UNDERSTANDING FACTORS THAT INFLUENCE THE DAILY LIVING SKILLS OF ADULTS WITH AUTISM

SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL OF APPLIED AND PROFESSIONAL PSYCHOLOGY OF RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY BY

SHIN ER TEH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PSYCHOLOGY

NEW BRUNSWICK, NEW JERSEY AUGUST 2022

APPROVED:

Vanessa H. Bal

Kate Fiske

DEAN:

Denise Hien
ABSTRACT

Existing literature has demonstrated that the adaptive functioning of autistic individuals is lower than what is expected of their age and cognitive abilities. Studies of children and adolescents suggest that autistic individuals may show a relative strength in the adaptive domain of daily living skills (DLS). DLS skills refer to a broad range of activities that are necessary in helping one maintain their day-to-day personal lives and wellbeing. To date, few studies have examined these skills in autistic adults. This dissertation aimed to understand individual characteristics (i.e., intellectual function, executive function and mental health) and contextual factors (i.e., provision of opportunities, requirement of reminders) that influence autistic individuals' performance of DLS. Participants included 33 autistic individuals ranging in age from 16 to 35 years. Results demonstrated associations between the Vineland Adaptive Behavior Scales, 3rd edition – Comprehensive Interview Form (VABS-3) DLS scores and intellectual and executive functioning, but not age and mental health. Qualitative analysis of parental responses indicated that not having an opportunity to learn and/or practice the assessed tasks was the most frequent reason for not performing DLS, particularly for adults with average or higher IQ. VABS-3 DLS scores tended to be lower than caregiver reported DLS scores on the Adaptive Behavior Assessment System, 3rd edition – Adult Form (ABAS-3), another measure of adaptive skills. While there were significant discrepancies between IQ and DLS measured by both VABS-3 and ABAS-3, the pattern varied by instruments, with the mean VABS-3 DLS standard score being approximately one standard deviation (SD) lower than the mean ABAS-3 DLS score. Even when accounting for the differences in floors between measures, the VABS-3 DLS remained lower than ABAS-3 DLS. These findings highlight a need for multi-dimensional assessment to characterize each individual’s patterns of strengths and difficulties, especially to understand contextual factors affecting daily living.
performance, to more readily inform the development of individualized intervention plans.

**Keywords.** Adaptive function. Daily living. Autistic. Adults.
ACKNOWLEDGMENTS

The completion of this study could not have been possible without the expertise of Dr. Vanessa Bal. You have been a pivotal figure in expanding my training on autism diagnostic assessments and in understanding the development of autism across the lifespan. Thank you for being incredibly generous with your time and wisdom in guiding me throughout my training and this dissertation project.

I am also extremely thankful to Dr. Kate Fiske, one of my earliest mentors at GSAPP and at DDDC. You have fostered such supportive and warm environments at all the externship sites that we worked at. Your mentorship enabled my achievements within and beyond my work at GSAPP, and it will continue to go a long way.

Next, I would like to thank all the professors and supervisors who have taught, supervised, and inspired me along the way. The diversity at GSAPP, both in terms of the people and the training opportunities, has provided me with meaningful growth beyond anything I expected.

And of course, I would like to express my gratitude towards my entire cohort. Each one of you is inspiring, brilliant, loving and supportive. I could not imagine going through graduate school without you all. Especially Hyein Lee, thank you for being with me through thick and thin since day one at GSAPP/DCCD.

To the families whom I interacted with, both within and outside of this project – thank you for letting me work with you. Your time and expertise inspired this project, and your experiences and resilience motivate me to continue working with individuals and families with autism.

Finally, I would not be who I am today if not for my family. I am eternally grateful to my parents for supporting me in pursuing my dream to become a psychologist. A big thank you to my dear husband, who has always provided me with unconditional support.
TABLE OF CONTENTS

ABSTRACT............................................................................................................................... ii

ACKNOWLEDGEMENTS ........................................................................................................ iii

LIST OF TABLES ...................................................................................................................... vii

LIST OF FIGURES ................................................................................................................... viii

INTRODUCTION ...................................................................................................................... 1
  Factors Affecting Adaptive Functioning in ASD ................................................................. 2
  Daily Living Skills ............................................................................................................... 5
  Factors Associated with DLS in ASD .................................................................................. 6
  Measurement of DLS .......................................................................................................... 12
  Capturing the Reasons for Not Performing Certain Adaptive Skills ............................... 18
  Current Study and Specific Aims ....................................................................................... 20

METHODOLOGY .................................................................................................................... 23
  Participants Characteristics ............................................................................................... 23
  Measures ............................................................................................................................ 23
  Assessment Procedures ..................................................................................................... 26
  Coding Categories and Procedures ................................................................................ 28

ANALYSES ................................................................................................................................ 33
  Aim 1 ...................................................................................................................................... 33
  Aim 2 ...................................................................................................................................... 34
  Aim 3 ...................................................................................................................................... 34
  Aim 4 ...................................................................................................................................... 34

RESULTS .................................................................................................................................... 34
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Participants Demographic and Characteristics</td>
<td>22</td>
</tr>
<tr>
<td>2. Categorizing and Definition for Summary and Reason Codes</td>
<td>29</td>
</tr>
<tr>
<td>3. Assignments of Additional Points to Subdomain Raw Score Based On Estimated Mastery Ability</td>
<td>33</td>
</tr>
<tr>
<td>4. Correlations between Adaptive Functioning and Study Variables</td>
<td>34</td>
</tr>
<tr>
<td>5. Differences in Mean between Groups</td>
<td>35</td>
</tr>
<tr>
<td>6. Predictors of DLS</td>
<td>36</td>
</tr>
<tr>
<td>7. Average Number and Proportion of 0-Score Items by Reason Across DLS DLS Subdomains</td>
<td>37</td>
</tr>
<tr>
<td>8. Gains in DLS Domain and Subdomain Scores After Allocation of Points</td>
<td>38</td>
</tr>
<tr>
<td>9. The Proportion of 0-scored Items in DLS Domain that Each Code Accounts for, Across Clinical Characteristics</td>
<td>41</td>
</tr>
<tr>
<td>10. NVIQ Group Differences in The Changes of Domain SS and Subdomain Scores (VS and AE)</td>
<td>41</td>
</tr>
<tr>
<td>11. VABS-3 DLS, Adjusted DLS, DLS (49), Adjusted DLS (49) and ABAS-3 PRAC Scores</td>
<td>42</td>
</tr>
<tr>
<td>S1. Differences in Mean between groups_ ABCL Internalizing</td>
<td>67</td>
</tr>
<tr>
<td>S2. Distribution of Reason Codes</td>
<td>67</td>
</tr>
<tr>
<td>S3. Participant Average 0-score Items per Reason Code Across DLS Subdomains</td>
<td>68</td>
</tr>
<tr>
<td>S4. Number of Participants in Each IQ group, and Breakdown of Measures</td>
<td>68</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figures</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. VABS-3 DLS, Adjusted DLS and ABAS-PRAC Score Distribution</td>
<td>43</td>
</tr>
<tr>
<td>2. NVIQ vs. VABS-3 DLS, Adjusted DLS and DLS (49)</td>
<td>45</td>
</tr>
<tr>
<td>3. NVIQ vs. VABS-3 DLS and ABAS-3 PRAC</td>
<td>46</td>
</tr>
<tr>
<td>4. NVIQ vs. VABS-3 DLS, Adjusted DLS, Adjusted DLS (49) and ABAS-3 PRAC</td>
<td>47</td>
</tr>
</tbody>
</table>
INTRODUCTION

Autism is a neurodevelopmental disorder that is characterized by deficits in the areas of social-communication and interaction, and the presence of restricted, repetitive behaviors, interests or activities (American Psychiatric Association, 2013). The prevalence rate of autism in the United States is about 1 out of 54 children (CDC, 2020). Although there are limited data on adult prevalence, the 2018 National Autism Indicator Report (Shattuck et al., 2018) stated that approximately 72,800 youth on the autism spectrum turned 18 years old in 2018. This means that roughly 728,000 youth with autism will enter adulthood in the next decade.

The extant literature highlights that autistic adults\(^1\) often struggle to achieve independence (Farley et al., 2019; Howlin et al. 2004, Matson et al., 2015). For example, Billstedt et al. (2005) followed 120 individuals with autism from childhood to adulthood (age 17-40 years) and found that only 3.3% (n=4) participants were able to live independently. Similarly, among a sample of 133 autistic adults (age 22 years and older), Krauss, Seltzer and Jacobson (2005) reported that 81.6% of the participants never lived outside of the home. While 6.7% of the participants had lived elsewhere for some period of time, at the point of survey they had returned and lived at home for the past decade. These results provide a clear picture of autism being a lifelong disorder (Seltzer et al. 2004).

While prior research has focused on broadly defined outcomes of autistic adults, such as living independently, more research is needed on potentially malleable factors that can inform development of supports for autistic adults. One area in the existing literature on autistic adults has focused on adaptive functioning (Bal et al., 2015; Gillespie-Lynch et al., 2012; Matthews et al., 2017; Perry et al. 2009; Pugliese et al. 2015; Tillman et al., 2019). Adaptive behavior is generally

\(^1\) Identity-first term is used for the adult populations as it is the preference of stakeholders
defined as “performing daily activities for personal and social sufficiency” (Sparrow, et al., 1984, p.6), which comprises conceptual, social and practical skills (AAIDD, 2002). Primarily influenced by Western culture (Price et al., 2018), conceptual skills include linguistic learning (i.e., expressive and receptive language, reading and writing) and understanding of concepts (e.g., money and time). Social skills cover interpersonal skills, self-esteem and rule following behaviors, while practical skills include activities of daily living (e.g., personal care, hygiene), occupational skills, community navigation (e.g., transportation), and basic financial management. Impaired adaptive functioning when an individual demonstrates lower adaptive skills than are expected for their chronological age (i.e., in comparison to same-aged peers), is often assumed to reflect deficits in adaptive skills (Sparrow et al., 1984; Tasse et al., 2012).

Importantly, however, measurement of adaptive skills emphasizes distinguishing between general ability to carry out daily tasks and one’s actual typical performance of those tasks. In other words, adaptive functioning focuses on whether one does exhibit the skill consistently when required, without prompts or supports, rather than whether one can perform a skill. There are numerous factors that can influence whether someone exhibits a skill. Thus, a more nuanced understanding of the factors that affect adaptive functioning is needed.

**Factors affecting adaptive functioning in ASD**

Adaptive functioning is strongly related to cognitive ability (Carter et al., 1998; Duncan & Bishop, 2017) and part of the diagnostic criteria for Intellectual Disability (APA, 2013; Barclay et al., 1996; Tasse et al., 2012). Within autistic samples, however, studies on children, youth and adults have reported that cognitive functioning may not serve as a consistent predictor of adaptive functioning. More specifically, autistic individuals with at least average cognitive abilities tend to have adaptive scores below what would be expected given their intellectual level (Charman et al.,
2011; Chatham et al., 2018; Duncan & Bishop, 2013; Klin et al., 2007; Saulnier & Klin, 2006). For example, in a sample of 187 autistic children, youth and young adults (ages 7-18.9), Klin et al. (2007) reported adaptive standard score deficits that ranged from 1-3 deviations in relation to the participants’ intellectual functioning across all areas of adaptive functioning. Mouga et al. (2015) compared 115 autistic children to 102 age and IQ-matched peers with other neurodevelopmental disorders (NDD) and reported that those with ASD had more adaptive deficits than those with NDD only. While several studies have explored adaptive functioning profiles in child and adolescent samples, fewer studies have examined this in autistic adults.

Beyond IQ, there are many factors that may affect adaptive functioning in autistic individuals. Hume and colleagues (2009) posited that three primary features may explain poor adaptive functioning in ASD, namely, initiation, generalization and prompt dependence. Initiation comprises five components: Planning, processing speed, attention to relevant environmental stimuli, motivation and unclear expectations. Notably, the first four reasons are components of executive functioning (EF). EF difficulties are well documented in autistic children and adolescents (Geurts et al., 2004; Gillotty et al., 2002; Granader et al., 2014; Pugliese et al., 2015), and there is some evidence that executive functioning is associated with adaptive behaviors in children (Clark, Prior & Kinsella, 2002; Gillotty et al., 2002; Oliveras-Rentas; 2012) and adults (Ashwood et al. 2015; Barkley & Murphy, 2011; Rumsey and Hamburger, 1990; Wallace et al., 2016; Williams et al., 2014). Difficulties with executive functioning could certainly also explain prompt dependence and make it more difficult for autistic individuals to generalize skills to other contexts.

The role of motivation and clarity of expectations in adaptive functioning has been less widely studied. Amotivation is typically correlated with mood disorders, especially depression
studies have shown that 50% to 70% of adults with depressive disorders also have anxiety symptoms (Kessler, Merikangas, & Wang, 2007; Lamers et al., 2011; Wu & Fang, 2014). There are some studies that explore how comorbid anxiety and depression impacts the adaptive behaviors of autistic children (Davidsson et al., 2017; Lawson et al., 2015) and adults (Mazurek et al., 2004, Tilmann et al., 2019; Wallace et al., 2016). Wallace et al. (2016) examined 35 autistic adults and reported that comorbid anxiety and depression were associated with adaptive functioning deficits (above and beyond the influence of age, IQ and co-morbid ADHD symptoms). Amotivation as a feature of depression could explain lower adaptive functioning for some individuals, but likely does not account for most low adaptive scores that have been consistently documented across studies. It is possible that autistic individuals feel less motivated to engage in adaptive tasks because the reasons for doing so are not clear. Alternatively, what may be perceived as a lack of motivation may reflect limited awareness of expectations. Unclear expectations could include not understanding that they are expected to initiate a particular behavior when the expectations are not clearly stated or, that they do not realize that expectations may generalize beyond a specific situation or timeframe.

Additionally, limited studies have examined how external factors, specifically the provision of opportunity, affects the acquisition and maintenance of adaptive skills. As adolescents and adults get older, there may be a shift in caregivers’ expectations of performance (Bal et al., 2015), which could result in there being fewer opportunities for the individual to learn, practice or perform the skill independently (Bal et al., 2015). Consistent with this, studies have found that autistic teenagers wanted more independence than they currently had and reported that they took pride in having agency rather than supports (Humphrey & Lewis, 2008; Rossetti et al., 2008).
Wehman et al. (2014)’s review on the transition of autistic youth from high school to adulthood highlighted that youth with ASD are not active participants in the transition planning of their lives; again, it is not clear if this is due to lower motivation or fewer opportunities to participate.

Unlike cognitive ability, which is considered relatively stable from middle childhood to adulthood (Fisher et al., 2016; Luna et al., 2004), there is some evidence to suggest that adaptive skills can be targeted through intervention (Duncan et al., 2018; Oswald et al., 2018). For example, Oswald et al. (2018) conducted a 19-session intervention that covered self-determination, social, coping and adaptive skills for autistic adults. Those who received the intervention showed significant improvements in parent-reported adaptive skills in comparison to autistic adults in the control group. With evidence of malleability and its association with independent living (Farley et al., 2019), job acquisition (Burke et al. 2010), social interactions (Garcia-Villamisar et al. 2011) and community participation (e.g., travel to unfamiliar places; Palmen et al., 2012), more information is clearly needed to understand factors affecting adaptive behaviors in autistic adults.

As features of adaptive functioning highly overlap with symptoms of autism (e.g., communication difficulties and social skills), the current study focuses on the practical skills component of adaptive functioning, referred to as Daily Living Skills, or DLS. The goal of this project is to understand the extent to which individual characteristics (e.g., cognitive impairment, executive functioning and comorbid anxiety and/or depression) and external factors (i.e., lack of opportunity to learn or perform skill) play a role in caregiver- reported DLS. This information will also be used to explore how these factors affect scoring of standardized assessments of adaptive function.

**Daily Living Skills**

Practical skills refer to a broad range of activities that are necessary in helping one maintain their day-to-day personal lives and wellbeing; as such, we will refer to these as “Daily Living
Skills” or DLS for short. DLS includes skills related to self-care and health (e.g., hygiene, dressing, medication intake and monitoring), maintaining the household (e.g., cleaning, cooking and securing property from theft) and navigating community systems, including financial management and understanding of personal rights (e.g., transportations, financial transactions, employment and rights to services). Many of these activities (e.g., hygiene, street safety, household chores) can be readily broken down into concrete steps, taught via systematic methods (e.g., applied behavior analysis) and acquired more readily by the learner through rote learning.

While conceptual and social skills are equally important to navigating adult life, research suggests that DLS are most strongly correlated with positive outcomes (e.g., independent living, employment, educational attainments, friendships and social life) in adulthood (Farley et al., 2009). Most existing interventions that target independent functioning in adults with ID, with and without ASD, also tend to focus on DLS, including vocational training (Burke et al., 2010), food preparation (Chazin et al. 2017; Tekin-Iftar et al. 2010) and community safety (e.g. street crossing, Harriage et al. 2016; navigating public transport, Lubin & Feeley, 2016; Price et al. 2018). Autistic individuals tend to show a strength in DLS relative to conceptual and social skills, which has been described as the “autism profile” (Carter et al. 1998; Duncan & Bishop, 2013; Klin et al, 2007). This profile likely reflects that conceptual and social skills comprise behaviors that are more directly related to autism-related difficulties, such as conversation, making friends and reading verbal and nonverbal social cues. Consistent with this, studies comparing autistic individuals with ID to peers with ID found that those with ASD had lower adaptive functioning in the areas of communication and socialization, and less difference for daily living skills (Jacobson and Ackerman, 1990; Klin et al. 2007; Perry et al. 2009; Tomanik et al. 2007).

Factors Associated with DLS in ASD
The VABS-3 authors (Sparrow et al., 2016) suggested several reasons that may affect performance of daily living activities, such as not yet having learned the behaviors, not being physically able to perform the behaviors, not being expected or allowed to perform the behavior, choosing not to or not being aware of the need to perform the behavior. Research has frequently explored the association between individual factors (e.g., cognitive ability, age, mental health and executive function), but less is known about environmental factors (i.e., opportunity). In the following section, research in these areas will be discussed.

**Cognitive ability and developmental level**

Similar to studies that examined the associations between cognitive ability and broad adaptive functioning, analyses focusing on DLS have yielded similar results. Cognitive impairment is associated with lower levels of DLS functioning in individuals with (Bal et al., 2015; Klin et al., 2017; Smith et al., 2012; Tillman et al., 2019) and without ASD (Klin et al., 2007, Perry et al., 2005). While IQ is an important factor, Matson et al. (2009) reported that participants with ID scored higher in daily living and self-help skills in comparison to those with ASD only, suggesting that ASD had an even greater impact on DLS.

While autistic individuals may perform relatively better on DLS skills than on conceptual and social skills, there often remains a discrepancy between levels of DLS and what is expected based on cognitive ability and age (consistent with that seen between overall adaptive function and IQ). In a sample of 417 autistic adolescents without cognitive impairment, Duncan and Bishop (2013) grouped the participants into three groups based on FSIQ level (FSIQ 85-89, 100-114, > 114) and observed that in more than half of the participants across all groups, their FSIQ scores on a standardized assessment were at least 1 standard deviation higher than their DLS scores.
Hence, while cognitive ability is an important factor, non-cognitive factors likely also play a role in the acquisition and performance of DLS.

**Age-related changes in adaptive skills**

As individuals grow older, adaptive skills are expected to continue to develop throughout childhood and into adulthood. Several studies have documented a negative association between chronological age and standardized scores on measures of adaptive function in autistic adolescents and adults. This apparent decrease in standardized scores does not reflect a loss of skills, but rather that autistic individuals are not acquiring adaptive skills at the same rate as their typically developing peers. As a result, the difference between autistic individuals and their typically developing same-aged peers was increasing with age (Klin et al., 2007; 2008; Mouga et al., 2015). Interestingly, that negative association was not readily replicated with the DLS domain, suggesting that DLS skills may be continuing to develop at a relatively greater pace than other adaptive skills. Consistent with this, studies examining raw scores or age equivalents demonstrate that autistic individuals show gains in skill development, with adaptive skill levels plateauing or showing slower growth in adolescence and early adulthood (Bal et al., 2015; Kanne et al. 2011; Matthews et al., 2015b; Matthews et al., 2017).

For example, in a sample of 397 autistic adolescents and adults, DLS improved during adolescence and young adulthood, but seemed to plateau as individuals approached their late 20s (Smith et al., 2012). By the end of the study period, on average, autistic adults were not yet independently performing more than one-third of the measured daily living skills. In a different longitudinal study by Bal et al. (2015), all autistic individuals seemed to gain DLS from ages 2 to 21. Only one-third, however made substantial gains (i.e., approximately a 12-year increase in DLS age equivalents), whereas the remaining two-thirds gained only 3-4 years of skills, on average.
This pattern was also observed across personal, domestic and community skills. Notably, however, even for the “High DLS” group that made the greatest gains, their skill levels fell considerably below age expectations, with an average age equivalent of approximately 14 at 21 years of age.

**Executive functioning**

Executive Functioning (EF) refers to a diverse range of skills, typically defined as top-down neurological regulation and monitoring processes (Lee, Bull & Ho, 2013), including but not limited to maintaining information in working memory, alternating efficiently between information or activities, resisting distractions and inhibiting behavioral urges. EF also includes organizational skills, including systematic planning for future tasks, organizing materials and examining quality of work before submission. Difficulties in EF are associated with lower DLS in children, adolescents and adults with ASD, with and without cognitive impairments (Ashwood et al. 2015; Granader et al., 2014; Pugliese et al., 2014; Williams et al., 2014). Pugliese et al., (2016) examined 447 children with ASD, and reported that more EF impairments in the areas of inhibition, organization/planning, organization of materials, working memory and monitoring behaviors (as reflected by higher BRIEF Metacognition Index (MCI) scores) were associated with greater impairments in DLS. Similarly, in a sample of 237 autistic adults and a range of cognitive functioning, Wallace et al. (2017) observed that more impaired overall EF (higher BRIEF Global Executive Composite scores) was associated with lower DLS. Both Gilloty et al. (2012) and Pugliese et al. (2016) identified that working memory and initiation subscales of the BRIEF were related to DLS in autistic adults with at least average cognitive functioning. According to Gilloty et al. (2012), elevated EF impairments in the area of initiation suggest that some autistic adults may have the ability to perform certain activities, but require reminders or clear instructions to begin task. As stated above, adaptive functioning measures regular performance without help,
which includes the ability to initiate task regularly, or whenever appropriate, without reminders or specific instructions each time. Therefore, better understanding the relationship between EF and DLS may guide intervention (e.g., having visual cues as reminders) to foster greater independence for some autistic adults.

**Mental health**

Anxiety and depression are few of the most identified comorbidities in ASD (Buck et al., 2014, Simonoff et al., 2008). The estimation of current and lifetime prevalence for autistic adults were 27% and 42% for any anxiety disorder, and 23% and 37% for depressive disorder, based off of studies examining these mental health comorbidities between year 2000 and 2017 (Hollocks et al., 2018). Existing studies on neurotypical adults have demonstrated that one’s functional level is negatively associated with severity of depressive (Ishak et al., 2018; Keller, 2002; Kessler et al., 2003) and anxiety symptoms (Kennedy, Lin & Schwab, 2002). Hammer-Helmich et al. (2018) study investigated 1159 outpatients with Major Depressive Disorder, and measured their functional ability by the Sheehan Disability Scale (SDS) and the Work Productivity and Activity Impairment questionnaire (WPAI). The SDS is a self-report questionnaire on functional impairment over the previous 7 days in three domains: work/school, social life/leisure activities, and family life/home duties. The participants reported elevated mean functional impairment on the SDS (M=19.2, SD=6.8). Depression severity was significantly associated with poor functional performance at p<.001 for SDS total score and all WPAI scores. However, limited studies have examined the association between mental health and adaptive functioning in autistic adults. As mentioned earlier, Wallace et al. (2016) reported that comorbid anxiety and depression were associated with general adaptive functioning deficits, including the DLS domain in VABS-II (above and beyond the influence of age, IQ and co-morbid ADHD symptoms). In a sample of 417
children, adolescents and adults, Tillman et al. (2019) reported that anxiety and depression (measured by the Development and Well-being Assessment questionnaire) did not correlate with any domains of adaptive function on the VABS-II; the authors did not provide potential factors that could explain the lack of relationship between psychiatric symptoms and adaptive functioning. Considering the high rates of mental health problems in autistic adults and limited research in this area, more attention is needed to explore how mental health may affect DLS performance in autistic adults.

**Opportunity**

A less explored possibility is the impact of opportunity on broad adaptive functioning, including on DLS performance. Considering the emphasis on typical performance in the assessment of adaptive skills, one must be provided with adequate opportunities to learn and perform DLS to allow distinction between impairments in adaptive functioning from more general limitations in ability. For example, as noted above, unclear expectations could influence self-initiation of tasks or consistency of performance. In cases of inconsistency, further distinction needs to be made between confusion because a task is not made a regular responsibility of the individual and the lack of regular opportunity to perform task.

Limited studies have examined how the presentation of opportunity, or lack thereof, affects the adaptive outcomes of youth and adults with ASD. McCollum (2016) used the Adolescent and Young Adult Activity Card Sort (AYA-ACS) to identify 26 young autistic adults’ participation in DLS activities as well as personal and environmental challenges in a variety of age-appropriate activities (e.g., household chores, job applications, care of personal health and wellness, and completion of school assignments). While a few barriers hindering participation in activities were identified, the most frequently identified barrier centralized around not having the opportunity to
participate in activities. The authors also reported that the AYA-ACS was moderately correlated with domestic skills measured by the Vineland Adaptive Behavior Scales (VABS-II), suggesting opportunity may be a factor in DLS performance. Cheak-Zamora (2015) compared 13 autistic adolescents to 19 neurotypical peers and reported that most autistic adolescents agreed that their caregivers controlled most of their activities and schedules. While some enjoyed having fixed routines, others reported appreciating more autonomy (Humphrey & Lewis, 2008; Rossetti et al., 2008; Wehman et al., 2014). These studies suggest a need for caregivers to be more conscious of providing opportunities for their autistic children to develop and practice DLS. This may be especially important for autistic young adults who often live at home with their caregivers (Farley, 2009; Wehman et al., 2014), as it is likely that at least some of their daily living needs (e.g., house chores, financial responsibilities) may be taken care of by parents or shared with other household members. This could result in autistic adults having fewer opportunities to perform learned skills, or to learn and practice novel adaptive skills. As such, opportunities for learning, practice and performance have important implications for intervention. Autistic individuals whose opportunities to engage in DLS might see a rapid acquisition in skills once these opportunities are increased at home or in other settings.

In sum, there are many factors that are associated with the DLS of autistic individuals. While some factors have been studied in autistic adults (i.e., IQ and age), many studies focus primarily on children and adolescents. Studies considering the influence of executive function, mental health and provision of opportunities are needed to inform development of supports for autistic adults to enhance their daily independence and quality of life.

**Measurement of DLS**
Two of the most commonly used adaptive functioning measures are the Vineland Adaptive Behaviors Scales (VABS; Sparrow et al., 2005; Price et al., 2018; Pugliese et al., 2015) and the Adaptive Behavior Assessment System (ABAS; Harrison and Oakland, 2003; Price et al., 2018). The majority of extant literature on DLS (and adaptive function more broadly) has focused on parent or caregiver report on these instruments, though forms for teachers and self-report are available. Each measure contains a domain that examines the practical area of adaptive behaviors, namely the Daily Living Skills (DLS) and the Practical (PRAC) domain in the VABS and ABAS respectively. Both DLS and PRAC target similar skill sets with both overlapping and distinct questions, which will be further delineated below.

*The Vineland Adaptive Behavior Scales, 3rd edition - Comprehensive Interview Form*

The Vineland Adaptive Behaviors Scales (VABS; Sparrow et al., 1984; 2005; 2016) is one of the most used measures for assessing adaptive functioning in individuals with and without ASD. The VABS has both interview and questionnaire forms, though the interview has been most used in research. The interview form is conducted in a semi-structured format, allowing the examiner to acquire specific examples of skills and behaviors, and is designed for use with caregivers of infants through adults up to the age of 90+ years (Sparrow et al., 1984, 2005, 2016). The three primary domains of VABS are Communication, Daily Living Skills and Socialization (a fourth domain, Motor Skills, is only used for assessment of young children). In the current version (Vineland-3), each domain is comprised of three subdomains. Within each subdomain, items are rated on a 3-point scale, where 2 reflects always (or almost always) performing the behavior when needed (without reminders and without help), 1 reflects sometimes performing the action without help, but sometimes failing to do it or needs prompting and 0 indicates that the participant never (or very seldom) performs a behavior independently (Sparrow et al., 2016). While the semi-
structured format also allows collection of detailed information regarding factors that may affect the individual’s day-to-day use of adaptive skills, reasons underlying frequency of performance are not considered in the scores. The VABS was standardized in a large normative US sample. Each domain and the overall Adaptive Behavior Composite result in a standard score, with a mean of 100 and a standard deviation of 15 (scores between 86 and 114 are considered “Adequate” on this instrument). Each subdomain yields a standardized v-scale scores (Mean=15, SD=3) and age equivalents, which provide a developmental estimate of the individual’s level of adaptive skill in that subdomain.

Assessing DLS using the VABS-3. The VABS-3 DLS domain includes the Personal, Domestic and Community subdomains. The Personal subdomain includes a range of self-care skills ranging from basic feeding skills (drinking and eating without spilling) to elements of dressing and hygiene (e.g., buttoning shirts and showering) and health management (e.g., exercise, medication). The Domestic subdomain includes a range of household chores with varying degrees of complexity (e.g., cleaning up after play and meals, doing laundry, using kitchen tools and appliances, preparing meals) and securing home against intruders. The Community subdomain covers a broad range of skills that are important to navigating situations outside of home, such as understanding and use of money (ranging from understanding value of coins to paying for goods, earning money and managing own finances). This subdomain also assesses EF-related skills and tasks (e.g., concepts of time; short- and long-term planning), travel independence and understanding of personal rights (e.g., medical records, accessing or discontinuing services).

The Adaptive Behavior Assessment System, 3rd edition – Adult Form (rated by others)

The Adaptive Behavior Assessment System (ABAS) is another frequently used adaptive measure in autism research (Kenworthy et al, 2008; Kraper et al., 2017; Woolf, Woolf & Oakland,
This instrument has separate forms for children (5-21) and adults (16-89). In contrast to the semi-structured interview format of the VABS-3, the ABAS-3 Adult Form is a questionnaire which can be rated by either the caregiver or the adult themselves. The ABAS-3 Adult form includes three domains comprised of 2-5 subdomains (referred to as “skill areas”): Conceptual (skill areas: Communication, Functional Academics, Self-Direction), Social (skill areas: Leisure, Social), and Practical (skill areas: Self-Care, Home Living, Community Use, Health and Safety and Work), as well as an overall General Adaptive Composite (GAC). ABAS items are scored on a four-point response scale. Scores of 3 reflect always (or almost always) performing the behavior when needed (without reminders and without help), 2 reflects sometimes performing the behaviors when needed and 1 reflects never (or almost never) performing the behavior when needed. The score of 0 indicates not having the ability to perform behavior due to many possible factors, including being too young, not being able to master the skill or not having been given the opportunity to learn the skill (Harrison and Oakland, 2015). The ABAS was standardized in a large normative US sample. Each domain and the General Adaptive Behavior Composite result in a standard score, with a mean of 100 and a standard deviation of 15 (scores between 90-109 are considered “Average” on this instrument). Each subdomain yields a standardized scaled score (Mean=10, SD=3).

**Assessing PRAC using the ABAS-3 Adult Form.** In contrast to the VABS-3 DLS domain having three subdomains, the ABAS-3 PRAC domain has five skill areas, namely Community Use, Home Living, Health and Safety, Self-care and Work. The Community Use skill area includes navigating streets and shops, using money or cards for purchases and assessing relevant services (e.g., repair shops). Home Living skill area primarily covers all domestic chores-related skills (e.g., making bed, cleaning, laundry) and contains only one item related to money (paying bills).
Health and Safety skill area comprises items assessing safe use of appliances, taking medications and avoiding risky social situations. The Self-care skill area contains dressing and personal hygiene skills. The Work skill area is only completed if the individual is at or above the age of 16 and has held a part-time or full-time job. Completion of the PRAC domain with or without the Work skill area does not affect the final standardized score of the PRAC domain, since different normative populations were used for those with and without work experiences. The Work skill area focuses on skills needed to navigate employment settings (e.g., cleaning up after self, keeping job for at least 1 year, showing teamwork, performing extra work on the job, verifying wages to ensure proper amount paid).

**Comparison of VABS-3 and ABAS-3 Adult Form**

In addition to different formats (i.e., usually caregiver interview for VABS-3 and questionnaire for ABAS-3), the biggest difference between the two measures is the scoring metric: the VABS-3 measure contains only choices of whether one performs a skill regularly, while the ABAS-3 has an option for “no ability”. In addition, while there is a great deal of overlap in both the type and specific tasks assessed across VABS-3 DLS subdomains and ABAS-3 Practical skill areas, there are also many notable differences. The VABS-3 Community subdomain and ABAS-3 Community Use skill area both include navigating streets and shops, using money or cards for purchases and assessing relevant services (e.g., repair shops). The ABAS-3 Self-care skill area contains dressing and personal hygiene skills, while the Home Living skill area primarily covers household chores (e.g., making bed, cleaning, laundry), which are highly similar to skill sets targeted in the VABS-3’s Personal subdomain and Domestic subdomains respectively. The ABAS-3 Health and Safety skill area comprises of using appliances safely, taking medications and avoiding risky social situations (maps onto the Coping Skill subdomain within the Socialization
domain in VABS-3, i.e., not part of the DLS domain). While the ABAS-3 Work skill area overlaps with a few skills in the VABS-3 DLS domain (e.g., cleaning up after self, keeping job for at least 1 year), many do not overlap with any items from the VABS-3 interview form (e.g., showing teamwork, performing extra work on job, and verifying wages to ensure proper amount paid).

The original ABAS-3 validation (Harrison & Oakland) was published in 2015, prior to the release of the VABS-3 in 2016, therefore, the authors of the ABAS were only able to compare ABAS-3 to VABS-II. These data supported the concurrent validity of the ABAS-3 Parent Form and the VABS-II Parent/ Primary Caregiver Forms with moderate-to-strong correlations between the ABAS-3 Skill areas and VABS-II domain scores. The authors did not compare VABS-II Interview Form to any of the ABAS-3 forms. Thus, despite different formats, questions and scoring systems on their response scales, these data support that both instruments are generally capturing similar elements of adaptive functioning. To date, there has been very limited research that compared the third editions. A recent article published by Tamm et al. (2021) was one of the first studies that compared VABS-3 Interview Form and ABAS-3 Parent/ Caregiver Ratings Forms through examining the scores of 62 adolescents between the ages of 14 to 18 with ASD. The study reported that while both measures strongly correlated with each other in the practical domain (r= 0.61), the “logically equivalent” subtests between measures for the practical area had mainly moderate correlations (r values between 0.24 to 0.56). The Work skill area of ABAS’ PRAC domain was not examined in relation to VABS-3. Notably, ABAS-3 PRAC scores were significantly higher than VABS-3 DLS scores by an average of 16 standard score points, which is approximately one standard deviation. Authors reported that this difference was unexpected, as previous studies examining the second editions of the measures found the exact opposite results with higher scores on the VABS-II. For example, Lopata et al. (2013) reported that while ABAS-
II Parent Form and VABS-II Parent/ Caregiver Rating Form had moderate correlations across all conceptually similar domains and subdomains in a sample of 50 children (ages 6 to 11). VABS-II yield significantly higher scores than the ABAS-II across all domains. Specifically for the Daily Living Skills/ Practical domains, the measures differed by an average of 13.5 points. Similarly, in a sample of 352 participants (ages 1.5-20.8) with ASD, Dupuis, Moon, Brian et al., (2020) reported significantly higher scores on VABS-II Interview Form across all domains in comparison to ABAS-II Parent Form, resulting in significantly more participants falling in the low adaptive function range on the ABAS-II than on the VABS-II. The potential reasons for differences in cross-measure comparisons between the second and third editions were not examined by existing studies. Some potential reasons may include ABAS-3 adult form focusing on adaptive behaviors that are required in adulthood, while the VABS-3 spanning child and adulthood adaptive functioning with the same item set; hence the VABS-3 has relatively fewer items to assess adaptive skills in adulthood to inform intervention planning for adults. It is also possible that the difference in ABAS-3 and Vineland-3 scoring (i.e., that ABAS-3 scoring differentiates lack of performance due to not being able to perform the skill) may influence measure comparisons. With the most recent study producing completely opposite results from past studies, further research is needed examine the correspondence between these measures.

**Capturing the Reasons for Not Performing Certain Adaptive Skills**

As previously mentioned, the biggest difference between the scoring metrics of VABS-3 and ABAS-3 is that the ABAS-3’s score of 0 accounts for the rated individual not having the ability to perform a skill. However, since the items’ scores are totaled to obtain a standardized score for each skill area, the scores do not indicate how many, or which items were scored 0. That is, one has to review the completed measure to locate items that the rated individual has not yet learned.
More importantly, the 0 score does not provide the reason(s) of why the skill was yet learned. For example, an adult with a severe to profound cognitive impairment may not have the requisite knowledge of math concepts needed to support understanding the concept or use of money. Whereas another individual may be capable of performing a task, but has never been given the opportunity to learn how to do this (e.g., an adult who does not call others when late because the caregiver always takes care of this or initiates checking in). Thus, scores do not differentiate individuals whose adaptive skills are affected by the different factors discussed in Chapter 2. Moreover, on the VABS-3, the distinction between lack of performance and lack of ability is even further muddied, as scores of 0 would be used to capture either. Thus, a major limitation of both instruments is the emphasis on the individual’s observable behaviors; hence discounting the fact that many factors may affect actual performance. While the authors of both measures acknowledged this issue in the manuals, and the ABAS-3’s score for “no ability” seems to compensate partially for this, further understanding how opportunity for performance influences scores on the standardized measures may have important implications for our use of these instruments as a treatment outcome measure.

Beyond implications for measurement of DLS, advancing understanding of factors affecting performance has important clinical implications. Failure to capture the nuances underlying lower adaptive function may place undue burden on the individual by suggesting this person has “impairments” in adaptive functioning when, in reality, external factors (e.g., opportunities) are affecting their daily performance of tasks. Therefore, when learning that someone seldom or never performs a task independently, it may be particularly important to differentiate individuals who do not perform because of a lack of prerequisite skills (i.e., they are unable to), those who have the skill but choose not to perform the task, and those who have not
had the chance to learn or perform skill regularly. Within those who are perceived as “choosing” not to perform the task, it is also important to consider whether a conscious choice is being made or if performance is affected by other factors (e.g., mental health; executive functioning difficulties). These distinctions are important to inform intervention planning, as each may be addressed in a different manner. As mentioned earlier, most existing interventions and research studies on skill acquisitions for those with ID, ASD and other neurodevelopmental disorders tend to focus on skill development but place less emphasis on the factors that may reinforce poor adaptive functioning, e.g., motivation or ensuring adequate opportunities. In such cases, addressing factors that could reinforce regular performance of DLS is as important as teaching those skills. For example, if the cause of the deficit is lacking motivation, helping to see value in performing the task or putting a reinforcement system in place may suffice. If there is a lack of opportunity, the first step of treatment might be examining family and individual expectations and identifying ways to create occasions in which the individual is required to complete the task. Thus, a more nuanced view of DLS performance will critically inform development of targeted interventions and personalized recommendations to promote skill acquisition and greater independence.

**Current Study and Specific Aims**

Studies that examine adaptive functioning in autistic individuals have been growing, yet more work is needed to identify factors that contribute to the acquisition and maintenance of adaptive skills, particularly in adulthood. While practical skills or DLS are often seen as a relative strength of autistic individuals (Duncan & Bishop, 2013; Klin et al; 2017), they remain lower than that of neurotypical peers and are closely related to independent living in adulthood (Farley et al., 2009). Their amenability to intervention further supports more targeted study of DLS, but likely will require a multifaceted approach to address other areas (e.g., executive functioning, comorbid
anxiety and depression, and opportunities) that may impede autistic adults’ ability to perform learned skills in their daily lives. The present study aims to fill a gap in our understanding of factors that affect DLS performance in older autistic adolescents and young adults and explore ways in which those different factors affect scores on commonly used instruments of adaptive functioning, the VBAS-3 and ABAS-3.

This was achieved through four specific aims.

1) Described relationships between individual characteristics (i.e., executive functioning; cognitive impairment; clinically elevated internalizing symptoms) and parent-reported DLS of autistic adolescents and adults.

   a. It was hypothesized that poorer DLS performance would be associated with greater impairments in executive functioning and the presence of cognitive impairment or clinically significant internalizing symptoms.

   b. It was hypothesized that autistic individuals across the range of cognitive abilities would show a clinically significant discrepancy between their DLS and IQ scores.

2) Explored the extent to which different factors [i.e., inability attributed to cognitive impairment, non-cognitive impairments (e.g., weak muscle tone, sensory sensitivity), able but requiring reminders, no opportunity] affected DLS performance in autistic adolescents and adults. This was achieved by using a novel coding system to capture the frequency with which factors of interest are reported. As this was a descriptive aim, no specific hypotheses were being made.

3) Described the relationships between individual characteristics (i.e., NVIQ, EF and Internalizing symptoms) and the above factors of interest.
a. It was hypothesized that individuals with average and above average cognitive functioning would have a higher percentage of items that were reported as seldom or never completing DLS tasks (i.e., score=0) due to not having an opportunity (code: No Chance) or motivation (code: Able-reminded), than individuals with below-average cognitive functioning.

b. It was hypothesized that individuals with under average cognitive functioning would have a higher percentage of items reported as seldom or never completing DLS tasks due to a perceived lack of ability attributed to cognitive impairment (code: Unable- cognitive).

c. It was hypothesized that not performing DLS tasks due to a perceived lack of ability attributed to other, non-cognitive reasons (code: Unable- other), would not be associated with individual characteristics.

4) Explored the extent to which reasons for not performing adaptive skills affected Vineland DLS scores and examined associations between the scores of the VABS-3 DLS and ABAS-3 PRAC domains. Differences between these adaptive scores and the participants’ NVIQ were also examined.

**METHODOLOGY**

**Participants Characteristics**

Caregivers of 37 participants were interviewed by this author. Four participants were removed from this study: three did not have interview recordings and one was not asked follow-up questions that allowed for coding. The project consists of 33 participants (see Table 1 below), ranging in age from 16-35 years ($M=22.2$, $SD=4.3$). Participants were referred to the Rutgers Center for Adult Autism Services Psychological Services Clinic (RCAAS PSC) for clinical
diagnostic evaluations \((n=10)\) or the Lifespan Symptom Profiles, Achievements & Needs in Autism Spectrum Disorder (LifeSPAN ASD) Lab for research purposes \((n=23)\). For the clinical sample, participants’ caregivers completed the Vineland interview as part of the diagnostic assessments for autism. For the research sample, the VABS-3 survey interview form was administered to the caregivers as part of the participants’ involvement in the Supporting Community Access through Leisure and Employment (SCALE) program \((n=17)\) and the College Support Program (CSP) \((n=6)\). All eligible participants had a diagnosis of autism spectrum disorder, confirmed by direct assessment.

<table>
<thead>
<tr>
<th>Participants Demographics and Characteristics ((N=33))</th>
<th>All</th>
<th>NVIQ&gt;85</th>
<th>NVIQ&lt;85</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>33</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>Age (M, SD)</td>
<td>22.2 (4.3)</td>
<td>21.5 (4.41)</td>
<td>24.0 (3.65)</td>
</tr>
<tr>
<td>No. participant age &lt; 18</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>No. of female</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Racial Distribution (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European origin/ White</td>
<td>72.7</td>
<td>69.2</td>
<td>85.8</td>
</tr>
<tr>
<td>African- American/ Black/ African origin</td>
<td>6.06</td>
<td>3.85</td>
<td>14.2</td>
</tr>
<tr>
<td>Asian American/ Asian Origin/ Pacific Islander</td>
<td>21.2</td>
<td>26.9</td>
<td>0.00</td>
</tr>
<tr>
<td>NVIQ Standard Score (M, SD)</td>
<td>88.9 (29)</td>
<td>104.3 (13.1)</td>
<td>50.5 (23.6)</td>
</tr>
<tr>
<td>VIQ Standard Score (M, SD)</td>
<td>89.8 (31.3)</td>
<td>106 (18.4)</td>
<td>48.1 (21.7)</td>
</tr>
</tbody>
</table>

M= mean; SD= standard deviation; NVIQ: non-verbal intelligence quotient; VIQ: verbal intelligence quotient

**Measures**

*Adaptive Functioning – primary measure*

The *Vineland Adaptive Behavior Scales – Third Edition: Comprehensive Interview Form (VABS-3)* is a semi-structured interview to elicit information about the participant’s adaptive functioning from their caregivers or informants. As described above, the VABS-3 consists of three domains: Communication, Daily Living, and Socialization, each comprised of three subdomains. The two optional domains, Motor Skills (for ages birth through age 9) and Maladaptive Behavior
(for ages 3 through adult) were not administered. Each domain and the overall Adaptive Behavior Composite result in a standard score, with a mean of 100 and a standard deviation of 15 (scores between 86 and 114 are considered “Adequate” on this instrument). Each subdomain yields a v-scale (VS) scores ($M=15$, $SD=3$) and age equivalents (AE), which provide an estimate of the individual’s level of adaptive skill in that subdomain. VABS items are scored on a 3-point scale of 2, 1 or 0 point. If the caregiver has not had the opportunity to observe a behavior, they were asked to estimate the frequency of the behavior, and the examiner tracked the number of estimated items; subdomains with more than three estimated items are not considered valid. Analyses utilized v-scale and AE from the Personal, Domestic and Community subdomains and DLS domain standard score.

**Adaptive Functioning – comparative measure**

The *Adaptive Behavior Assessment System- Third Edition (ABAS-3)* Adult Form (Ages 16-89) is a comprehensive measure of adaptive functioning in the home and community. While the forms were completed by both caregivers and participants, only caregiver-reported data were used for this study. As described above, the ABAS consists of three domains (Conceptual, Social and Practical) and 10 subdomains, as well as an overall General Adaptive Composite (GAC). Domain scores have a norm-referenced mean of 100 and standard score of 15, while the subdomains have a norm-referenced mean of 10 and standard score of 3. ABAS items are scored on a four-point response scale of 3, 2, 1 or 0 point. The Practical domain (PRAC) of the ABAS-3 Adult Form (rated by informant) was utilized as a comparison measure for the VABS-3 DLS domain in this study. This study examined the PRAC domain standard score only. The skill areas within the PRAC domain were excluded from analyses since the focus was to compare domain-level scores between the DLS of VABS-3 and ABAS-3.
Comparison of measures. To account for the different floors of the measures (i.e., VABS-3=20, ABAS-3 =50), participants with original VABS-3 DLS scores under 50 had their DLS scores changed to 49. The variable was labelled as “DLS (49)”.

Cognitive Functioning

Nonverbal IQ (NVIQ) scores were used as a measure of cognitive ability. Scores were derived using the following hierarchy of measures: the Wechsler Adult Intelligence Test, Fourth Edition (Wechsler, 2008), Wechsler Abbreviated Scale of Intelligence, Second Edition (Wechsler, 2011), Differential Abilities Scale, Second Edition (Elliott 2007), Mullen Scales of Early Learning (Mullen 1995). Instruments were selected according to the ability of the participant; where instruments were used out of normed age range (e.g., Mullen for an adult), ratio IQs were computed by dividing the average age equivalents for nonverbal subtests by chronological age and multiplying by 100, consistent with best clinical practices in autism assessment (e.g., Bishop et al., 2015). Participants were split into two IQ groups, those with NVIQ at or above 85 (NVIQ≥85; n=23) and those with NVIQ under 85 (NVIQ<85; n=10).

Executive Functioning

The Behavior Rating Inventory of Executive Function Adult form (BRIEF-A) is a standardized measure that assesses an individual’s executive functions or self-regulation in his or her everyday environment for individuals ages 18 and older. Parent-rated forms were used for this study. One participant was removed from analysis because he was under 18 years of age. The BRIEF-A has 75 items comprising two domains: Behavioral Regulation Index (BRI) and Metacognition Index (MI), as well as an overall Global Executive Composite (GEC). The BRI is further divided into three scales (initiate, emotional control, shift) and the MCI is divided into five scales (inhibit, organize/plan, organization of materials, working memory, monitor). T-scores at
or above 65 on the BRI, MI and GEC are considered clinically elevated. Participants were split into two executive functioning groups of those with elevated scores (i.e., GEC ≥ 65) and those with scores within the average range (GEC < 65). Twenty-three participants had informant-reported BRIEF-A scores, with six adults (26%) in the GEC ≥ 65 group.

**Mental Health Indicators**

The Achenbach Adult Behavior Checklist (ABCL)/18-59 is a parent-report measure of emotional, behavioral, and social functioning in adults aged 18 to 59 years. There are three broad problem scales (Internalizing, Externalizing and Total Problems) and eight syndrome scales. Each of the scales yields standardized scores that allow for comparison with adults of the same age and gender (T-scores with a mean of 50 and a standard deviation of 10). On the broad problem scales, scores above 60 are considered to be in the “Borderline Clinical” range and scores above 63 are considered to be in the “Clinical” range. On the syndrome scales, scores above 65 are considered to be in the “Borderline Clinical” range, while scores above 70 are considered to be in the “Clinical” range. Clinically elevated T-score (i.e., T ≥ 63) on the ABCL Internalizing broad problem scale, which consists of three syndrome scales (i.e., Withdrawn, Somatic and Anxious/Depressed), were used as an indication of anxiety and/or depressive symptoms. Participants were split into two internalizing symptom scale groups of those with elevated scores (i.e., ABCL-INT ≥ 63) and those with scores within the average range (ACBL-INT < 63). Twenty-eight participants had ABCL score, with 11 (35.7%) adults in the ABCL-INT ≥ 63 group.

**Assessment procedures**

**Clinical Assessment Procedures**

The clinical assessments comprised two sessions. In the first session, the participant’s caregivers were administered the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003)
and VABS-3, along with questionnaire packets that included BRIEF-A and ABCL. In the second session, the participants were administered the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012) Module 4 and cognitive tests, academic assessments, and self-report questionnaires to assess mental health, executive functioning and adaptive skills. All assessments were conducted in-person by trained graduate student clinicians and directly supervised by a licensed clinical psychologist.

**Research Assessment Procedures**

Participants recruited for research purposes were administered the ADOS-2 Module 4 or an adapted version of the ADOS for minimally verbal adolescents and adults (Bal et al., 2020). They also completed cognitive tests and self-report questionnaires if able. Caregivers participated in a phone or videoconference interview to complete the VABS-3 and gather information regarding participants’ education, current jobs or positions, daily schedules and previous diagnoses.

**Adaptive Functioning Interview Procedure**

Since this study focused specifically on DLS skills, the VABS-3 administration was modified for only the DLS domain (i.e., Personal, Domestic and Community subdomains). For each DLS item on which a participant received a score of zero, the examiner followed-up with additional questions to identify the reasons that the participant did not exhibit the skill (if reasons or examples were not apparent from the caregiver’s response). The follow-up questions began with open-ended questions (e.g., *Tell me more*, or *Can you explain why they are not doing it*?), which tended to elicit responses that were sufficient for coding purposes. However, if the informant provided limited responses, additional close-ended questions were asked (e.g., *Are they not doing because they are not interested in performing, or they are not required to perform it?*).
Coding Categories and Procedures

Development of Coding Scheme

A coding scheme was developed to capture the reason an item was rated as “Never or seldom” based on the reasons that the VABS-3 authors (Sparrow et al., 2016) suggested respondents may endorse a rating of zero. As noted above, the reasons are: the examinee (a) has not yet learned the behaviors (e.g., using pronouns correctly), (b) is not physically able to perform the behaviors (e.g., writing, running), (c) is not expected or allowed to perform the behavior (e.g., cooking or using tools), (d) can perform the behavior, but chooses not to (e.g., following household rules and (e) is not aware of the need to perform the behavior. The initial coding scheme had three codes: Able but does not perform, Not able to perform due to not having ability and Not provided with opportunity to learn or perform. Based on review of the first two interviews, it was apparent that these categories could be further divided into subcategories, leading to the final coding scheme comprised of four summary codes and five reason codes (see Table 2).

Summary and Reason Codes

An overview of codes is provided in Table 2 below. The following provides the characteristics and a few examples on each summary and reason codes. See Appendix for codebook, which provides more examples on responses that fall under each code.
Table 2

*Categorization and Definition for Summary and Reason Codes*

<table>
<thead>
<tr>
<th>Summary Codes</th>
<th>Definition of Summary Codes</th>
<th>Reason Codes</th>
<th>Definition of Reason Codes</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Does not do</td>
<td>Has had regular chances to perform skill, but fails to perform regularly</td>
<td>(a) Reason Unknown/ Unclassified OR confounding reasons provided&lt;sup&gt;2&lt;/sup&gt;</td>
<td>response does not provide reasons for not performing task regularly. <em>(ability to perform task unknown to parent or interviewer)</em> OR Follow-up question not asked OR Response falls on more than one reason code</td>
<td>Unspecified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) Unless reminded OR Does not perform even when reminded</td>
<td>Not performing—chooses not to or doesn’t care to perform. Has a “conscious” factor to it. <em>Able to perform task if made to perform.</em></td>
<td>Able-reminded</td>
</tr>
<tr>
<td>2) Not Able to do</td>
<td>has had chances to learn or perform skill, with clear deficit in mastering the skill OR inability to regularly perform skill due to factors not attributed to conscious choices</td>
<td>(c) Not able to do—cognitive (intellectual, conceptual)</td>
<td>Participant has been taught, but can’t master at independent level OR Participant doesn’t have prerequisite skills or sufficient cognitive abilities <em>(prior attempts to teach may be null)</em></td>
<td>Unable-cognitive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) Not able to do—non-cognitive</td>
<td>Participant had chance to perform or learn, but can’t perform skill due to non-cognitive reasons (e.g. sensory sensitivity, weak muscle tone)</td>
<td>Unable-other</td>
</tr>
<tr>
<td>3) No Chance</td>
<td>Not provided with opportunity to learn/perform task OR not provided with consistent opportunity/requirement to perform task</td>
<td>(e) Never had chance to assess performance / Never had regular chance to perform skill</td>
<td>Participant was never asked to, or never had chance to perform skill. <em>Ability to perform skill if required is unknown to parent or interviewer</em> OR No Regular Opportunities: While Opportunity had occurred, the task was not made a requirement that the participant has to regularly fulfill. Hence, participant never had regular chance to showcase skill</td>
<td>No Chance</td>
</tr>
</tbody>
</table>

<sup>2</sup> Previous coding system had one additional summary code i.e., Code 4: *Confounding Factors*, to allocate for responses that fell on more than one of the five reason codes (see Codebook in appendix). However, results indicated that this code was utilized for less than 1% of all 0-score items within the DLS domain. Since both Code 1a (reasons unknown) and Code 4 do not provide meaningful reasons to explain lack of DLS task performance, these codes were collapsed as one, and interpreted as one throughout all analyses.
“Does Not do”. This summary code indicates that the participant has had regular opportunity to learn and perform the skill, but did not independently perform the skill regularly, or whenever required. This category is further split into two reason codes: (a) Reasons Unknown OR Unclassified, in which the informant’s response was insufficient for coding purposes, and (b) Unless reminded OR Does not perform even when reminded, in which the participant has demonstrated clear ability in performing task, but does not do so unless prompted, or rarely performs skill even when prompted. This reason code was specifically allocated to responses that provided definite statements on participant being able to perform skill, but required prompts or reinforcements at varying degrees to evoke the target behavior. Reasons under code 1(b) of does when reminded vs. does not do even when reminded were not differentiated because both captured having the ability to perform; the only difference was participant’s compliance to command, which could be impacted by a number of other factors not measured.

“Not Able to Do”. This summary code indicates that the participant has had opportunity to learn or perform the skill, but has impairments that prevent mastery of the skills at independent level. This category is further split into two reason codes: (c) Not Able to Do - Cognitive Reasons, reflecting parents’ perceptions that the participant is not able to master the skill due to level of intellectual disability, and (d) Not Able to Do – Non-Cognitive Reasons, in which the participant fails to master skills due to other non-cognitive factors, including but not limited to weak muscle tone, sensory sensitivity, food aversion, executive functioning deficits (e.g., consistent difficulty with following multi-step instructions or instructions that required delayed execution, not related to factors of motivation), anxiety and medical conditions.

“Never had chance to assess performance/ Never had regular chance to perform skill”. This summary code indicates that the participant either did not have any opportunity to learn or
perform the skill (i.e., the ability to perform skill is unknown), or was not provided with consistent opportunities or requirements to perform skill (i.e., participant had shown ability to perform skill on one or few occasions, but did not have chance to consistently perform it). This code was also used to capture if the participant has not been exposed, or required to learn about certain concepts (e.g., rights to medical records).

“Not Able to Do”. If informant describes the participant as not having the pre-requisite skill to learn a skill and hence, never provided learning opportunity (e.g. not teaching participant how to use a stove given participants difficulty with navigating the microwave – a task that is deemed simpler than using the stove); the code would be coded under “Not Able to Do”. The abbreviations of the reason codes as shown in Table 2 will be referenced throughout the rest of the paper.

**Coding Procedures**

All items before the individual’s ceiling (i.e., 4 subsequent items scored 0) that received a score of zero in the DLS domain were coded using the coding scheme outlined in Table 1. The interview portion for those items were transcribed verbatim; transcripts were then coded by the author and another student who was blind to the participants’ diagnoses, IQs and ages, to minimize chance of rater bias. The rater was trained by this author with a combination of written instructions, in-vivo coding and feedback. A codebook similar to the version in the appendix was constructed prior to the training and used as a guide as the author demonstrated how the responses would be coded, using data from one participant. For the second participant, both author and student independently coded one item at a time and compared codes immediately; feedback from the student were used to modify reason codes and refine definition of codes in the codebook.
After this in-vivo coding session, the student was assigned three participants to code independently, and met an average reliability criterion of 80% for both summary and reason codes. Then, the student and this author began coding the responses independently. The author assigned two to four participants to be coded at a time. After those participants were coded, this author generated inter-rater reliability (IRR) to ensure that average reliability remained above 80%, and both author and student met for consensus discussion, before the next few participants were assigned for coding. This process was repeated for seven times to complete coding for all participants. The first two participants that were used for training were excluded from the final IRR calculation. The three participants used in the first round of coding to assess reliability criterion were re-coded again after 6 weeks. The updated coding reliability for these three participants were included in the final IRR calculation.

**Inter-Rater Reliability**

IRR scores was obtained for both summary ($M= 87.6\%$) and reason codes ($M= 84.5\%$). Excluding the two participants whose data were used for training purposes, this author and the student independently reviewed 93.9\% ($n=31$) of the VABS interviews and compared our codes. We used trial-by-trial IRR, by computing the percent of items with 0 score, in which both raters were in exact agreement on the reason codes assigned to 0-score items over the total number of 0-score items. The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100%. IRR ranged from 85.7\%- 100\% for summary codes and 75\%-100\% for reason codes. All disagreements were discussed between the coders and consensus codes were used for analyses.

**Allocating Raw Points to 0-scored Items Based on Reason Codes**
For items previously scored as 0 (per the standard VABS-3 guidelines), scores of zero, one or two points were assigned to each code based on their definitions, as described below in Table 2. For each subdomain, the total assigned scores for all items with a prior score of zero were added to the raw score of the subdomain to yield an adjusted raw score. The modified scores of each participant were then used to derive adjusted DLS domain standard score, adjusted subdomain V-scale scores and adjusted subdomain Age-Equivalent scores.

### Table 3

**Assignment of additional points to Subdomain raw score based on estimated mastery ability**

<table>
<thead>
<tr>
<th>Points added to 0-score item</th>
<th>Estimated ability to perform skill without assistance</th>
<th>Code Name</th>
<th>Definition of codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Clear ability to perform when asked to</td>
<td>Able-reminded</td>
<td>- Unless Reminded or Does not Perform even when reminded</td>
</tr>
<tr>
<td>1</td>
<td>Might be able to perform skill if asked to OR might be able to master skill if taught</td>
<td>Unable-other</td>
<td>- Unable to master due to non-cognitive reasons</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Chance</td>
<td>- No chance to assess performance, or regular chance to perform skill</td>
</tr>
<tr>
<td>0</td>
<td>Chance of mastering skill is perceived to be low OR information collected is insufficient to determine possibility of mastering skill</td>
<td>Unable-cognitive</td>
<td>- Unable to master due to cognitive reasons</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unspecified</td>
<td>- Reasons Unknown or Unclassified</td>
</tr>
</tbody>
</table>

**ANALYSES**

The study aims were analyzed as follows:

**Aim 1**

Relationships between individual characteristics (i.e., NVIQ, executive functioning measured by BRIEF-A [Behavioral Regulation Index (BRI), Metacognition Index (MI) and overall Global Executive Composite (GEC)], and ABCL Internalizing broad problem scale) and the VABS-3 DLS (domain and subdomain standard, v-scale and age equivalents), and the ABAS-3 PRAC domain standard score were examined using *Pearson correlations*. Independent sample *T-tests*
were also used to compare the VABS-3 DLS domain and subdomain scores, and the ABAS-3 domain score of groups divided on clinically significant characteristics (i.e., NVIQ ≥ 85 vs. NVIQ < 85; BRIEF GEC ≥ 65 vs. GEC < 65; ABCL Internalizing ≥ 63 vs. Internalizing < 63). To understand the relative contributions of each of the factors explored above, hierarchical regression analyses were conducted with the VABS-3 DLS serving as the dependent variable. NVIQ was entered in the first step of the model, while GEC was entered in the second step.

**Aim 2**

*Descriptive statistics* were used to describe the frequency with which Reason codes (as described in Table 2) are reported for each DLS subdomain, the proportion of 0-scored items that each code accounts for in each subdomain and the adjusted scores for each subdomain and overall domain.

**Aim 3**

*Independent sample T-tests* were used to compare the proportion of 0-scored items that each reason code accounts for between groups divided on clinically significant characteristics (i.e., NVIQ ≥ 85 vs. NVIQ < 85; BRIEF GEC ≥ 65 vs. GEC < 65; ABCL Internalizing ≥ 63 vs. < 63).

**Aim 4**

*Paired sample T-tests* were used to describe the discrepancies between the standard scores of the VABS-3 DLS domain (i.e., unadjusted and adjusted), DLS (49), adjusted DLS (49), ABAS-3 Practical domain and NVIQ.

**RESULTS**

**DLS and IQ, Executive Function, Internalizing Symptoms and Age**

**IQ**

As shown in Table 4 below, NVIQ was positively correlated with DLS subdomain scores, with the correlation being the highest for the Community subdomain VS ($r = .782$) and AE ($r = .804$).
The correlation between NVIQ and the domain scores were also large, but stronger for DLS, \((r=.701)\) than PRAC \((r=.529)\). Overall, the average DLS standard score fell in the “Low” range for both the NVIQ>85 and <85 groups (see Table 5). Independent sample t-tests between NVIQ groups as shown in Table 5 revealed that adults in the NVIQ≥85 group scored higher across all subdomains than did adults in the NVIQ<85 group), though the Domestic AE difference was not statistically significant.

| Table 4 |
| Correlations between adaptive functioning and study variables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NVIQ | - | .617 | .453 | .541 | .484 | .782 | .804 | .701 | .529 | .361 | .06 |
| 2 | Age | -.023 | - | -.170 | -.226 | .078 | .764 | -.085 | -.279 | -.179 | -.053 | -.14 |
| 3 | PERS VS | .617 | .453 | .541 | .484 | .782 | .804 | .767 | .701 | .529 | .361 | .06 |
| 4 | PERS AE \(^3\) | .090 | -.021 | .907 | .687 | .667 | .668 | .767 | .453 | .190 | .035 | \(-.36\) |
| 5 | DOM VS | .814 | .705 | .705 | .767 | .701 | .667 | .767 | .541 | .190 | .035 | \(-.36\) |
| 6 | DOM AE | .941 | -.226 | .907 | .602 | .668 | .644 | .941 | .484 | .190 | .035 | \(-.36\) |
| 7 | COM VS | .713 | .687 | .602 | .668 | .767 | .667 | .767 | -.36 | -.053 | .035 | \(-.36\) |
| 8 | COM AE | .968 | .602 | .602 | .667 | .667 | .644 | .968 | -.085 | -.279 | -.179 | -.053 | \(-.36\) |
| 9 | VABS-DLS | .877 | .767 | .767 | .745 | .745 | .745 | .810 | -.279 | -.179 | -.053 | -.14 | \(-.29\) |
| 10 | ABAS-PRAC | .821 | .777 | .777 | .754 | .754 | .754 | .810 | -.279 | -.179 | -.053 | -.14 | \(-.29\) |
| 11 | ABCL INT | .815 | .782 | .782 | .754 | .754 | .754 | .810 | -.279 | -.179 | -.053 | -.14 | \(-.29\) |
| 12 | BRIEF BRI | .557 | .891 | .891 | .852 | .852 | .852 | .557 | .529 | .179 | .035 | \(-.36\) | \(-.29\) |
| 13 | BRIEF MI | .045 | .571 | .571 | .571 | .571 | .571 | .045 | -.16 | .000 | .035 | \(-.86\) | \(-.29\) |
| 14 | BRIEF GEC | .941 | .777 | .777 | .754 | .754 | .754 | .810 | -.279 | -.179 | -.053 | -.14 | \(-.29\) |

\(a\) = Correlation is significant at the 0.05 level (2-tailed).

\(b\) = Correlation is significant at the 0.01 level (2-tailed).

Note. NVIQ= Non-verbal Intelligence Quotient; VS= V-Scale score; AE= Age Equivalent in years; PERS= VABS-3 Personal subdomain; DOM= VABS-3 Domestic subdomain; COM = VABS-3 Community subdomain; VABS-DLS= VABS-3 Daily Living Skills domain standard score; ABAS-PRAC= ABAS-3 Practical domain standard score; ABCL INT =Adult Behavior Checklist Internalizing syndrome scale; BRIEF= BRIEF-A informant report; BRI= Behavioral Regulation Index; MI= Metacognition Index; GEC= Global Executive Composite

**Executive Functioning**

As shown in Table 4, all indices of the BRIEF-A (i.e., BRI, MI and GEC) were strongly negatively correlated with the Personal and Domestic subdomains, but associations with the Community subdomain were more moderate. BRIEF-A indices exhibited moderate negative
correlations with VABS-DLS and ABAS-PRAC standard scores. Since the correlations between BRI, MI and GEC had very large effects ($r > .90$), GEC was used to group participants. Overall, the average DLS standard score fell in the “Low” range for both the GEC $\geq 65$ and $<65$ groups (see Table 5 below). Independent sample t-tests between GEC groups in Table 5 show that adults with GEC $<65$ (i.e., within average range) had higher scores across all subdomains than adults in the GEC $\geq 65$ group, though the DLS difference was not statistically significant.

**Internalizing Symptoms**

ABCL-INT score did not correlate with any of the adaptive functioning scores, nor were there any significant differences in score between the INT groups (see Table S1 in appendix). Effect sizes ranged from .10 to .55.

**Age**

Age was not associated with DLS, PRAC or any subdomains.

Table 5

<table>
<thead>
<tr>
<th>Variable (n)</th>
<th>NVIQ</th>
<th>BRIEF-GEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d</td>
<td>T $\geq 65$ (6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVIQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;85 (10)</td>
<td>50.5 (23.6)</td>
<td>104.3 (13.1)</td>
</tr>
<tr>
<td>$\geq 85$ (23)</td>
<td>54.10 (21.73)</td>
<td>106.0(18.43)</td>
</tr>
<tr>
<td>DLS SS</td>
<td>39.30(20.75)</td>
<td>69.91(18.47)</td>
</tr>
<tr>
<td>ABAS PRAC</td>
<td>61.29(9.11)</td>
<td>80.0(14.40)</td>
</tr>
<tr>
<td>PERS VS</td>
<td>5.60 (4.25)</td>
<td>9.70(3.04)</td>
</tr>
<tr>
<td>PERS AE</td>
<td>7.61(4.68)</td>
<td>11.4(4.42)</td>
</tr>
<tr>
<td>DOM VS</td>
<td>6.50(5.32)</td>
<td>10.00(3.67)</td>
</tr>
<tr>
<td>DOM AE</td>
<td>9.81(2.61)</td>
<td>12.66(3.96)</td>
</tr>
<tr>
<td>COM VS</td>
<td>4.80(3.46)</td>
<td>11.74(3.11)</td>
</tr>
<tr>
<td>COM AE</td>
<td>8.06 (4.46)</td>
<td>15.99(3.52)</td>
</tr>
</tbody>
</table>

**p < .01 level (2-tailed)**

* p < .05 level (2-tailed)
Explanatory Model of Factors Associated with Daily Living Skills

As shown in the following Table 6 regression model, NVIQ and GEC explained 49.7% of the variance in VABS-3 DLS score. Consistent with the overall sample, NVIQ was a significant predictor of DLS ($R^2=0.350$), with moderate effect size. Addition of GEC to the model resulted in an $R^2$ increase of .147 ($F (1,20)= 5.83, p=.025$) with small effect size, demonstrating that GEC accounted for a unique and significant degree of variability in DLS adaptive scores, over and above cognitive functioning. The final model demonstrated that higher NVIQ and lower GEC were associated with higher VABS-DLS standard score.

Table 6

<table>
<thead>
<tr>
<th>Predictors of DLS</th>
<th>Block 1</th>
<th></th>
<th></th>
<th>Block 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$B$</td>
<td>SE $B$</td>
<td>95% CI</td>
<td>$r_{part}$</td>
<td>$B$</td>
<td>SE $B$</td>
</tr>
<tr>
<td>constant</td>
<td>24.79**</td>
<td>12.07**</td>
<td>-.32**</td>
<td>49.89**</td>
<td>61.35**</td>
<td>18.65**</td>
</tr>
<tr>
<td>NVIQ</td>
<td>.16**</td>
<td>.69**</td>
<td>.592**</td>
<td></td>
<td>.15**</td>
<td>.63**</td>
</tr>
<tr>
<td>GEC</td>
<td>-.08*</td>
<td>-.475*</td>
<td></td>
<td></td>
<td>-.108*</td>
<td>-.08*</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.350**</td>
<td></td>
<td>.497**</td>
<td></td>
<td>.147*</td>
<td></td>
</tr>
<tr>
<td>$R^2$ change</td>
<td>.350**</td>
<td></td>
<td></td>
<td></td>
<td>.147*</td>
<td></td>
</tr>
<tr>
<td>Effect size ($f^2$)</td>
<td>.538</td>
<td></td>
<td>.172</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P<.05  
**p<0.01

Application of Reason Codes

Reason code distributions across the DLS domain

As seen in Table 7, the number of items within the DLS domain that received 0-scores ranged from 4 to 29 across participants, with a total of 476 items and an average of 14.4 items per participant ($SD=6.44$; see Table S3 in appendix). Community subdomain had the highest number of 0-score items. As shown in Table S2, all participants had at least one item that was coded as No Chance. No Chance also had the highest possible percentage of response at 100%, with two participants having all of their 0-scored items coded as such.
**Distribution of reason codes by subdomain**

As shown in Table 7, *No Chance* was the most frequently applied code across all subdomains at 48.7% of the 0-score items. It was assigned to at least one-third of the 0-scored items under each subdomain, up to above 50% for the Community subdomain. *Unable-cognitive* was the next most commonly scored reason for a 0-score in the Personal and Community subdomains, while *Able-reminded* was second most frequently scored for Domestic subdomain. Similar to the Domestic subdomain, in the Personal subdomain approximately 20% of the codes were coded as *Able-reminded*; however, only 3.5% of codes under the Community subdomain was coded as such.

Overall, across all subdomains, the *Unable-other* code (e.g., poor memory, anxiety, allergies) was rarely scored (2.3% of items across the DLS domain). The code of *Unspecified*, which does not provide meaningful explanation of the participants not performing tasks was consistently scored at around 15% across all subdomains. See Table S3 for the mean zero-rating items per reason code across subdomains.

| Table 7 |

Average number and proportion of 0-Score items by reason across DLS Subdomains

<table>
<thead>
<tr>
<th>Number of Items</th>
<th>DLS domain</th>
<th>PERS</th>
<th>DOM</th>
<th>COM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total 0-score items</td>
<td>476</td>
<td>130</td>
<td>146</td>
<td>200</td>
</tr>
<tr>
<td>Participant Mean (SD)</td>
<td>14.4 (6.44)</td>
<td>3.93 (2.42)</td>
<td>4.42 (3.08)</td>
<td>6.06 (3.10)</td>
</tr>
<tr>
<td>Range</td>
<td>[4-29]</td>
<td>[0-13]</td>
<td>[0-14]</td>
<td>[0-14]</td>
</tr>
<tr>
<td>Raw point added</td>
<td>Reason Codes</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>2</td>
<td>Able-reminded</td>
<td>58 (12.2%)</td>
<td>25 (19.2%)</td>
<td>26 (17.8%)</td>
</tr>
<tr>
<td>1</td>
<td>No chance</td>
<td>233 (48.9%)</td>
<td>47 (36.1%)</td>
<td>75 (51.4%)</td>
</tr>
<tr>
<td>1</td>
<td>Unable-other</td>
<td>11 (2.3%)</td>
<td>7 (5.38%)</td>
<td>1 (0.68%)</td>
</tr>
<tr>
<td>0</td>
<td>Unable-cognitive</td>
<td>98 (20.6%)</td>
<td>29 (22.3%)</td>
<td>21 (14.4%)</td>
</tr>
<tr>
<td>0</td>
<td>Unspecified</td>
<td>76 (15.9%)</td>
<td>22 (16.9%)</td>
<td>23 (15.8%)</td>
</tr>
</tbody>
</table>

Note: % refers to the percent of 0-score items that were being assigned the codes within the domain or each subdomain. % were calculated by dividing n over the number in the first row (i.e., Total 0-score items).
*Adjusted DLS and subdomain scores, taking into account reasons for nonperformance*

It is important to note that the relationship between number of items with zero-rating and the gain in raw points was not linear, given that the assignment of scores based on the reason codes varied from 0 to 2 (see Table 2). For the DLS domain, participants gained between 0 and 15 points \((M=5.91, SD=4.34); \text{Table 8}\) across 4 to 29 \((M=14.40, SD=6.44)\) 0-scored items (Table S3).

As shown in Table 8 below, across subdomains, rescoring 0-scored items resulted in an increase of approximately 3-4 raw score points, which translated into increases of only approximately 1 v-scale point and 1-3 years in age equivalence. The Community subdomain showed the highest average gains in Raw score. However, its average VS and AE gains were the lowest, and was the only subdomain of which the VS gain did not exceed one point, and AE gains did not exceed one year. This could be explained by the disproportionate number of items in each subdomain and the spread of AE. For example, at the raw score of 100, every one raw point gain results in a one year AE gain for the Personal subdomain, but only a 3-month AE gain in the Community subdomain. Overall, taking into account reasons for nonperformance resulted in an average gain in DLS standard scores of nearly 6 points.

Table 8

<table>
<thead>
<tr>
<th>Gains in DLS domain and subdomain scores after allocation of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Gain in points (SD)</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Raw</td>
</tr>
<tr>
<td>V-Scale</td>
</tr>
<tr>
<td>Age Equivalent (in years)</td>
</tr>
<tr>
<td>DLS SS for all participants (N=33)</td>
</tr>
</tbody>
</table>
Associations between Reason Codes and Individual Characteristics

**NVIQ groups**

As predicted, individuals in the NVIQ < 85 group had significantly higher percentage of items coded as *Unable-cognitive*, while having significantly lower percentage of items coded as *Able-reminded* and *No Chance* (see Table 9 below). Code *Unable-other*, aimed at capturing non-cognitive-related factors, was rarely utilized. However, there were significant group differences between the NVIQ groups on the use of Unable-other code, reflecting that none of the NVIQ < 85 group was reported to have non-cognitive reasons for not performing daily living activities.

Considering that different reason codes had different point assignments, additional t-tests were performed to explore whether NVIQ groups differed in how capturing reasons affected their adjusted subdomain and domain scores. As shown in Table 10 below, adults with ≥85 NVIQ gained more in their scores across all domains and subdomains than did participants with <85 NVIQ, with statistically significant gains for Domestic VS and AE, Community VS, original DLS, Adjusted DLS and DLS (49) scores.

**BRIEF GEC groups**

As shown in Table 9, *No Chance* was the only code that statistically differed in its application between the groups based on executive functioning, with it being applied to 63.6% of the 0-score items in DLS in the GEC> 65 group, in comparison to 33.8% of the 0-score items in DLS in the GEC< 65 group. This suggested that adults with at least average executive functioning had fewer chances to learn or perform skills than those with reported EF difficulties.

**ABCL Internalizing groups**
As shown in Table 9, individuals in the INT $\geq 63$ group had significantly higher percentage of items being coded as *Able-reminded* than those in the INT $< 63$ group. None of the other codes had statistically significant differences in application between groups.

Table 9

*The proportion of 0-scored items in DLS domain that each code accounted for, across clinical characteristics*

<table>
<thead>
<tr>
<th>Reason Codes</th>
<th>NVIQ (N=33)</th>
<th>BRIEF-A GEC (N=23)</th>
<th>ABCL INT (N=28)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;85 (n=10)</td>
<td>$\geq$85 (n=23)</td>
<td>$\geq$65 (n=6) $&lt;65$ (n=17)</td>
</tr>
<tr>
<td></td>
<td>M% (SD)</td>
<td>M% (SD)</td>
<td>M% (SD)</td>
</tr>
<tr>
<td>Able-reminded</td>
<td>3.33(5.51)</td>
<td>14.3(16.0)</td>
<td>16.2(13.6)</td>
</tr>
<tr>
<td>No Chance</td>
<td>39.9(28.6)</td>
<td>59.0(21.7)</td>
<td>33.8(18.7)</td>
</tr>
<tr>
<td>Unable-other</td>
<td>0.00(0.00)</td>
<td>3.00(6.00)</td>
<td>0.00(0.00)</td>
</tr>
<tr>
<td>Unable-cognitive</td>
<td>43.4(30.4)</td>
<td>4.80(8.43)</td>
<td>26.7(37.9)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>13.4(18.3)</td>
<td>19.1(16.0)</td>
<td>23.3(17.0)</td>
</tr>
</tbody>
</table>

**=p<.01 (2-tailed)
*=p<.05 (2-tailed)

Table 10

*NVIQ Group differences in the changes of Domain SS and Subdomain scores (VS and AE)*

<table>
<thead>
<tr>
<th>NVIQ (n)</th>
<th>&lt;85 (10)</th>
<th>$\geq$85 (23)</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PER VS change</td>
<td>0.80 (1.14)</td>
<td>1.61 (1.12)</td>
<td>.72</td>
</tr>
<tr>
<td>PER AE change</td>
<td>1.82 (2.80)</td>
<td>3.12 (2.39)</td>
<td>.52</td>
</tr>
<tr>
<td>DOM VS change</td>
<td>0.20 (0.42)</td>
<td>1.48 (1.34)</td>
<td>1.11**</td>
</tr>
<tr>
<td>DOM AE change</td>
<td>0.54 (0.65)</td>
<td>1.94 (1.28)</td>
<td>1.23**</td>
</tr>
<tr>
<td>COM VS change</td>
<td>0.30 (0.48)</td>
<td>0.96 (0.71)</td>
<td>1.01*</td>
</tr>
<tr>
<td>COM AE change</td>
<td>0.57 (0.60)</td>
<td>1.10 (0.72)</td>
<td>.76</td>
</tr>
<tr>
<td>Adjusted DLS vs. DLS difference</td>
<td>1.90 (2.73)</td>
<td>7.65 (3.73)</td>
<td>1.66**</td>
</tr>
<tr>
<td>DLS</td>
<td>39.3 (25.8)</td>
<td>69.9 (18.5)</td>
<td>1.60**</td>
</tr>
<tr>
<td>Adjusted DLS</td>
<td>41.2 (22.7)</td>
<td>77.6 (17.9)</td>
<td>1.88**</td>
</tr>
<tr>
<td>DLS (49)</td>
<td>53.8 (6.50)</td>
<td>71.4 (15.3)</td>
<td>1.31**</td>
</tr>
</tbody>
</table>

**=p<.01 (2-tailed)
*=p<.05 (2-tailed)

Note: DLS (49) = all participants with original DLS score $<50$ assigned scores of 49
Comparing VABS-3 DLS and ABAS-3 PRAC Domain Standard Scores

The 24 (72.7%) participants with paired VABS-3 DLS and ABAS-3 PRAC data were used in the subsequent analyses.

DLS and PRAC Comparison (n=24)

First, VABS-3 DLS and ABAS-3 PRAC scores were plotted in Figure 1 below for each of the 24 participants. To investigate how these discrepancies may affect classification of adaptive functioning, the participants were grouped using cut-offs as Standard Score ≥70 and ≥ 85 (see Table 11). Out of 24 participants, 20.8% were misclassified using a cut-off of ≥70 on the ABAS-3; i.e., five participants scoring above 70 on the ABAS-3 scored below 70 on the VABS-3. Misclassification using a cut-off of 85 on the ABAS-3 was at 16.7%. None of the misclassified participants using the ≥70 or ≥85 classifications overlapped. The majority (n=19, 79.2%) had lower DLS than PRAC score, with 6 (25%) participants scoring less than 50 on the DLS (i.e., lower than the ABAS-3’s floor). Of these six participants, three had PRAC SS of 50 to 53, while the remaining three varied between 61 and 71. As shown in Table 12, the difference in floors on each of the tests affected the comparisons, with mean VABS-DLS 13.4 points (SD=14.5) lower than PRAC. When the six DLS scores below 50 were reassigned values of 49 to minimize floor effects, the average difference decreased to 8.38 (SD=9.62), but remained significant (Table 12, Pair 2).

<table>
<thead>
<tr>
<th>Contingencies between VABS-3 DLS and ABAS-3 PRAC scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ABAS≥70</td>
</tr>
<tr>
<td>ABAS&lt;70</td>
</tr>
<tr>
<td>ABAS≥85</td>
</tr>
<tr>
<td>ABAS&lt;85</td>
</tr>
</tbody>
</table>
Figure 1. Differences in Standard Scores between DLS, Adjusted DLS and PRAC (n=24)

**Adjusted DLS, DLS and PRAC Comparison (n=24)**

As shown in Figure 1, six participants (25%) did not make gains in DLS score after adjusting for reason codes, and 17 participants’ (70.8%) adjusted DLS scores remained lower than their respective PRAC scores. PRAC vs. DLS score difference ranged from -10 to 51 (negative values indicate DLS > PRAC; positive values indicate PRAC > DLS) and PRAC vs. Adjusted DLS difference ranged from -17 to 51. As shown in Table 1, while the mean Adjusted DLS score was significantly higher than the DLS ($M$ difference = 6.20, $SD$ = 5.23; Pair 4), mean Adjusted DLS remained lower than mean PRAC ($M$ difference = 7.21, $SD$ = 17.3, $p$ = .053; Pair 5). Of the six participants with DLS under 50, four with DLS score at 20 made no gains in Adjusted DLS and were reassigned values of 49; the other two increased to scores above 50 after adjusting the Raw score points (see Figure 1). The mean PRAC vs. Adjusted DLS (49) difference then decreased to 2.38 points ($SD$ = 11.2; Table 11, Pair 6). In sum, participants tended to score higher on the ABAS-3 than the VABS-3 measure in the area of DLS, with the differences attenuated after accounting for floor effects.
**Adjusted DLS, DLS and PRAC Comparison (NVIQ ≥ 85 only, n=17)**

As shown in Table 11, when limited to the 17 participants with NVIQ above 85, the average difference between the PRAC and DLS reduced to 8.12 points ($SD=12.7$), but remained statistically significant ($t=-6.86$; Table 11, Pair 3). In comparison, the mean difference between the PRAC and Adjusted DLS was reduced to -0.35 point ($t=-0.12$; Table 11, Pair 7). This suggests that the adjustment of DLS score in adults with at least average cognitive functioning, based on their projected ability in performing tasks, produced scores that were very similar to their PRAC scores.

Table 12

<table>
<thead>
<tr>
<th>VABS-3 DLS, Adjusted DLS, DLS (49), Adjusted DLS (49) and ABAS-3 PRAC Comparisons</th>
<th>Statistics</th>
<th>Paired-Sample Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M (SD)</td>
</tr>
<tr>
<td>VABS-DLS vs. ABAS-PRAC</td>
<td>Pair 1</td>
<td>VABS-DLS</td>
</tr>
<tr>
<td></td>
<td>ABAS-PRAC</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Pair 2</td>
<td>VABS-DLS (49)</td>
</tr>
<tr>
<td></td>
<td>ABAS-PRAC</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Pair 3</td>
<td>VABS-DLS (NVIQ ≥ 85)</td>
</tr>
<tr>
<td></td>
<td>ABAS-PRAC (NVIQ ≥ 85)</td>
<td>17</td>
</tr>
<tr>
<td>Adjusted VABS-DLS vs. VABS-DLS and ABAS PRAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 4</td>
<td>Adjusted VABS-DLS</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>VABS-DLS</td>
<td>24</td>
</tr>
<tr>
<td>Pair 5</td>
<td>Adjusted VABS-DLS</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>ABAS-PRAC</td>
<td>24</td>
</tr>
<tr>
<td>Pair 6</td>
<td>Adjusted VABS-DLS (49)</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>ABAS-PRAC</td>
<td>24</td>
</tr>
<tr>
<td>Pair 7</td>
<td>Adjusted VABS-DLS (NVIQ ≥ 85)</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>ABAS-PRAC (NVIQ ≥ 85)</td>
<td>17</td>
</tr>
</tbody>
</table>

**= p<0.001 (2-tailed)
*=p<0.01 (2-tailed)

Note. (NVIQ ≥ 85) = examining participants with NVIQ ≥ 85 only. DLS (49) = original DLS score <50 reassigned value of 49. Adjusted DLS (49) = adjusted DLS score that remained <50 reassigned value of 49
Discprepancies between NVIQ and estimates of daily living skills

**NVIQ-DLS (n=33)**

Participants in both NVIQ groups showed a clear discrepancy between their NVIQ and DLS standard scores, i.e., the “NVIQ-DLS gap”. As shown in Figure 2 below, the NVIQ-DLS gap in the NVIQ≥85 group was at 34.4 points ($p=.000, d=1.63$), which was more than twice larger than the NVIQ-DLS gap of 12 in the NVIQ<85 group ($p<.001, d=1.60$). After adjusting DLS scores based on reason codes, the NVIQ-Adjusted DLS gap was attenuated, but remained significant in both NVIQ≥85 ($p=.000, d=1.33$) and NVIQ<85 ($p=0.04, d=0.78$) groups. When DLS scores below 50 were reassigned values of 49, the NVIQ-DLS(49) pattern reversed in the NVIQ<85 group, with mean DLS (49) score becoming higher than NVIQ ($p=0.60, d= -0.17$). In contrast, the NVIQ>85 group retained a large NVIQ > DLS (49) gap of 32.6 ($p=.000, d=1.70$), similar to the original NVIQ-DLS gap of 34.4 points.

![Figure 2. Discrepancies between NVIQ vs. DLS, Adjusted DLS and DLS (49) (n=33)](image)

- **= $p<0.001$ (2-tailed)
- *= $p<0.05$ (2-tailed)

Note: Data points above bars reflect effect sizes of score differences
**NVIQ-PRAC (n=24)**

As demonstrated in Figure 3, the NVIQ-PRAC took on a very similar pattern as the NVIQ-DLS (49). In the NVIQ≥85 group, the NVIQ-PRAC gap was significant at 26 points with NVIQ>PRAC ($p<0.001$, $d=1.22$). However, in the NVIQ<85 group, the PRAC was markedly higher than NVIQ by an average of 17 points ($p=0.035$, $d=1.03$). Notably, the subset of participants with both DLS and ABAS had somewhat lower NVIQ ($M=44$) compared to the overall VABS sample ($M=51$).

![Figure 3. Discrepancies between NVIQ vs. DLS and PRAC (n=24)](image)

**NVIQ-DLS-PRAC (n=24)**

As shown in Figure 4 below, additional paired-sample t-tests were performed to compare the DLS vs IQ differences among participants with both VABS-3 and ABAS-3 data. Participants showed a similar pattern of results, though greater NVIQ-DLS (49) difference emerged in the NVIQ<85 group.
**DISCUSSION**

**Summary**

Existing studies that examined adaptive skills in children, youth and adults with autism, have commonly highlighted the “autism profile” — having higher scores or performances in practical or daily living skills (DLS), in comparison to the areas of social and communication skills. While autistic individuals may indeed have relative strength in the practical domain, their DLS scores usually remained at least one standard deviation lower than what is expected of their age (Bal et al., 2015; Kanne et al., 2010) and cognitive functioning (Duncan, 2017; Kanne et al., 2010). Previous studies have identified multiple factors that are associated with adaptive skills in autistic individuals, including intellectual ability, age, executive functioning and mental health. However, limited studies have examined how the provision of opportunities contribute to adaptive function.
Hence, this study investigated factors that affect the practical area of adaptive functioning. Based on qualitative coding (i.e., whether opportunities, cognitive and non-cognitive factors affected DLS performance), this study also sought to examine to what extent other contextual factors may affect DLS scores. Finally, VABS-3 DLS standard scores and adjusted scores were compared to the ABAS-3 Practical domain, which incorporates cognitive reasons into its scoring to further understanding of measurement of these important skills.

**Age and Daily Living Skills**

While many studies have supported the negative association between age and DLS in autistic youth and adults (Bal et al., 2015; Kanne et al., 2011; Klin et al., 2007; Matthews et al., 2015), the current study failed to find any association between age and the VABS-3 DLS and ABAS-3 PRAC domains standard scores, including the DLS subdomains’ v-scale and age equivalents. While this study’s small sample size could have contributed to this unexpected result, a few other reasons are possible. Many of the aforementioned studies included a wide age range (Kanne et al., 2011) or compared different developmental stages (e.g., teenagers 16-18 vs. young adults 20-24; Matthews et al., 2015). While the current study had participants ranging from ages 16 to 34, most participants \( n=28, 84.8\% \) were between 18 and 26. With studies supporting that adaptive skills tend to plateau in adulthood (Bal et al., 2015), most participants in our study could have already reached plateau at the time of interview. This, in addition to the reduced age range may explain the lack of association between age and adaptive functioning scores.

**Intellectual Functioning and Daily Living Skills**

Consistent with previous studies (Charman et al., 2011; Kanne et al., 2011; Klin et al., 2007; Perry et al., 2009), NVIQ was a strong predictor of DLS skills (i.e., 35% of the variability). However, autistic adults, regardless of intellectual functioning, presented with substantial adaptive
challenges, with NVIQ-DLS gap of one to two standard deviations. The discrepancy for those with average or higher NVIQ was larger than those with lower NVIQ. These findings were similar to results reported in Kanne et al. (2010) and Duncan and Bishop’s 2017 study, which identified an increase in FSIQ-DLS gap with increasing IQ (i.e., FSIQ 85-99 vs. 100-114 vs. >114).

The NVIQ-IQ gap remained even after adjusting for contextual factors that were affecting DLS performance. After allocating scores based on reason codes, the gain in DLS scores was 7.5 points for those in the NVIQ ≥ 85 group, and only 1.9 points for adult with NVIQ < 85 (Table 10). Although the NVIQ-DLS difference of 7.5 points or half a standard deviation (SD) may be small in relative to the NVIQ-IQ gap of 2 SDs, the addition resulted in the average NVIQ group’s DLS moving from the boundary of a standard score of 70 (usually used to classify mild intellectual disability) to 78, which falls in the borderline range of function. The gains in DLS scores may suggest that provisions of opportunities and interventions for autistic adults with at least average IQ has the potential to improve their adaptive functioning. However, while DLS score gains attenuated the NVIQ-DLS gap for participants with NVIQ ≥ 85 and changed their adaptive functioning classification, their average NVIQ- adjusted DLS gap remained considerable, at 26.7 points apart. Similarly, their adjusted DLS scores remained significantly lower in comparison to the normative sample. This suggests that NVIQ, while a strong predictor of DLS, may not be a strong protector against adaptive impairment in autistic adults with at least average IQ levels.

With regard to the distribution of reason codes (Table 9), autistic adults in the NVIQ ≥ 85 group had remarkably higher percentage of items coded as No Chance (i.e., no opportunity to perform or learn) and Able-reminded (i.e., having ability or skills within repertoire), in comparison to adults in the NVIQ<85 group having more items coded as Unable-cognitive (i.e., reported difficulty in skill acquisition). Therefore, it appears that adults with below-average intellectual
functioning may have been presented more opportunities to learn or perform tasks, and thus demonstrated a clearer pattern of having difficulty in acquiring skills. In contrast, adults with NVIQ $\geq 85$ seemed to have fewer opportunities to perform or learn DLS expectations or responsibilities in comparison to what is expected of their age. This may explain the NVIQ-DLS discrepancy being 34.4. points in the NVIQ $\geq 85$ group, which was more than twice the size of the NVIQ-DLS gap in the NVIQ $< 85$ group. These contrasting distribution of reason codes between NVIQ groups also suggest that while the VABS-3 is in theory, supposed to capture performance instead of ability, it may actually more accurately capture performance in adults with at least average functioning, while performance is confounded with ability in those with under average IQ.

These distinctions are important in highlighting the different reasons for low adaptive functioning scores among individuals of different IQ functioning, which have important implications on intervention planning. Behavioral interventions (e.g., Applied behavioral analysis) are typically utilized as the first line of treatment for increasing DLS-related skills given their nature of providing systematic teaching and rote learning (Chazin et al. 2017, Harriage et al. 2016, Lubin & Feeley, 2016). However, if motivation is the bigger driving cause of adaptive performance, the intervention could range from implementing a simple reward-system to a more complex treatment of psychotherapy, including behavioral activation or family therapy if the amotivation is maintained by parent-child conflicts (Malti & Buchmann, 2010; Marmorstein & Iacono, 2004).

**Executive functioning and VABS-3 DLS**

While EF functioning is well-documented in children and adolescents with ASD (Gilotty et al., 2002; Pugliese et al., 2015), very limited studies examined EF in autistic adults (Wallace et al., 2016). Consistent with previous literature, participants with GEC less than 65 (i.e., at least average EF functioning) consistently scored higher on all DLS domains and subdomains and the PRAC
domain than participants with elevated EF symptoms. BRIEF-A GEC score was negatively associated with DLS performance in our adult sample. Even after controlling for intellectual functioning, GEC remained a predictive factor of DLS, contributing to 14.7% of the variability. This result was expected, as many components of DLS skills require EF skills, such as working memory for checking changes in a store, organizational skills for house chore and planning skills for achieving short- and long-term goals. Specifically, GEC had strong associations with the DLS Personal and Domestic subdomains’ VS and AE; in contrast, its association with DLS Community subdomain was more moderate.

With regard to the distribution of reason codes, individuals with GEC scores less than 65 had higher percentage of items coded as No Chance (63.6%) in comparison to 33.8% in adults with GEC equal or greater than 65 (Table 9). In contrast, individuals with GEC scores < 65 had lower percentage of items coded as Unable-cognitive (8.50%) in comparison to 26.7% in adults with GEC ≥ 65. This indicates that autistic adults who had no reported concerns with executive functioning had fewer opportunities in performing DLS tasks, in comparison to those with elevated EF difficulties. This may reflect that caregivers who have concerns with their adult child’s abilities or are aware of their need for supports may more readily require their child to perform activities to practice or develop their skills.

Interestingly, the Unable-other code, which aimed at capturing factors including EF difficulties, was the least utilized (2.3%) within the DLS domain. With strong correlation between GEC and ABCL-Internalizing scores, it is possible that EF challenges and amotivation may behaviorally appear similar (Lam, Kennedy, McIntyre, & Khullar, 2014). This would make it hard for parents to differentiate and may have resulted in some executive difficulties being captured in the Able-reminded category. For example, requiring multiple reminders to complete a task could
be contributed to amotivation in one individual, while reflecting difficulty with planning or working memory in another individual. It is also possible that significant executive functioning difficulties were considered evidence of inability to perform certain tasks (i.e., consistent with the application of Unable-cognitive reason).

**Internalizing Symptoms vs DLS**

Mental health has been a less-examined factor of adaptive function in autistic individuals. Participants in this sample with ABCL-Internalizing scores (≥ 65; i.e., higher internalizing symptoms) and ABCL-INT < 65 did not show between-group differences in DLS scores (see Table S1). In terms of the distribution of reason codes, the INT groups differed in the *Able-reminded* code only, which was coded at 20% and 5.60% for those in the ABCL-INT ≥ 65 and < 65 group respectively (Table 9). As mentioned earlier, amotivation, which is a common symptom of depression, could explain the higher application of the *Able-reminded* code. For example, one participant in this study with elevated INT scores had difficulties with cleaning up their room, waking up on time, setting short and long term goals, and leaving the house, despite having the abilities to perform these skills. *No chance* was again, the most-applied code in both groups.

**Opportunity to learn or regularly perform adaptive skills, or lack thereof**

*No Chance* emerged as the most utilized code across all VABS-3 DLS subdomains. The Community subdomain had the highest percentage of items coded as *No Chance* (55%), followed by the Domestic (51.4%) and Personal (36.1%) subdomains. The *No Chance* category was more commonly endorsed in individuals with higher IQ and average executive function. On average, adults with NVIQ ≥ 85 had 59% of items and adults with GEC < 65 had 64% coded as *No Chance*, while adults with lower IQ or impaired executive function had only 40% and 34% as *No Chance*, respectively. Therefore, autistic adults who supposedly have higher cognitive and executive
function abilities appeared to have fewer opportunities to perform the skills regularly or learn the skills, suggesting that parental expectations or delegation of responsibilities to the autistic adult changes or reduces with the adults’ increasing developmental level. This outcome may be explained in multiple ways. The simplest explanation is that adults with at least average IQ tend to have a higher ceiling on the VABS questionnaires, thus being inquired on tasks that may be more complex, but less essential to independent daily function in comparison the more fundamental adaptive skills. For example, an adult who struggles with mastering basic hygiene may have caregivers put in extra effort or interventions in place (e.g., visual cues) to ensure completion of personal hygiene routines (e.g., hand washing, showering; item 16 & 36 in Personal subdomain). In contrast, for adults who successfully take care of their basic routines, parents may not further expect or explore if the adults make healthy eating choices, exercise for health, plan for changes in weather and takes own temperature when needed (i.e., items 49, 51, 47 & 55 in Personal Subdomain) since these skills may seem less essential than ensuring the success of basic personal hygiene.

The biggest factor contributing to No Chance being the highest-used code could be that most participants in this study had never lived alone at the time of interview (n=31). Hence, many were reported to rely on caregivers for community travels, purchasing living needs (e.g., groceries), monitoring financial needs and attending doctor appointments. Multiple caregivers remarked during the VABS-3 interviews that they had never thought of letting their adult child ever or regularly perform the inquired task, and when asked to estimate if the adult child could perform the task independently and regularly, many could not give a clear estimate. At the end of the interview, a few parents even commented that the interview helped them learn about skills that
should be within the repertoire of an adult, and they were already considering asking their adult child to perform those skills to promote more independence.

It is important to stress that the adaptive measures were normed against the US population, of which most young adults tend to live independently for at least some period of time (e.g., when they go to college), even if requiring partial or full financial support. U.S. Census Bureau’s data on America’s Families and Living Arrangement reported that in year 2012, 44.1% of young adults ages 18 to 34 reported moving out of their parents’ homes (Vespa, Lewis & Kreider, 2013). Requirements for living independently in comparison to living with caregivers vary significantly. Based on caregivers’ reports in this study, a common reason that prevented caregivers from delegating tasks to their adult children that were staying at home was for convenience purpose, e.g., preferring to do laundry a certain way or buying groceries since they are more aware of what items the family is low on. Many parents also preferred cooking for the family on a daily basis, rendering limited chance for the targeted adults to prepare raw ingredients, use stove and cook full meals regularly, which correspond to items 17, 26 and 30 in the Domestic subdomain respectively. For adults with siblings who also lived at home, their responsibilities were often shared with those siblings, which further reduced chances to perform tasks regularly. It is imperative to stress that these reasons should be similar to any adult children who live at home, not specifically to autistic adults. Of course, autism symptoms could affect one’s mastery of skills and pose stressors on caregivers in teaching or delegating adaptive responsibilities. Hence, it is crucial to identify if poor adaptive functioning is caused by lack of expectations or by challenges posed by severity of autism, cognitive and executive functions, to better inform intervention planning. Clinicians should also be sensitive towards cultural factors when developing interventions—what constitutes the norm of the average American households may differ from other Western and non-Western countries.
Similarly, certain DLS items were not applicable to participants who had never lived independently, specifically items in the Community subdomain that inquire about participant’s understanding of their personal rights—item 40 and 41 (rights to services) and 47 (accessing personal records). This was particularly true for the younger adults in their final year of mainstream or extended high school at the time of interview ($n=7$), who were reported to have not encountered situations that required the demonstration of understanding those rights. Similarly, skills that require independent financial navigation, including using a bank account, managing monthly expenses and paying bills (items 53, 56 & 57; Community subdomain) were not readily required of young adults, including those who were in already in college. Again, while this cause of “not exposed to opportunity due to age” is accounted for by the norms, neurotypical adults tend to leave home and encounter these opportunities before or during their early twenties, but most autistic adults in our sample have never lived independently away from their parents. Hence, it may be more meaningful if normative comparisons were done with adults who all live at home. Additionally, while one could argue that the autistic adults’ lower adaptive functioning was the cause, not the outcome of them not living independently, it is nonetheless important to identify how living at home leads to reduced opportunities, which further impact DLS performance.

In sum, the No Chance code seemed to affect not only tasks that are typically found within the immediate household or academic and work environment, but also responsibilities or concepts that are contacted naturally by the young adults as they age and have more expectations placed on them. Although adjustments to scores based on a lack of opportunity to learn/exhibit these skills did not fully close the NVIQ-DLS gap, the frequency of endorsement of these codes and comments from parents suggest that more awareness is needed of the types of skills that need to be targeted in interventions for older individuals. Importantly, this intervention should not wait until young
adults encounter a need to utilize these skills. Rather, a pro-active approach, providing opportunities to learn and practice skills before they are exposed to those foreseeable challenges is likely to be needed to prepare autistic adults for independent living and financial stability. An example of such interventions is the Transitioning Together Program by Smith, Greenberg & Mailick (2012), which is 10-week intervention designed specifically for high school students with autism and their caregivers. Primary focuses of the intervention were to increase the youths’ community activities and connections, learn problem-solving skills, improve social skills and gain skills in advocacy. Therefore, helping both caregivers and autistic individuals understand potential developmentally-appropriate challenges that their adult children may face, specifically in the transition from high school to college, and from living at home to living independently, may help autistic adults set the stage for success.

**Gains in Subdomain AE and VS Based on Reason Codes**

Of the three DLS subdomains, the Community subdomain had the highest mean Raw score gain but lowest VS and AE gains, while the Personal subdomain had the lowest mean Raw score gain but the highest gains in VS and AE (see Table 8). These contradicting patterns were caused by differences in raw-to-score mapping across subdomains of the Vineland-3. Sparrow et al. (2016) explained that AE should be interpreted carefully, since every one-year-growth in AE has different meaning at different ages and for each VS scale increase, the corresponding raw score changes in a non-consistent progression. Take for example, the normative scale for adults ages 21:0-29:11 (p. 84, Appendix B, Sparrow et al., 2016). On the Personal subdomain, starting from a VS of 9, every one-point gain in Raw score results in one-point gain in VS (i.e., at a 1:1 ratio). In contrast, this 1:1 ratio starts at the VS score of 11 for the Personal subdomain, and VS score of 14 for the Community subdomain. Furthermore, for the four participants who scored at the floor (i.e., DLS
SS=20) for the DLS domain, gains in Raw score, VS and AE did not produce any changes in the DLS domain standard score, which skewed the total sample’s mean Adjusted DLS towards the negative direction. This presents challenges to measuring and comparing the influence of contextual factors across subdomains.

Adjustment in DLS Based on Reason Codes

At face value, the 7.5 DLS point increase between DLS and Adjusted DLS in the NVIQ ≥ 85 group may seem small and interpreted as an indication that even taking into account contextual factors affecting DLS performance, one’s adaptive functioning may not improve by much. It is important to note, however, that half of a standard deviation increase in DLS score resulted in the group’s mean DLS falling in the range of borderline impairment, rather than at the cusp of mild intellectual disability. Furthermore, the AE gains showed promising results – participants in the high NVIQ group showed average of 3.12, 1.94 and 1.10 years of skill gain in the Personal, Domestic and Community subdomains respectively (see Table 8). This indicates that just by caregivers providing clear expectations and opportunities for their child, the autistic adults could potentially gain more DLS independence. Additionally, these scores were allocated based on hypothetical gains, while their actual gains may differ. First, the No Chance code was allocated a raw score of 1. However, with opportunities to learn or perform skills, some individuals may score a 2 on the item (i.e., performing regularly or whenever need, and without support), while others may fail to master skill and continue to receive a score of 0. In short, the allocation of 1 point suggests a 50% chance of performing without support, while the actual mastery varies by individual – which could not be determined until the individual is allowed to perform the target skills regularly. Second, the score assignment of 2 points to Able-reminded code may appear generous. However, this code was specifically used to capture skills that the participants already
mastered and hence, should have a high success rate when interventions are put in place, including making expectations clear to the autistic adults or setting external reminders in place (e.g., visual schedules, timers). Interventions would certainly be more sophisticated for those whose DLS score was affected by amotivation rather than lack of expectations or poor executive function. In sum, actual adjusted DLS score gains would certainly differ based on the function of behavior and type of intervention.

**VABS-3 DLS vs ABAS-3 PRAC Standard Score Comparison**

There had been limited studies examining the reliability between the third versions of both adaptive functioning measures. As previously mentioned, the study by Tamm et al. (2021), which compared ABAS-3 Parent Form and VABS-3 Caregiver Interview in adolescents with ASD, might be the first study examining the comparability of these measures. The authors reported that participants consistently scored higher on the ABAS-3 than the VABS-3 domain and subdomains, with differences ranging between one to two standard deviations in standard score. In terms of DLS function, participants’ average ABAS-3 PRAC score was 15.3 points larger than their average VABS-3 DLS score.

This study identified very similar results to the Tamm et al. article. Of the 24 participants with VABS-3 and ABAS-3 data, 19 had higher ABAS-PRAC than VABS-DLS domain standard scores, with an average difference of 13.4 points (Table 11). To account for the different floors of the measures (i.e., VABS-3=20, ABAS-3=50), six participants with original DLS scores under 50 had their scores changed to 49. However, even with this change, the average DLS score remained 8.38 points below the average PRAC score. Even after adjusting the VABS-3 DLS scores based on the reason codes, the average difference remained large at 7.21 points (Table 11). These differences of approximately 0.5 standard deviation or larger had some effect on consistency of
clinical classifications across instruments. This sample’s mean ABAS-PRAC score of 74.5 is classified as “Low” – which is second from the ABAS’ lowest classification of “Extremely Low”. In contrast, the mean VABS-DLS score of 61.1 and 66.2 for original DLS and DLS (49) are both classified as “Low”, which is the lowest classification on the VABS. If the mean ABAS-PRAC reduces by 0.5 SD, the classification would fall to “Extremely Low”; in contrast, if the mean VABS-DLS gains 0.5 SD, the classification would increase to “Moderately Low”. In sum, the 0.5 SD difference in standard score is not just statistically significant, but also impacts the qualitative classification of one’s adaptive levels.

Notably, discrepancies were more prominent for individuals with lower IQ; those with average or higher IQ showed no difference in ABAS-3 and VABS-3 scores after adjustment. This was particularly captured in the mean VABS-3 DLS being lower than NVIQ but mean ABAS-PRAC being higher than NVIQ for those in the NVIQ<85 group (Figure 4), while those in the NVIQ ≥ 85 group remained having a NVIQ than ABAS-PRAC score. Therefore, VABS-3 may be more sensitive towards capturing adaptive impairments in autistic individuals with lower IQ.

**Reasons for VABS-3 vs. ABAS-3 Standard Score Discrepancies**

Tamm et al. provided a few potential reasons for the discrepancy between the VABS-3 and the ABAS-3, including the VABS-3 Interview format providing more specific probes, which allows for more in-depth understanding of the participants’ performance. In support of this, this author noted that parents’ first responses to the questions could change with additional probes. For example, some parents would quickly give a “Yes” or “No” response when first asked; with further probes for examples or clarifications, they would re-consider their responses. In such situation, the final responses typically landed on “sometimes”, i.e., score of 1 on the VABS-3. While score of 1 is not examined in this study, this example shows that caregivers’ responses could change based
on probes, which would not occur as they are completing the ABAS-3, since it is completed without supervision. Fatigue or misunderstanding of the questionnaire’s instruction could also affect ABAS’ score. Diagnostic evaluations in both clinical and research setting typically assign multiple informant-reported questionnaires in one sitting. The list of measures could be overwhelming for caregivers to fill out, or caregivers could be fatigued by the time they reached the ABAS-3 measure, thus reducing their capacity in carefully considering their responses. While the VABS-3 Interview Form is also frequently assigned in conjunction with other diagnostic interviews (e.g., ADI-R, general intake session), and the interview typically lasts for at least 45 minutes, having specific probe questions and opportunities for clarification could assist caregivers in providing more accurate information.

Tamm et al. (2021) also proposed that the difference in targeted skills between the measures could have led to the observed differences. Hence, this author did a basic comparison of the items between the corresponding ABAS-3 PRAC skill areas and the VABS-3 DLS domain and subdomains, specifically in comparing the tasks and their levels of difficulty. Within the ABAS-3 PRAC Community Use skill area, 14 out of 24 items were found in the VABS-3 DLS domain (e.g., navigating public transport, using credit card). Items that were only present in the ABAS-3 Community Use Skill area were tasks that were more social-facing in nature, e.g., calling a repairperson when needed or asking other people’s advice on where to shop. Whereas, items found only in the VABS-3 DLS Community subdomain included multiple higher-level financial skills, including holding a full-time paid job, paying bills and managing expenses. In terms of the ABAS-3 Home Living skill area, 15 out of 24 items were similar to those in the VABS-3 DLS Domestic subdomain (e.g., doing laundry, cleaning bathroom and room). Primary differences included the
VABS-3 Domestic subdomain having three items on keeping intruders out of home and two items on saving or preparing leftovers, which were not in the overall ABAS-3 PRAC domain.

In terms of the Self-Care skill area, which maps onto the VABS-3 DLS Personal subdomain, 16 out of 26 items were similar, including putting on shoes and clothes, and choosing to eat healthy. Primary differences included the ABAS-3 having more items related to using public restroom, and being more specific in skill requirement (e.g., “ Brushes teeth before leaving for work or appointments” in ABAS-3 PRAC vs. “completes brushing teeth sequence” in the VABS-3 DLS). The ABAS-3 Health and Safety skill area only had 9 out of 20 items that matched with tasks in the overall VABS-3 DLS domain, including using electrical appliances safely and taking medications. The ABAS-3 Work skill area, which only applies to those who hold part-time or full-time job, had only one item that was found in the overall DLS domain (i.e., keeps a stable part-time or full-time job for at least one year). To clarify, there were a few items in the ABAS-3 Work skill area that were similar to items in the VABS-3 DLS regarding the tasks’ pre-requisite skills (e.g., perform task quietly, clean-up, follow directions). However, the specificity of those skills, i.e., applied specifically to work ethics and environment, were not found in the VABS-3 DLS domain. In sum, 23 out of 24 items in the ABAS-3 Work skill area did not apply to the VABS-3 DLS domain.

In conclusion, the differences in skill specificity and level of difficulty between items in the ABAS-3 PRAC and VABS-3 DLS domains could have contributed to the score differences. Future studies that examine item to item comparison of the VABS-3 and ABAS-3 may provide a better understanding of if, and how the differences in targeted skills contribute to the measures’ score discrepancies.
Limitations of study

The present study has several limitations. The analyses were restricted to a small sample size of predominantly white families. This study would benefit from having a larger and more diverse sample. Additionally, as is often observed in autism research, participant scores were highly variable across instruments. For example, there were only 6 individuals in the GEC ≥ 65 group, in comparison to 17 individuals in the GEC < 65 group. The huge gap between sample sizes suggests high variances in data, which could lead to “dramatic effects on statistical power and Type I error rate” (Rusticus & Lovato, 2014). According to Slavin and Smith (2008), effect sizes found in small sample sizes are more varied, less reliable, and could potentially be artifacts of unequally distributed data. Therefore, the present results should be interpreted with caution and need to be replicated in larger samples of adults with ASD.

Furthermore, while the reason codes were derived from factors identified in past research and suggested in the Vineland manual (Sparrow et al., 2016), this is the first known study to assign additional points based on reason codes that approximated the potential for the individual to learn or eventually perform skills without support. Considering that Vineland scores are standardized in “normative” samples, it may be that these point assignments are “over-correcting.” In other words, factors such as amotivation, lack of opportunity, etc., may also drive daily living skill performance in neurotypical adults. It would be informative for future studies to directly compare the ways in which adolescents and adults learn daily living skills (i.e., what opportunities are they given to learn/practice, what is expected of them at different ages, etc.) to identify whether autistic adults differ from their non-autistic peers in their opportunities.

Cultural Considerations

It is important to note that the skills listed in the VABS-3 and ABAS-3 were created based
on the broad cultures and norms in the United States. The creation of individualized intervention plans for each adult should also consider each family’s cultures, practices and goals, rather than rely solely on the tasks in adaptive instruments as guidelines. Similarly, non-American or non-Western countries that utilize adaptive measures construed within Western constructs and normed against Western populations, should be cautious in interpreting their results if they choose to use the Western populations’ normative values.

**Conclusion**

Research suggests that better DLS are associated with increased independence in adulthood. In this sample, autistic adults presented with DLS skills that were much lower than what would be expected of their intellectual functioning. Although those with higher NVIQ had higher DLS scores on average, their NVIQ-DLS gap was twice the gap of those with NVIQ < 85. Therefore, while NVIQ was associated with DLS, the gains in DLS were not commensurate with gains in intellectual functioning. Executive functioning as measured by the BRIEF-A GEC was predictive of DLS performance, above and beyond intellectual functioning. With regard to contextual factors that affect DLS, opportunity emerged as one of the most common influences across all VABS-3 DLS subdomains. This has important implications for approaches to fostering independence for autistic adults. Clinicians who work with autistic adolescents and their families could provide caregivers psychoeducation on the importance of delegating responsibilities to the autistic individuals, to ease transitions into adulthood. For adolescents, it may be important to consciously incorporate opportunities to learn and practice skills. For adults, intervention plans should start with providing opportunities to tease apart the reason they are not (consistently) performing daily living activities, which could improve the specificity of interventions and treatment targets. Notably, even when using the ABAS-3, an instrument which tries to take into account ability to
perform tasks in its scoring, discrepancies remained between NVIQ and performance of practical skills, though ABAS-3 tended to yield higher scores than the VABS-3. Differences in the items on each measure may be an important part of these discrepancies and warrant future research.

Taken together, the findings highlight numerous factors that impact performance and measurement of conceptual and daily living skills in autistic adults. Findings highlight a need for multi-dimensional assessment to characterize each individual’s patterns of strengths and difficulties, as well as the necessity of moving beyond the standard scores on a given instrument to understand the contextual factors influencing skill performance. Better understanding of how these factors intersect will be critical to development of interventions aimed at promoting independence for autistic adults and selection of best approaches to foster skill development for an individual.
APPENDIX A

Codebook

Vineland’s adaptive behavior measurement is not about whether one can, or cannot perform an act, but whether one performs it **regularly** (e.g., cooking) or at **any time the act is required/ necessary** (e.g. dress appropriately for weather, call 911 when in danger).

**At times, participant’s past behaviors might be queried (such as in high school). Focus only on current functioning.**

**At times, participant’s predicted behaviors might be queried (e.g. “Do you think he can do it, if taught?”). Focus only on current functioning.**

1) **Does not Do**
- have had regular chances to perform skill, but fails to perform regularly
a) **Reasons Unknown/ Unclassified**
- response does not provide reasons for not performing task regularly. Ability to perform task may be unknown.
- response does not fall under b) to f)
  o He doesn’t do it
  o No.

b) Unless Reminded or Does not Perform even when reminded
- Not performing—chooses not to or doesn’t care to perform. Has a “conscious” factor to it. Able to perform task if asked to.
  o Only when reminded
  o You can tell him, but he doesn’t care to do it.

2) **Not Able to do**
- have had chances to learn or perform skill, BUT clear deficit in mastering the skill
  OR
- inability to regularly perform the skill due to factors not attributed to conscious choices

c) Not able to do—cognitive (intellectual, conceptual)
- Participant has been taught, but can’t master at independent level
- Participant doesn’t have pre-requisite skills or sufficient cognitive abilities (prior attempts to teach may not have been made)
  o We have tried teaching him, but he still doesn’t really understand about finances
  o He can do it only if picture schedules are provided. If we remove it, he can’t do it
  o No, he doesn’t have the idea of what that is [of what’s muddy or dirty]
  o No, he can’t do it

d) Not able to do—non-cognitive (e.g., sensory sensitivity, weak muscle tone)
- Participant had chance to perform or learn, but can’t perform skill due to any non-cognitive reasons
  o The smell of vegetables makes him nauseous
- He has poor muscle tone, so he doesn’t really use knives
- She is allergic to most chemical products, so we don’t make her do any cleaning

3) No Chance
- Not provided with opportunity to learn/perform OR not provided with consistent opportunity/requirement to perform task

e) Never had chance to assess performance/ Never had regular chance to perform skill
- Participant was never asked to or had chance to perform skill. Hence, coder/parent may not know for sure if participant is able to perform the skill if asked to.

OR
- Opportunity had occurred, but the task was not made a requirement/responsibility that the participant has to regularly fulfill. Hence, participant never had chance to showcase skill regularly
  - That never happened, so I am not sure
  - I will just do it for him
  - No, we never talked about it. He might understand if we teach him.
  - He offered but I choose to do it.

f) Unaware of concept
- Participant not exposed to certain “concepts” (as opposed to not having opportunity to showcase “skills”)
  - Not sure if he is aware of his rights to his medical records
  - He wakes up at 7am every day for work, He’s never been late before. I am not sure if he would understand the need to notify others if that ever happens.

4) Unable to code
- confounding information that does not clearly fall into coding a) to f)
APPENDIX B

Supplemental Tables

Table S1

**Difference in mean between groups – ABCL Internalizing**

<table>
<thead>
<tr>
<th></th>
<th>$T \geq 63$ (n=11)</th>
<th>$T &lt; 63$ (n=17)</th>
<th>$t$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVIQ</td>
<td>97.55 (30.07)</td>
<td>81.14 (30.11)</td>
<td>1.41</td>
<td>0.55</td>
</tr>
<tr>
<td>VIQ</td>
<td>96.45 (33.45)</td>
<td>83.24 (32.24)</td>
<td>1.04</td>
<td>0.40</td>
</tr>
<tr>
<td>DLS SS</td>
<td>62.09 (18.96)</td>
<td>59.88 (23.62)</td>
<td>0.26</td>
<td>0.10</td>
</tr>
<tr>
<td>Adjusted DLS SS</td>
<td>69.45 (20.21)</td>
<td>65.24 (25.69)</td>
<td>0.46</td>
<td>0.18</td>
</tr>
<tr>
<td>Change in DLS SS</td>
<td>7.36 (4.68)</td>
<td>5.35 (4.27)</td>
<td>3.74</td>
<td>0.45</td>
</tr>
<tr>
<td>ABAS</td>
<td>72.33 (17.22)</td>
<td>74.64 (14.67)</td>
<td>1.17</td>
<td>-0.15</td>
</tr>
<tr>
<td>PERS VS</td>
<td>8.55 (2.98)</td>
<td>8.82 (4.04)</td>
<td>-0.20</td>
<td>-0.08</td>
</tr>
<tr>
<td>PERS AE</td>
<td>9.80 (4.31)</td>
<td>10.64 (5.08)</td>
<td>-0.45</td>
<td>-0.18</td>
</tr>
<tr>
<td>DOM VS</td>
<td>8.36 (4.15)</td>
<td>9.53 (4.27)</td>
<td>-0.71</td>
<td>-0.28</td>
</tr>
<tr>
<td>DOM AE</td>
<td>10.47 (4.25)</td>
<td>12.64 (4.95)</td>
<td>-1.20</td>
<td>-0.46</td>
</tr>
<tr>
<td>COM VS</td>
<td>9.91 (4.23)</td>
<td>9.24 (4.09)</td>
<td>0.42</td>
<td>0.16</td>
</tr>
<tr>
<td>COM AE</td>
<td>13.78 (5.26)</td>
<td>13.20 (4.93)</td>
<td>0.30</td>
<td>0.12</td>
</tr>
</tbody>
</table>

**=p<.01 (2-tailed) 
*=p<.05 (2-tailed)

Table S2

**Distribution of reason codes**

<table>
<thead>
<tr>
<th>Distribution of codes</th>
<th>Percentage (%)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>N with 0 Score</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Able- reminded</td>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td>No Chance</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>Unable- other</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Unable- cognitive</td>
<td>0</td>
<td>93</td>
</tr>
<tr>
<td>Unspecified</td>
<td>0</td>
<td>69</td>
</tr>
</tbody>
</table>
Table S3

Participants average 0-score items per reason code across DLS subdomains

<table>
<thead>
<tr>
<th></th>
<th>DLS</th>
<th>PERS</th>
<th>DOM</th>
<th>COM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Items with 0-score</td>
<td>476</td>
<td>130</td>
<td>146</td>
<td>200</td>
</tr>
<tr>
<td>Participant’s mean</td>
<td>14.4 (6.44)</td>
<td>3.93 (2.42)</td>
<td>4.42 (3.08)</td>
<td>6.06 (3.10)</td>
</tr>
<tr>
<td>Able - reminded</td>
<td>1.76 (2.39)</td>
<td>0.76 (1.25)</td>
<td>0.79 (1.47)</td>
<td>0.21 (0.42)</td>
</tr>
<tr>
<td>No chance</td>
<td>7.06 (4.16)</td>
<td>1.42 (1.39)</td>
<td>2.27 (1.72)</td>
<td>3.36 (2.51)</td>
</tr>
<tr>
<td>Unable - other</td>
<td>0.33 (0.85)</td>
<td>0.21 (0.65)</td>
<td>0.03 (0.17)</td>
<td>0.09 (0.38)</td>
</tr>
<tr>
<td>Unable - cognitive</td>
<td>2.97 (5.13)</td>
<td>0.88 (2.22)</td>
<td>0.64 (1.19)</td>
<td>1.45 (2.33)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>2.30 (2.34)</td>
<td>0.67 (1.08)</td>
<td>0.70 (0.92)</td>
<td>0.94 (1.14)</td>
</tr>
</tbody>
</table>

Note: M = Mean item per participant

Table S4

Number of participants in each IQ group, and breakdown of measures

<table>
<thead>
<tr>
<th></th>
<th>Total participants</th>
<th>Total participants</th>
<th>Total participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVIQ &lt; 85</td>
<td>10</td>
<td>23</td>
<td>33</td>
</tr>
<tr>
<td>Total participants (n)</td>
<td>70</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td>ABAS</td>
<td>9</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>BRIEF</td>
<td>6</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>ABCL</td>
<td>9</td>
<td>19</td>
<td>28</td>
</tr>
</tbody>
</table>
REFERENCES


