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Adding the missing voice: How autistic youth self-report on an executive functioning rating scale compares to parent report and that of youth with ADHD or neurotypical development

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Lay

Executive functions are often impaired in autistic people and relate to important outcomes such as mental health, success in school and work, and quality of life. Evaluating executive functions helps autistic people, clinicians and families identify targets for external supports and skill building. Youth self-report of executive function has not been studied, yet we know that self-report from autistic youth is key to understanding other cognitive/behavioral phenomena in autism such as anxiety, obsessions/compulsions, sensory sensitivities and repetitive behaviors. We investigated self- and parent-report of executive function problems in 197 autistic youth without intellectual disability (ages 11–18 years), including the magnitude and profiles of executive function problems autistic youth report across subdomains of EF. We compared autistic self-report with that of 114 youth with ADHD without intellectual disability and 197 neurotypical youth. We found that autistic youth report significant executive function problems compared to neurotypical youth and a distinctive profile of challenges in comparison to ADHD youth. Parents and their autistic children diverged regarding the magnitude of the youth's EF difficulties, but both identify inflexibility as the most impaired EF subdomain. Autistic youth and their parents were somewhat more concordant in their report of executive function problems than youth with ADHD and their parents, but only showed moderate concordance at best. These findings elevate the importance of asking autistic youth directly about their executive functioning when engaging them in assessment and intervention, or researching executive functions in autism.

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Scientific Abstract

Executive functions (EF) are related to key outcomes. Studies of autistic youth self-report of other nonsocial traits indicate that their insights into their own functioning and internal experiences provide important information that is not captured by their parents' report, but youth self-report of EF has not been researched in autism. We investigate self- and parent-report on the Behavior Rating Inventory of Executive Function-2 (BRIEF-2) in 197 autistic youth without intellectual disability, including the magnitude and profile of problems reported across subdomains of EF. We also compare autistic self-report to that of 114 youth with ADHD and 197 neurotypical (NT) youth. We find that autistic youth report significant EF challenges in comparison to NT youth and a distinctive profile of challenges in comparison to ADHD youth. Parents and their autistic children diverge regarding the severity of the youth's EF difficulties, but both emphasize flexibility problems within their profile of EF challenges. Intraclass correlation coefficients between parent and youth ratings were moderate-poor in the autistic group, indicating that autistic youth report adds important information beyond that captured by their parents' report. These data elevate the importance of asking autistic youth directly about their own EF.

Keywords

Autism; Executive Function; Youth; Self-report; ADHD; Parent-report; Psychometrics

Executive function (EF) is an umbrella term for a set of self-regulatory abilities that include inhibition, flexibility and working memory (Miyake & Friedman, 2000). Impairment in EF is common in autistic people (Hill, 2004; Kenworthy et al., 2008), related to key outcomes (Hume et al., 2009), and responsive to external supports (Schopler et al., 1995) and skill building (Kenworthy et al., 2014). There is extensive research documenting EF challenges in autism using cognitive tasks and questionnaires completed by parents, or, in a few studies, by autistic adults. However, self-report regarding EF has not been investigated in autistic youth even though it has been demonstrated to be essential for a full understanding of symptoms of anxiety, obsessive compulsive disorder, sensory sensitivities and repetitive behaviors in autism (Blakeley-Smith et al., 2012; Keith et al., 2018; Santore et al., 2020). Asking autistic youth about their own EF challenges is important for a complete understanding of EF in autism. It can also increase self-understanding and motivation to build EF and self-advocacy skills in autistic youth, for whom motivation is a moderator of treatment response (Kim et al., 2019), as is the case for most people (De Nadai et al., 2017).

Several decades of research have established that EF, especially the flexibility subdomain of EF, is often impaired in autism (Hill, 2004; Kenworthy et al., 2008). Recent meta-analyses confirm global EF problems (Demetriou et al., 2017) as well as specific impairment in flexibility (Landry & Al-Taie, 2016). Evidence from a large factor analytic study of parent-reported EF problems in autistic children identifies flexibility as a key driver of EF problems in multiple subdomains (Granader et al., 2014), introducing the possibility that flexibility challenges are pivotal in their EF profile of global deficits (Craig et al., 2016). EF challenges, and specifically inflexibility, are central to the daily struggles of autistic people in many domains of functioning, including: academic learning (St. John et al., 2018), social abilities (Faja et al., 2016; Pellicano, 2013; Berger et al., 2003; Szatmari et al., 1989),

adaptive skills (Pugliese et al., 2015, 2016) and quality of life (Dijkhuis et al., 2017). The potency of EF challenges in autistic people's lives is also evidenced in its contribution to co-occurring psychiatric symptoms in people in general (Snyder et al., 2015) and in autistic people in particular (Hollocks et al., 2014; Zimmerman et al., 2017; Wallace et al., 2016; Lawson et al., 2015). Important new work has also identified that EF abilities, along with general intelligence and anxiety, allow some autistic people to compensate or match other's expectations in social situations (Livingston et al., 2019).

Informant and self-report on questionnaires play a special role in the assessment of EF, which is most evident in unstructured, unpredictable, real-world settings, and is therefore difficult to capture with many laboratory tasks (Burgess et al., 2006; Toplak et al., 2013). In the case of autism, Leung and Zakzanis (2014) conducted a quantitative review of 72 studies and found that: (1) autistic individuals without intellectual disability demonstrated variability in the magnitude of EF impairment depending on the type of assessment measure and (2) parent-report and adult self-report of inflexibility robustly discriminated between autistic and NT individuals. We are aware of three recent studies of autistic adults' self-report of their EF. They demonstrate the validity of autistic self-report in a variety of ways. Autistic adults report EF challenges that correlate with white matter abnormalities (Ikuta et al., 2014), and with their own performance on EF tasks (Davids et al., 2016). Autistic adults also self-report a similar pattern of EF problems across subdomains as is reported by parents of their autistic children (Dijkhuis et al., 2017).

The accuracy of autistic youth report has been questioned, however, based on arguments related to difficulty engaging in introspection and identifying and expressing emotions (Baron-Cohen, 2000), and a lack of full concordance with parent report (Mazefsky et al., 2011). Nevertheless, other investigations have documented good agreement between autistic adolescents and their parents regarding their anxiety symptoms (Farrugia & Hudson, 2006; Blakeley-Smith et al., 2012). More importantly, youth report has been validated through correlation with biological markers. For example, autistic adolescents without intellectual disability self-reported anxiety and auditory hypersensitivity that was significantly related to their autonomic arousal at rest and autonomic reactivity during a noise task, respectively. These relationships were not significant for parent-report (Keith, Jamieson, & Bennetto, 2019). Santore and colleagues (2020) report that autistic youth are better than their parents or clinicians at differentiating their restricted and repetitive behaviors from symptoms of obsessive-compulsive disorder, providing further indication that, especially when investigating internal experiences, youth report is not only helpful, but essential for understanding autism, as it is in other conditions (De Los Reyes et al., 2015).

Youth self-report of EF could inform research and treatment in several different ways: it could confirm adult self-report and data from performance tasks that indicate EF, and specifically flexibility, problems in autism; or it could provide evidence of a unique perspective regarding EF challenges from autistic youth, which in turn might inform treatment and future research questions. Low correspondence between informant and child self-report is common across conditions and may reflect differences in: developing cognitive abilities and/or differences in the contexts in which the reporters are drawing their conclusions (see reviews Kaurin et al., 2016; De Los Reyes et al., 2015). The identification

of the specific contexts or reporters that reveal EF deficits can inform targeted treatment (De Los Reyes, 2013).

Therefore, we document the pattern of challenges across EF subdomains self-reported by autistic youth for the first time. We investigate parent and self-report on the Behavior Rating Inventory of Executive Function-2 (BRIEF-2) in youth with autism, and compare it to parent report on and self-ratings by NT youth and youth with ADHD, another neurodevelopmental condition associated with EF problems, particularly disinhibition, and poor working memory and planning (e.g., Gioia et al., 2002). We address the following questions: 1) Do autistic youth report more EF problems than NT youth and a distinctive pattern of problems across BRIEF-2 subdomains in comparison to ADHD youth? 2) Are self- and parent-reported patterns of BRIEF-2 subdomain scores similar within the autism and ADHD groups? 3) Are the youth and parent scores concordant at the Scale and Index level in each of the groups? 4) Do youth and parents report EF problems of significantly different magnitude? We expect autistic youth to report more EF challenges than NT youth. We also predict that autistic youth will describe a distinct profile within EF subdomains that emphasizes inflexibility, as represented by higher scores on the BRIEF-2 Shift scale, than reported by either NT or ADHD youth. We expect modest concordance between youth self and parent report in both autism and ADHD.

Methods

Archival data from youth with autism or ADHD who were evaluated for clinical purposes in the Children's National Neuropsychology Division were analyzed in compliance with standards established by the Children's Research Institute Institutional Review Board (CRI-IRB). Under two protocols (00007028 and 00010507), the CRI-IRB has waived the requirement for informed consent in favor of notification with the opportunity to opt out of inclusion in research databases collected in Children's National Neuropsychology Division clinics, for use in a deidentified fashion. Additionally, baseline archival data from two intervention studies were included in the sample of autistic youth (CRI-IRB protocols 00006140 and 00007377). NT participants were drawn from the deidentified normative database created during the development of the BRIEF-2 by Psychological Assessment Resources, Inc.

Participants

Participants were: 197 autistic youth (54 female), 114 youth with ADHD (45 female) and 197 NT youth. NT youth were selected to match the autistic youth for gender (also 54 female) and age (within one year and within the same BRIEF normative age range (11–13 or 14–18)). Participants were included in this investigation if: they and their parents completed BRIEF or BRIEF-2 self- and parent-report forms at the same time (although the forms were occasionally completed several weeks apart, parents and youth were directed to reflect on the prior 6 months when responding per BRIEF/BRIEF-2 standardization), were 11–18 years old, and did not have a medical condition with known impact on the brain (i.e., brain tumor, cancer, central nervous system infection, demyelinating disease, epilepsy, hydrocephalus, leukemia, sickle cell disease, traumatic brain injury). All participants with

autism or ADHD met DSM-5 criteria for a primary diagnosis of autism or ADHD following a cognitive and behavioral assessment by an experienced psychologist with expertise in diagnostic procedures for developmental disabilities. Autistic and ADHD participants were also required to have a full scale IQ (FSIQ)>70, as evaluated with: Wechsler Abbreviated Scale of Intelligence, version I and II; Wechsler Intelligence Scale for Children, versions IV and V (Wechsler, 1999; Wechsler & Zhou, 2011; Wechsler, 2003; Wechsler, 2014). Full-Scale IQ scores were not significantly different between the autistic (range: 71–142) and ADHD (range: 74–141) youth. Autism diagnosis was informed by the Autism Diagnostic Interview (ADI) or Autism Diagnostic Interview-Revised (ADI-R; Le Couteur et al., 1989; Rutter et al., 2003) and/or the first or second edition of the Autism Diagnostic Observation Schedule (ADOS, ADOS-2; Lord et al., 2000, 2012) in 124 of the autistic participants. IQ data were not collected for the NT sample. See Table 1 for demographics.

Measures

Behavior Rating Inventory of Executive Function, Parent and Self-Report Forms—(BRIEF; BRIEF-2; Gioia et al., 2000; Guy et al., 2004, Gioia et al., 2015). The BRIEF/BRIEF-2 assess behavioral manifestation of EF problems in children through parent or youth self-report questionnaires. The BRIEF/BRIEF-2 has good reliability (e.g., mean BRIEF-2 parent and self-report form test-retest correlation coefficients=.79 and .74 respectively) and validity, as supported by factor analyses within the BRIEF and convergence with other rating scales and laboratory tests (see Gioia et al., 2015, Chapter 6). For the purposes of this study, all data collected on the original BRIEF was transformed into BRIEF-2 scores. The BRIEF-2 parent and self-report forms contain a subset of the total items contained in the BRIEF (BRIEF-2 parent=63 of original 86 items and BRIEF-2 self-report=55 of original 80 items). BRIEF data was transformed into BRIEF-2 data by removing items not included in the BRIEF-2 and recalculating scale and index scores using the BRIEF-2 normative data. BRIEF-2 scores include the Global Executive Composite (GEC), which is divided into three indices, Behavioral Regulation (BRI), Emotion Regulation (ERI) and Cognitive Regulation (MCI). Each index is further divided into scales, which are slightly different for the parent and self-report forms. The two forms have the following scales in common: Inhibit and Self-Monitor scales, which make up the BRI; Shift and Emotional Control, which make up the ERI; and Working Memory and Plan/Organize, which make up part of the CRI. Scores are reported as T-scores, with higher scores indicating more problems and scores ≥65 falling in the *suspected clinically elevated range.*

***Diagnostic and Statistical Manual of Mental Disorders-IV Attention Deficit Hyperactivity Disorder Rating Scale-Parent Edition* (DSM-IV; ADHD rating scale).—**The ADHD Rating Scale (DuPaul, Power, Anastopoulos, & Reid, 1998) assesses inattention and hyperactivity/impulsivity symptoms. This 18-question scale yields two domains: Inattention and Hyperactivity/Impulsivity. Six or more significant symptoms in either the Inattention or Hyperactivity/Impulsivity domains is the cut-off criteria for ADHD diagnosis. The ADHD Rating Scale informed diagnosis of ADHD and also allows comparison of ADHD symptoms in the ADHD and autism groups where available.

Data Analytic Plan

Analyses were conducted using IBM SPSS Statistics, Version 26. Independent sample t-tests and chi-square analyses, as appropriate, were conducted to evaluate differences in age, gender, FSIQ and ADHD symptoms between the autism and ADHD groups, but not the NT and autism groups, as they were matched *a priori* (see above) for gender and age within one year, and there was no data available on IQ or ADHD symptoms in the NT sample.

Within the autism group, baseline data from a subset of participants taking part in a school based treatment trial (n=84) were included in this study. The remainder of participants in the autism group, and all participants in the ADHD group were referred to a children's hospital for clinical assessment. To assess for potential recruitment bias, mean scores on the BRIEF self- and parent-report for the community treatment versus assessment groups were compared using independent sample t-tests. Parent-report means were not significantly different across scales and indexes (p-values ≥.13), nor were self-report means, with the exception of the Shift scale (p=.01) and the Emotion Regulation Index (p=.04). In both cases, the autistic youth in the community trial reported more problems. However, it is important to note that p-values were not adjusted for the multiple comparisons made, the effect size of the differences between the mean scores were small (Cohen's d <.39), and the pattern of relative problems across the scales is the same, with the greatest problems reported by the youth in both the assessment and community treatment groups on the Shift scale.

We investigated each of our primary questions with the following statistical approaches:

1. Do autistic youth report more EF problems than NT youth and a distinctive pattern of problems across BRIEF-2 subdomains in comparison to ADHD youth? And
2. ***Is the pattern of self- and parent-reported BRIEF scale scores similar within autism and within ADHD?*** Patterns of BRIEF scale scores were compared across reporters (parent and self) and diagnostic groups (autism, ADHD or NT) in one omnibus mixed model repeated measures ANOVA in order to be parsimonious in our analytic approach. Where Mauchly's Test of Sphericity was significant, the Greenhouse-Geisser statistic was interpreted. Post hoc tests were performed to probe significant interactions and focused on addressing these *a priori* questions.
3. ***Are the youth and parent scores concordant at the Scale and Index level in each diagnostic group?*** In order to evaluate concordance between youth self- and parent-report in the autism as compared to ADHD and NT groups, intraclass correlations (ICC) were calculated for each group between parent- and self-report on the BRIEF Scale, Index and the Global Executive Composite scores. ICCs were calculated with a two-way random effects model, and consistency (versus absolute) values are reported in order to identify similarities between parent and self-report on this continuous measure (Ko & Li, 2016). Absolute differences between the raters' scores are addressed below. The Average (versus

Single) ICC is reported because collecting both self and parent report, not one or the other, is expected.

4. ***Do youth and parents report EF problems of significantly different magnitude?*** We investigated magnitude of differences between parent and youth report across the diagnostic groups through analyses of the effect size of the difference between self and parent mean scores and Cohen's kappa ($_K$) values of the proportion of scores for parent and self in the *suspected clinically elevated range* of the BRIEF.

Community Involvement

Two autistic people were involved in the genesis of this research and the interpretation of the findings in this manuscript. Their ideas influenced the development of the research question and they reviewed drafts of the paper and provided edits and discussion points. They are authors of the paper (JB and SdV).

Results

The ADHD and autism groups did not differ on age, FSIQ scores and Hyperactive/Impulsive symptoms, but the ADHD sample had a significantly higher number of Inattentive symptoms. Parents of youth with ADHD reported relatively few Hyperactive/Impulsive symptoms (mean 2.3) in this sample. There were proportionally more boys in the autism and NT groups than the ADHD group. See Table 1.

The ANOVA revealed significant main effects of: diagnostic group ($F(2,205)=209$, $p<.001$ $\eta_p^2=.45$), BRIEF scale ($F(5,2525)=29$, $p<.001$, $\eta_p^2=.06$), and reporter ($F(1,505)=38$, $p<.001$, $\eta_p^2=.07$); these main effects were qualified by significant two-way interactions between BRIEF scale and diagnosis ($F(10,2525)=20$, $p<.001$; $\eta_p^2=.07$); BRIEF scale and rater ($F(5,2525)=13$, $p<.001$; $\eta_p^2=.03$); rater and diagnosis ($F(2,505)=28$, $p<.001$; $\eta_p^2=.10$) and a three-way interaction among BRIEF scale, rater, and diagnosis ($F(10,2525)=6.3$, $p<.001$ $\eta_p^2=.02$) (see Figure 1). Given significant group differences in gender ratio, the ANOVA was re-run with gender as a covariate and the pattern of results remained unchanged. Post hoc analyses were conducted to interpret the significant three-way interaction. To mitigate issues related to multiple comparisons, we only addressed our *a priori* questions as described below.

1) Do autistic youth report more EF problems than NT youth and a distinctive profile of problems in comparison to ADHD youth?

Youth self-report was different across diagnoses. Both the autistic and ADHD youth reported greater problems on all scales as compared with the NT group (ts≥6.28; ps≤.001; ds>0.71). Autistic youth report a distinctive profile of problems when compared to ADHD youth report, with significantly greater problems reported by autistic youth on the Self-Monitor, Shift and Emotional Control scales (ts≥2.6; ps≤.01; ds>.31). ADHD youth do not report significantly greater problems than autistic youth on any BRIEF scale.

2) Is the pattern of self- and parent-reported BRIEF scale scores similar within ASD and within ADHD?

Parents and their autistic children reported overall similar patterns of problems across BRIEF scale scores. The same was true for parents and their ADHD children. Autistic youth and their parents both reported significantly greater problems with flexibility (Shift Scale) than all other EF domains (parents: all *t*s≥5.58; *p*s<.001; *d*s≥.42; youth: all *t*s≥3.0; *p*s<.003; *d*s>.33). ADHD parents and youth both reported greater problems on the Working Memory Scale than all other scales (parents: all *t*s ≥3.27; *p*s<.001; *d*s>.28; youth: all *t*s≥2.13; *p*s<.04; *d*s>.17).

3) Are youth and parent report of EF problems correlated at the Scale and Index level?

Table 2 presents ICCs for all three diagnostic groups. Concordance was in the poor range (ICC<.50) across all scales and indices for parent and self-report in the ADHD group with the exception of the Inhibit and Emotional Control Scales and the BRI, which had ICCs in the moderate range (ICC between .50–.75). For the autistic group, ICCs were somewhat better, in the moderate range for the GEC and each of the Indices and Scales, with the exception of: Shift, Working Memory and the Emotion Regulation Index, which were in the poor range. Comparison of the ADHD and autistic ICCs using Feldt's F test for the comparison of two ICCs (Feldt, Woodruff & Salih, 1987) reveals that the ICC is significantly higher in autism than in ADHD for the CRI (*p*<.01) and the GEC, Working Memory and Plan/Organize scores (*p*s<.05). ICCs are stronger in NTs than both clinical groups, with two BRIEF Scales showing moderate reliability and all other Scales and Indices showing good reliability between parent and self-report.

4) Do youth and parents report EF problems of significantly different magnitude?

In order to evaluate absolute differences between reporters across the three diagnostic groups, mean difference scores between parent and self-report, and the effect size (Cohen's *d*) of the difference of means were calculated. See Table 2. Self-report for the ADHD and autistic groups is universally lower than parent report, with generally small effect size differences for the ADHD group, with the exception of Working Memory and Plan/Organize, where the effect size of the difference is medium. The autistic group shows the same pattern, with the exception that effect sizes of the differences of means on the Shift scale and GEC are also medium. All differences between parent and self-report for the NT group are negligible, as would be expected, because the NT group is drawn from the normative sample.

In order to probe the effect of these absolute differences between raters' scores on the proportions of individuals whose scores fall in the *suspected clinically elevated range*, Kappa values were calculated for the two clinical groups. See Table 3. Forty-one percent of autistic youth reported global problems with EF in the clinically elevated range, 48% reported emotion regulation problems that were in the clinically elevated range and 44% reported clinically elevated problems with flexibility. Parents identified the same three areas of EF as having the greatest proportion of autistic youth showing clinical elevations, but they consistently reported that higher proportions of youth were in the clinically elevated range (64% with global EF problems, 72% with flexibility problems; and 64% with emotion

regulation problems). There was significant, but weak agreement between parent and self-report for the autistic group across all BRIEF scales and indices ($_K$ range=.16-.29, *p*s<.03), with the exception of the Shift scale ($_K$=.06). The ADHD youth and parents also agreed on which areas of EF had the greatest proportions of youth with clinically elevated problems (global EF, cognitive regulation and working memory) and parents also reported that higher proportions of youth had clinically elevated EF problems than the youth did. The agreement between parent and ADHD youth report was only significantly better than chance (*p*<.05) for the following scores: Inhibit, BRI, Emotional Control, and CRI.

Discussion

This novel investigation of 197 autistic youth elevates the importance of asking them directly about their own executive functions. Autistic youth self-report significantly greater EF challenges than NT youth, and a distinctive pattern of EF problems when compared to youth with ADHD. Autistic and ADHD youth identify similar profiles of EF challenges as their parents do, with autistic youth and parents reporting greatest difficulty with flexibility and ADHD youth and parents reporting greatest difficulty with working memory. The correspondence between self and parent reported EF was generally in the moderate range in the autism group, indicating that autistic youth and their parents' views of their EF functioning are related, but not identical. Intraclass correlation coefficients between parent and youth ratings were stronger in the autistic, as compared to the ADHD group in this study. In both autism and ADHD, youth and their parents differ on the magnitude of EF problems, with youth reporting less severe challenges than their parents.

This investigation indicates that autistic youth report of their EF is both nuanced and meaningful. They describe greater EF problems across all BRIEF scales than their NT peers, and a pattern of EF difficulties that distinguishes them from their peers with ADHD. They report significantly greater challenges with flexibility, emotional control and self-monitoring than ADHD youth. Fully 44% of autistic youth indicated that their flexibility challenges were severe enough to fall in the clinically significant range of BRIEF scale scores. Their report accords with their parents' report, that of autistic adults (Dijkhuis et al., 2017), and two decades of research using objective EF measures (e.g., Hill, 2004; Landry & Al-Taie, 2016).

Youth with ADHD and their parents were also consistent in reporting a peak in working memory problems, demonstrating that youth with neurodevelopmental conditions, in this case ADHD and autism, self-report distinct patterns of EF difficulties that track with their condition. The lack of a second peak in inhibition problems for the ADHD group was unexpected and inconsistent with previous studies of parent report on the BRIEF (e.g., Gioia et al., 2002). The consistency of parent and ADHD youth report regarding inhibition, combined with parent report of a relative lack of hyperactive/impulsive ADHD symptoms, which are associated with inhibition problems, indicates that inhibition may be less impaired in this sample than is often observed.

In addition to probing similarities in the profiles of EF challenges reported by parents and their children, the consistency of autistic youth and their parent's report was also

investigated with intraclass correlations. When observed, inconsistencies across reporters may reflect the contexts under which ratings are completed. While parents are reporting on outwardly observed behaviors in the context of the home and community, for example, youth are reporting on their inner experiences across many contexts (e.g., school) that parents are less likely to observe frequently. Multiple informants' report on the same construct may be important precisely because it is discrepant, and therefore, complementary (De Los Reyes et al., 2015). We find that NT youth and their parents show moderate to strong concordance in their description of EF problems, while youth with autism and their parents show generally moderate levels of concordance regarding EF problems. This parallels report of moderate concordance between parents and autistic youth regarding anxiety (Blakely-Smith et al., 2012). Youth with ADHD and their parents were less consistent in their description of EF problems than the autistic youth-parent pairs, indicating that autistic youth do not hold uniquely discrepant perspectives on their own EF, as has been implied by invocation of autism specific deficits in self-awareness (e.g., Baron-Cohen, 2002; see Blakeley Smith et al., 2012 for discussion). Our data are especially compelling because youth and parent report of EF was gathered on parallel measures with consistent items and factor structure, allowing for a true comparison between youth and parent report (De Los Reyes et al., 2015).

There was greater divergence between autistic and ADHD youth and their parents regarding the magnitude of their EF problems. The effect sizes for these discrepancies were generally small, although the magnitude of the discrepancies was greatest for the peak problems for each group of youth: flexibility in autism and working memory in ADHD. The same pattern, showing that greatest divergence between parent and youth report, occurred on EF subdomains representing peak problems was observed when comparing the proportions of parents and youth who reported scores falling in the *suspected clinically elevated range*. There was significant, albeit weak agreement between parent and self-report for the autistic group across all BRIEF scales and indices, with the exception of the Shift Scale. Overall, autistic youth and their parents generally show moderate concordance regarding EF problems. However, parents tend to systematically perceive their children to be more impaired than the children perceive themselves to be, a pattern that has been observed in other investigations and attributed to possible parental over-estimation of problems, although the evidence for this hypothesis is modest (De Los Reyes et al., 2015). In any case, these findings support the idea that autistic youth may be drawing their conclusions from different environmental data and cognitive frameworks than their parents, as has been argued for parents and teachers of autistic youth (Lerner et al., 2017).

A future direction for this work is to explore the unique contributions of youth, parent and teacher report to understanding EF in autism and other developmental conditions and leverage recent work in other disorders suggesting that informant discrepancies can represent clinically meaningful information (Deroas et al., 2018). In addition to inclusion of performance-based measures, future studies should include larger numbers of autistic females and self-report from autistic youth with intellectual disability. The lack of youth with intellectual disability in this study limits its relevance to this important segment of the autistic population. Other limitations include: variable recruitment methods across the two diagnostic groups and incomplete data on the presence of ADHD symptoms and

diagnoses in the autistic participants, as well as the lack of information on IQ, autism and ADHD symptoms in the NT sample, and the gender of the parent who provided informant report on the BRIEF. Furthermore, understanding the full impact of EF in the lives of autistic people would be advanced by moving beyond simply asking autistic people to fill out questionnaires about EF problems. Sethi and colleagues (2019) describe the use of qualitative methods to probe the meaning and presentation of the construct of behavioral flexibility for parents and clinicians. These approaches can also be applied to capture the lived experience of EF for autistic individuals. Qualitative and community based participatory research methods with autistic people could generate descriptors of EF in autism that expand our understanding of the construct. As is the case of repetitive stimming behaviors (Kapp et al., 2019), autistic youth and adults may identify components of autistic EF profiles that provide positive benefits, or support compensation efforts (Livingston & Happe, 2019). They may also reveal new aspects of EF that might "help us think outside the 'normative' box … have far-reaching and disruptive effects on basic autism science research" (Pellicano, 2020).

Despite their limitations, these data provide clear evidence of the EF problems experienced by autistic youth and observed by their parents, as well as the primary role inflexibility plays in the EF problems of autistic youth. Whether evaluating EF for clinical or research purposes, these findings support the inclusion of youth self-report measures. As is the case for other traits within autism, and for other diagnostic groups of individuals, parent and self-report capture related but distinct data on EF. Therefore, the additional perspective and context for the experiences of these EF problems are of high clinical value and complement more frequently gathered informant ratings of EF. In light of this, and the fact that autistic youth report nuanced and meaningful EF challenges, integrating their perspective regarding this pivotal ability will improve our understanding, as well as increasing their ability to recognize and address EF difficulties. Having established that autistic youth have insight into their EF challenges, these data raise the importance of: 1) future incremental validity studies to investigate the additive power of different perspectives (parent, teacher, self) on EF problems in autism, and 2) probing whether discrepancies between reports are indicative of clinically important outcomes, such as intervention response, family dynamics, parental functioning, or insight (Lerner et al., 2017).

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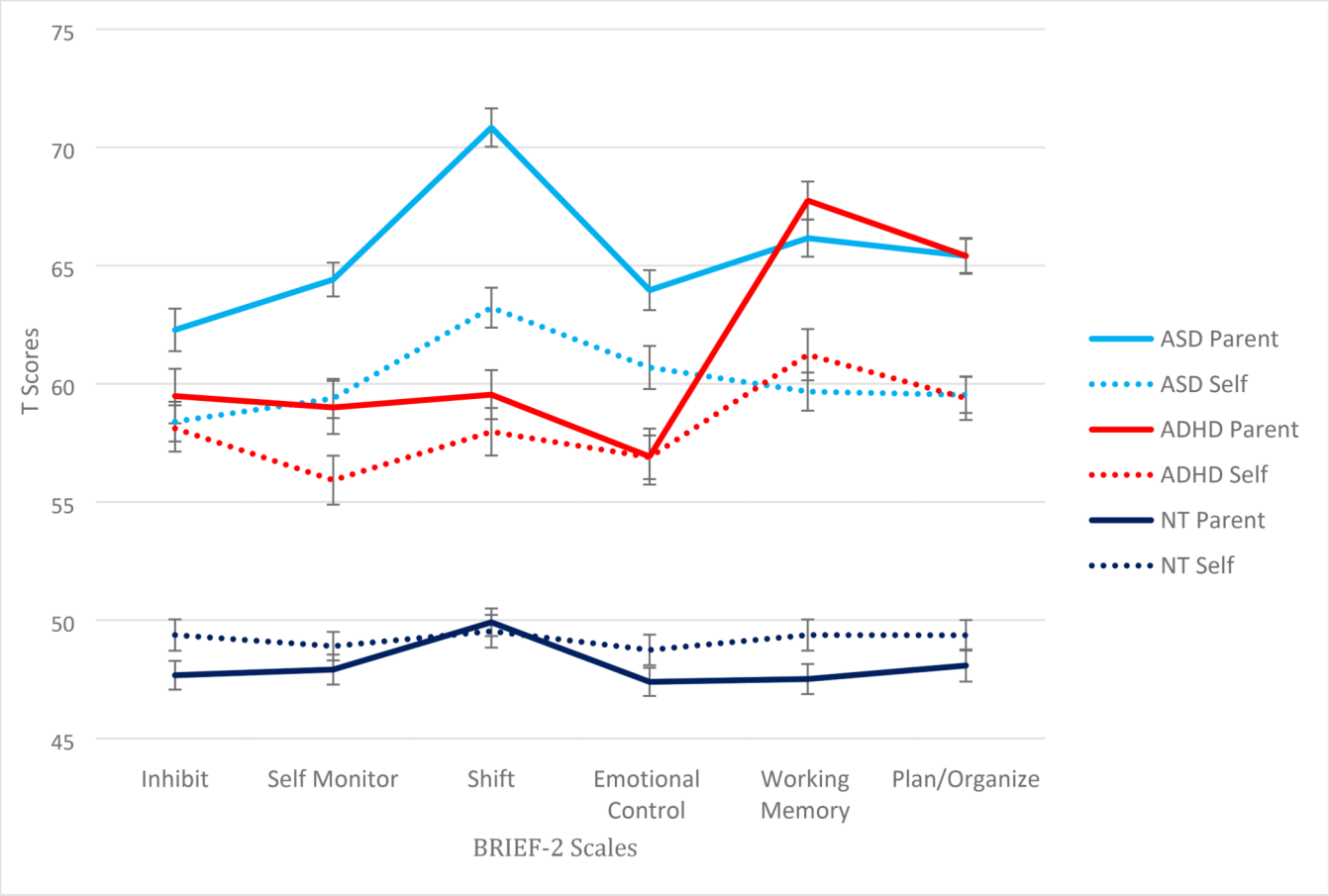

Figure 1.

Executive Function profiles as reported on the BRIEF-2 by youth with autism, ADHD or neurotypical development (NT) and their parents. Mean and standard error are indicated

Table 1.

Demographic and diagnostic characteristics for autistic, Attention Deficit Hyperactivity Disorder (ADHD), neurotypical (NT) participants. Mean Score (SD) is reported, except as noted.

	AUTISM (*n*=197)	**ADHD (*n*=114)**	**NT (*n*=197)**	**Group Comparisons[1]**
Age (years)	14.8 (2.1)	14.3 (2.0)	14.5 (2.1)	t = 1.82, *p* = *ns*
Male *n*,(%)	143 (72.6)	69 (60.5)	143 (72.6)	$\chi^2(1) = 4.8$, *p*=.03
FSIQ[2] (standard score)	101.6 (16.1)	100.6 (14.5)		t = 0.56, *p* = *ns*
Race *n*,(%)				
Asian	10 (5.1)	0 (0)	0 (0)	
African American	13 (6.6)	18 (15.8)	21 (10.7)	
Native Hawaiian	2 (1.0)	0 (0)	0 (0)	
White	95 (48.2)	62 (54.4)	122 (61.9)	
Other	18 (9.1)	12 (10.5)	54 (27.4)	
Missing	59 (30.0)	22 (19.3)	0 (0)	
Ethnicity *n*, (%)				
Hispanic/Latin(*x*)	18 (9.1)	9 (7.9)	40 (20.3)	
Not Hispanic/Latin(*x*)	90 (45.7)	105 (92.1)	157 (79.7)	
Missing	89 (45.2)	0 (0)	0 (0)	
ADHD Rating Scale (Symptom Count [3])				
Inattentive	4.94 (3.2)	5.87 (2.5)		t = 2.39, *p* = .02
Hyperactive/Impulsive	2.46 (2.7)	2.32 (2.7)		t = 0.39, *p* = *ns*

[1] Independent sample t-tests were conducted for Age, FSIQ and ADHD symptom comparisons. Pearson Chi-Square analyses were conducted for Gender comparisons.

[2] FSIQ=Full Scale IQ Score (Wechsler Scales)

[3] Autism n=109, ADHD n=110

Table 2.

Correlation and absolute difference between youth self and parent report on the BRIEF-2 for youth with autism, ADHD and neurotypical development (NT)

		Inhibit	Self-Monitor	Behavior Regulation Index	Shift	Emotional Control	Emotion Regulation Index	Working Memory	Plan/ Organize	Cognitive Regulation Index	Global Executive Composite
Autism	ICC *r*[1]	.67 (.56−.75)	.50 (.33−.62)	.62 (.50−.72)	.33 (.12−.50)	.58 (.45−.69)	.46 (.29−.60)	.48[6] (.31−.61)	.53[6] (.37−.64)	.54[7] (.39−.65)	.54[6] (.39−.65)
	Parent M (SD)[2]	62.3 (12.6)	64.4 (10.0)	64.0 (11.2)	70.8 (11.4)	64.0 (11.9)	68.5 (11.7)	66.2 (11.0)	65.4 (10.1)	65.9 (10.4)	68.0 (10.5)
	Self M (SD)[3]	58.4 (11.8)	59.4 (11.7)	59.5 (11.6)	63.2 (11.8)	60.7 (12.8)	63.4 (11.9)	59.7 (11.3)	59.5 (10.7)	61.3 (10.6)	62.1 (10.7)
	Diff (M)[4]	3.9	5	4.5	7.6	3.3	5	6.5	5.9	4.6	5.9
	Cohen's *d*[5]	0.32	0.4	0.38	0.52	0.24	0.36	0.5	0.5	0.39	0.5
ADHD	ICC *r*[1]	.57 (.39−.70)	.49 (.26−.65)	.61 (.44−.73)	.33 (.03−.54)	.57 (.38−.70)	.48 (.24−.64)	.29 (−.04−.51)	.37 (.09−.57)	.27 (−.05−.50)	.33 (.02−.53)
	Parent M (SD)	59.5 (12.3)	59.0 (12.0)	60.0 (12.0)	60.0 (11.1)	56.9 (12.7)	58.8 (11.9)	67.8 (8.6)	65.4 (8.1)	67.0 (8.1)	64.8 (9.2)
	Self M (SD)	58.1 (10.5)	55.9 (11.0)	57.8 (10.5)	58.0 (10.8)	56.9 (9.9)	58.3 (9.8)	61.2 (11.6)	59.4 (9.8)	62.0 (10.4)	60.6 (9.5)
	Diff (M)	1.4	3.1	2.2	1.6	0	0.5	6.5	6	5.1	4.2
	Cohen's *d*	0.11	0.23	0.19	0.11	0	0.25	0.5	0.54	0.42	0.36
NT	ICC *r*[1]	.79 (.71−.83)	.61 (.48−.71)	.76 (.68−.82)	.73 (.65−.80)	.80 (.73−.85)	.79 (.72−.84)	.81 (.74−.85)	.86 (.81−.89)	.86 (.82−.90)	.85 (.80−.89)
	Parent M (SD)	47.7 (8.5)	47.9 (8.9)	47.6 (8.7)	49.9 (8.2)	47.4 (8.4)	47.1 (7.6)	47.5 (8.9)	48.1 (9.5)	47.8 (9.1)	47.4 (8.8)
	Self M (SD)	49.4 (9.3)	48.9 (8.5)	49.0 (9.1)	49.5 (9.7)	48.7 (9.1)	49.1 (9.5)	49.4 (9.3)	49.4 (9.0)	49.5 (9.3)	49.2 (9.2)
	Diff (M)	−1.7	−1	−1.5	0.4	−1.4	−2	−1.9	−1.3	−1.7	−1.8
	Cohen's *d*	0.22	0.11	0.19	0.05	0.19	0.27	0.25	0.2	0.27	0.28

[1] Intra Class Correlation *r* reported with 95% confidence intervals

[2] Mean Parent-report T-Score (SD)

[3] Mean Self-report T-Score (SD)

[4] Difference of Means; Parent-report Mean T-score minus Self-report Mean T-score

[5] Cohen's *d* of the difference of means (paired t-test)

[6] AUTISM ICC>ADHD ICC ($p<.05$)

[7] AUTISM ICC>ADHD ICC ($p<.01$)

Table 3.

Proportions of youth and parents reporting clinically elevated EF problems in the autistic and ADHD youth

	AUTISM (n=197)			ADHD (n=114)		
BRIEF-2 Scales & Indices	**Self (%) 65+**[1]	**Parent (%) 65+**	**Self-Parent Agreement Kappa (p-value)**	**Self (%) 65+**	**Parent (%) 65+**	**Self-Parent Agreement Kappa (p-value)**
Inhibit	30	40	.29 (.000)	25	33	.32 (.000)
Self-Monitor	35	44	.16 (.024)	24	29	.14 (.122)
Behavior Regulation Index	34	47	.26 (.000)	25	36	.35 (.000)
Shift	44	72	.06 (.335)	29	35	.10 (.139)
Emotional Control	36	49	.21 (.003)	18	30	.19 (.030)
Emotion Regulation Index	48	64	.26 (.000)	24	33	.14 (.128)
Working Memory	32	62	.15 (.009)	36	67	.15 (.053)
Plan/Organize	31	57	.20 (.001)	28	51	−.45 (.593)
Cognitive Regulation Index	35	61	.27 (.000)	38	68	.23 (.004)
Global Executive Composite	41	64	.23 (.000)	31	53	.15 (.082)

[1]Percentage of T-scores in the *suspected clinically elevated range* (T ≥ 65)