognitive Regulation Index (CRI). The composite of these derived scores determine the overall Global Executive Composite (GEC) summary score. On each of the scores, a *higher* score suggests increased difficulties with EF.

BRIEF-2 clinical scales and indexes suggest T scores from 60 to 64 are considered mildly elevated, and *T*-scores from 65 to 69 are considered potentially clinically elevated. *T*-scores at or above 70 are considered clinically elevated.

In an effort to increase and improve the understanding of the role of EFs, the academic outcomes of students with ID, and the impact of different variables (e.g., comorbid conditions, age, severity of diagnosis), we focused on the reports of parents of students with ID who rated their child's EF abilities. Specifically, this study examined the results of the raw scores of the BRIEF-2 as reported by parents of children between the ages of 5 and 18 with ID. Our study addressed the following research questions: 1) What relationship (if any) exists between EFs and academic performance based on parent reports? 2) Do other co-occuring disabilitiy diagnoses (e.g., ASD) impact overall EFs and outcomes in students with ID based on parent reports? Results of this study could lend insight into which EFs may be impacting the outcomes of students with ID based on parent reports, and help determine how teachers and professionals working with students with ID can better support this population of learners.

Method

Procedures and Participants

After obtaining consent from the Institutional Review Board (IRB) at a public research institution in the southeast region of the United States, researchers posted an invitation to participate in the study on websites and social media sites for parents of students with ID. Due to restrictions in place in response to the global COVID-19 pandemic, survey dissemination used online platforms only to request participation in this research. There was no other community involvement in this work. The invitation included a weblink to demographic questions and the BRIEF-2 parent survey. Surveys were not sent directly to participants, nor were any participants asked to complete rating scales; rather, all participation was voluntary, and participant-initiated. Following the agreed-upon terms of use for the survey, the link was accessible for a two-month period. All responses were anonymous, albeit demographic information was obtained, and there was no incentive for participating.

When participants accessed the survey link, they first completed a short online demographic questionnaire before

proceeding to a second link, which navigated them to the BRIEF-2 parent questionnaire. According to data from the demographic questionnaire, all participants self-identified as a parent who had at least one child between the ages of 5 and 18 with a formal diagnosis of ID. Comorbid diagnoses in children did not exclude participation. Parents were asked to select the age of their child based on the following age categories: 5-6 7-8, 9-10, 11-12, 13-14,15-16, or 17-18 years of age, then asked to select mild, moderate, or severe intellectual disability to describe their child. Participants indicated if their child had any other co-occurring conditions or diagnoses. If they selected "yes" they were prompted to identify co-occurring disability condition(s), which included ASD, ADHD, emotional/behavioral disorder, and "other," where participants wrote in the disability diagnosis.

The participants then proceeded to complete the next section, the BRIEF-2 parent report.

Design

This study was a non-experimental research design with analysis of 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). Investigators confirmed collection and scoring accuracy; reliability was ensured via individual investigator analyses. Consistency and outcome reliability checks were completed prior to statistical analyses. Specifically, IP addresses were screened to rule-out spammed responses and confirm actual participants had responded to the survey request.

Materials and Procedures

Statistical Analysis

The BRIEF-2 survey responses were scored according to previously published manual guidelines [23,24]. Descriptive analyses were used to understand the level of missing data, sample socio-demographics, and BRIEF-2 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-2 scale raw scores between age categories, condition severity, presence of another diagnosis, presence of ADHD, and presence of ASD. A p-value < 0.05 was used to determine statistical significance.

The assumptions of MANOVA were met within this study. As there are four key assumptions associated with MANOVA (i.e., [1] multivariate normality, [2] independence, [3] equal variance, and [4] no multivariate outliers), the assumption of independence is assumed to be achieved through our sampling procedures. We posted an invitation to participate in the study on Listservs, newsletters, websites, and social media groups for parents of students with ID. It is assumed that this sampling procedure would yield a random sample of parents of students with ID. To check the assumption of multivariate normality, we examined residual plots. The residual plots did not indicate any substantial departures from multivariate normality. Additionally, MANOVA is fairly robust again departures from normality. As a result, small and moderate departures are not typically causes for great concern, suggesting that we can be confident that the requirements of this assumption are met. The assumption of equal variance can be assessed using Levene's test, as well as looking at the residual plots for patterns. The null hypothesis for Levene's test is that the groups we are comparing have equal variances. Therefore, p-values>0.05 indicate that the assumption of equal variances is met. Levene's test yielded a p-values>0.05 for all MANOVA tests we conducted, suggesting that the assumption of equal variances was also met. Lastly, the assumption of no multivariate outliers was tested using Mahalanobis distance. Observations having a Mahalanobis distance with a corresponding p-value<0.001 are considered to be extreme outliers. None of the observations in this data set met this criterion, suggesting that there were no extreme outliers. Taken together, these analyses show that the assumptions of MANOVA were met.

An a priori power analysis was conducted to determine the study's power to detect different effect sizes given a sample size of 45. Assuming 2-6 groups and 11 outcomes, a sample size of 45 gave us 30-60% power to detect an effect size of 0.25 and 8-14% power to detect an effect size of 0.1. This sample size gave us at least 80% power to detect effect sizes of .04 to 0.5.

A post hoc power analysis showed that the observed power was <20% for age, <15% for severity, <50% for presence of emotional/behavioral problems, <55% for presence of ADHD, and 5-83% for presence of ASD.

Results

Sixty-nine subjects were enrolled in the study. Thirteen subjects (18.8%) did not complete any of the BRIEF-2 questions and 11 (15.9%) ceased completion of the BRIEF-2 survey prematurely, leaving an analytic sample of 45 participants. Table 1 shows data from 13 subjects who started the BRIEF-2 but did not complete all the survey items. This table compares the socio-demographics of those who started the survey but did not complete it and those who were in the final analytic sample. Fisher Exact tests were used to compare the socio-demographics between the two groups. The groups did not significantly differ on any

of the socio-demographic variables except ADHD, ASD, and emotional/behavioral disorders. The study non-completers were less likely than the final study sample to have these disorders. Table 2 displays the sample characteristics. Table 3 shows the correlation matrix, with a *p*-value < 0.05 used to determine statistical significance.

Socio-demographic	Final Study Sample n (%)	Study Non-completers n (%)	p
N	45	13	
Parent education level			0.13
Associate degree	3 (6.7)	3 (23.1)	
Bachelor's degree	16 (35.6)	2 (15.4)	
High school graduate or GED	7 (15.6)	1 (7.7)	
Master's degree	14 (31.1)	3 (23.1)	
Some college	5 (11.1)	4 (30.8)	
Parent Race			0.99
Asian	1 (2.2)	0 (0)	
Black or African American	10 (22.2)	3 (23.1)	
Hispanic	2 (4.4)	0 (0)	
Other	1 (2.2)	0 (0)	
White	31 (68.9)	10 (76.9)	
Parent Sex			0.21
Female	43 (95.6)	11 (84.6)	
Male	2 (4.4)	2 (15.4)	
Parent or Family? Income			0.3
<$10,000	2 (4.4)	0 (0)	
$10,000-19,999	1 (2.2)	0 (0)	
$20,000-29,999	4 (8.9)	2 (15.4)	
$30,000-39,999	1 (2.2)	3 (23.1)	
$40,000-49,999	3 (6.7)	0 (0)	
$50,000-59,999	5 (11.1)	1 (7.7)	
$60,000-69,999	3 (6.7)	1 (7.7)	
$70,000-79,999	5 (11.1)	0 (0)	
$80,000-89,999	2 (4.4)	0 (0)	
$90,000-99,999	4 (8.9)	0 (0)	
$100,000-149,999	10 (22.2)	2 (15.4)	
>$150,000	5 (11.1)	4 (30.8)	
Parent age			0.15
25-34 years	4 (8.9)	3 (23.1)	
35-44 years	19 (42.2)	2 (15.4)	
45-54 years	16 (35.6)	5 (38.5)	
55-64 years	4 (8.9)	3 (23.1)	
≥ 65 years	2 (4.4)	0 (0)	

Child age			0.7
5-6 years	7 (15.9)	3 (25.0)	
7-8 years	3 (6.8)	0 (0)	
9-10 years	8 (18.2)	1 (8.3)	
11-12 years	1 (2.3)	0 (0)	
13-14 years	6 (13.6)	3 (25.0)	
15-16 years	13 (29.6)	2 (16.7)	
17-18 years	6 (13.6)	3 (25.0)	
Severity			0.99
Mild intellectual disability	17 (38.6)	5 (41.7)	
Moderate intellectual disability	23 (52.3)	6 (50.0)	
Severe intellectual disability	4 (9.1)	1 (8.3)	
Another diagnosis	38 (84.4)	8 (72.7)	0.39
ADHD	29 (64.4)	2 (8.3)	<0.0001
Autism spectrum disorder	29 (64.4)	5 (20.8)	0.0009
Emotional/behavioral disorder	10 (22.2)	0 (0)	0.01

Table 1: Comparison of those who responded to the study advertisements and those who were in the final analytic sample.

Sociodemographic Characteristics of Participants (Parents of Children with ID).

Sociodemographic Information		
	n	**%**
Parent level of education		
High school graduate or GED	7	16
Some college	5	11
Associate degree	3	7
Bachelor's degree	16	36
Master's degree	14	31
Race		
Asian	1	2
Black or African American	10	22
Hispanic	2	4
White	31	69
Other	1	2
Sex		
Female	43	96
Male	2	4
Income		
< $10,000	2	4
$10,000-19,999	1	2
$20,000-29,999	4	9
$30,000-39,999	1	2

$40,000-49,999	3	7
$50,000-59,999	5	11
$60,000-69,999	3	7
$70,000-79,999	5	11
$80,000-89,999	2	4
$90,000-99,999	4	9
$100,000-149,999	10	22
> $150,000	5	11
Parent age		
25-34 years	4	9
35-44 years	19	42
45-54 years	16	36
55-64 years	4	9
65 years or older	2	4
Child age		
5-6 years	7	16
7-8 years	3	7
9-10 years	8	18
11-12 years	1	2
13-14 years	6	14
15-16 years	13	30
17-18 years	6	14
Intellectual disability diagnosis		
Mild intellectual disability	17	39
Moderate intellectual disability	23	52
Severe intellectual disability	4	9
Secondary disability diagnosis		
Attention deficit hyperactivity disorder	29	64
Autism spectrum disorder	29	64
Emotional disturbance	10	22
None		

Table 2: Sociodemographic characteristics of participants (parents of Children with ID).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Socio-demographics																						
Education	1																					
Race	0.08	1																				
Sex	-0	-0.1	1																			
Income	0.34*	0.31*	-0	1																		
Parent Age	-0.1	0.18	0	0.27	1																	
Child Age	-0.30*	0.30*	0.02	0.27	0.46*	1																
Severity	-0.1	-0.1	-0.3	-0.23	-0.24	-0.1	1															

Other diagnosis	0.04	0.41*	0.09	0.03	0.15	0.28	-0	1														
Emotional/ behavioral Disorder	-0.41*	-0.3	0.14	-0.18	-0.09	0.07	-0	-0.1	1													
ADHD	-0.1	0.07	-0.1	0.22	0.19	-0	-0.4	0.19	0.17	1												
Autism	0.04	0.13	0.16	-0.21	-0.24	0.06	-0.1	0.45	-0.05	0.03	1											
BRIEF-2 Scores																						
Emotional Control	0.08	-0.2	-0	-0.24	-0.23	-0.1	-0.1	0.11	0.30*	0.15	0.34*	1										
Inhibit	-0.1	0.03	-0.1	-0.40*	-0.19	-0.1	0.11	-0.1	0.01	-0	0.22	0.60*	1									
Shift	-0.1	-0.1	0	-0.21	-0.13	0.1	-0.1	0.2	0.19	0.08	0.39*	0.68*	0.55*	1								
Initiate	-0.1	-0.1	-0.1	-0.03	0.15	-0.1	-0.1	0.13	0.19	0.26	-0.01	0.42*	0.28	0.38*	1							
Working Memory	0.03	0.05	-0.2	0.1	0.11	-0.2	0.1	-0	-0.21	0.17	-0.09	0.11	0.34*	0.2	0.55*	1						
Plan/ organize	0.01	0.05	-0.2	-0.01	0.05	0.09	-0.3	0	-0.01	0.09	0.06	0.49*	0.65*	0.56*	0.64*	0.56*	1					
Organization of materials	-0.1	0.26	-0.2	-0.04	-0.01	-0	-0.1	0.16	0.04	0.15	0.2	0.33*	0.45*	0.37*	0.48*	0.45*	0.59*	1				
Monitor	0.13	0.15	-0	0.02	0.02	0.15	-0.1	0.11	0.04	-0.1	0.11	0.21	0.34*	0.32*	0.47*	0.25	0.50*	0.24	1			
Behavioral regulation index	0	-0.1	-0	-0.31*	-0.2	-0.1	-0	0.08	0.18	0.07	0.32	0.88*	0.86*	0.82*	0.42*	0.27	0.67*	0.44*	0.32*	1		
Metacognitive index	0.05	0.11	-0.2	0	0.08	-0	-0.1	0.04	-0.09	0.13	0.06	0.36*	0.57*	0.46*	0.71*	0.80*	0.87*	0.72*	0.54*	0.54*	1	
Total Score	0.02	-0	-0.1	-0.17	-0.07	-0.1	-0.1	0.06	0.08	0.12	0.19	0.71*	0.79*	0.71*	0.70*	0.61*	0.87*	0.66*	0.48*	0.86*	0.87*	1

* $p<0.05$

Table 3: Correlation matrix for study variables.

Behavior Rating Inventory of Executive Function-2 Scale Raw Score Summary Statistics.

Variable				
	Mean	**SD**	**Minimum**	**Maximum**
Emotional control	21.9	5	10	29
Inhibit	23.2	5	10	30
Shift	18.8	4	9	24
Initiate	18.8	3	12	24
Working memory	24.2	4	15	30
Plan/organize	29.5	5	17	36
Organization of materials	14.3	3	6	18
Monitor	20.5	3	13	24
Behavior regulation index	63.9	12	39	83
Metacognitive index	88.5	12	61	107

Table 4: displays the descriptive statistics for the BRIEF-2 scale raw scores. MANOVA showed that there was a borderline significant main effect of ASD on the BRIEF-2 scale raw scores (Wilks' Lambda = 0.68, $F(8, 36) = 2.09$, $p = 0.06$). Post hoc comparisons showed that those with ASD had higher scores on the emotional control scale ($M = 23.2$ vs. $M = 19.5$, $F = 7.82$, $p = 0.01$), the shift scale ($M = 19.9$ vs. $M = 16.8$, $F = 8.78$, $p = 0.01$), and behavioral regulation index ($M = 67.2$ vs. $M = 58.0$, $F = 7.62$, $p = 0.01$). There was no main effect of age, severity, presence of another diagnosis, presence of ADHD, or presence of emotional/ behavioral problem.

Comparis*ons* of socio-demographic variables between *the ID and ID + ASD groups.*

Socio-demographic	ID n (%)	ID + Autism n(%)	*P*
N	16	29	-
Parent education level			0.13
Associate degree	0 (0)	3 (10.3)	
Bachelor's degree	8 (50.0)	8 (27.6)	
High school graduate or GED	4 (25.0)	3 (10.3)	
Master's degree	4 (25.0)	10 (34.5)	
Some college	0 (0)	5 (17.2)	
Parent Race			0.65
Asian	0 (0)	1 (3.5)	
Black or African American	5 (31.3)	5 (17.2)	
Hispanic	1 (6.3)	1 (3.5)	
Other	0 (0)	1 (3.5)	
White	10 (62.5)	21 (72.4)	
Parent Sex			0.53
Female	16 (100)	27 (93.1)	
Male	0 (0)	2 (6.9)	
Parent or Family Income			0.55
<$10,000	1 (6.3)	1 (3.5)	
$10,000-19,999	0 (0)	1 (3.5)	
$20,000-29,999	2 (12.5)	2 (6.9)	
$30,000-39,999	1 (6.3)	0 (0)	
$40,000-49,999	0 (0)	3 (10.3)	
$50,000-59,999	0 (0)	5 (17.2)	
$60,000-69,999	1 (6.3)	2 (6.9)	
$70,000-79,999	1 (6.3)	4 (13.8)	
$80,000-89,999	1 (6.3)	1 (3.5)	
$90,000-99,999	2 (12.5)	2 (6.9)	
$100,000-149,999	4 (25.0)	6 (20.7)	
>$150,000	3 (18.8)	2 (6.9)	
Parent age			0.44
25-34 years	1 (6.3)	3 (10.3)	
35-44 years	5 (31.3)	14 (48.3)	
45-54 years	6 (37.5)	10 (34.5)	
55-64 years	3 (18.8)	1 (3.5)	
≥ 65 years	1 (6.3)	1 (3.5)	

Child age			0.33
5-6 years	3 (20)	4 (13.8)	
7-8 years	0 (0)	3 (10.3)	
9-10 years	3 (20)	5 (17.2)	
11-12 years	0 (0)	1 (3.5)	
13-14 years	3 (20)	3 (10.3)	
15-16 years	6 (40)	7 (24.1)	
17-18 years	0 (0)	6 (20.7)	
Severity			0.72
Mild intellectual disability	5 (31.3)	12 (42.9)	
Moderate intellectual disability	9 (56.3)	14 (50)	
Severe intellectual disability	2 (12.5)	2 (7.1)	
Another diagnosis	10 (62.5)	28 (96.6)	0.005
ADHD	10 (62.5)	19 (65.5)	0.99
Emotional/behavioral disorder	4 (25)	6 (20.7)	0.73

Table 5: depicts comparative socio-demographic variables between the ID students and ID + ASD students using Fisher Exact tests in order to control for how similar or dissimilar the groups were and how that could impact our initial results. The ID + Autism group was more likely to have another diagnosis; however, the groups did not significantly differ on any of the other socio-demographic variables.

Discussion

Although no statistical significance was noted at the $p = .05$ level when the variables included in this study were correlated, the near-significant effect noted in the parent reports of students with ID who had a co-morbid ASD diagnosis on the Emotional Control Scale, the Shift Scale, and the Behavior Regulation Index warrants further discussion.

The Emotional Control Scale of the parent version of BRIEF-2 asks parents to report how well the student can regulate their emotional responses. Based on the results reported by participants, it could be suggested that emotional management in students with ID and ASD is a significant concern for parents and may overshadow abilities or challenges. In the literature, researchers have found that social-emotional interventions have shown to benefit outcomes in students with ASD [25].

In the BRIEF-2, the Shift Scale reports by parents of students with ID and ASD in this study indicate their children demonstrated more difficulty moving from one task to the other, and that students demonstrated a tendency to perseverate or resist change. Lastly, as parents of children with ID and ASD in this study reported greater behavior regulation difficulties for their students than parents of other children with ID, investigating how much influence lack of inhibition and poor self-monitoring have on academic outcomes and performance in these students should be further examined.

Our work supports the findings of other researchers investigating EFs in students with ASD and ID. In their systematic review of 26 studies investigating the EFs in children with ASD + ADHD and ASD + ID, Benallie, et al. [26] reported children with ASD + ID demonstrated difficulties in planning and organizing, flexibility and shifting, attention, behavior regulation, and overall global EF skills. Thus, although it has been reported by parents that students with ASD demonstrate elevated levels of difficulty in the shift scales on the BRIEF [27,28] and BRIEF-2 [29] our results shed novel insight into the potential interactions of ASD with underlying ID.

From a practical standpoint, it is important that educators recognize the multifactored influences that children with ID may encounter. The determination of ID in a student may shed light on the intellectual needs and supports required for that student. Yet the presence of co-occurring diagnoses such as ASD and the challenges of EF skills warrant much consideration. Indeed, for the student with ID and ASD, unlocking areas of opportunities as well as strengths promotes optimal individualized planning within the classroom and in community settings.

Limitations

Although we did our best to control for variables and optimize data for analysis, certain inherent limitations of this study should be acknowledged. First, due to sample size and the categorical nature of our independent variables, we were

unable to estimate MANCOVA (i.e., multivariate analysis of covariance) models. However, despite these limitations, the lack of significance for age, severity, presence of emotional/behavioral problems, and presence of ADHD should not be viewed as an indication that no relationship exists. While our study did not provide evidence for such relationships, we agree that this is something that should be examined further in a larger study, and they should continue to be studied using other larger samples. In addition, and probably the most limiting revelation was that we were not able to calculate *T*-scores for this sample of participants as we did not request for parents to identify their child's gender on the demographic form, which prevented us from determining clinically elevated scores. In addition, there were several participants who did not complete the BRIEF-2. We have data on 13 participants who started the BRIEF-2 but did not complete all the survey items. Fisher Exact tests were used to compare the socio-demographics between the two groups. The groups did not significantly differ on any of the socio-demographic variables except ADHD, ASD and emotional/behavioral disorders. The study non-completers were less likely than the final study sample to have these disorders, and this is an area that could be further investigated. Lastly, the nature of a parent self-report survey has certain limitations as well. Further investigation into the comparison of actual EF testing with the perceptions of EF abilities would provide greater insight into this population.

Conclusion

This manuscript raises an important message about the necessity to consider and work to better understand the executive functioning and cognitive processes in children with intellectual disability. What the results suggest is that parents whose children have been diagnosed with both ID and ASD are likely to rate their children's emotional control to be somewhat lower relative to all other parent groups. This is important information for educators and clinical professionals as they move forward working with this unique population of individuals.

References

1. (2013) American Psychiatric Association. Diagnostic and statistical manual of mental disorders 5th (Edn.).

2. Bergeron R, Floyd R, Vanderwood M (2013) Individual part score profiles of children with intellectual disability: A descriptive analysis across three intelligence tests. School Psychology Review 42(1): 22-38.

3. Behavior Rating Inventory of Executive Function®, Second Edition (BRIEF®2).

4. Hartman E, Houwen S, Scherder E, Visscher C (2010) On the relationship between motor performance and executive functioning in children with intellectual disabilities. J Intellect Disabil Res 54(5): 468-477.

5. McIntyre L, Blacher J, Baker B (2006) The transition to school: Adaptation in young children with and without intellectual disability. J Intellect Disabil Res 50(5): 349-361.

6. Peters Scheffer N, Didden R, Sigafoos J, Green VA, Korzilius H (2013) Behavioral flexibility in children with autism spectrum disorder and intellectual disability. Research in Autism Spectrum Disorders 7(6): 699-709.

7. Test DW, Mazzotti VL, Mustian AL, Fowler CH, Kortering L, et al. (2009) Evidence-based secondary transition predictors for improving postschool outcomes for students with disabilities. Career Development and Transition for Exceptional Individuals 32(3): 160-181.

8. Vermunt JD, Endedijk MD (2011) Patterns in teacher learning in different phases of the professional career. Learning and Individual. Differences 21(3): 294-302.

9. Sansone SM, Schneider A, Bickel E, Berry Kravis E, Prescott C, et al. (2014) Improving IQ measurement intellectual disabilities using true deviation from population norms. J Neurodev Disord 6(1): 1-14.

10. Diamond A (2013) Executive functions. Annu Rev Psychol 64: 135-168.

11. Nigg J, John O, Blaskey L, Huang-Pollock C, Willcutt E, et al. (2002) Big five dimensions and ADHD symptoms: Links between personality traits and clinical symptoms. J Pers Soc Psychol 83(2): 451-469.

12. Pennington BF, Ozonoff S (1996) Executive functions and developmental psychopathology . J Child Psychol Psychiatr 37(1): 51-87.

13. Castellanos FX, Sonuga Barke EJ, Milham MP, Tannock R (2006) Characterizing cognition in ADHD: Beyond executive dysfunction. Trends Cogn Sci 10(3): 117-123.

14. Craig F, Margari F, Legrottaglie AR, Palumbi R, de Giambattista C, et al. (2016) A review of executive function deficits in autism spectrum disorder and attention-deficit/hyperactivity disorder. Neuropsychiatr Dis Treat 12: 1191-1202.

15. Peng P, Fuchs D (2016) A meta-analysis of working memory deficits in children with learning difficulties: Is there a difference between verbal domain and numerical domain?. J Learn Disabil 49(1): 3-20.

16. Loveall SJ, Conners FA, Tungate AS, Hahn LJ, Osso TD

(2017) A cross-sectional analysis of executive function in Down syndrome from 2 to 35 years. J Intellect Disabil Res 61(9): 877-887.

17. Nader Grosbois N (2014) Self-perception, self-regulation and metacognition in adolescents with intellectual disability. Res Dev Disabil 35(6): 334-1348.

18. Emerson E, Felce D, Stancliffe RJ (2013) Issues concerning self-report data and population-based data sets involving people with intellectual disabilities. Intellect Dev Disabil 51(5): 333-348.

19. Priel B, Leshem T (1990) Self-perception of first and second grade children with learning disabilities. J Learn Disabil 23(10): 637-42.

20. Reynolds CR, Kamphaus RW (2004) BASC-2: Behavior Assessment System for Children: Second Edition, manual. Bloomington, MN: Pearson Assessments.

21. Reynolds CR, Kamphaus RW (2015) BASC-3: Behavior Assessment System for Children. Bloomington, MN: Pearson.

22. Muris P, Van der Pennen E, Sigmond R, Mayer B (2008) Symptoms of anxiety, depression, and aggression in non-clinical children: Relationships with self-report and performance-based measures of attention and effortful control. Child Psychiatry Hum Dev 39(4): 455-467.

23. Toplak ME, Bucciarelli SM, Jain U, Tannock R (2008) Executive functions: performance-based measures and the Behavior Rating Inventory of Executive Function (BRIEF) in adolescents with attention deficit/ hyperactivity disorder (ADHD). Child Neuropsychol 15(1): 53-72.

24. Gioia GA, Isquth PK, Guy SC, Kenworthy L (2015) Behavior Rating Inventory of Executive Function, Second Edition Professional Manual. PAR.

25. Ratcliffe B, Wong M, Dossetor D, Hayes S (2014) Teaching social–emotional skills to school-aged children with Autism Spectrum Disorder: A treatment versus control trial in 41 mainstream schools. Research in Autism Spectrum Disorders 8(12): 1722-1733.

26. Benallie KJ, McClain MB, Bakner KE, Roanhorse T, Ha J (2021) Executive functioning in children with ASD+ ADHD and ASD+ ID: A systematic review. Research in Autism Spectrum Disorders 86.

27. Gioia GA, Isquith PK, Kenworthy L, Barton RM (2002) Profiles of everyday executive function in acquired and developmental disorders. Child Neuropsycho 8(2): 121-137.

28. Granader Y, Wallace GL, Hardy KK, Yerys BE, Lawson, et al. (2014) Characterizing the factor structure of parent reported executive function in autism spectrum disorders: The impact of cognitive inflexibility. J Autism Dev Disord *44*(12): 3056-3062.

29. Granader Y, Isquith P, Dudley R, Kenworthy L (2015) Updated BRIEF profiles in children with autism spectrum disorders. Poster presented at the 43rd Annual International Neuropsychology Society Meeting Denver CO.