
Learning Differences, Cognitive Diversity and Examinations in Higher Education: Bringing Disability Services and Faculty Together - Part1

Abstract

Exams are hurdles. They are gatekeepers to education, careers, professional endeavors and the articulation of everyone's strengths and gifts. Because both standardized and faculty-made exams are typically not flexible or adaptable, they can pose particular barriers to people who need to demonstrate their knowledge through a variety of ways. Simple changes along the principles of universally designed exams can allow a greater number of students with and without disabilities to demonstrate what they know and can do, while upholding high academic standards and required course content.

Many accomplished individuals are challenged by cognitively-based disabilities (as opposed to physically-based disabilities), that impact access to the information on an exam and ability to demonstrate what they know. These disabilities may include depression, Attention-Deficit Hyperactivity Disorder (ADHD), and learning disabilities. The impact of these conditions can cause students to perform slower and more variably on timed exams, have difficulty with recall of learned information under time constraints, or require them to read aloud in order to comprehend (Nelson & Harwood, 2011a; Ofiesh, Moniz, & Bisagno, 2015). While commonly believed to be related mostly to the constructs of processing speed or reading rate, other aspects of cognition affect how an individual interacts with the demands of an exam.

It is not only students with disabilities who bring a range of cognitive considerations to the postsecondary environment. As the diversity rises among the population of students in higher education faculty will experience greater differences in the cognitive diversity of their students with increased frequency. Disability service providers are already experiencing greater demands for exam accommodations for individuals with disabilities and this need will continue to rise even with universally designed exams in place. For faculty to increase the accessibility of exams and to measure the knowledge and skills that they intend to measure, an understanding of cognition as it relates to exams is needed. The purpose of this paper is to offer disability service providers a basic understanding of how a variety of cognitive traits may intersect with taking an exam and how to work with faculty in order to increase awareness of cognitive diversity and exam design.

In Part 1 of this article the authors' cover the cognitive demands of exams and the increase in diversity in higher education. In the next AHEAD Journal (no. 4, Autumn 2016) we will publish the second part of the article - **Putting Research to Practice: service providers and faculty have the power to change exam design.**

Introduction

The demographics of classrooms in higher education have been changing internationally for years becoming more and more diverse in a myriad of ways. Discussions surrounding students and diversity have generally included disability, race, ethnicity, culture, first generation students, and second language learners. However, each of these

groups is now becoming even more diverse in terms of the increasing age of students, veteran status, immigrant or refugee status, mental health disorders, and students who have a paucity of academic vocabulary as a result of poverty. Shinn and Ofiesh (2012) created the term 'cognitive diversity' to describe the vast array of cognitive traits found in academic settings. This term captures a larger group of students who, along with many assets, bring with them cognitive profiles that require faculty to rethink traditional modes of teaching. While most individuals' brains share a similar cognitive framework, research suggests there are groups of persons with distinctly variable patterns of thinking and perceiving, in the face of extraordinary creativity, problemsolving and reasoning. For example, individuals with attention deficit hyperactivity disorder (ADHD) have greater challenges with inattention and distractibility, and individuals with dyslexia are usually stymied with the rapid recognition of symbols, leading to difficulty reading words.

While individuals with disabilities can exhibit differences in their ability to process information and perform academic tasks, the same is true of other segments of the postsecondary population who are not considered to be disabled. Older students returning to higher education, culturally and linguistically diverse students, returning war veterans and refugees exposed to trauma or violence, as well as students from varying socioeconomic backgrounds, also bring a level of cognitive diversity to postsecondary institutions. For example, Washington (2016) found that African-American students from poverty who lived in areas with distinct English dialects often read slower than their peers who spoke without a pronounced dialect. This was found not to be a result of poverty or a reading disorder, but rather a result of the same type of 'code switching' that non-native speakers of English go through when they are learning English and need to construct meaning from their own native language into English. Yet neither group is allowed extended time on an exam because poverty, dialect, and second language acquisition are not associated with disability.

Current data surrounding postsecondary enrollment trends suggests that greater awareness, understanding, and responsiveness to cognitive diversity within postsecondary institutions is needed. Obtaining a postsecondary education for employment is more critical now than ever, shedding light upon the need for all individuals to be able to demonstrate their true aptitude on exams in higher education in order to successfully graduate. In addition to adult students with diagnosed disabilities, it is important to consider the cognitive diversity within a variety of populations. Clearly the face of the 'typical' college student has become 'not so typical' and consequently, university faculty can be encouraged to be judicious when it comes to the design of exams.

Exams that are not adaptable are barriers in the same way that a textbook that is not available through Braille or audio is a barrier to the information within the text. Presently most exams in higher education are paper-pencil based and can only be modified with disability-related accommodations. There are however, a variety of ways faculty can modify exam presentation without accommodations, in order to increase their accessibility to the ever-growing body of diverse learners in postsecondary academic settings today. It is critical for disability service providers and faculty to understand the intersection of cognition and test-taking, as well as how to adapt exams so that they meet the needs of the wider population of students with and without disabilities.

In order to understand how these emerging populations of students bring greater diversity to the classroom, an understanding of what it takes to sit for an examination cognitively is required.

This understanding is the link between meeting the needs of the most rapidly growing populations of students, and success on examinations; ultimately this means increased retention rates and the successfully completion of college or university. This understanding opens the door to the paradigm of Universal Design and universally designed assessments (Block, 2006; Rose & Meyer, 2002).

Exam-related cognitive demands

Some common types of postsecondary exam formats include, but are not limited to, multiple-choice, true/false, fill-in-the-blank, short answer written responses, diagram and/or label, and question and answer. While students and faculty alike are often familiar with these common exam formats, less is widely known regarding the cognitive demands required to access, attempt, and complete these common exams. Recent research from the fields of neuropsychology and neuroscience has helped us to understand what is occurring in the brain when it comes to learning and taking an exam (Gregg, 2010). Moreover, there has been an increase in the amount of research on how learning disabilities and emotions, such as Post Traumatic Stress Disorder (PTSD) and anxiety, (Boaler, 2013; Rutkowski, et al., 2010) influence taking an exam. To help with greater conceptualization, select test-related cognitive demands are presented in three categories. We caution that there is a great deal of overlap and 'back and forth' when it comes to cognitive demands; therefore, this framework is best applied when addressing exam design (see Figure 1).

Cognitive Demands Associated with Exam Access	Access and Output	Cognitive Demands Associated with Exam Output
<ul style="list-style-type: none"> • Language Comprehension • Visual Spatial Thinking • Perceptual Speed 	<ul style="list-style-type: none"> • Working Memory • Attention Processing Speed • Cognitive Flexibility 	<ul style="list-style-type: none"> • Visual Motor Integration • Long-term Retrieval

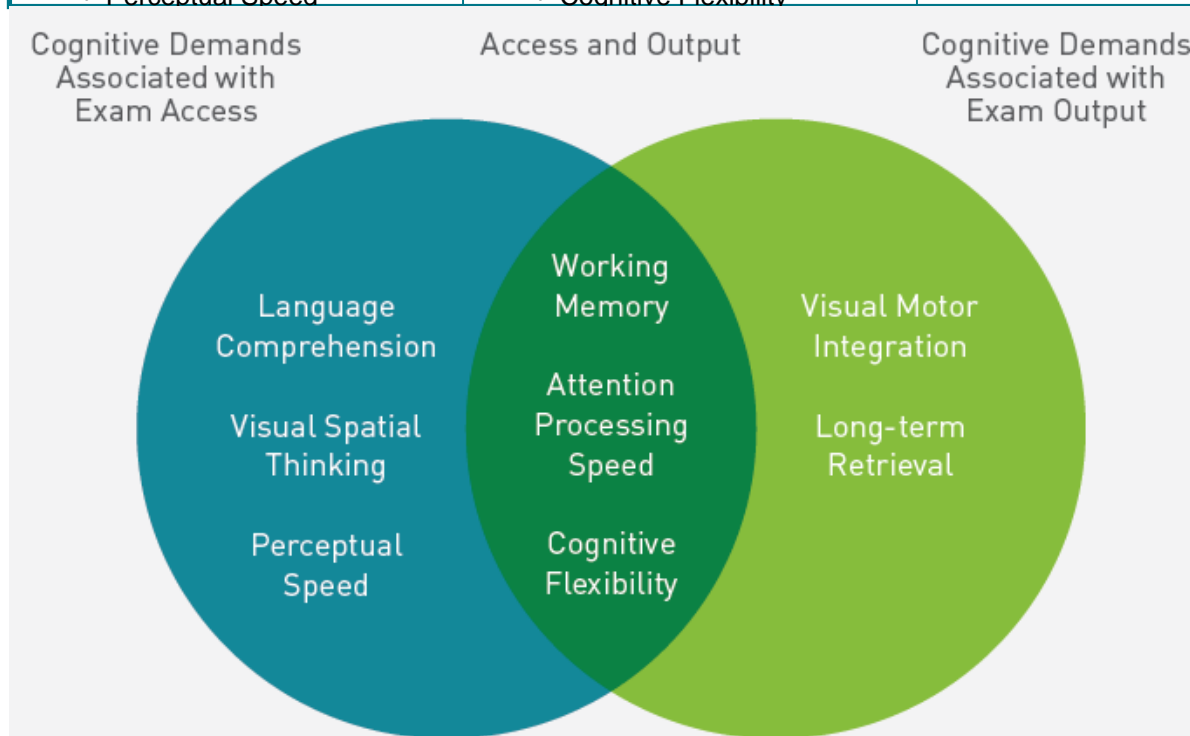


Figure 1:

Cognitive demands of exam access and output (Adapted from Shinn& Ofiesh 2012)

First, there are the cognitive demands we refer to as language comprehension, visual-spatial skills, and perceptual speed that primarily influence access to the exam. Second, longterm retrieval and visual motor integration primarily influence the student's ability to respond to the exam or demonstrate knowledge; we refer to this as output. Third,

working memory, attention, processing speed, and cognitive flexibility are mediating influences that affect both exam access and exam output.

Cognitive demands associated with exam access

Language comprehension

Language comprehension, or the ability to understand spoken and/ or written language, is fundamental to accessing exam content. Within the context of taking an exam, language comprehension is different from the ability to accurately hear sounds in spoken words or the ability to decode or read text. Rather, language comprehension refers to the student's ability to understand what a professor is saying or asking for, be it in spoken or written form. Often difficulties can arise as the student may misunderstand directions or directional words. The ability to comprehend language in this vein may, or may not be related to whether the language is native or non-native to the speaker. Language comprehension differences can be found in both non-native speakers of English, as well as those with language disorders. It is common for students with weak language comprehension to show high levels of performance on nonverbal tasks (mathematical calculations), unless the nonverbal tasks require a great deal of language comprehension (applied statistics).

It is critical for both faculty and exam authors alike to appreciate the importance of language comprehension because most, if not all, postsecondary exams require some level of language comprehension. Across all subject areas, including chemistry, biology, world religion, and so forth, exams include written directions and specific problems posed through language, which are separate from important technical and academic vocabulary. Furthermore, inattention, anxiety and depression, three of the fastest growing conditions in the modern world, significantly contribute to inefficient language processing.

Visual-spatial thinking

While language comprehension encompasses the verbal demands of exams, visual-spatial thinking is also needed to access exams. Visual-spatial thinking (distinct from visual acuity) refers to the ability to perceive, analyze, synthesize, and think with visual patterns, including the ability to store and recall visual representations. Visual-spatial thinking allows the student to make sense of and work with nonverbal, visual input. Some examples of visual-spatial demands required for taking an exam include gauging time, reading a map for directions or topography, interpreting graphs or flowcharts, filling in bubbles on Scantron® exam forms, labeling parts of an image, graphing an equation, organization and planning of projects, creating a timeline, and recognizing patterns.

Perceptual speed

Most exams require some combination of reading, writing, and/ or math skills; therefore, a certain level of perceptual speed for numbers and letters is required to access exams. Perceptual speed is measured by an individual's ability to rapidly and automatically interpret letters and numbers, a cognitive trait that has been found to be lower than average even among highly intelligent mathematicians or writers. Horn and Blankson (2012) found that in homogeneous samples of young adults, measures in which there is much emphasis on speediness correlate near zero, perhaps negatively so, with exams that require solving difficult problems. This often leaves faculty perplexed when some of the most analytical mathematicians need more time for simple calculations. Indeed, perceptual speed often impacts academic fluency, which is the 'ease and speed by which an individual performs simple to more complex academic tasks'. A common mantra in education is 'first you learn to read, then you read

to learn, first you learn to calculate, then you calculate to learn' the premise being that once a student masters foundational academic skills, then those basic skills serve as the foundation for deeper, richer learning. In the realm of an exam, a student must be able to quickly read an exam question, solve a simple equation, or write words in order to have enough mental energy to think critically about the exam content.

Cognitive demands associated with exam output

Visual-motor integration

All exams require some form of output, by giving a speech, writing an essay, executing pencil-to-paper calculations, or even running a mile. Assuming every postsecondary student takes exams that require written output, the cognitive demand of visual motor integration holds great weight. Specifically, visual motor integration is the ability to coordinate information from the eyes with body movements; '[it] is the degree to which visual perception and finger-hand movements are well coordinated' (Beery, Buktenica, & Beery, 2010). In turn, the cognitive demand of visual motor integration encompasses copying text, writing spontaneously, drawing a diagram, aligning numbers for a math calculation, filling in a bubble, circling an answer, and so forth.

For example, a student with dysgraphia, a learning disability which

impacts handwriting legibility must copy a demographics chart from a board and then write an essay explaining the significance behind the chart for an exam. Compared to his classmates, he needs to exert more mental energy to visually comprehend the chart and then process this information through his fingers and onto the page. Complicating matters, he must also expend more mental energy or cognitive resources to form each and every letter.

Long-term retrieval

Ideally, exams assess mastery of course content by asking students to think back and demonstrate what they have learned. The cognitive demand of long-term retrieval refers to the ability to recall what was previously learned.

Long-term retrieval has two components:

1. the student must be able to accurately learn course material and store that information in memory, and
2. the student must be able to retrieve or 'find' that information during the exam.

Long-term memory is also impacted by how effectively the information is organized in storage since this impacts how efficiently a student can retrieve it. A student may have studied for several hours for his sociology exam, but if he has longterm retrieval weaknesses, it may take longer to retrieve that information while writing an essay. The tip-of-the-tongue phenomenon is another good example. This phenomenon was first defined as an inability to retrieve a word even though there is a feeling of knowing the intended word (Brown & McNeill, 1966).

Subsequently, students with compromised retrieval systems often know course material and have received high marks throughout the course, but cannot demonstrate that knowledge when required to do so quickly on multiple choice exams, exams that include problem sets, and written expression. More time can be a significant adaptation

for these students.

Cognitive Demands Associated with Both Exam Access and Exam Output

Working memory

Working memory is fundamental to taking an exam. Working memory refers to the ability to hold information in awareness while performing a mental operation or manipulation on the information. Moreover, working memory is highly related or central to all types of academic learning including reading, mathematics, written language, and reading comprehension. Unlike long-term retrieval, working memory focuses on recall while work is being done.

Rebecca, a 24-year-old graduate student, reads the essay prompt for her course final. She must hold onto the content of the prompt, while simultaneously reflecting upon information learned in the course. To complicate matters and place heavier demands on working memory, she must then hold that information while thinking about the best way to convey her knowledge in written form.

Miles is a 19-year-old college freshman taking his Calculus exam. Miles reviews the first problem then begins to execute his calculations. Miles must perform each calculation step while simultaneously thinking about the next move, thus placing demands on his working memory.

Of all the cognitive demands associated with exam taking, working memory may be the most fundamental and multi-faceted (Swanson, 2004). Indeed, Baddeley breaks working memory into a three-component system (Baddeley, 2000).

1. The first component is the 'phonological loop', which refers to holding and manipulating sounds or speech-based information while performing a mental operation. In Miles' case, he must use a verbal retrieval system for recalling basic math facts (e.g., $5 + 5 = 10$) as he solves more complex calculations.
2. The second component is the 'visual-spatial sketch pad', which refers to holding and manipulating visual, spatial, and kinesthetic information in awareness in the form of visual imagery. If Miles needs to graph an equation for his midterm, then he will need to use his visual-spatial sketchpad as he works.
3. The third component of Baddeley's working memory systems is the 'central executive system', which controls the functions of phonological loop and visual-spatial sketchpad.

This complex component system brings into focus the complexity and far-reaching aspects of working memory. Students with fewer working memory capabilities are likely to be challenged and taxed on a variety of exams, regardless of content area.

Attention

Similar to working memory, attention is critical to exam taking. While attention is a seemingly simple concept, the neurological underpinnings required for us to pay attention are complex. Attention requires selecting and focusing on what is important, maintaining that focus over a period of time, filtering out or ignoring what is not necessary and visually attending to detailed elements such as mathematical notations and punctuation (McCabe, Roediger,

McDaniel, Balota, & Hambrick 2010). Examples of how inattention can play out for a student on common postsecondary exams are:

One student, Anna, has significant depression, which impacts her concentration and attention. During her anatomy course final, which includes several multiple-choice questions, Anna must pay careful attention to the questions; for example, multiple-choice questions with words or phrases such as all, including, excluding, and best matches. These require Anna's close attention not only to the content or purpose of the question, but also to discrete words. If Anna misses the word except or not due to inattention, then her answer may be wrong but unrelated to her understanding of the material (e.g., anatomy of the lungs), and solely due to inattention.

Jose is in Anna's course, and he too is taking the anatomy final. Unlike Anna, Jose is an adult student with Attention Deficit Hyperactivity Disorder (ADHD) and has consequent difficulty filtering out extraneous visual input and attending to visual details on the exam. The lecture hall where the exam is being proctored has several windows looking out onto a busy street. Jose must exert more mental energy than his peers to filter out or ignore the distracting view of bustling cars and pedestrians, leaving less mental energy to demonstrate his knowledge of the human lung.

Processing speed

Assuming that most postsecondary exams must be completed within a set time frame, processing speed is another core exam taking demand that impacts both input and output. Indeed, many higher education exams are timed according to the length of a class versus the purpose or function of the exam. While different researchers refer to the cognitive construct of speed in different ways, processing speed, in a broad sense, refers to the ability to process or make sense of incoming information and to then produce a response. Students with slower processing speed, whether due to a learning disability, depression, or other contributing factors, oftentimes do not finish exams within standard administration time, and use the most time on exams that involve math reasoning or math calculations (Ofiesh & Hughes, 2002). When students are unable to access an entire exam due to limited time, then their exam performance may be reflective of slower processing speed, among other constructs, and not an accurate measure of their understanding of the exam content.

Cognitive flexibility

Deak (2003) writes:

Flexible cognition entails the dynamic activation and modification of cognitive processes in the response to changing task demands, representations and responses based on information. As task demands and context factors change, the cognitive system can adapt by shifting attention, selecting information to guide and select upcoming processes, forming plans, and generating new activation states to feed back into the system in order to adjust goals or self-correct.

Cognitive flexibility is one aspect of executive functioning and a characteristic of many individuals with learning differences. In an exam, cognitive flexibility shows up most apparently when students are required to prioritize how much time to allot to specific exam items or sections, know when to persevere on a difficult item or when to move on, generate multiple approaches to problem solving, synthesize multiple sources of information, and recognize mathematical concepts when the algorithms appear in a variety of contexts. The ability to be flexible in one's thinking can be tremendously impacted by a learning disability, anxiety, depression, mental illness. We can help students to demonstrate their knowledge on exams by allowing them time to employ the same organizational learning strategies they used to successfully master course content.

Increasing Diversity in Higher Education: Exams and Persons

In the previous section the most common cognitive traits associated with taking exams have been briefly explained.

What does this all mean in terms of retention and success for the large numbers of diverse students with and without disabilities entering higher education?

Here we look more closely at these diverse groups of students and discuss how highly capable learners can successfully gain entrance into higher education, and become stymied by a variety of learning differences as a result of many conditions, some not related to disability. It can be helpful for disability service providers and professors alike to better understand the cognitive diversity or specific cognitive abilities individuals may bring to the learning environment.

Populations are described with respect to how some individuals within each group may interact with an exam as a result of circumstance, experience, or disability.

Learning disabilities

More and more students with learning disabilities are attending colleges and universities.

Learning disabilities cross-culturally describe significant and impairing difficulties in reading, writing, and math domains (Mugnaini et al., 2009).

Within the scope of this article, students with learning disabilities exhibit functional limitations in their ability to access and complete exams. Deficits in speeded performance are one of the most common ways in which learning disabilities can impact an individual. This is why extended time is often requested by individuals with learning disabilities in postsecondary settings. More time on exams helps to ameliorate the variable processing speed, rapid word recognition, long-term retrieval and working memory. Students with learning disabilities often need extended time on a variety of academic tasks. These include organizing ideas when writing (Gregg, 2010), reading text and performing math calculations.

Students with learning disabilities are also at a disadvantage when it comes to allocation of cognitive resources. Adult students with learning disabilities allocate their mental energy or cognitive resources differently than their

same age, non-learning disabled peers when it comes to reading, writing, and math (Meyer et al., 2001).

For example, students with reading disabilities, such as dyslexia, or poor readers in-general, must place heavier cognitive demands on word identification, thereby draining other cognitive resources needed to comprehend or construct meaning from text (Ofiesh, et al., 2004). Similarly, students with writing disabilities, such as dysgraphia, have to work harder and longer when it comes to handwriting (spontaneous writing and copying), spelling, and integrating capitals and punctuation (Gregg, 2010). In turn, when exams require written output, students with writing disabilities have fewer cognitive resources available for demonstrating their concept mastery or knowledge. Moreover, fearful of misspelling words, students with learning disabilities may also 'dumb down' their word choice in addition to limiting the amount of their written output. The same pattern is true for math. When students have to exert extra energy to recall basic math facts, fewer cognitive resources are available for the intended content of the exam (Swanson, 2004). **Simply put, adult students with learning disabilities exhibit impairment in the exam-related cognitive demand of speed.**

Attention Deficit Hyperactivity Disorder (ADHD)

Research demonstrates a co-morbidity or concurrence of learning disabilities and ADHD (Mugnaini et al., 2009). It is estimated that 2% to 8% of college students within the United States have ADHD. This statistic does not reflect students with undiagnosed ADHD. This is noteworthy since Biederman, & Faraone (2005) studied a group of 19-year-olds formerly diagnosed with ADHD and found that while 60% of the group no longer met full criteria for ADHD, 90% still presented with ADHD symptoms. Indeed, individuals with ADHD have life-long difficulties (American Psychiatric Association, 2006), underscoring the need for support at the postsecondary level. Adult students with ADHD exhibit impairment in the following exam-related **cognitive demands: attention, working memory, long-term retrieval, and processing speed**. As in Jose's case, he must exert more mental energy to filter out the extraneous visual and auditory stimuli outside the window of his lecture hall. Moreover, Jose must work harder to sustain attention to the exam over time, meaning that his cognitive resources are drained or taken away from the actual purpose of the exam. For longer, more complex problems, fewer working memory resources can lead to small errors or mistakes, not reflective of poor course mastery, but rather of functional limitations associated with ADHD. Similarly, many students with ADHD exhibit weaknesses in the cognitive demand of long-term retrieval. Furthermore, ADHD symptomology in higher education is pervasive across cultures (Norvilitis, Sun, & Zhang, J., 2010).

Language disorders

Language disorders such as receptive and expressive aphasia are different in nature and manifestation than academic difficulties sometimes associated with being an English language learner. However, for some individuals who struggle with a language disorder, comprehending English functions as if it were a foreign language, even if it is their native language. Individuals with language disorders exhibit impairment in comprehending and/ or using spoken, written, or other symbolic language systems. While about one million people in the United States have aphasia (partial or complete impairment of language comprehension caused by stroke, or brain damage), many individuals attend school from early on with mild to moderate language comprehension difficulties and are considered to have developmental language disorders. Fahey (2000) in a chapter on Oral Language Problems, states

children do not outgrow language and learning problems. Rather, the problems change and manifest

differently over time as demands increase in complexity (p. 138).

Anxiety: situational, generalized, and co-existing

Survey data indicates that approximately 18% of American adults have an anxiety disorder (Kessler, Chiu, Demler, & Walters, 2005). Students with ADHD and/or learning disabilities can experience anxiety (Mugnaini, et al., 2009). While many students with learning disabilities and/or ADHD may not meet criteria for clinically significant levels of anxiety, they do report increased scores on measures of anxiety (Nelson & Harwood, 2011a; 2011b). There is a wealth of research on the interplay between anxiety, clinical or not, and academic performance (Eysenck, Derakshan, Santos, & Calvo, 2007; Nelson & Harwood, 2011a; 2011b).

Individuals with anxiety exhibit particular difficulty with the **cognitive demand of long-term retrieval, working memory, and processing speed**, all critical components to performing well on an exam.

Depression

According to the World Health Organization (2004), depression is the leading cause of disability in the world. This is particularly noteworthy within academic settings because depression detrimentally influences **cognitive functioning, academic achievement** (Nelson & Harwood, 2011b), **memory recall** (e.g. long-term retrieval) **and recognition** (Maag & Reid, 2006).

Because depression impedes learning and achievement beyond LD itself, depressive symptomology among students with LD has implications for educational programming and assessment (Mugnaini et al., 2009).

Because depression can influence alertness, a depressed student may show impairment in the test-related cognitive demands of attention and speed of performance. There is also an interplay between depression and memory (Burt, Zembar, & Niederehe, 1995), such that students with depression show impairment in the test-related cognitive demand of long-term retrieval.

Post Traumatic Stress Disorder (PTSD)

Rutkowski, Vasterling, Proctor, & Anderson (2010) studied military personnel before and after war zone exposure to ascertain the impacts of PTSD symptoms (e.g. intrusive thoughts, poor concentration, and hyper-vigilance) on test-taking. These researchers found that post traumatic stress symptoms have potential detrimental effects on standardized exam performance. This is significant because over 1.5 million service members have been deployed to war zones (Rutkowski et al, 2002). A substantial number who return not only present with PTSD, but also impaired cognitive abilities in processing speed, short-term memory and long term retrieval, as well as other areas of cognition (Tanielian & Jaycox, 2008). Moreover, many veterans return and pursue postsecondary education funded by their government (Rutkowski et al, 2002). Many individuals who seek refuge or asylum enter higher education with the hope of rebuilding their lives.

If we speculate that Rutkowski's findings map onto a percentage of the civilian population exposed to or living with trauma or violence, such as the recent influx of refugees to all parts of the world, then the need for exams that are designed for a broad array of cognitive diversity is all the more critical.

Linguistic diversity

Within the United States alone, there are growing numbers of culturally diverse students, including English language learners (ELL). Also of importance, data in the United States indicates that culturally and linguistically diverse students, including ELL students, have higher rates of school drop-out, disproportionate representation in special education, and the lowest outcomes of all students. This unfortunate statistic calls even greater attention to the need for postsecondary educators to be aware of and sensitive to the cognitive diversity and consequent needs of this already underserved population of students. Much like students with language disorders, students new to the English language carry associated challenges into postsecondary education settings, specifically in regards to the test-related cognitive demand of language comprehension (Rasmussen, 2010).

Poverty

There is an expanding corpus of research discussing the relationship between poverty and education (Pfeffer and Glodrick- Rab, 2011). Sadly, educational outcomes for students with some family poverty experience are far from ideal. For example, '22 percent of children with some family poverty experience do not graduate from high school, a figure about three times greater than the 6 percent rate for children with no family poverty experience' (Hernandez, 2011). Students from an impoverished or financially disparate background, different from the majority of their postsecondary peers, often have weaker academic skills. They exhibit less developed literacy skills due, in part, to living in communities with less access to print, such as the lack of bookstores and libraries funded by local tax dollars. This, in turn, can impact the cognitive demand of language comprehension and academic fluency.

Increasing age

According to the National Center for Education Statistics (NCES), during the 2007-2008 academic year, 23% of the total postsecondary student population in the United States was age 30 or older (Institute of Education Sciences, 2010). Of note, older students are and have been returning to postsecondary schools in substantial numbers. In 2002 they were subsumed under the data category of 'nontraditional' students, which includes students who delay enrollment, attend school part time, work full time, have dependents, are single parents, and so forth. Research tells us that students who do not start postsecondary education in the same calendar year as high school completion are going back to school in record numbers for additional education and training (Kim, Collins-Hagedorn, Williamson, & Chapman, 2004). With aging come changes in cognition, most notably short-term memory, and another type of memory known as episodic memory. These changes begin to appear in midlife, and are exacerbated with anxiety and depression.

In summary, given the intersection between cognitive diversity and exam demands in higher education, there is an apparent need for creating and using exams that address the needs of all learners while staying true to what faculty members want to measure. Further, when exams are designed in a manner that removes barriers to access and barriers to output, then exams can be considered more true measures of a student's concept mastery, knowledge and skill set.

This article was adapted from: Cognitive Diversity and the Design of Classroom Tests for All Learners (Shinn & Ofiesh, 2012).

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