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Do Post-Secondary Students With ASD Process Information More Slowly Than Others? Implications for Accommodations of Extra Time

Beth Pollock[1], Nathaniel Davin[1], Dylan Kwan[1], Kieran Bodner[1], and Allyson G. Harrison[1]

Abstract

Given the frequency with which students with Autism Spectrum Disorder (ASD) receive extended time accommodations in post-secondary settings, this study examined whether students with ASD—alone or with comorbid conditions—perform below peers without neurodevelopmental diagnoses on speeded tasks. A total of 729 post-secondary students who completed psychoeducational assessments were divided into four groups: ASD only ($n = 56$), ASD with Learning Disorder (LD; $n = 58$), ASD with ADHD and/or mental health conditions (MH; $n = 27$), and a No Diagnosis (No Dx) group ($n = 588$). Participants completed a flexible battery of individually administered tests assessing intellectual ability, processing speed, speed of retrieval, efficiency of cognitive flexibility and academic fluency. Overall, students in the ASD groups did not perform significantly below the No Dx group on most speeded cognitive and academic tasks. Further, mean scores on measures of speeded cognitive and academic functioning generally fell in the Average range across study groups. As such, the results did not suggest a need for extended time accommodation based on a diagnosis of ASD alone. The results reinforce the need for performance-based data to understand the diverse cognitive and academic profiles among students with ASD to guide appropriate supports.

[1]Queen's University, Kingston, ON, Canada

Corresponding Author:
Beth Pollock, Regional Assessment Resource Centre, Queen's University, Mackintosh-Corry Hall, B100, 68 University Avenue, Kingston, ON K7L 3N6, Canada.
Email: beth.pollock@queensu.ca

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Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition with an estimated prevalence of 1%–2.5% among children, adolescents, and young adults (Christensen et al., 2016; Idring et al., 2015). ASD is characterized by the presence of functionally disabling social communication and interaction challenges, as well as restricted, repetitive behaviors and interests (Hirvikoski et al., 2016; Järbrink, 2007; Knapp et al., 2009). While ASD can be associated with intellectual disability (American Psychiatric Association [APA], 2013), an increasing number of individuals with average to above average intelligence (i.e., IQ > 85) have been diagnosed with ASD over the past several decades (Christensen et al., 2016). As such, an increasing number of students diagnosed with ASD are completing secondary school and are now considering post-secondary education (e.g., college/university) as a viable option (Bakker et al., 2019; Barnhill, 2016; Shattuck et al., 2012; Volkmar et al., 2017). However, while estimates suggest that nearly 44% of transition-aged young adults with ASD enroll in some form of post-secondary program following high school, graduation rates for this population, at least in the United States, have historically been low (Newman et al., 2011).

The core diagnostic features of ASD, including challenges with social skills, interpersonal communication, and restricted, repetitive patterns of behavior, interests, or activities, place students with ASD at risk for academic and non-academic challenges in the post-secondary setting (Jansen et al., 2017). Based on a literature review, Anderson et al. (2019) concluded that the most common academic difficulties identified by post-secondary students with ASD include challenges understanding abstract or ambiguous concepts, poor planning skills, a tendency toward procrastination, and struggles with group work, presentations, and social skills during class. Non-academic difficulties most often reported included challenges with socialization, anxiety, depression, sensory sensitivities, and everyday living tasks. Thus, students with ASD reported experiencing a wide range of difficulties in the post-secondary environment that could reasonably be expected to contribute to functional impairment.

To compensate for disability-related functional impairments, post-secondary institutions provide academic accommodations and supports, such as exam accommodations, extensions for assignments, tutors, mentors, and counseling (Jackson et al., 2018; Jansen et al., 2017; Sarrett, 2018). A survey of 30 colleges and universities, conducted by Barnhill (2016), indicated that the most often provided accommodations for students with ASD included access to an advisor, modifications to testing procedures (e.g., extra time on examinations or alternate testing sites), tutoring, and access to a note taker. Jackson et al. (2018) surveyed post-secondary students with ASD to

obtain information regarding their self-reported needs and supports provided. On average, participants in this study utilized 2.38 support services while at school, the most common of which was academic advising (53.6%), followed by exam accommodations (44.6%), counseling/psychological services (39.3%), academic tutoring (30.4%), time management training (17.9%), and study skills training (12.5%). Further, based on a survey of the experiences of post-secondary students with ASD, Jansen et al. (2017) documented that extended time for completing exams was both the most frequently used accommodation as well as the accommodation perceived by students as most effective.

While studies have been undertaken to determine the effectiveness of various academic supports for post-secondary students with ASD (Anderson et al., 2019), much of the research that has been done in this area is in the form of surveys or case studies (Bouck, 2017; Zeedyk et al., 2016). In fact, no studies were identified that compared speed of task completion between post-secondary students with and without ASD, and reliance on self-report alone is problematic because a majority of non-disabled students also report being slow to complete timed tasks (L. J. Lewandowski et al., 2008; Suhr & Johnson, 2022; Weis & Waters, 2023). For example, L. Lewandowski et al. (2014) found that over 87% of non-disabled students believed that accommodations such as 50% extra time on tests would help them perform better academically, a proportion that was not different from that reported by students with disabilities. Since most students, regardless of disability status, report that commonly provided accommodations would improve their performance, relying on self-reported need to recommend appropriate accommodations may therefore result in a decision-making paradigm that may not be equitable or reliable. Academic accommodations should be tailored to address the interaction between the student's individual cognitive profile, measured academic deficits, and the specific task demands of each course (Roberts, 2012). For ASD, there is a general dearth of research on whether extra time accommodations are effective or equitable (A. G. Harrison et al., 2022). As such, there is no research evidence to either support or refute the provision of additional test-taking time for individuals with ASD. As this appears to be one of the most commonly provided and used accommodations for individuals with ASD, further research is needed to determine whether this accommodation is warranted.

Thus, the current study examined whether post-secondary students with ASD take more time to complete speed-related cognitive or academic tasks than do students without a disability diagnosis. To this end, we compared performance on measures of processing speed, academic fluency, speed of knowledge retrieval, and cognitive flexibility between students with ASD and those without a diagnosed neurodevelopmental disability. In addition, given the high rates of comorbidities in individuals with ASD (Khachadourian et al., 2023), those with comorbid Learning Disability (LD), Attention Deficit/Hyperactivity Disorder (ADHD), and/or Mental Health (MH) diagnoses were also compared to the ASD only group and the group of students without a disability diagnosis.

Given the frequency with which extra time accommodations are provided and used by students with ASD, it was hypothesized that students with ASD, either alone or comorbid with another condition, would perform significantly below the no diagnosis

Table 1. Demographic by Diagnostic Group.

Variable	Total	ASD	ASD + LD	ASD + ADHD/MH	No Dx
N	729	56	58	27	588
Age					
Mean	22.36	20.61	19.17	20.19	22.94
SD	6.98	4.92	1.89	3.52	7.44
Sex (% female)	55.4	23.2	19.0	25.9	63.4

Note. ASD = Autism Spectrum Disorder; ASD + LD = Autism Spectrum Disorder and Learning Disability; ADHD + ADHD/MH = Autism Spectrum Disability and Attention Deficit/Hyperactivity Disorder and/or Mental Health Disorder; No Dx = no diagnosis given.

group on cognitive and academic tasks that required speeded performance. Further, given previous research indicating that students with LD may require additional time to complete timed assessment tasks due to challenges with cognitive and academic fluency (A. G. Harrison et al., 2022), it was hypothesized that students with comorbid ASD + LD would perform significantly below the ASD only, ASD + ADHD/MH, and No Dx groups on speeded tasks of cognitive and academic functioning

Method

Sample

Data for this archival study were drawn from a database of community college and 4-year university students who had completed a psychoeducational assessment at a university-based regional assessment center between 2008 and 2024 to investigate reported problems with learning, attention, and/or mental health. All students had agreed during the informed consent process to allow their de-identified information to be included in this research database. Given research questioning the validity of test scores produced by individuals who fail to invest adequate effort during testing (An et al., 2012; Green et al., 2001; A. G. Harrison et al., 2008; A. G. Harrison & Edwards, 2010), those who failed at least one performance validity test (PVT) were excluded from subsequent analyses.

As summarized in Table 1, 729 students (Mean age = 22.46 years, $SD = 6.87$) were assessed using a flexible battery, and subsequently divided into four diagnostic groups: ASD-only (ASD), $n = 56$; ASD comorbid with a Learning Disorder (ASD + LD), $n = 58$; ASD comorbid with ADHD and/or Mental Health diagnosis (ASD + ADHD/MH), $n = 27$; and No Diagnosis (No Dx), $n = 588$. Of note, individuals in the ASD + LD group also included some individuals with additional comorbidities, such as ADHD and MH disorders. Performance was compared across tests of general intellect, processing speed, speed of retrieval, efficiency of cognitive flexibility, and academic fluency.

Groups differed significantly in age, $F(3,725) = 7.613$, $p < .001$ due to the No Dx group being significantly older than the three ASD groups. There were also significant

differences based on sex, $\chi^2(6) = 83.428$, $p < .001$, with more males than females in all three of the ASD groups. This aligns with the male-to-female ratio typically observed for ASD (Christensen et al., 2016).

Instruments

Clinicians administered a flexible battery of individually administered tests depending on the referral question and the clinician's preference. Each battery assessed general intellectual ability, processing speed, speed of information retrieval from memory, efficiency of cognitive flexibility, and academic fluency. Performance validity was also assessed, and students were informed that their test-taking effort would be evaluated throughout the testing days. Additionally, they were advised to work as quickly and as accurately as possible on all timed tests, as per individual test instructions. Tests included in the current study are discussed below.

Clinicians used at least two performance validity tests (PVTs) in each assessment, chosen from the list that follows. For the Word Memory Test (WMT; Green, 2003) or the Medical Symptom Validity Test (MSVT; Green, 2004), cut scores as outlined in the manual were used. On the Test of Memory Malingering (TOMM; Tombaugh, 1996) scores less than or equal to 45 for both Trial 2 and the retention trial were deemed non-credible. On the Victoria Symptom Validity Test (VSVT; Slick et al., 1997) scores lower than 19 on the "hard items" indicated validity concerns (Frazier et al., 2008).

The Wechsler Adult Intelligence Scale–Fourth Edition (WAIS-IV; Wechsler, 2008) measures Full Scale IQ (FSIQ) and also provides various index scores including the Processing Speed Index (PSI). The PSI measures "the speed and fluency at which very simple repetitive tasks. . .can be performed" (Schneider, 2013, p. 312). The Woodcock-Johnson III (WJ-III; Woodcock et al., 2001) and the Woodcock-Johnson IV (WJ-IV; Shrank, Mather, & McGrew, 2014; Shrank, McGrew, & Mather, 2014) Tests of Achievement include subtests that measure academic fluency, including tasks assessing reading fluency, writing fluency, and math fluency. The Essay Composition subtest of the Wechsler Individual Achievement Test, Third Edition (WIAT-III; Wechsler, 2009) was used to evaluate speeded essay writing (as it provides a 10-min timeframe to complete the task), and the Oral Reading Fluency subtest was used to evaluate accuracy and speed of oral reading. These measures produce age-norm referenced standard scores with a mean of 100 and a standard deviation of 15. Standard scores on the WAIS, WJ, and WIAT at or below 85 were used to define academic impairment.

The Delis Kaplan Executive Function System (D-KEFS; Delis et al., 2001) assesses processing speed (Visual Scanning, Number Sequencing, and Letter Sequencing), word reading speed (Color-Word Interference Test: Word Reading), speed of accessing information from long-term memory (Color-Word Interference Test: Color Naming; Verbal Fluency Test: Letter Fluency and Category Fluency), and efficiency of cognitive flexibility (Verbal Fluency Tests: Category Switching; Trail Making Test: Letter-Number Sequencing; Color-Word Interference: Switching). These measures produce age-norm referenced scaled scores with a mean of 10 and a standard deviation of three. Scaled scores below seven indicate a deficit in speed of processing visual

Table 2. WAIS Overall Ability and Thinking and Reasoning as a Function of Diagnostic Group.

Variable	ASD	ASD + LD	ASD + ADHD/MH	No Dx	*p*
WAIS-IV Full Scale IQ *N* = 562					
N	49	53	21	439	
Mean	106.06	98.49[b]	107.29[a]	100.51	.005
SD	17.91	11.68	10.47	13.77	
% ≤85	14.3	13.2	0	14.4	.319

Note. Means with different superscripts are significantly different from one another based on Tukey or Tamhane's T2 Post Hoc analyses. Where no superscripts occur, or superscripts with matching letters occur, no pairwise differences were found; ASD = Autism Spectrum Disorder; ASD + LD = Autism Spectrum Disorder and Learning Disability; ADHD + ADHD/MH = Autism Spectrum Disability and Attention Deficit/Hyperactivity Disorder and/or Mental Health Disorder; No Dx = no diagnosis given.

symbols, reading words, accessing learned verbal information, or efficiently switching between categories or task demands.

Design

Community college or 4-year university students diagnosed with ASD, alone or with co-morbid conditions, were identified in an archival dataset, and their scores on measures of interest were compared with non-diagnosed clinical controls. Students were assessed by either a registered psychologist or a supervised graduate student. Clinical diagnoses provided were based on the diagnostic criteria from the Diagnostic and Statistical Manual for Mental Disorders (DSM)-Fourth or Fifth Edition, depending on the timing of the student's assessment. All research procedures were approved by the Queen's University General Research Ethics Board.

Results

Statistical analysis was performed using Fisher's Analysis of Variance (ANOVA) with Levene's test for homogeneity of variance and Tukey's post hoc pairwise analysis. Where assumptions for Fisher's ANOVA were not met, Welch's ANOVA was substituted, and pairwise post hoc analysis was done using Tamhane's T2 which allows for unequal sample size and heterogeneity of variance.

Table 2 shows mean Full Scale IQ scores by group for those who had taken the WAIS-IV. Across groups, mean FSIQs were all in the average range. A one-factor ANOVA using WAIS-IV FSIQ as the dependent measures found an omnibus significance in IQ scores, $F(3, 64.55) = 4.731$, p .005. Tamhane's T2's post hoc pairwise analysis indicated that the ASD + ADHD/MH group obtained a significantly higher mean IQ score than the ASD + LD group. Percentage of individuals falling in the impaired range (at or below a standard score of 85) did not differ significantly by group.

Table 3. Speed of Processing Routine Information as a Function of Diagnostic Group.

Variable	ASD	ASD + LD	ASD + ADHD/MH	No Dx	*p*
WAIS-IV Processing Speed N = 561					
N	49	53	21	438	
Mean	93.61[b]	88.66[b]	96.19[ab]	98.96[a]	<.001
SD	15.85	11.35	10.68	13.39	
% ≤85	28.6[b]	45.3[b]	23.8[ab]	13.2[a]	<.001
WAIS-IV Coding N = 559 Scaled Score mean 10 SD 3					
N	49	53	21	436	
Mean	8.59[b]	7.47[b]	8.86[ab]	9.69[a]	<.001
SD	2.87	2.24	2.29	2.58	
% ≤85	26.5[ab]	48.0[b]	33.3[ab]	16.7[a]	<.001
WAIS-IV Symbol Search N = 558 Scaled Score mean 10 SD 3					
N	49	53	21	435	
Mean	9.27[ab]	8.32[b]	9.76[ab]	9.98[a]	.001
SD	3.83	2.64	2.39	2.98	
% ≤85	28.6[ab]	40.0[b]	19.0[ab]	17.5[a]	.016
D-KEFS Visual Scanning N = 238 Scaled Score mean 10 SD 3					
N	14	23	9	192	
Mean	7.79[b]	7.35[b]	7.44[b]	10.82[a]	<.001
SD	3.40	3.61	1.94	2.37	
% ≤7	28.6[ab]	47.8[b]	66.7[b]	9.8[a]	<.001
D-KEFS Number Sequencing N = 345 Scaled Score mean 10 SD 3					
N	26	34	17	268	
Mean	9.00[ab]	7.88[b]	8.47[ab]	9.96[a]	<.001
SD	3.15	3.26	3.47	2.66	
% ≤7	34.6	35.3	29.4	17.9	.027
D-KEFS Letter Sequencing N = 416 Scaled Score mean 10 SD 3					
N	35	36	20	325	
Mean	8.63[ab]	6.94[b]	9.55[ab]	10.11[a]	<.001
SD	3.41	3.70	3.49	2.73	
% ≤7	37.1[b]	52.8[b]	20.0[ab]	13.8[a]	<.001

Note: Means with different superscripts are significantly different from one another based on Tukey or Tamhane's T2 Post Hoc analyses. Where no superscripts occur, or superscripts with matching letters occur, no pairwise differences were found; ASD = Autism Spectrum Disorder; LD = Learning Disability; ADHD = Attention Deficit Hyperactivity Disorder; MH = Mental Health Disorder; No Dx = no diagnosis given.

Table 3 shows mean standard scores for Processing Speed on the WAIS-IV, as well as the component subtest scores and D-KEFS tasks assessing scanning speed. Mean scores across measures were within normative limits (standard score of 86 or above on the WAIS-IV subtests; scaled score of 7 or above on the D-KEFS subtests), with the exception of the ASD + LD group which performed below normative limits on the D-KEFS Letter Sequencing subtest. Analysis via ANOVA found significant differences

between groups on the WAIS-IV PSI, $F(3, 557) = 10.909$, $p < .001$ with the No Dx group scoring significantly higher than both the ASD and the ASD + LD groups. Similarly, the ASD and ASD + LD groups had significantly higher percentages of individuals with impaired scores (at or below a standard score of 85) than the No Dx group.

Two subtests make up the PSI, Coding, which includes a motoric (handwritten) response, and Symbol Search, which makes less motoric demands (Crowe et al., 1999). When looking at the difference across groups, the No Dx group scored significantly higher than both the ASD and the ASD + LD groups on the WAIS-IV Coding subtest $F(3, 555) = 13.707$, $p < .001$, but the No Dx group only scored significantly higher than the ASD + LD on the WAIS-IV Symbol Search subtest $F(3, 554) = 5.251$, $p < .001$. A similar profile was noted when percentages of impaired scores were compared across these measures, with only the ASD + LD group being significantly different from the No Dx group, with the latter having a significantly lower percentage of impaired scores.

On the D-KEFS scanning measures, the No Dx group outperformed all ASD groups on the Visual Scanning subtest, $F(3, 22.30) = 16.172$, $p < .001$, a task that makes similar scanning demands as the WAIS-IV Symbol Search subtest. However, the percentage of impaired scores only differed significantly between the ASD + LD and ASD + ADHD/MH groups and the No Dx group, with the latter having a significantly lower percentage of impaired scores. On the Number Sequencing and Letter Sequencing tasks, the No Dx only significantly outperformed the ASD + LD group (Number Sequencing = $F(3, 341) = 7.029$, $p = < .001$; Letter Sequencing = $F(3, 49.46) = 9.667$, $p < .001$). The percentage of impaired scores was also significantly higher in the ASD and ASD + LD groups than the No Dx group on the latter measure.

Table 4 shows mean standard scores on timed tests of silent and oral reading fluency. It should be noted that all mean subtest scores were within normative limits (within at least one standard deviation from the mean) across the reading subtests administered. The D-KEFS Word Reading score differed by group, $F(3, 406) = 10.259$, $p < .001$. Specifically, the ASD, ASD + ADHD/MH, and No Dx groups all outperformed the ASD + LD group, with a significantly higher percentage of impaired scores in the ASD + LD group than the ASD and No Dx groups. Reading Fluency scores across versions III and IV of the WJ were combined, as the test items are the same in both versions and mean scores did not differ significantly by version. In contrast to the D-KEFS Word Reading task, which assesses speed of single word reading, there were no significant differences amongst the groups with respect to the WJ Reading Fluency test or WIAT-III Oral Reading Fluency test, $F(3, 50.08) = 1.124$, $p = .348$ and $F(3, 157) = 0.222$, $p = .881$, respectively. Similarly, there were no significant differences in terms of percentage of impaired scores obtained as a function of group membership on the WJ or WIAT-III reading fluency subtests.

As can be seen in Table 4, mean scores on measures of speeded writing fell within normative limits across the subtests examined. Writing Fluency scores across versions III and IV of the WJ were combined, as the test items are the same in both versions and mean scores did not differ by version. There were no significant differences across groups for the combined WJ III and IV Writing Fluency scores, nor were the

Table 4. Academic Fluency Scores for Reading, Written Language, and Mathematics as a Function of Diagnostic Group.

Variable	ASD	ASD + LD	ASD + ADHD/MH	No Dx	*p*
D-KEFS Color Word Reading N = 410 Scaled Score mean 10 SD 3					
N	36	35	20	319	
Mean	11.11[a]	7.74[b]	9.80[a]	10.18[a]	<.001
SD	2.33	2.84	2.57	2.80	
% ≤7	5.6[a]	48.6[b]	15.0[ab]	12.9[a]	<.001
Woodcock-Johnson III & IV Reading Fluency N = 536					
N	38	39	19	440	
Mean	101.29	94.38	97.16	98.08	.348
SD	19.93	14.63	15.21	14.14	
% ≤85	18.4	28.2	15.8	16.4	.312
WIAT-III Oral Reading Fluency N = 161					
N	13	21	6	121	
Mean	97.85	96.05	100.17	96.88	.881
SD	10.61	10.91	8.77	11.96	
% ≤85	7.7	14.3	0.0	16.5	.606
Woodcock Johnson III & IV Writing Fluency N = 492					
N	36	38	17	401	
Mean	99.06	94.34	95.29	99.91	.050
SD	16.02	13.14	15.78	12.74	
% ≤85	19.4	18.4	17.6	10.0	.137
WIAT-III Essay Composition N = 279					
N	34	29	16	200	
Mean	99.56[b]	96.97[b]	105.00[ab]	107.89[a]	<.001
SD	15.86	15.39	10.49	10.82	
% ≤85	14.7[bc]	24.1[c]	0.0[ab]	2.5[a]	<.001
Woodcock-Johnson III & IV Math Fluency N = 247					
N	18	26	8	195	
Mean	91.67	82.04	89.00	87.75	.334
SD	16.41	13.10	14.70	14.13	
% ≤85	27.8	57.7	37.5	43.6	.256

Note. Means with different superscripts are significantly different from one another based on Tukey or Tamhane's T2 Post Hoc analyses. Where no superscripts occur, or superscripts with matching letters occur, no pairwise differences were found; ASD = Autism Spectrum Disorder; LD = Learning Disability; ADHD = Attention Deficit Hyperactivity Disorder; MH = Mental Health Disorder; No Dx = no diagnosis given.

percentage of impaired scores significantly different based on diagnostic group. The WIAT-III Essay Composition scores were significantly different $F(3, 275) = 10.248$, $p < .001$, with the No Dx group outperforming the ASD only and ASD + LD groups. The percentage of impaired scores was also significantly discrepant based on group membership, with the ASD and ASD + LD group having more individuals with scores in the impaired range.

Scores from the WJ-III and -IV Math Fluency subtests were combined, given the similarity between the two versions. As seen in Table 4, mean scores were all within normative limits and there were no statistically significant differences between the subtest scores by group. Similarly, there was no significant discrepancy in the percentage of individuals with impaired scores based on group membership.

Table 5 shows the speed of information retrieval from long-term memory for all groups. All mean scores fell within normative expectations. On the D-KEFS, speed of access to stored lexical information and word production based on an initial letter (Letter Fluency task) was not significantly different across groups. Similarly, the speed of producing words within a semantic category on the D-KEFS Category Fluency subtest was not significantly different across groups. There were additionally no significant differences in the percentage of individuals with impaired scores based on group membership for the verbal fluency tasks. The omnibus F statistic for Color Naming, $F(3, 280) = 4.114$, $p < .007$ was significant, with the No Dx group significantly outperforming the ASD + LD group, though the percentage impaired was not significant based on diagnostic group.

In addition to speed of retrieval, efficiency of cognitive flexibility was assessed using the Verbal Fluency Category Switching, Number-Letter Sequencing, and the Color Word Interference Switching subtests from the D-KEFS. Mean scores were within normative limits across the areas assessed. As can be seen in Table 5, the omnibus statistic for all three of these metrics was statistically significant, Verbal Fluency Switching task, $F(3, 230) = 3.308$, $p = .021$, D-KEFS Trail Making Letter-Number Sequencing subtest, $F(3, 49.109) = 4.273$, $p = .009$, and Color Word Interference Switching subtest, $F(3, 403) = 4.911$, $p = .002$. Despite the omnibus significance, post hoc analysis of the Verbal Fluency Switching task by group did not indicate specific group differences, nor were there significant differences in the percentage of impaired scores by group membership. For the D-KEFS Number-Letter Sequencing task, post-hoc analysis indicated that the No Dx group significantly outperformed the ASD + LD group, with the percentage of impaired scores being significantly higher in the ASD + LD group than the No Dx group. On the Color Word Interference Switching task, both the No Dx and ASD group outperformed the ASD + LD group, with a significantly higher percentage of the ASD + LD than the No Dx group obtaining impaired scores.

Discussion

The current study aimed to objectively evaluate whether post-secondary students with Autism Spectrum Disorder (ASD), either alone or comorbid with other neurodevelopmental or mental health conditions, exhibit significantly slower performance on speeded cognitive and academic tasks compared to peers without a disability diagnosis. This question is particularly relevant given the widespread provision of extended time accommodations for students with ASD, despite limited empirical evidence supporting the necessity of this accommodation.

Table 5. Speed of Retrieval From Long-Term Memory and Cognitive Flexibility as a Function of Diagnostic Group.

Variable	ASD	ASD + LD	ASD + ADHD/MH	No Dx	*p*
D-KEFS *Letter Fluency N = 236 Scaled Score mean 10* SD *3*					
N	18	16	11	191	
Mean	12.06	11.13	11.36	10.82	.480
SD	3.78	3.72	4.06	3.21	
% <7	11.1	18.8	18.2	14.1	.910
D-KEFS *Category Fluency N = 234 Scaled Score mean 10* SD *3*					
N	18	16	11	189	
Mean	11.56	10.75	11.09	12.32	.210
SD	4.09	3.44	3.65	3.39	
%<7	22.2	18.8	18.2	10.3	.116
D-KEFS *Color Naming N = 284 Scaled Score mean 10* SD *3*					
N	19	26	12	227	
Mean	9.42[ab]	8.19[b]	8.00[ab]	9.73[a]	.007
SD	2.19	2.64	2.22	2.67	
% <7	15.8	38.5	33.3	19.4	.094
D-KEFS *Color Word Reading N = 410 Scaled Score mean 10* SD *3*					
N	36	35	20	319	
Mean	11.11[a]	7.74[b]	9.80[a]	10.18[a]	<.001
SD	2.33	2.84	2.57	2.80	
% ≤7	5.6[a]	48.6[b]	15.0[ab]	12.9[a]	<.001
D-KEFS *Verbal Fluency Category Switching N = 234 Scaled Score mean 10* SD *3*					
N	18	16	11	189	
Mean	9.22	9.31	10.73	11.25	.021
SD	3.49	3.93	4.45	3.28	
% ≤7	33.3	31.3	18.2	12.7	.038
D-KEFS *Letter-Number Sequencing N = 416 Scaled Score mean 10* SD *3*					
N	35	35	20	326	
Mean	9.40[ab]	7.80[b]	9.45[ab]	9.71[a]	.009
SD	3.22	3.04	3.10	2.43	
% ≤7	28.6[ab]	34.3[b]	20.0[ab]	14.7[a]	.009
D-KEFS *Color Word Interference Switching N = 407 Scaled Score mean 10* SD *3*					
N	36	34	20	317	
Mean	9.75[a]	7.65[b]	9.20[ab]	9.67[a]	.002
SD	3.01	2.82	2.75	2.99	
% ≤7	21.6[ab]	44.1[b]	30.0[ab]	18.6[a]	.005

Note. Means with different superscripts are significantly different from one another based on Tukey or Tamhane's T2 Post Hoc analyses. Where no superscripts occur, or superscripts with matching letters occur, no pairwise differences were found; ASD = Autism Spectrum Disorder; LD = Learning Disability; ADHD = Attention Deficit Hyperactivity Disorder; MH = Mental Health Disorder; No Dx = no diagnosis given.

It should be noted that the mean IQ scores for all of our groups, including those with individuals with ASD, were within the Average range. As IQ is often used to differentiate between high and low functioning individuals and is an important predictor of outcome in ASD (Billstedt et al., 2007; Venter et al., 1992), the results would assume that individuals with ASD who have been able to succeed sufficiently in secondary school to allow access to post-secondary education are likely at the higher end of the spectrum. Our finding of more males than females in all three ASD groups is consistent with research indicating that ASD is diagnosed more frequently in males than females (Christensen et al., 2016).

The first hypothesis, that students with ASD, either alone or comorbid with another condition, would perform significantly below the No Dx group on cognitive and academic tasks that required speeded performance was not supported. Across all of the speeded tasks compared across groups, there was only one, D-KEFS Visual Scanning, on which all ASD groups were outperformed by the No Dx group, although mean scores for the ASD groups were still within normative limits. While atypical visual scanning of faces has been identified in young children with ASD (Wang et al., 2022), less research has been conducted on the general visual scanning efficiency of older individuals with ASD. One recent study by Canu et al. (2022) suggested that it was not necessarily visual processing speed, per se, impacting their efficiency when completing a visual scanning task but rather delayed initiation of the search in certain visual scanning conditions. Supporting this assertion, other measures of processing speed considered did not suggest that students with ASD were globally slow to complete "clerical" or other scanning tasks. As such, the results did not support the hypothesis that individuals with ASD generally perform more slowly than their peers with No Dx on measures of cognitive and academic fluency.

Two of the groups with ASD, the ASD only and ASD + LD groups, performed significantly below the No Dx group in terms of assessed processing speed on the WAIS-IV, which appears to have been due to lower performance on the Coding subtest, a task confounded by fine-motor handwriting speed. In addition, the ASD only and ASD + LD groups performed below the No Dx group on the WIAT-III Essay Composition task which required sustained handwriting. As such, it could be opined that handwriting speed may be the underlying issue contributing to slower performance on the Coding and Essay Composition subtests. However, mean scores and the percentage of individuals attaining scores in the impaired range did not differ significantly across groups on the WJ Writing Fluency test, contradicting this theory. In addition, mean scores on both the Coding and the Essay Composition subtests were within normative limits across the groups assessed. As such, while there were some group differences found that could suggest that students with ASD only and ASD + LD may complete tasks with a handwriting component slower than their ASD + ADHD/MH and No Dx counterparts, this is not a global finding across participants nor tests.

The second hypothesis, that students with comorbid ASD + LD would perform significantly below the ASD only, ASD + ADHD/MH, and No Dx groups on speeded tasks of cognitive and academic functioning, was only marginally supported. The ASD + LD group performed significantly lower than the other three groups on one

brief measure of word reading speed (D-KEFS Color Word Reading). While this makes intuitive sense, given their Learning Disability diagnosis, a similar discrepancy was not found across groups on the WJ and WIAT-III reading fluency measures, which are arguably much more challenging reading tasks than simply naming color words. Further, students with ASD + LD did not perform significantly below all three other groups on any of the cognitive measures administered. Thus, there is not conclusive evidence that students with comorbid ASD + LD consistently perform significantly below those with ASD only, ASD + ADHD/MH, or No Dx across measures of academic and cognitive functioning administered.

On the other hand, the ASD + LD group did consistently perform significantly below the No Dx group (but not the ASD only and ASD + ADHD/MH groups) across some tasks assessing processing speed (Symbol Search, Number Sequencing, and Letter Sequencing), speeded retrieval (Color Naming), and cognitive flexibility (Letter-Number Sequencing and Color Word Interference Switching). Interestingly, however, not all speeded tasks showed these group differences. For example, tasks assessing speed of lexical retrieval (e.g., verbal fluency) did not significantly differentiate the groups, suggesting that not all speed-related domains are uniformly affected in those with ASD + LD.

In contrast, students with ASD + ADHD/MD did not perform significantly below the No Dx group on any speeded measure, with the exception of their lower performance on the D-KEFS Visual Scanning task. As such, and consistent with previous research indicating that those with ADHD/MH do not generally perform at a slower pace than their peers with No Dx on speeded tasks (Lewandowski et al., 2013; Lovett & Leja, 2015), results do not suggest that comorbidities of ADHD/MH with ASD will cause additive deficits on timed academic and cognitive tasks.

Relevance to the Field of School Psychology

The current findings offer some practical implications for the provision of academic accommodations to students with ASD. Although extended time is one of the most commonly provided and used accommodations among students with ASD, results from this study suggest that only a subset, particularly those with comorbid LD, perform below those with no diagnosis on selected standardized measures of processing speed, speeded retrieval from long-term memory, cognitive flexibility, and academic fluency. While still generally performing within normative expectations, those with ASD only additionally performed below the no diagnosis group on measures of graphomotor speed, which may reflect fine-motor challenges often associated with ASD (Bhat et al., 2022), and essay writing, which may be related to graphomotor speed and/or challenges composing essays without warning and under timed demands (Finnegan & Accardo, 2018). It should be noted, however, that the percentage with individuals with scores that fell in the impaired range for graphomotor speed (WAIS-IV Coding subtest) was only approximately a quarter (26.5%) of the ASD group and half of the ASD comorbid with LD group (48.0%), and 14.7% and 24.1% for the WIAT-III Essay Composition subtest, respectively. Thus, while there may be some individuals

with only ASD who take longer to complete graphomotor and essay composition tasks and a higher percentage of individuals with ASD comorbid with LD who require additional time to complete these and other cognitive activities (e.g., processing speed, speeded retrieval from long-term memory, efficient cognitive flexibility), those with scores sufficiently low to suggest cognitive or academic impairment are still less than half (at most).

Further, despite the significantly lower scores on some measures of speeded cognitive functioning for those with ASD and ASD with comorbid LD, individuals with ASD generally performed within normative limits, and consistent with their counterparts with no diagnosis, on measures of reading and math fluency, with only a small proportion, less than a quarter, achieving scores in the impaired range, on a timed measure of essay composition. Thus, despite displaying evidence of a slower processing speed on some cognitive measures, there was no evidence that this translated into consistently weaker performance on measures of academic fluency. This aligns with recent research findings (Lovett et al., 2022) indicating that processing speed scores are a very poor index of timed academic skills (e.g., on average, processing speed scores account for only 6% of variance in academic fluency).

Thus, based on these results, the routine provision of extended time based solely on diagnostic label is not always justified. Instead, decisions should be guided by evidence of functional impairment in speeded performance as measured by reliable, norm-referenced instruments. This approach aligns with best practice guidelines that emphasize individualized assessment and consideration of the interaction between documented impairments and course demands (Roberts, 2012). Furthermore, clinicians and accessibility service providers should be mindful of the variability in performance across speeded cognitive and academic measures within the ASD population. Extended time may be appropriate for some individuals with ASD comorbid with LD, specifically when impairments in performance on speeded tasks are objectively demonstrated. However, as noted above, most areas of speeded academic functioning and speeded retrieval of linguistic information were not impaired and, in the few areas where some difference was found, the percentage functioning in the impaired range was low. Thus, the results of the current study support the assertion made by Brown et al. (2014) that accommodations typically granted to other population groups (e.g., extended assessment time), may not be as helpful for students with ASD.

Further, an extended test-taking time accommodation should not be provided as a matter of routine; additional time should be decided on an individual basis depending on objective evidence of functional impairment in processing, retrieving, and producing certain types of information relevant to the specific requirements of each test or assignment. These research findings challenge the prevalent assumption that all students with ASD require extra test-taking time accommodations, highlighting the importance of basing accommodation decision making on empirical evidence rather than on diagnoses alone. Our results suggest a shift away from the typical extended time accommodations for students with ASD, encouraging clinicians to explore alternative supports that may better address the unique needs of each student. These findings advocate for an informed decision-making model that will ultimately enhance the

ability of students with ASD to engage with and participate in their education curriculum whilst maintaining the integrity and validity of obtained test scores.

Limitations

While the current study contributes empirical data to an understudied area, several limitations must be acknowledged. The archival nature of the dataset precluded random sampling and may introduce referral bias. However, as students were referred for assessment due to academic concerns, this allowed us to focus on students with academic needs, those who would be most likely to require accommodations. Thus, while the results may not generalize to all post-secondary students with ASD, the data represents those who were of particular interest to the study, specifically, post-secondary students with ASD reporting academic impairments.

Second, given the high rate of comorbidities in the ASD population, the authors attempted to create diagnostic groups that made intuitive sense, such as grouping those with ASD and LDs, irrespective of their additional diagnoses of ADHD and/or MH, into one category while placing those with ASD and no LD, but with comorbid ADHD and/or MH diagnoses, into another. Although these classifications reflect the complexity and real-world heterogeneity of ASD presentations, future studies using more refined subgrouping criteria could yield more nuanced insights.

Third, to reflect the naturalistic clinical presentations during the specific time period, no cases were removed, with the exception of those whose results suggested possible issues with performance validity. This resulted in uneven group sizes, with the no diagnosis group being significantly larger than the clinical samples. Further, the no diagnosis group was significantly older and had more females than the ASD groups. While age-appropriate normative data was used and statistical corrections were applied to account for unequal variances and sample sizes (e.g., Welch's ANOVA, Tamhane's T2), larger and more balanced samples would increase the robustness of the findings.

Fourth, although research focusing on the relationship of extended test time on performance and fairness is indeed important to explore, research tends to occur in clinical or simulated settings and does not include how much time students use in actual college testing situations, nor the variables that predict the time used (Holmes & Silvestri, 2019; Sokal & Vermette, 2017; Spenceley & Wheeler, 2016). Sokal and Wilson (2017) also pointed out that many of the studies on extended time assume that homogeneity exists among students with disabilities, ignoring the diversity of students within such groups. Future studies will need to follow the actual amount of time used by students with ASD on tests with differing demands to better understand in which particular situations these students may require extra time. Similar to research on those with ADHD (A. G. Harrison & Armstrong, 2022), future investigations may find that alternative test accommodations, such as stop-the-clock breaks during testing, may be more beneficial to those with ASD than simply remaining in the test environment for longer. Such untimed breaks might allow those with ASD to remove themselves from the test environment anytime that they become frustrated, feel confused, or experience

trouble switching from one train of thought to another, and return more refreshed, clear headed, and better able to focus.

Conclusion

In conclusion, extended test-taking time accommodations are frequently provided to students with ASD in the postsecondary sector; however, whether this accommodation is actually warranted has not been investigated previously, with existing research in this area being derived predominantly from surveys and focus groups. Across a large range of tests, students with ASD in this study did not, as a group, display challenges with academic fluency, or speed of producing or retrieving information from long-term memory relative to those students who received no formal DSM diagnosis. This finding suggests that, if those with ASD were accommodated with extra time for tests due to their diagnosis of ASD alone, they would experience an unfair differential boost (Fuchs et al., 2000) relative to other students, rather than an equal opportunity to demonstrate their knowledge. In addition, it does not appear that students with ASD and comorbid ADHD/MH require additional time for tests and examinations due to persistent deficits in speeded information processing or academic fluency. On the other hand, students with ASD and comorbid LD demonstrated the weakest performance on some efficiency and fluency measures administered. As such, extended time accommodations for individuals with both ASD and LD may be warranted, though accommodations should be determined on an individual basis and clearly linked to areas of functional impairment identified and specific task demands of the evaluation.

ORCID iDs

Beth Pollock https://orcid.org/0000-0001-8687-9455
Allyson G. Harrison https://orcid.org/0000-0002-0426-2011

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Author Biographies

Beth Pollock is the Clinical Director of the Regional Assessment Resource Centre. As a Clinical Neuropsychologist, her work focusses on the assessment and support of students with neurodevelopmental conditions that impact learning.

Nathaniel Davin is a Senior Psychometrist for the Regional Assessment Resource Centre. His work focusses on the assessment and support of students with neurodevelopmental conditions.

Dylan Kwar and **Kieran Bodner** were summer work experience students who worked with the Regional Assessment Centre to gain experience in the research field.

Allyson G. Harrison is a Research Psychologist at the Regional Assessment Resource Centre. Her work focusses on the assessment and support of students with neurodevelopmental conditions that impact learning.