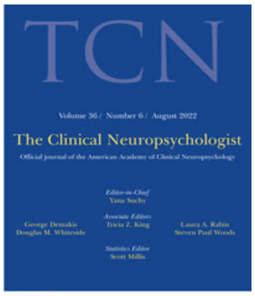

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The impact of depression and anxiety on speed of academic performance and retrieval fluency in postsecondary students

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ABSTRACT

Objective: This study evaluated the functional effects of severe mental health symptoms on speed of academic performance to assist clinicians and educators in determining whether extra time accommodations are evidence-based for students with such diagnoses. **Method:** Using archival data from 1476 post-secondary students, we examined the performance of students with existing mental health diagnoses who were also reporting extremely high levels of symptoms. Their performance on timed academic achievement and cognitive processing measures was compared with performance of students with learning disabilities, Attention Deficit Hyperactivity Disorder, and clinical controls. Students failing stand-alone performance validity and/or symptom validity measures were excluded from this investigation. **Results:** Students diagnosed with anxiety and/or depression did not differ from clinical controls on any timed performance measure, typically performing academic tasks within a normal amount of time. By contrast, those with reading disabilities were typically the slowest on all academic tasks. **Conclusion:** Across the range of timed tests, students with mental health diagnoses did not show functional impairments in tests with a speed component. As such, they would not typically require increased time to perform speeded academic tasks, but they might require alternative accommodations in their post-secondary programmes in order to participate equally.

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Anxiety; depression; mental health; accommodations; postsecondary; functional impairment; speed

The number of students with mental health complaints enrolled in postsecondary institutions has grown markedly (American College Health Association, 2011, 2019a, 2019b), with diagnoses of depression and anxiety being the problems most frequently endorsed. Indeed, mental health disorders in general are now the disability category most commonly accommodated in colleges and universities in both Canada (Nadira Ramkissoon, Ministry of Advanced Education and Skills Development, personal

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communication, March 13, 2017; Glowacki, 2018) and the United States (Castillo & Schwartz, 2013).

Accommodations for mental health complaints among postsecondary students are also increasing at a much higher rate than for other disabilities. For example, Meeks et al. (2019) reported that in 2019, 4.6% of medical school students reported disabilities, a 69% relative increase from 2016. The largest increase in disability categories was a 53% increase in psychiatric disabilities, compared to a slight decrease of −5.9% in attention deficit hyperactivity disorder (ADHD) and a bigger decline of −14.5% in learning disabilities (LD). In community colleges in Ontario there was a 110% increase in mental health disabilities requiring accommodation between 2009 and 2015 as compared to a 25% increase in LD and a 71% increase in ADHD (Deloitte, 2017). All of these students accessed accommodations of extra time for tests. This general pattern is not limited to Canada; it has been noted also in the United States (e.g., Belkin, 2018; Castillo & Schwartz, 2013), the United Kingdom (e.g., Quinn et al., 2009; Riddell et al., 2005), and Australia (e.g., Manalo et al., 2010).

The challenge for postsecondary Disability Services Offices in supporting students with disabilities is determining which accommodations or supports will reasonably compensate for the identified functional impairment(s) without violating the essential requirements of a program or conferring an academic advantage relative to other non-disabled students (Lovett, 2020; Lovett & Bizub, 2019; Pardy, 2016). However, it is not clear if and/or how diagnosed mental health disorders affect equal participation and functioning when taking timed tests.

The Diagnostic and Statistical Manual of Mental Disorders-IV-TR (DSM-IV-TR; American Psychiatric Association [APA], American Psychiatric Association, 2000) and −5 (DSM-5; APA, 2013) diagnostic criteria suggest that students with diagnoses of depression and/or anxiety may experience symptom-related functional impairments that could potentially interfere with equal participation in timed evaluations. For example, Major Depressive Disorder and Persistent Depressive Disorder may include symptoms such as: psychomotor agitation or retardation that is not merely subjective, but is severe enough to be noticeable by others; difficulty thinking, concentrating or making decisions; and decreased energy and fatigue (APA, 2013). Additionally, DSM-5 notes that depressed individuals often interpret their behaviors in an unrealistically negative light, and misinterpret neutral or trivial events as evidence of their own personal deficiencies In fact, such negative beliefs may frequently seem delusional (APA, 2013).

The few studies examining effects of depression on cognitive functioning in young adults also suggest there may be speed-related effects associated with this condition. For instance, a meta-analysis by McDermott and Ebmeier (2009) found that the severity of depression correlated significantly with cognitive functions of episodic memory, executive function and processing speed. In relatively young adults, a mild and limited cognitive impairment was found during the course of a mild to moderate major depressive disorder (Halvorsen et al., 2012). In their meta-analysis of the literature on depression-related cognitive impairments in young adults, Castaneda et al. (2008) found only studies evaluating deficits associated with Major Depressive Disorder. Here, the few studies in existence suggest that young adults with this diagnosis demonstrate executive functioning impairments, attentional deficits including working memory problems, and psychomotor retardation. There was also some suggestion that Major Depression was associated with slower rate of learning material. Additionally, Gorlyn et al. (2006) found that unmedicated subjects in major depressive episodes scored lower than healthy volunteers on the WAIS-III Processing Speed index and timed subtests in general. In all of these studies, however, no performance or symptom validity measures were included in the testing.

Very little is known about the nature of cognitive deficits associated with anxiety disorders in young adults (Castaneda et al., 2008). However, DSM-5 (APA, 2013) indicates that generalized anxiety disorder may include symptoms such as worry and anxiety severe enough to disrupt attention and concentration, sometimes causing one's mind to go blank. In younger individuals, their excessive worries may center on their competence in school or the quality of their performance (APA, 2000; 2013). DSM-IV-TR notes that younger students with this diagnosis may tend to redo tasks due to excessive dissatisfaction with anything they feel is less than perfect performance. In their meta-analysis of the literature, Castaneda et al. (2008) note that little agreement has been found regarding the possible cognitive deficits associated with anxiety disorders in young adults. Some studies suggest deficits in verbal episodic memory, but other deficits appear to depend on the specific subtype of anxiety. For instance, those with Obsessive-Compulsive Disorder appear to have problems with some types of executive functioning, whereas those with panic disorder may have difficulties with divided attention. Castaneda et al. (2011) conducted a further investigation of the cognitive deficits associated with anxiety disorders in young adults. Here, they found little evidence of significant cognitive impairments compared with healthy peers. Specifically, while they did find that young adults with anxiety disorders who were not in remission scored lower than healthy peers on a visual working memory task, no deficits were found in verbal and visual short-term memory, verbal long-term memory, attention, psychomotor processing speed or executive functioning. As was true for the literature on cognitive deficits and depression, none of the studies examining cognitive impairments in young persons with anxiety included objective measures of performance or symptom validity.

More recently, Holmes and Silvestri (2016) found that postsecondary students with a mood disorder diagnosis self-reported challenges with alertness/attention, while those with anxiety disorders were more likely to report issues with memory/executive functions. These students reported that their mental health symptomology may impact upon their academic skills and ability to consistently access the postsecondary curriculum. However, these subjective self-reports were not validated through objective indicators of academic impairments.

Accommodations recommended for mental health problems are often based solely on self-reported symptoms or clinical judgment, in contrast to the requirements from objective evidence from a psycho-educational assessment to document functional impairment that would require accommodations for LD or ADHD. Yet, reliance on self-evaluation of functional impairment is particularly problematic, as self-report may be prone to inaccurately reflect the actual functioning of those with mental health conditions. For example, the very features that define some mental illnesses easily influence self-report of problems. Individuals with high levels of anxiety may over-estimate the extent to which they experience functional impairments and under-estimate their actual level of functioning (Gentes & Ruscio, 2014; Lovett & Nelson, 2017; O'Donohue & Fisher, 2006). From their review of the literature, Patterson and Mausbach (2010) concluded that "self-reports may produce suspect information which may be neither a valid nor reliable measure of a patient's actual level of functioning" (p. 5). This conclusion mirrors previous studies by Gathje et al. (2008), and Gordon et al. (2006), both of which discuss the tenuous relationship between self-reported symptoms of ADHD and objective measures of functional impairment. Hence, reliance on the self-evaluation of those with certain mental health conditions may not be an accurate way to determine functional impairments in academic tasks with a subsequent need for academic accommodations or supports.

Nevertheless, the notion that the client is the best person to determine if functional impairments exist and to make decisions about what accommodations are required is consistent with the recommendations of Condra and Condra (2015) in Canada, and with the disability documentation guidelines published by the Association on Higher Education and Disability (AHEAD) in the United States (2012). Both of these papers advocate that the use of clinical judgment in the course of interviewing a student about their experienced functional impairments should usually be sufficient to determine required academic accommodations, and that no further objective evaluation is typically needed.

There are clear pitfalls, however, to reliance on clinical judgment, especially when based on self-report. For instance, Harrison et al. (2018) found that physicians typically receive no training in determining functional impairment of postsecondary students with mental health challenges, and typically recommend academic accommodations based on the wishes of the patient or their own clinical judgment without using objective assessment methods to determine functional impairment. Clinical judgment relies on anecdotal evidence, which is considered the weakest form of empirical evidence in both research and medical practice guidelines (Burns et al., 2011; Iverson, 2014; Lee & Hunsley, 2015). In fact, Lee and Hunsley state that "although anecdotal evidence can inform hypotheses to be evaluated systematically, such evidence should not be equated with scientific data" (p. 536).

Reliance on self-report alone is further problematic because a majority of non-disabled students also report being slow to complete timed tasks and needing extra time to read and understand course material (Lewandowski et al., 2000, 2008). Additionally, Lewandowski et al. (2014) found that over 87% of non-disabled students also 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 or clinical judgment to recommend appropriate accommodations may therefore result in a decision-making paradigm that may not be equitable or reliable.

The intended use of accommodations according to the Americans with Disabilities Amendments Act of 2008 in the United States and both National and Provincial Human Rights legislation in Canada (Roberts, 2012) is to ensure equal access to test items and ensure the accurate measurement of an individual's mastery of course material, but not to optimize an examinee's performance or remove pressure from the test situation (Coulter, 2009; Roberts, 2012). The test accommodation that is most frequently requested and granted is extended time (Thurlow & Bolt, 2001). The logic of extended time as an accommodation is based on the premise that individuals with certain disabilities a) have a functional impairment that affects performance on academic tasks or b) they lose time during examinations due to significant distractibility or mental interference. Current research indicates that students with ADHD should not experience difficulties accessing speeded tests relative to non-disabled students. (e.g., Jansen et al., 2019; Miller et al., 2015; Pritchard et al., 2016). However, no research has investigated whether high levels of mental health symptoms secondary to a psychiatric condition such as anxiety and/or depression interferes with test-taking. Nonetheless, current practice is typically to accommodate individuals with these diagnoses with at least 50% extra time for writing tests and exams in both Canada (Harrison & Wolforth, 2012; Sokal & Wilson, 2017) and the United States (Association on Higher Education & Disability, 2012; Colker et al., 2015).

Many of the academic accommodations provided to students with non-evident disabilities (e.g., LD, ADHD, mental health, etc.) might improve the performance of non-disabled students as well (Gordon et al., 1998; Kettler, 2012; Lewandowski et al., 2013; Sireci et al., 2005; Sireci & Hambleton, 2009). Therefore, the justification for extended time should be whether extra time improves performance on tests only for those with a specific type of disability but not for non-disabled students (Phillips, 1994; Zuriff, 2000). Alternatively, Fuchs et al. (2000) argued that extra time accommodations could provide a "differential boost" to those with disabilities relative to non-disabled students. A number of studies have failed to find evidence that extra time improves only the performance of those with specific reading disabilities (Lewandowski et al., 2013; Sireci et al., 2005), and in fact improves the performance of non-disabled students to a greater extent than for students with specific reading disabilities or ADHD (Lewandowski et al., 2013; Miller et al., 2015). Additionally, more than 25% extra time for students with specific reading disabilities actually confers a competitive advantage relative to their non-disabled peers writing within normal time limits (Lewandowski et al., 2013). Furthermore, recent studies show that those with ADHD are given a distinct competitive advantage when provided with any extra time for tests (Jansen et al., 2019;; Miller et al., 2015). Any extra time may therefore provide an unfair advantage if the accommodated test taker does not truly have a reading impairment (Kettler, 2012; Lewandowski et al., 2015; Miller et al., 2015). Accommodation is meant to level the playing field, not tip the advantage in favor of the person with a disability.

While some extra time may be required to compensate for the functional impairments associated with a specific reading disability, it is currently unclear what academic accommodations are needed to level the playing field for students with mental health challenges. The most common rationale for the accommodation of extended time is that students with certain disabilities characteristically take more time to complete a variety of timed tasks than students without disabilities because of slower general processing speed (Zuriff, 2000). This rationale persists, even though research has failed to show that general processing speed measures actually predict speed of performance on real-world academic tasks (Lovett et al., 2017, 2020). On the other hand, if symptoms of a specific disability result in impaired speed of reading, writing, math, or retrieval fluency, then evidence-based accommodations of extra time accommodation would allow equal access to test material (Lovett & Lewandowski, Lovett & Lewandowski, 2015; Mather & Jaffe, 2002). As such, if students with high current levels of anxiety or depression symptoms show substantial impairments in these types of processes in the absence of a diagnosed learning disability, then accommodations of extra time for tests might be warranted to compensate for their mental health disorder.

The current study therefore examined whether postsecondary students with diagnosed depression, anxiety, or both, along with significantly high symptom levels on the dates of testing, take more time to complete speed-related cognitive or academic tasks than do students with no formal DSM diagnosis or if they show more deficits in executive functions such as speed of retrieving known information. We hypothesized that students with depression, anxiety, or both would complete academic activities more slowly than non-disabled students (i.e., clinical controls). We further compared their speeds to students who have LD or ADHD, given that students with these latter diagnoses typically receive extra time accommodations (Colker et al., 2015; Harrison & Wolforth, 2012; Lindstrom & Lindstrom, 2017; Sokal & Wilson, 2017).

We hypothesized that students with LD in reading alone or comorbid with ADHD, would perform below average on any academic tasks that require speeded reading, information retrieval, or production. Based on recent research, we hypothesized that students with only ADHD would score in the average range or better on time-limited academic tasks. Finally, we hypothesized that students with comorbid mental health conditions would perform such tasks less efficiently compared with those who have only one mental health diagnosis.

The students in this retrospective study had all undergone a comprehensive psychological assessment using standardized tests, and had been given DSM diagnoses where applicable by the examining Psychologist. Conclusions about the need for more time are based on empirical data collected in these prior assessments.

Method

Participants

Data for the current study were drawn from a database of community college and four-year university students who had completed a psycho-educational assessment at a university-based regional assessment center between 2008 and 2019 to investigate reported problems with learning, attention 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. To quantify the level of psychological distress currently experienced by students, we reviewed data from 1476 students whose assessment had included the Personality Assessment Inventory (PAI; Morey, 1991) to assess for possible mental health issues. The mental health symptom groups included students who were diagnosed with depression and/or anxiety, and whose T-score on the Depression (DEP) and/or Anxiety (ANX) clinical scales of the PAI were at or above 70. This cutoff of 2 SD above the mean represents self-report of a wide variety of clinically significant depression and/or anxiety symptoms and likely notable impairment in multiple life domains (Keiski et al., 2007; Morey, 1991, 1996).

Morey (1996) notes that the overall ANX scale on the PAI is intended to be a general, all-purpose measure of anxiety, assessing both state and trait symptoms. In this interpretive guide, Morey specifically states that those with high T scores on the ANX scale are "likely to be plagued by worry to a degree that interferes with their ability to concentrate, attend, and manage stressful periods in their lives. Anxiety is experienced in all modalities, ideationally as well as physically. Such people will ruminate about issues and events of seemingly minor significance and over which they have no control. There is likely to be prominent motor tension, little capacity to relax, and a general fatigue and malaise as a result of high perceived stress." (p. 32). Additionally, Hill et al. (2013) found that state and trait anxiety symptoms as measured by the State-Trait Anxiety Inventory (STAI: Spielberger et al., 1983) appear to capture a separate dimension of "general negative affect" in post-secondary students, whereas the PAI anxiety subscales all contributed to an overall "anxiety" construct. Furthermore, these authors found that both state and trait anxiety as measured by the STAI correlated equally well with all three of the PAI Anxiety subscales; no significant difference was found in the relationship between state vs. trait anxiety complaints on the STAI and ANX scale scores on the PAI. Hence, it appears that the PAI ANX scale evaluates both state and trait anxiety symptoms.

Participants were categorized into seven groups based on their diagnoses and actual clinical scores. Diagnoses were based on DSM-IV or DSM-5 criteria, depending on year evaluated. To ensure clarity of findings, we excluded students with mental health complaints who had comorbid diagnoses of LD or ADHD.

1. RD: DSM diagnosis of a specific learning disorder in reading; n = 325;
2. ADHD: DSM diagnosis of ADHD; n = 323;
3. RD/ADHD: DSM diagnosis of both a RD and a diagnosis of ADHD; n = 52;
4. Dep: A DSM diagnosis of dysthymia/persistent depressive disorder or a major depressive disorder, along with a score on the PAI DEP scale greater than or equal to T = 70; n = 100;
5. Anx: A DSM diagnosis of a generalized anxiety disorder, along with a score on the PAI ANX scale greater than or equal to T = 70; n = 150;
6. Dep/Anx: Comorbid diagnoses of both anxiety and depression, along with scores on both the PAI DEP and ANX scales equal to or greater than T = 70; n = 86
7. No Dx: The clinical control group of assessment-seeking students who, despite reporting worrisome symptoms, failed to meet diagnostic criteria for any DSM diagnosis; n = 440.

Groups differed in age, $F_{(6,1160)} = 2.71$, $p = .013$ (see Table 1). No post hoc pairwise comparisons were found. The groups also differed by sex, $X^2_{(6)} = 89.9$, $p < .001$, with the ADHD and RD/ADHD groups majority male and all other groups majority female.

Materials

Clinicians administered a flexible battery of individually administered tests widely used in clinics and research, depending on the referral question and clinician's preference. Each battery assessed general intellectual ability, processing speed, speed of retrieval

Table 1. Demographics of archival sample.

	Total	RD	ADHD	RD/ ADHD	Dep	Anx	Dep/ Anx	No Dx
N	1476	325	323	52	100	150	86	440
Age								
Mean	22.0	21.3	21.8	21.1	23.2	21.5	22.2	22.9
SD	6.0	5.5	5.6	4.3	7.6	4.5	5.6	6.9
Sex (% female)	58.9	62.1	41.9	31.1	53.9	82.4	79.6	63.1
Valid N	1167	277	271	45	74	124	52	324

Note: RD = Reading Disability, ADHD = Attention Deficit Hyperactivity Disorder; Dep = Depression; Anx = Anxiety; No Dx = No diagnosis given; Valid N = after removing individuals with invalid symptom and performance validity tests.

from memory and academic fluency. Performance and symptom validity were also assessed. Notably, any subtest that was given to fewer than 150 students in total was not included in the study due to very small numbers per group. Students were informed that their effort would be tested throughout the day, and 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 listed below.

The Personality Assessment Inventory (Morey, 1991) is a self-report measure of adult personality and psychopathology. In addition to a DSM diagnosis, extreme scores from the Anxiety (ANX) and Depression (DEP) clinical scales of the PAI were employed for the current study because of their diagnostic relevance for anxiety and/or mood disorders (Morey, 1996), and to demonstrate that students were currently experiencing significantly high levels of symptoms.

The validity of each PAI protocol was determined using Morey's (1991) cutoff T-scores for three validity scales Inconsistency (ICN) index $\geq$73; Infrequency (INF) index $\geq$75; and Negative Impression Management (NIM) index $\geq$92. PAI profiles that exceeded one or more of these scale scores ($n = 119$) were considered invalid and removed from the study. We did not remove students with high scores on Positive Impression Management (PIM) who were denying symptoms.

Clinicians used at least two performance validity tests (PVTs) in each assessment, chosen from the list that follows. To ensure that the current sample reflected the performance of students who were not objectively attempting to magnify or exaggerate their current symptoms, those who failed one or more PVT based on the test's cutoff score were not assigned to any group.

For the Word Memory Test (WMT; Green, 2003, 2005) or the Medical Symptom Validity Test (MSVT; Green, 2004), invalid scores on any of the first three subtests were deemed noncredible. Out of an abundance of caution, students showing a Severe Impairment Profile (Green, 2008), which might indicate test failure due to a genuine neurological condition rather than poor effort, were also removed from further analysis. 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 noncredible. On the Victoria Symptom Validity Test (VSVT; Slick et al., 1997) scores lower than 19 on the "hard items" were deemed noncredible (Frazier et al., 2008). After removing 190 individuals who failed at least one of these PVTs, 1167 data records remained.

The Wechsler Adult Intelligence Scale –Third Edition (WAIS-III; Wechsler, 2001a) or Fourth Edition (WAIS-IV; Wechsler, 2008) measure Full Scale IQ (FSIQ), and also provides various index scores including Processing Speed (PSI); this latter index 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., 2001a, 2001b) and the Woodcock-Johnson IV (WJ-IV, Schrank, Mather, & McGrew, 2014; Schrank, McGrew, & Mather, 2014) include subtests that measure Processing Speed, Reading Fluency, Writing Fluency and Math Fluency. The Written Expression subtest of the Wechsler Individual Achievement Test II and III (WIAT II and WIAT III, Wechsler, 2001b; Wechsler, 2009) and the Kaufman Test of Educational Achievement–Second Edition (KTEA-II; Kaufman & Kaufman, 2004) evaluate an essay written within a time limit. Standard scores on the WAIS, WJ, WIAT and KTEA at or below 85 were used to define academic impairment.

The Nelson Denny Reading Test (NDRT; Brown et al., 1993) assesses timed reading comprehension with a limit of 20 minutes, as well as one minute reading rate. Scale scores below 175 indicate normative academic impairment (Harrison & Harrison, 2019).

The Delis Kaplan Executive Function System (D-KEFS, Delis et al., 2001) assesses processing speed (Letter Sequencing, Number Sequencing, and Visual Scanning), and speed of accessing information from verbal long-term memory (Color-Word Interference Test: Color Naming and Word Reading; Verbal Fluency Tests: Letter Fluency and Category Fluency). Scaled scores below seven indicate a deficit in speed of processing visual symbols or accessing learned verbal information.

Procedure

Students registered at either a community college or four-year University in Ontario, Canada, were provided with a psycho-educational assessment at a government-funded regional assessment center. Referrals were for either an updated assessment of a previously-diagnosed disorder or to investigate the cause for currently-reported academic difficulties. Students were assessed by either a registered psychologist or a supervised graduate student. All research procedures were approved by Queen's University's General Research Ethics Board.

Results

Statistical analysis was performed using Fisher's Analysis of Variance 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 Hochberg's GT2 which allows for unequal sample size and heterogeneity of variance.

Table 1 shows that the sample size is robust, with 1476 students completing psycho-educational assessments. Among those, 1167 students met our criteria for validity, with no scores on tests of performance validity or symptom validity failed. Using group and gender as fixed factors in an ANOVA, only two gender by group interactions were found: KTEA Written Expression and Nelson Denny Reading Comprehension. These interactions are reported within the tables and otherwise, for clarity, only one-way ANOVA are reported.

Table 2. Wechsler Adult Intelligence Scale (WAIS) overall ability and thinking and reasoning as a function of diagnostic group.

	RD	ADHD	RD/ ADHD	Dep	Anx	Dep/ Anx	No Dx	P
WAIS-IV Full Scale IQ N = 930								
N	242	211	39	58	103	31	246	
Mean	93.3[a]	101.1[b]	97.5[ab]	101.8[b]	97.3[ab]	101.0[b]	99.1[ab]	<.001
SD	9.2	12.9	11.5	13.7	11.1	12.2	15.0	
% <= 85	18.2	11.8	15.4	12.1	13.6	6.5	22.0	.044
WAIS-III Full Scale IQ N = 74								
N	18	15	4	1	6	2	28	
Mean	102.7	102.7	107.8	110.0	98.0	98.0	107.0	.774
SD	12.6	11.4	7.0		10.5	21.2	17.7	
% <= 85	11.1	6.7	0	0	0	50.0	10.7	.514
WAIS-IV Working Memory Index Scaled Scores N = 930								
N	242	211	39	58	103	31	246	
Mean	85.92[a]	95.40[b]	86.79[a]	93.71[b]	91.1[ab]	96.29[b]	93.27[b]	<.001
SD	10.3	12.9	10.4	14.0	12.1	13.8	13.8	
% <= 85	50.4	22.3	43.6	27.6	33.0	22.6	25.2	<.001

Note: Means with different superscripts are significantly different from one another based on Tukey or Hochberg's GT2 Post Hoc analyses; RD = Reading Disability; ADHD = Attention Deficit Hyperactivity Disorder; Dep = Depression; Anx = Anxiety; No Dx = No diagnosis given.

Table 2 shows mean Full Scale IQ scores by group who had taken the WAIS (87.5% of sample). Full Scale IQ scores were analyzed separately for Versions III and IV, since a t-test comparing mean FSIQ scores found significant differences between the two groups ($t_{(228)} = 6.0$, $p < .001$ equal variance not assumed). Across groups, the mean FSIQs were all in the average range. A one factor ANOVA using WAIS III and IV FSIQ as the dependent measures found differences in mean IQ for version IV, $F_{(6,\ 923)} = 9.36$, $p < .001$; but not for version III, $F_{(6,\ 67)} = .54$, $p = .774$, likely due to the small sample size in the latter. Post hoc Hochberg's GT2 pairwise analysis of version IV FSIQ revealed that the RD group had the lowest IQ and the ADHD, Depression, and Depression/Anxiety groups were all significantly higher. The RD/ADHD, No Diagnosis and Anxiety groups did not differ from the other groups.

To test whether those with working memory impairments may take longer to comprehend information, we evaluated if diagnostic groups differed on the Working Memory Index (WMI) scores from the WAIS-IV. An ANOVA of WMI scores by group (Table 2) found significant differences among groups. Post-hoc analyses revealed that the RD group had the lowest WMI mean score. There were no significant differences amongst the remaining groups. Importantly, the MH groups did not obtain lower WMI scores relative to any but the RD group.

Table 3 shows mean standard scores for Processing Speed on the WAIS PSI (combining version III and IV), WJ-III Processing Speed, and D-KEFS measures. We justify the combination of the two versions of the WAIS as mean PSI scores did not differ across versions, $t_{(2676)} = .36$, $p = .719$. Too few students took the WJ-IV Perceptual Speed to include their results. For all groups on the WAIS and WJ-III the mean score was in the Average range. One factor ANOVAs found differences between groups on WAIS PSI, $F_{(6,\ 995)} = 7.49$, $p < .001$ and on WJ-III Processing Speed, $F_{(6,553)} = 2.67$, $p = .015$. Post hoc Hochberg's GT2 pairwise analysis revealed that on WAIS, the RD and the RD/ADHD groups had lower mean PSI scores than the Depression/Anxiety and the No Dx groups. No other group means differed. No post hoc pairwise comparisons were

Table 3. Speed of processing routine information as a function of diagnostic group.

	RD	ADHD	RD/ ADHD	Dep	Anx	Dep/ Anx	No Dx	*p*
WAIS (Versions III and IV) Processing Speed N = 1002								
N	260	225	43	59	109	33	273	
Mean	93.5[a]	95.1[ab]	93.1[a]	96.4[ab]	97.4[ab]	99.8[b]	99.8[b]	<.001
SD	11.1	12.2	13.0	14.9	10.9	9.3	13.2	
%<= 85	24.0	25.1	28.2	22.4	12.6	9.7	12.2	.001
WJ-III Processing Speed N = 560								
N	111	154	28	28	59	23	157	
Mean	91.2	92.1	93.0	91.1	95.0	96.8	96.2	.015
SD	11.6	12.6	12.3	16.4	11.7	11.4	13.2	
% <= 85	28.8	34.4	25.0	32.1	18.6	26.1	19.1	.061
D-KEFS Letter Sequencing N = 696 *Scaled Score mean 10 SD 3*								
N	146	195	31	45	80	21	178	
Mean	9.1	9.6	9.1	9.4	9.7	10.0	10.2	.041
SD	3.0	3.0	3.0	3.3	3.0	2.4	2.7	
% <= 85	23.3	20.5	19.4	26.7	18.8	19.0	11.2	.095
D-KEFS Number Sequencing N = 603 *Scaled Score mean 10 SD 3*								
N	127	169	26	41	72	18	150	
Mean	9.7	9.5	9.5	9.5	9.5	9.5	10.3	.235
SD	2.9	2.8	3.0	2.9	2.8	2.6	2.5	
% <= 85	21.3	20.7	19.2	19.5	19.4	27.8	13.3	.569
D-KEFS Visual Scanning N = 441 *Scaled Score mean 10 SD 3*								
N	95	116	22	28	49	13	118	
Mean	9.9	9.7	10.8	9.3	10.6	10.0	10.8	.013
SD	2.6	2.9	2.4	3.0	2.2	2.3	2.5	
% <= 85	16.8	16.4	9.1	28.6	6.1	15.4	10.2	.105

Note: Means with different superscripts are significantly different from one another based on Tukey or Hochberg's GT2 Post Hoc analyses. Where no superscripts occur, no pairwise differences were found; RD = Reading Disability; ADHD = Attention Deficit Hyperactivity Disorder; Dep = Depression; Anx = Anxiety; No Dx = No diagnosis given; WAIS = Wechsler Adult Intelligence Scale; WJ = Woodcock Johnson Test of Cognitive Abilities; D-KEFS = Delis-Kaplan Executive Function System.

significant amongst groups in their WJ-III Processing Speed scores. Groups having the largest proportion of students scoring below average on processing speed on the WAIS were RD/ADHD, ADHD and RD, and on WJ-III were Depression and ADHD.

While omnibus differences were found for group means on D-KEFS Letter Sequencing and Visual Scanning, $F_{(6,689)} = 2.21$, $p = .041$; $F_{(6,434)} = 2.72$, $p = .013$, respectively, no post hoc pairwise comparisons were significant. There were no differences found for D-KEFS Number Sequencing, $F_{(6,596)} = 1.35$, $p = .235$. Further, there were no between-group differences in the percentage of below average scores (equal to or less than 7) for the D-KEFS subtests Letter Sequencing, $X^2_{(6)} = 11.17$, $p = .083$; Number Sequencing, $X^2_{(6)} = 5.13$, $p = .528$; Visual Scanning, $X^2_{(6)} = 9.12$, $p = .173$.

Table 4 shows mean standard scores on timed tests of silent and oral reading fluency, math and writing fluency, timed written expression, and timed reading comprehension. We combined Reading Fluency scores across version III and IV of the WJ as the test items are the same in both versions and mean scores did not differ by version, $t_{(2278)} = 1.10$, $p = .271$. Groups differed on all tests of reading speed: WJ-III and WJ-IV Reading Fluency, $F_{(6,888)} = 32.55$, $p < .001$; WIAT-III Oral Reading Fluency, $F_{(6,306)} = 13.09$, $p < .001$; Nelson-Denny Reading Rate, $F_{(6,186)} = 2.50$, $p = .024$; and NDRT Timed Reading Comprehension, $F_{(6,424)} = 7.44$, $p < .001$. Post hoc Hochberg's GT2 pairwise analyses revealed the following: the RD group and RD/ADHD group mean scores were lower than other groups on WJ-III and WJ-IV Reading Fluency, with both groups having the largest percentage of individuals with below average

Table 4. Academic fluency scores for reading, written language and mathematics as a function of diagnostic group.

	RD	ADHD	RD/ ADHD	Dep	Anx	Dep/ Anx	No Dx	*p*
Woodcock-Johnson III and IV Reading Fluency N = 895								
N	185	225	39	52	103	42	249	
Mean	84.1^{a}	97.1^{b}	82.1^{a}	96.0^{b}	97.1^{b}	98.7^{b}	98.3^{b}	<.001
SD	9.1	14.0	13.2	14.4	12.6	15.0	13.5	
% <= 85	57.6	19.7	76.5	20.6	21.2	19.2	20.4	<.001
WIAT-III Oral Reading Fluency N = 313								
N	108	43	14	23	25	8	92	
Mean	85.9^{ab}	99.8^{c}	80.6^{a}	97.7^{c}	98.5^{c}	90.9^{abc}	95.3^{bc}	<.001
SD	11.9	10.8	15.3	11.3	11.6	13.1	12.3	
% <= 85	54.6	9.3	48.6	21.7	12.0	37.5	22.8	<.001
Nelson-Denny Reading Test (NDRT): Speed Subtest N = 193 *Standard mean = 200 SD = 25*								
N	48	40	8	9	19	11	58	
Mean	175.3	191.1	183.0	190.4	188.1	191.1	189.3	.024
SD	19.2	22.4	35.4	19.5	19.7	22.5	24.9	
%< =175	70.8	27.5	62.5	33.3	26.3	27.3	36.2	<.001
NDRT Timed Reading Comprehension N = 431 *Standard score mean = 200 SD = 25*								
N	95	112	17	25	38	21	123	
Mean	177.6^{a}	198.3^{b}	191.9^{ab}	198.3^{b}	195.3^{ab}	194.5^{ab}	196.6^{b}	<.001
SD	22.0	25.4	24.9	28.5	22.4	27.4	26.8	
%< =175	52.6	17.0	35.3	28.0	18.4	23.8	22.0	<.001
Woodcock-Johnson III Writing Fluency N = 574								
N	119	151	32	31	54	25	162	
Mean	88.9^{a}	96.6^{b}	86.6^{a}	99.4^{b}	101.8^{b}	100.0^{b}	100.1^{b}	<.001
SD	11.7	13.6	13.6	9.8	1.9	11.6	11.7	
% <= 85	35.3	19.9	50.0	12.9	3.7	12.0	9.3	<.001
Woodcock Johnson IV Writing Fluency N = 237								
N	53	49	5	18	37	16	59	
Mean	93.5^{ab}	98.4^{ab}	91.2^{a}	102.6^{ab}	101.6^{ab}	101.8^{ab}	105.1^{b}	<.001
SD	10.8	13.5	10.6	10.5	13.1	15.1	10.4	
% <= 85	18.9	18.4	40.0	5.6	10.8	18.8	3.4	.055
KTEA Written Expression N = 208								
N	59	41	14	12	22	8	52	
Mean	89.0^{ab}	95.8^{b}	84.3^{a}	87.1^{ab}	93.2^{ab}	88.1^{ab}	97.8^{b}	<.001
SD	9.8	11.9	8.	10.6	12.4	11.1	11.7	
% <= 85	35.6	22.0	50.0	50.0	22.7	25.0	13.5	.023
WIAT II Written Expression N = 200								
N	28	59	4	6	13	15	75	
Mean	88.9^{ab}	96.1^{ab}	84.5^{a}	103.8^{b}	107.2^{b}	106.3^{b}	101.5^{ab}	<.001
SD	8.9	13.1	3.7	7.1	12.5	13.8	18.1	
% <= 85	39.3	18.6	75.0	0	0	0	14.7	<.001
WIAT III Written Expression N = 118								
N	32	32	5	6	12	2	29	
Mean	93.3^{ab}	100.4^{abc}	85.0^{a}	108.5^{bc}	96.8^{abc}	109.5^{c}	103.5^{bc}	<.001
SD	8.5	9.6	2.8	16.0	7.6	7.8	10.7	
% <= 85	18.8	12.5	60.0	16.7	8.3	0	0	.014
Woodcock-Johnson III Math Fluency N = 306								
N	71	87	15	12	26	15	80	
Mean	74.9^{ab}	78.5^{ab}	72.1^{a}	85.3^{b}	80.7^{ab}	84.2^{ab}	85.4^{b}	<.001
SD	13.7	13.6	18.9	15.8	154	13.3	14.3	
% <= 85	80.3	72.4	80.0	58.3	61.5	46.7	51.2	.003
Woodcock Johnson IV Math Fluency N = 116								
N	19	25	1	12	19	9	31	
Mean	78.5	87.4	83.0	89.7	84.7	85.6	93.7	.012
SD	10.8	12.6		9.0	14.4	17.8	13.9	
% <= 85	78.9	32.0	100	25.0	63.2	44.4	32.3	.006

Note: Means with different superscripts are significantly different from one another based on Tukey or Hochberg's GT2 Post Hoc analyses; RD = Reading Disability; ADHD = Attention Deficit Hyperactivity Disorder; Dep = Depression; Anx = Anxiety; No Dx = No diagnosis given; Writing Fluency, and Math Fluency are combination of WJ-III and WJ-IV scale scores; WIAT = Wechsler Individual Achievement Test; KTEA = Kaufman Test of Educational Achievement.

scores; the RD/ADHD group mean score was lowest on WIAT-III Oral Reading Fluency, and the RD and RD/ADHD groups having the largest percentage of impaired scores; and the RD group had the lowest mean scores for timed reading comprehension on the NDRT and also the largest proportion of those scoring below average. Group mean Reading Comprehension scores also interacted with gender showing lower mean scores for LD/ ADHD and depressed women. Across all tests of reading speed, mean scores for groups with mental health diagnoses were in the average range, and the percentage who scored below average did not differ between the mental health groups and the No Dx group. This was true on reading tests of both short and long duration.

Writing Fluency scores were analyzed separately for WJ-III and WJ IV, since the two versions have different time limits and the means scores differed across versions, $t_{(594)} = 6.10$, $p < .001$. Writing Fluency showed differences across diagnostic groups on version III, $F_{(6,\ 567)} = 15.7$, $p < .001$ and version IV, $F_{(6,\ 230)} = 5.21$, $p < .001$. For WJ-III Writing Fluency the RD and RD/ADHD groups scored lower than the other groups and had the most students scoring below average; and for WJ-IV Writing Fluency the RD/ ADHD group scored lower than the other groups and had the most students scoring below average. Only the No Dx group had higher mean scores. KTEA-II Written Expression mean scores also differed across groups, $F_{(6,201)} = 5.62$, $p < .001$; again, the RD/ADHD group had the lowest mean score; the ADHD and No Dx groups had the highest. Scores also interacted with gender: mean scores for men with LD were significantly lower; and mean scores for men with anxiety or both anxiety and depression were significantly higher. WIAT Written Expression versions II and III were also analyzed separately, since these tests also differ slightly by version as did their mean scores, $t_{(686)} = 2.28$, $p = .023$ equal variances not assumed. WIAT Written Expression mean scores differed across groups, on both version II, $F_{(6,\ 193)} = 5.03$, $p < .001$, and version III, $F_{(6,\ 111)} = 6.28$, $p < .001$. The RD/ADHD group had the lowest mean score for both versions and the largest proportion of impaired scores. For version II, the Depression, Anxiety and Depression/Anxiety groups had the highest mean scores; for version III the No Dx group had the highest mean score. The mean scores for the Depression, Anxiety and Depression/Anxiety groups were in the average range, with few students scoring below average.

The WJ-III and -IV Math Fluency subtests were analyzed separately, since the mean scores differed across versions, $t_{(1245)} = 6.05$, $p < .001$. Significant differences emerged amongst the groups on WJ-III, $F_{(6,\ 299)} = 4.81$, $p < .001$ and WJ-IV $F_{(6,\ 109)} = 2.80$, $p = .012$. Post hoc Tukey tests were conducted only for WJ-III and revealed that the ADHD/RD group scored lower than all other groups while Depression and No Dx had the highest mean scores. However, the mean scores for the RD, ADHD, RD/ADHD, Anxiety and Depression/Anxiety groups were all below average. Notably, between 46% (Dep/Anx) and 80% (RD) of students in all groups scored below average on WJ-III Math Fluency. Similar trends were observed in WJ- IV. Note that both WJ-III and WJ-IV Math Fluency subtests have been classified as tests of processing speed and quantitative knowledge (Flanagan et al., 2006; Mather & Wendling, 2014). However, as seen in Tables 3 and 4, the percentage of students showing deficits on these Math Fluency Tests is both larger and more general than the percentage in each group who had deficits in Processing Speed.

Table 5. Speed of retrieval from long-term memory as a function of diagnostic group.

	RD	ADHD	RD/ ADHD	Dep	Anx	Dep/ Anx	No Dx	*p*
D-KEFS Letter Fluency N = 384 *Scaled Score mean 10 SD 3*								
N	90	93	22	18	44	9	108	
Mean	9.4	10.6	10.0	9.9	10.3	11.2	10.9	.045
SD	3.2	3.4	2.6	3.1	3.3	4.1	3.1	
% <= 7	32.2	17.2	18.2	16.7	22.7	11.1	13.9	.061
D-KEFS Category Fluency N = 383 *Scaled Score mean 10 SD 3*								
N	90	93	22	18	43	9	108	
Mean	11.6	11.8	11.1	10.9	11.6	12.8	12.2	.561
SD	3.1	3.5	3.9	3.8	2.9	4.0	3.4	
% <= 7	8.9	9.7	22.7	16.7	4.7	11.1	7.4	.284
D-KEFS Color Naming N = 464 *Scaled Score mean 10 SD 3*								
N	90	121	24	28	51	14	136	
Mean	7.9[a]	8.9[ab]	8.4[ab]	8.5[ab]	10.0[b]	9.7[ab]	10.1[b]	<.001
SD	2.7	2.6	2.3	3.3	2.5	2.0	2.4	
% <= 7	45.6	27.3	20.8	32.1	19.6	14.3	13.2	<.001
D-KEFS Word Reading N = 670 *Scaled Score mean 10 SD 3*								
N	130	190	32	44	77	22	175	
Mean	7.7[a]	9.9[b]	7.2[a]	9.5[b]	10.3[b]	10.5[b]	10.4[b]	<.001
SD	2.9	2.7	2.7	2.9	2.5	2.4	2.6	
% <= 7	40.8	12.6	53.1	22.7	6.5	9.1	9.7	<.001

Note: Means with different superscripts are significantly different from one another based on Tukey or Hochberg's GT2 Post Hoc analyses; RD = Reading Disability; ADHD = Attention Deficit Hyperactivity Disorder; Dep = Depression; Anx = Anxiety; No Dx = No diagnosis given; D-KEFS = Delis-Kaplan Executive Function System.

Table 5 shows the speed of information retrieval from long-term memory for all groups. On the D-KEFS, speed of access to stored lexical information and word production based on an initial letter (Letter Fluency task) was significantly different across groups, $F_{(6,377)} = 2.17$, $p = .045$. Post hoc Tukey tests showed no pairwise differences between groups. Of interest, the speed of producing words within a semantic category on the D-KEFS Category Fluency subtest was not significantly different across groups, $F_{(6,376)} = .81$, $p = .561$.

Scores for D-KEFS Color Naming subtest were different across groups, $F_{(6,457)} = 8.03$, $p < .001$. Post hoc Tukey tests showed that the RD group scored lower than other groups, and the Anxiety and No Dx groups had the highest scores. The RD group also had the highest proportion of below average scores. Finally, speed scores on the D-KEFS Word Reading subtest were also different across groups, $F_{(6,663)} = 19.36$, $p < .001$. Post hoc Tukey tests showed that the RD and the RD/ADHD groups scored lower than other groups, with all other groups returning equivalently high scores. The RD and RD/ADHD groups also had the highest proportion of below average scores.

Discussion

The purpose of this study was to investigate whether postsecondary students with mental health diagnoses who reported high levels of depression and/or anxiety at the time of the assessment show objective deficits in speed of processing information, speed of information retrieval from long-term memory, or speed of academic task performance than do students with no formal DSM diagnosis or those with reading and/or attention disabilities. All students had passed at least two validity tests, meaning that they were likely performing and reporting their symptoms in a credible manner.

All students in our mental health groups had been given a disability diagnosis, and also reported extremely high levels of mental health symptoms on the date tested. Given that mental health symptoms may wax and wane during the academic year, we specifically chose this group to represent those who were currently experiencing subjectively severe symptoms. We therefore anticipated that functional impairments in academic performance would be evident in these groups if, indeed, high levels of subjective mental health symptoms do interfere with performance on timed academic measures. Furthermore, because all speeded tasks in the assessment specifically warn the student of a time limit and instruct them to work as quickly and accurately as possible, we expected that there would be some level of performance anxiety present in all timed measures. Finally, we also anticipated that comorbid anxiety and depression would result in increased levels of impairment in academic processing tasks relative to those with only one diagnosed mental health condition.

Contrary to expectation, those with mental health diagnoses and high symptom reports (Anxiety, Depression and Depression/Anxiety groups) did not show deficits on any measures (apart from math fluency, to be discussed below); this finding was true both relative to the clinical controls and also to those with other non-evident disabilities (e.g., RD, ADHD, RD/ADHD) for whom provision of extra time is fairly routine.

On tests measuring speed of processing routine information (WAIS, WJ-III, and D-KEFS Trails), speed of information retrieval from long-term memory (D-KEFS Verbal Fluency, Category Fluency, Color-Word Interference Color Naming and Word Reading), and tests of reading speed (WJ-III, WJ-IV, WIAT III and NDRT), mean scores for the three mental health groups were in the normal range and were not significantly lower than other diagnosed groups or the group with no diagnosis. In fact, the Depression/Anxiety group obtained the highest scores on the WAIS PSI, on D-KEFS Letter Fluency, and on WIAT-III Written Expression.

As expected, those with RD were, in general, the most impaired on almost all measures of reading and processing speed. This finding certainly supports the need to provide those who have RD with some extra time to read information on tests and retrieve known information from memory. However, their level of impairment was, in general, mild. Thus, consistent with the findings of Lewandowski et al. (2013), it is likely that 25% extra time would be sufficient to allow for equal test participation in the majority of cases.

The ADHD group did not return scores in the impaired range on any speeded academic task apart from math fluency (to be discussed more below). In fact, they performed at the highest speeds on measures of reading rate and timed reading comprehension compared to all other groups. These findings are consistent with recent research indicating that those with ADHD do not require extra time to participate equally on timed exams (Jansen et al., 2019; Miller et al., 2015; Pritchard et al., 2016). It was true, however, that those with combined ADHD and RD did experience more difficulty in oral reading fluency and written expression than those with RD alone, and in many other instances (reading speed, writing speed, general speed of information processing) they were as impaired as those with RD alone. These results suggest that the combination of the two disorders may result in impaired speed of completing certain academic tasks.

In summary, across a large range of tests the mental health groups in this study did not show deficits in speed of processing routine information, producing information, or in speed of retrieval from long-term memory or in working memory skills relative to other groups and, particularly, relative to those students who received no formal DSM diagnosis. This finding suggests that, if those with mental health complaints were accommodated with extra time for tests due to their mental health disability, they would experience an unfair differential boost (Fuchs et al., 2000) relative to other students, rather than an equal opportunity to demonstrate their knowledge.

Proportion in each group having scores at or below 16th percentile on various tests

One might wonder about the relatively small proportion of students, including those in each of the mental health groups, who scored at or below the 16th percentile on various subtests. First, on tests of academic performance, those with anxiety, depression or both typically performed within the normal range, and in no case were their timed achievement scores equal to or worse than those with RD and/or ADHD. While students in all groups tended to score below the 16th percentile on math fluency, the lowest scoring group was the combined RD/ADHD group and the relatively highest scorers were both the depression and the No Dx groups.

American third-and fourth-graders who were at risk or had serious math deficits showed processing speed, attentive behavior and incoming calculation skill to be significant predictors of math skills (Fuchs et al., 2008). However, the wide-spread lack of automated math facts fluency found in our subjects may be a function of the Ontario math curriculum. Studies by the Province-wide Education Quality and Accountability Office (EQAO) show math deficits to be wide-spread and continuing into the high school years. For example, the results of the 2018-2019 standardized province-wide EQAO tests found that only 46% of 6th grade students met the provincial math standard, and among 9th grade students only 44% studying at the applied (community college-stream) level and 84% studying at the academic (university-stream) level met the provincial standard. In addition, only one-third of 9th grade students enrolled in the applied math course saw themselves as being good at math (Education Quality and Accountability Office, 2019). Studies of declining math scores across Canada over the past 15 years have blamed the adoption of a discovery-based math curriculum (adopted in Ontario in 2005) as a reason for these wide-spread deficits (CMEC (Council of Ministers of Education), CMEC (Council of Ministers of Education) and (2012; Stokke, 2015). This elementary-school curricular change minimized direct instruction methods (including explicit explanations followed by plenty of practice to develop automaticity) in favor of a discovery-based approach and reliance on calculators for basic math problem solving. Math fluency as measured by the WJ-III and WJ-IV, requires both basic quantitative knowledge and speeded retrieval of information from memory. The deficits seen across all groups in the present study link well to a math curriculum that did not emphasize explicit explanations and the development of automaticity with basic math facts.

The Ontario 11th and 12th grade mathematics curriculum encourages the use of technology including calculators and computers (Ontario Ministry of Education, 2007), but these are not permitted on standardized tests of math fluency used in our assessments. Lack of automaticity with math facts was not limited to students with mental health problems in our study, suggesting this is a more general deficit found in many postsecondary students in Ontario.

Second, with two exceptions (WAIS PSI & WJ-III PS) the proportion of low scorers in the mental health groups was not significantly different than that found in the No Dx group. In other words, while a few students in each of the mental health groups scored below average on a few subtests, so too did the non-disabled but treatment-seeking students. This is not unexpected. Indeed, recent studies show clear evidence that it is quite common for non-disabled individuals to obtain at least one or two low scores when completing any of a number of frequently used neuropsychological and academic achievement tests (Harrison, 2020). Across a number of commonly administered test batteries, research has consistently shown that anywhere between 38–92% of normal, non-disabled individuals return at least one subtest score below the 16th percentile (Harrison, 2020), and that 61.2% of normative, non-disabled individuals in the WJ-III normative sample had at least one academic cluster score equal to or below the 25th percentile (Maddocks, 2018). In other words, it is actually very common for individuals to obtain a few low scores in an assessment that employs a flexible battery of tests (Binder et al., 2009; Brooks et al., 2007; 2009; 2011; Iverson et al., 2008; 2008; Iverson & Brooks, 2011; Karr et al., 2017).

The exceptions were the WAIS PSI and WJ-III Processing Speed subtests where a relatively high proportions of the Depression group scored at or below 85 (between a quarter and a third for WAIS and WJ-III, respectively), along with many in the RD, RD/ADHD and ADHD groups. First, research has shown that processing speed, on its own, has minimal ability to predict test taking speed, and when measures of reading fluency are included in prediction equations, processing speed offers no unique predictive contribution (Lovett et al., 2017, 2020). In fact, the best predictor of the need for extra time is reading fluency (Lovett et al., 2017). Second, the Depression group did not show a high incidence of students scoring below average on the other timed tests of reading, information retrieval, or essay writing. In other words, low scores on processing speed tasks that do not measure academic abilities may have little relation to the real-world need for extra test-taking time. Similarly, Lovett et al. (2020) found that Processing Speed scores were a very poor index of timed academic test performance, averaging only six percent overlap between the two types of scores. Hence, these authors advise that recommendations for extra time requirements should be based on actual (genuine) academic test performance rather than inferring the need based on PS scores.

Limitations and directions for future research

This exploratory study had several expected limitations, each of which points to clear directions for future work. First, our sample sizes varied by diagnosis and subtest given, with some tests having relatively few individuals per group. Smaller samples yield higher variability, which usually limits the number of significant findings. It might well be that several insignificant post hoc findings might have been significant with larger samples. Further studies to examine specific symptoms and any related functional impairment could specify tests to administer more broadly.

Second, while it might be expected that students diagnosed with clinical levels of anxiety may experience more stress at testing, measures of test anxiety were administered to fewer than 150 students in our sample. Future studies, however, could evaluate the extent to which test anxiety affects the performance of all students, not just those with identified mental health complaints. Nonetheless, even if our mental health groups were experiencing test anxiety, their scores on our measures of academic speed did not fall below the normal range overall, and were no different than the No Dx group.

A related limitation is that we did not test the impact of knowing that one has extra time to do a test. Does that knowledge in itself reduce anxiety about the test to the extent that one may complete it in the standard time? A meta-analysis examining the relationship between test anxiety and academic performance shows only a modest (-0.20) correlation (see von der Embse et al., 2018) and the few studies that have tried to measure causal effects of test anxiety on academic performance have generally failed to find them (see Lovett & Nelson, 2017 for a review of this topic). This does not mean that the effects of performance anxiety during tests should be ignored; this is an unpleasant condition when extreme, and effective treatments exist to minimize the impact of this psychological condition (von der Embse et al., 2013). Given, however, that little research has investigated the actual effect of performance anxiety on test-taking ability, this is an area in need of future research. Should a further study examine that question, it should evaluate the effects of anxiety on the test performance of all students. Indeed, given that between 15-22% of non-disabled students report experiencing high levels of test anxiety (Putwain & Daly, 2014; Thomas et al., 2018), universal design principles would have professors more often choose power tests without time limits instead of speed tests, when speed is not a component of the ability being tested.

Fourth, we did not evaluate the effect that specific anxiety disorders such as Obsessive-Compulsive disorder, or personality disorders such as Obsessive-Compulsive Personality Disorder, may have on time taken to complete tests. However, it seems counterintuitive to offer someone who already obsesses over information even more time to obsess during an exam. For such students, counseling and skill-development to help them learn how to limit their worry and obsessing may be a more valuable long-term strategy than reinforcing their obsessional behavior by offering them more time; this requires further investigation.

Fifth, we did not administer measures of sustained and divided attention abilities to all subjects. It is possible that students with mental health conditions have difficulty with these types of attention-sustaining tasks and this requires further study. However, previous research (e.g., Jansen et al., 2019;; Miller et al., 2015; Pritchard et al., 2016) suggests that deficits in attention, on their own, are not sufficient to compel the need for extra time accommodation. Indeed, the logical accommodation for such deficits might be a distraction-reduced setting and stop-the-clock breaks to allow them to rest and renew their attention skills rather than leaving them in a prolonged test-taking situation where they continue to have flagging attention abilities and depleted cognitive resources.

Finally, even though the current study failed to identify a general pattern of impairment in working memory or executive functioning in those with mental health conditions, specific individuals with deficits in these cognitive skills may require extra time to complete complex academic tasks. Some previous studies have suggested that those with severe depression and/or anxiety may sometimes show deficits in executive functions (e.g., Ajilchi & Nejati, 2017; Christopher & MacDonald, 2005; Darke, 1988). Executive functions such as working memory have been shown to relate to reading comprehension (Daneman & Merikle, 1996) and math word problem solving performance (Swanson & Beebe-Frankenberger, 2004). Individuals with working memory or executive functioning impairment, while they may not have explicit speeded retrieval deficits, may struggle to efficiently retrieve information and complete certain academic tasks in a timely manner as a result of such cognitive weaknesses. A more in-depth study of the impact of executive functioning deficits on academic fluency in post-secondary students is therefore warranted.

Implications for the need for extra test-taking time

Students with mental health problems report experiencing a broad range of clinical symptoms on self-report checklists, more so than did the other groups. However, they did not show functional impairments in speed of processing routine information, speed of retrieval from long-term memory, or speed of completing academic tasks compared to the other groups. These findings provide further evidence that self-reported symptoms do not necessarily indicate functional impairments in speed of producing or accessing information. Equally, a student's belief that they take longer to complete tests would be inadequate evidence to warrant an accommodation of extra time. Indeed, in the absence of a functional impairment in speed, extra time for tests would not be an evidence-based accommodation. Students without speed impairments already have equal access to test materials. Providing extra time as an accommodation would also erroneously validate their self-perception that they process slowly and cannot keep up with their peers, adding to their (unrealistic) negative self-appraisal. It would also give the mental health groups enhanced access to test material relative to their non-disabled peers, potentially improving their opportunity to achieve higher marks relative to other students. As Roberts (2012) notes, "Accommodations are meant to level the playing field … not tilt it to the student's advantage, or act as insurance against failure (p. 78)".

Mental health disabilities such as anxiety and depression are treatable through psychotherapy or medication to alleviate symptoms and enhance functioning. These students would be advised to seek psychotherapy, including learning strategies to control anxiety prior to tests. Lovett and Lewandowski (2015, p. 88) note that, "accommodations for psychiatric disorders are not based on research showing their validity or effectiveness, but rather determined rationally as a matter of advocacy". One example is taking breaks that stop the clock to address time lost when engaged in task-irrelevant cognitions. Breaks to administer medications would be an exception.

To address social anxiety and reduce distractions, students could write tests in a room with fewer students. A time management aid could indicate the amount of time to allocate to each question or group of questions, along with a clock or timer to track the time allocation. For students whose psychiatric disability involves fatigue that restricts functioning to fewer hours a day, the student could be limited to taking only one test or exam per day. They could also request their professors to give them the assignments for the course as early as possible in the semester, to increase the amount of time available for completion. In addition, students with mental health impairments may have ineffective or inefficient study and test taking skills; such deficits are remedied easily by specific coaching offered by trained learning skills specialists who typically work in college libraries or are embedded within student wellness services.

Students with severe depression may take longer to encode and learn information initially; this deficit would be best addressed by suggesting a reduced course load in order to have more time to devote to learning a smaller amount of material, leading to a greater experience of success. In cases of severe symptoms of depression, an appropriate accommodation might be to allow the student to withdraw from a course/program mid-semester without academic penalty or take a leave of absence from their studies while they get treatment and stabilize their mood well enough to return to school. Review of these accommodations would be warranted each semester due to potential positive effects of medication and/or psychotherapy.

All of the students in this study had undergone a psycho-educational assessment as they believed that they had a learning, attention, or mental health disorder that interfered with their academic functioning. Yet, assessments found that 30% of them had no diagnosed disorder. Had all of these students been accommodated on the basis of their self-report alone, some would have received accommodations that gave them an unfair differential boost (Fuchs et al., 2000) over other students who had no disability. This confirms the importance of objective assessment to establish any functional impairment beyond self-report of problems.

Scores on academic tests alone, however, are not sufficient to confirm need for academic accommodations. Indeed, a surprisingly large number of students (21%) were removed from the study due to evidence of performance/symptom magnification or exaggeration. Implications are that assessors need to ensure that students engage adequately in the tests before making any diagnosis or recommendation for accommodations. Our study reconfirms recommendations that performance validity tests and symptom validity indicators be included as an integral part of any psycho-educational assessment (Lewandowski et al., 2014).

The slow speed of doing simple math computations found in all groups suggests that slow computation speed is not specific to students with disabilities in math. It may be a more general function of the math curriculum in Ontario. As such, one low score on math fluency alone would not be adequate evidence of the need for extra time on tests with a math facts fluency component, especially when more than half of the No Dx group scored below the 16th percentile. To diagnose a math disability in a young adult, a history of math deficits throughout the student's education would be needed, as indicated by math marks, extra support through special education or tutoring in the elementary and secondary grades, studying Math at the Workplace or

Modified level, failed or repeated math courses in secondary school to raise grades, and ceasing to take math courses after obtaining the compulsory credits. Nevertheless, our data provide strong support for the application of the principles of universal design to tests/exams with a math component (c.f., Lovett & Lewandowski, 2015, Chapter 10). For example, permit all students the use of calculators for computations, as well as the use of equation sheets, unless computation and memorization of appropriate equations is the specific skill being tested. With a calculator and formula sheets, computations are fast, eliminating the need for extra time due to deficient math fluency.

Finally, this study provides a positive message to postsecondary students who have been diagnosed with depression, anxiety, or both. Our data could not establish a functional impairment in speed of processing, speed of retrieval from memory, or speed of reading or written language functioning in this large clinical sample. Advising students that slow speed is not an inevitable consequence of their mental health disorder provides them with a message of optimism, both for their functioning in their postsecondary education and in their career going forward. They should not avoid programmes of study or careers that require academic functioning within time constraints. Any negative appraisal of their speed of academic performance is unlikely to be consistent with a genuine impairment. counseling them to accurately appraise their functioning and to overcome negative self-appraisal is highly recommended.

Disclosure statement

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