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The Validity of the Test of Memory Malingering (TOMM) with Deaf Individuals

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by

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Abstract

There has been an increase in the tendency to implement performance validity tests (PVTs) to detect possible malingering in patients during neuropsychological assessments. The Test of Memory Malingering (TOMM) is a well-validated PVT amongst hearing populations. A major gap in the literature is the use of the TOMM amongst culturally Deaf individuals who use American Sign Language (ASL). Performance within this population may differ for a few reasons. Firstly, the use of ASL interpreters may affect consistent instruction delivery and receptive comprehension. Secondly, there may be a difference in semantic categorization and retrieval using ASL signs rather than English words. This study recruited 30 (11 male, 19 female) culturally and linguistically Deaf adults aged 21-64 years (*M* = 45.9, *SD* = 12.2). Participants were screened for cognitive ability using non-verbal components of the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II) and using a cognitive screening tool, the Mini Mental State Examination: ASL Version (MMSE:ASL). We found that no participants scored lower than the cut-off score for Trial 2 or the Retention Trial on the TOMM. These results suggest that culturally Deaf individuals who use ASL are able to perform just as adequately on the TOMM as hearing individuals. The TOMM can be considered a valid measure to use with this group of individuals.

Thank you to Dr. Cathy Chovaz for opening my eyes and providing me with a deeper understanding of the Deaf world, as well as the importance of advocating for this group of individuals. For guiding me through the hardships of this project and ensuring the execution of good research. Thank you to Dr. Lynn Rennison for her sharing her expertise in neuropsychological assessments and leading the direction of this research. I would also like to thank Angela Core for her impressive organizational skills when recruiting participants and patience while interpreting during every assessment. This project could not have been completed without your support and dedication. I will carry this experience along with me throughout the remainder of my academic career.

Validity of the Test of Memory Malingering (TOMM) with Deaf Individuals

Assessing a Deaf individual's cognition can oftentimes be challenging for neuropsychologists due to the language barrier and the use of an interpreter (Hill-Briggs, Dial, Morere & Joyce, 2007). In Canada, 357,000 individuals identify themselves as culturally and linguistically Deaf (Canadian Association of the Deaf, 2015). Cultural Deafness defines those who do not perceive themselves as disabled and who primarily use American Sign Language (ASL) as their first language of choice (du Feu & Chovaz, 2014). These individuals may lack fluent English competency, as the vocabulary, syntax, and grammar in ASL differs significantly from English (Morere, 2013). Although accessing a qualified sign language interpreter for a Deaf individual in a clinical setting may be difficult, it is an essential component clinicians need to include to ensure that instructions are accurately interpreted (Williams & Abeles, 2004). If neuropsychological assessments are not made accessible for Deaf individuals the validity of testing can be compromised. This may then impact the ability for a clinician to accurately interpret patient results and come to a conclusive diagnosis.

The Test of Memory Malingering (TOMM) is a non-verbal visual object recognition task that is a well-validated and commonly used free-standing performance validity test (PVT) administered during assessment (Tombaugh, 1996). The largely non-verbal component of the TOMM, makes the test appear appropriate on its surface as a measure that could be used with Deaf individuals. However, to date there has not been a study conducted exploring whether the TOMM is truly a valid measure to use amongst Deaf individuals. This study seeks to provide normative data on the use of the TOMM in a culturally Deaf population which uses ASL as their first and/or preferred language.

Performance and Symptom Validity Testing in Neuropsychology

To determine how cognitively engaged a patient is in the task during neuropsychological testing, it is required that the patient give their “best effort” and perform most accurately according to their ability level (Bigler, 2014). If a patient does not put forth their best effort, an additional impediment to a neuropsychological assessment’s validity becomes malingering. Malingering has been defined recently by the DSM-5 as “…the intentional reporting of symptoms for personal gain in contrast to factitious disorder that…requires providing false information or behaving deceptively (p.326) (Bigler, 2014). A more comprehensive definition of malingering was found in the DSM-IV, describing it as “…the intentional production of false or grossly exaggerate physical or psychological symptoms, motivated by external incentives such as avoiding military duty, avoiding work, obtaining financial compensation, evading criminal prosecution or obtaining drugs.” (Teichner & Wagner, 2004). This highlights the medical necessity for clinicians to include tests of effort such as PVTs and symptom validity tests (SVT) during an assessment, has been emphasized recently as an essential component of a neuropsychological evaluation (Bush et al. 2005).

SVTs have been developed to examine the degree real symptoms reflect self-report measures and symptomatic complaints, while PVTs are stand-alone tests that assess effort and accuracy of cognitive ability in task performance (Larrabee, 2012; Van Dyke, Millis, Axelrod, & Hanks, 2013). SVT’s and PVT’s are specifically designed to detect malingering and symptom exaggeration within patients and are insensitive to measuring actual cognitive ability (Etcoff & Kampfer, 1996; Greve, Binder, & Bianchini, 2009). Neuropsychologists are advised to objectively examine malingered symptoms when patients are involved in any of the following: litigation or application for disability, presence of incentives for exaggerating, symptoms do not make sense, lack of cooperation, inconsistencies in complaints and behaviour, and contradictions between medical records and self-reports (Teichner & Wagner, 2004).

Currently, there are no professional standards outlining how neuropsychologists should implement SVTs or PVTs in their practice according to the correct number, in what order, and in what context (Bigler, 2012). This makes it difficult for clinicians to establish consistency across how they choose to implement these measures into their practice. It has been suggested that an appropriate way to determine whether a patient's responses over several PVTs are valid or not is by a criterion of "two or more" failed tests (Medici, 2013). When individuals fail on validity measures, it has been confirmed that this is indicative of poor cognitive performance and a lack of effort across neuropsychological tests (Bigler, 2012; Sollman & Berry, 2011; Denning, 2012; Heyanka et al., 2015; Larrabee, 2012). This means that all tests performed during the neuropsychological assessment with the individual would also be considered invalid, and conclusive results from testing would not be interpreted to the patient.

It has been noted that malingering symptoms occur more commonly in forensic settings where higher incentives are present, making administration of at least one SVT or PVT crucial in these cases rather than in clinical contexts (Bush et al., 2005). This can include personal injury contexts, where the evaluation of neurocognitive and/or psychiatric complaints must be investigated for those seeking out money or benefits (Easter Cottingham, Victor, Boone, Ziegler, & Zeller, 2014). Although in the majority of situations neuropsychological deficits are feigned to result in personal gain, situations do exist where individuals may also present themselves inaccurately to avoid a loss of independence or due to cultural differences (Bush et al. 2005). The issue of false positives arises in these situations, where individuals' failure on SVTs or PVTs are attributed to malingering rather than other factors.

The false positive rates on individual validity tests have been described to range from 10% or less, meaning the tests have high specificity and are able to accurately identify individuals without the disorder as truly not having the disorder (Larrabee, 2012). With increased specificity, there is a reduction in the sensitivity of these tests which can be offset through the use of multiple PVTs and SVTs (Chafez et al., 2015). However, unavoidable Type I and Type II errors on forced-choice PVTs arise with “Near-Pass” individuals who perform above-chance but below cut-off scores (Bigler, 2012). Clinicians are advised to review the literature when selecting effort tests to implement in their practice as cut-off scores are routinely examined in various clinical groups (Iverson, Le Page, Koehler, Shojania, & Badii, 2007). Therefore, it is important for neuropsychologists to consider a variety of components which may potentially impact the validity of the assessment.

The Test of Memory Malingering (TOMM)

The TOMM is a 50-item forced-choice visual recognition task with cut-off scores that have been normed in adult hearing samples (Tombaugh, 1996). The administration of the test includes an initial learning trial (Trial 1), followed by Trial 2, and a Retention Trial over a period of 15 minutes. The TOMM is considered a free-standing PVT that has a single purpose in identifying failure to perform to true ability (Chafetz et al., 2015). This test has been designed to discriminate between individuals with *bona fide* memory impairment and those who feign symptoms of impaired memory (Tombaugh, 2003). If a patient receives a low score on the TOMM, this suggests that the memory impairment symptoms are exaggerated or false (Tombaugh, 1996). Thus, the way in which the test was designed was to require little cognitive ability and to assess the integrity of the patient’s symptomatic complaints for memory (Denning, 2012).

In a study using participants suffering from a mild Traumatic Brain Injury (mTBI), researchers identified that memory and effort can be considered unique constructs and that validity tests are highly distinct from memory tests (Heyanka et al., 2015). The TOMM has shown to be an effective measure of effort, as at face value the test appears to the patient as being a difficult task. A malingering patient believes that it would be expected that if they truly suffered from a memory impairment, they should perform poorly (Tombaugh, 1996). However, the TOMM has been validated amongst a variety of clinical groups in the literature who have all demonstrated the ability to achieve the established cut-off score. Reasonably so, researchers have described the TOMM as an effortless measure of effort (Iverson et al., 2007).

In one of the first validation studies of the TOMM, individuals not involved in any litigation but who suffered from cognitive impairments, aphasia, traumatic brain injuries, and dementia were all assessed to determine whether they could achieve the established cut-off score (Tombaugh, 1996). Although the dementia group had the poorest performance on the TOMM at achieving the established cut-off score, it was found that a vast majority (91%) of participants were identified as not malingering. A study by Teichner and Wagner (2004) attempted to replicate findings with dementia patients, and found that individuals with dementia performed poorly on the TOMM and resulted in a high rate of false positives when using the established cut-off score. This suggests that neuropsychologists could rule out individuals with moderate-to-severe dementia when detecting malingering of memory deficits. However, research has outlined a variety of other groups which have achieved similar performance levels as control groups and the established cut-off score on the TOMM. These include individuals suffering from depression (Rees, Tombaugh, & Boulay, 2001), anxiety (Ashendorf, Constantinou, & McCaffrey, 2004), psychotic disorders (Duncan, 2005), fibromyalgia (Iverson et al., 2007), and children as young as five years old (Constantinou & McCaffrey, 2003; Donders, 2005).

In addition, the literature has supported that the TOMM is a widely used test with neuropsychologists when assessing effort. In a study by Sharland and Gfeller (2007), members of the National Academy of Neuropsychology (NAN) were asked to list measures that are most effective and most regularly used to detect suboptimal effort. When asked how often respondents assessed effort level during a neuropsychological assessment, 56% responded that they always or often included a measure. It was reported by 75.3% that the most frequent measure used to detect poor effort in their practice was the TOMM. This was due to the majority of respondents being most familiar with the TOMM as a test of effort in comparison to other PVT's that also assess effort. Greve et al. (2009), used a private practice forensic sample to investigate the difference amongst below-chance results on three forced-choice PVTs. Although the TOMM displayed significantly less below-chance results than the Portland Digit Recognition Test gerand the Word Memory Test, it is still considered as accurate as other measures at clinically diagnosing malingering (Greve et al., 2009). However, this finding suggests that neuropsychologists should assign multiple PVTs during an assessment where malingering is seen as a potential issue. While a variety of PVTs have shown to be valid in assessing effort in hearing populations, determining the validity of the TOMM needs to be accounted for amongst Deaf individuals as well.

Deaf Individuals in Neuropsychological Testing

There are various factors neuropsychologists need to take into consideration when assessing a Deaf individual. Individuals with severe hearing impairments who use ASL often lack access to effective assessments in health settings, creating a power differential between the clinician who is hearing and client who is Deaf (Gerber, 1980). It is therefore important for clinicians to effectively assess the Deaf patient using culturally and linguistically appropriate and accessible assessments (du Feu & Chovaz, 2014). To do so, the preferred language style for the patient must be applied during an assessment to ensure understanding of task instructions, which oftentimes requires using an ASL interpreter (Hill-Briggs et al., 2007).

The presence of an ASL interpreter during neuropsychological testing with a Deaf individual may also significantly impact validity. This is often the only options clinicians have, as few mental health professionals have developed sign language skills or knowledge of deafness (Gerber, 1980; McCay & Miller, 2001). It is important for clinicians to include a qualified and registered interpreter who understands Deaf culture as well as the importance of standardized behaviour during testing, a code of ethics, and confidentiality (du Feu & Chovaz, 2014). Neuropsychologists need to recognize that many words in English also do not have sign equivalents in ASL, leading the interpreter to explore other options of how to get the point across to the patient which can impact the standardized process (Hill-Briggs et al., 2007).

Deaf individuals are also often a minority group in areas they reside in, making it likely that the interpreter and Deaf individual are previously known to one another on a personal capacity, which can lead to excess dialogue during testing (du Feu & Chovaz, 2014). This can create the third-party observer effect, which is a phenomena that occurs when a third party known to the patient is present during test administration (Gavett, Lynch, & McCaffrey, 2005). In a meta-analysis by Eastvold, Belanger, & Vanderploeg (2012), it was found that overall, the presence of observers negatively impacted performance during testing especially on tasks involving attention, learning/immediate memory, and delayed recall. Overall, the researchers found that the presence of a third party during neuropsychological assessment had a medium effect on memory test performance of .12 (Cohens $d = .74$). This is explained by Zajonc's theory of social facilitation, which describes how the physical presence of another person or an audience during performance increases an individual's drive or state of arousal (Platania & Moran, 2001). This effect has been shown to hinder an individual's performance on novel or difficult tasks. During a neuropsychological assessment, all the test batteries implemented would appear as novel to the patient. Therefore, it is important for clinicians to meet with interpreters and outline the expectations for a standardized testing procedure. This includes limiting feedback during testing, reinforcements or reassurance, and not engaging in conversations with the patient.

An outstanding concern is that an increasing number of measures have been standardized and validated for hearing individuals using spoken language, while there is a major lack in measures that are held to the same standard for individuals using sign language (Morere, 2013). It is common for the stimuli and instructions for a variety of neuropsychological measures, including PVTs and SVTs, to be written in English with no ASL video-presentation or standardization available (Denmark, Marshall, Mummery, Roy, Woll, & Atkinson, 2016). By choosing to administer cognitive measures which are heavily loaded in verbal skills, results may be biased by tapping into issues of language deprivation or a lack of knowledge in English due to it being second language, rather than truly reflecting the Deaf individual's level of cognition (Hill-Briggs et al., 2007). Therefore, non-verbal assessments such as the TOMM would be considered an ideal measure for a neuropsychologist testing a Deaf individual to avoid language issues. Although a task may be non-verbal, the instructions require interpretation into ASL which may require clarification if the patient has limited understanding of English grammar (Hill-Briggs et al., 2007).

What further may complicate a Deaf patient's understanding during a neuropsychological assessment is the lack of emotion, feedback, body language, and reinforcing facial expressions.

With individuals who use ASL, it is part of the Deaf culture to incorporate an increased used of eye contact, body language, facial expressions and grand gestures (Williams & Abeles, 2004). These types of non-verbal feedback are critical amongst individuals who use ASL and not providing this during communication with a Deaf patient violates cultural expectations. The reason why typical neuropsychological assessments restrict non-verbal feedback is because each test is required to be conducted in the same manner for every patient. This is to ensure that instructions and scoring procedures are highly standardized in order to interpret patient results to pre-existing norms (Kirlin & Locke, 2014). The lack of this non-verbal communication by the examiner and constraints on the interpreter to provide this feedback, may make the Deaf individual feel uncomfortable. This also has the potential to affect the patient's understanding of task instructions, which could negatively impact test results.

Semantic Labeling Concerns on the TOMM

The TOMM is a task that requires individuals to observe a large number of visual stimuli, specifically everyday common objects for a total of 3 seconds each, one at a time (Tombaugh, 1996). The cognitive processes involved in the task includes a quick encoding process of the visual stimulus by incorporating semantic information of the names of the objects (Koutstaal, Reddy, Jackson, Cendan, & Schacter, 2003) and categorization; a technique requiring a variety of cues to group discriminable properties, events, or objects into classes (Johanson & Papafragou, 2016). Although instructions on the TOMM clearly state that individuals must learn to remember the object itself rather than its name, individuals still engage in semantic categorization. This occurs when semantic or conceptual information obstructs the encoding of non-conceptual perceptual information (Koutstaal et al., 2003). Individuals may be more concerned with automatically trying to determine the name of the object to use it for later recall.

It is an innate process for individuals to associate images and corresponding language accurately to one another to later retrieve these images and the words (Mesnil, Bordes, Weston, Chechik, & Bengio, 2014).

Odom, Blanton, and McIntyre (1970) compared Deaf participants with hearing fifth graders on how well 16 English words could be learned. In this word list, eight had a direct interpretation into sign while the remaining eight did not. The researchers found that signable words were recalled significantly better for Deaf participants than the unsignable words in the list. This displays how ambiguous words were more difficult for deaf individuals to recall, as they were not encoded into something meaningful due to the lack of a linguistic cue. In a study by Liben (1979), profoundly Deaf children and hearing children were asked to recall black and white line drawings of objects. The participants were both shown pictures and immediately after were asked to write down what they saw. Furthermore, the researchers trained half of both deaf and hearing children to engage in semantic categorization as a memory aid (sorting pictures, pointing, counting, verbal labeling etc.). Although deaf children used the same semantic clustering efforts as hearing children, they still performed significantly worse at the number of line drawings they could recall. The poor performance could be attributed to the fact that instructions were not clear in the study. Another reason is that 90% of Deaf individuals with early profound deafness are born into hearing families, making them more susceptible to delayed and deficient oral language and reading skills if language deprived at a young age (du Feu & Chovaz, 2014).

As described above, Deaf individuals are at a disadvantage to have the ability to use the process of relying on labeling images to later use as a retrieval tactic on the TOMM. This is because some images of objects on the TOMM lack a direct sign ASL. These include objects such as a butterfly net, spinning wheel, light bulb, and jack-in-the-box. This means that the images chosen for use on the TOMM are not culturally appropriate for Deaf individuals who use ASL as their first language, as they may have trouble with assigning a semantic label to the image if they are unfamiliar with the English word. In combination with the use of interpreters during testing and the lack of semantic labels for objects on the TOMM, important questions are raised on the validity of its use with culturally Deaf individuals who use ASL as their first language. Acquiring a score above the cut-off on the TOMM and avoiding false positives is critical for Deaf individuals especially if they are involved in litigation or a forensic setting. This is because Deaf individuals are already considered at a disadvantage of being perceived as legally incompetent to stand trial due to linguistic incompetence (O'Rourke & Grewer, 2005). The current study seeks to answer two questions that have not been addressed in previous research:

(1) Is the TOMM culturally and linguistically appropriate to use with Deaf individuals?

(2) Does the TOMM provide valid results when used on Deaf individuals?

The Present Study

Previous research has established the TOMM to be a well validated and commonly used PVT within neuropsychological assessments. The present study will fill the gap that has been found in the literature of no validity assessment to date on culturally and linguistically Deaf individuals and the TOMM. The research is largely exploratory, and no specific hypotheses can currently be made on whether or not Deaf individuals will score similarly or differently on the suggested TOMM cut-off score that has been normed only in hearing samples. However, there are two major factors which have the potential to explain why the TOMM may not be considered an appropriate measure to use with Deaf individuals as it currently stands. The first issue is that the presence of an ASL interpreter may affect consistent instruction delivery and receptive comprehension. This could impact standardization of testing for reasons such as the third party observer effect, potentially making it more probable for Deaf individuals to score below the cut-off on the TOMM. Secondly, there may be a difference in semantic categorization and retrieval using ASL signs rather than English words. This could negatively impact Deaf individuals by having difficulty when recalling the images, increasing their likelihood of scoring below the cut-off.

The goal of this research was to recruit 30 community-based Deaf adults (aged 18 years and older) who considered ASL as their first language and use it on a daily basis. Participants were excluded if involved in litigation or secondary gain, possible dementia, visual deficits, or did not use ASL. The research aimed to add multiple contributions in addressing how Deaf individuals are assessed within neuropsychological settings, including: (1) determining the appropriateness of the TOMM as an SVT, (2) decreasing the likelihood of a false positive, (3) providing sound diagnosis and treatment, (4) informing clinicians about validity of the TOMM, (5) providing normative data for this group of individuals, and (6) possibly suggesting what changes need to be made to the TOMM.

Method

Participants

The total sample consisted of 30 (11 male, 19 female) participants. Three participants were excluded due to possible cognitive impairments. All participants considered themselves culturally and linguistically Deaf individuals who use American Sign Language (ASL) as their first and/or preferred language on a daily basis. None of the participants met exclusionary criteria of being involved in litigation or secondary gain issues, had suspected or possible dementia, or vision deficits that could not be corrected with lenses. The participants ranged from ages 21-64 years (*M* = 45.9, *SD* = 12.2). In regards to education, 18 of the participants reported attending a Provincial School for the Deaf, 12 participants held a University degree, and three participants held a Master's degree. Participants were required to be 18 years of age or older. A total of 24 participants were right-handed, while 6 were left-handed. The participants were recruited through community contacts of the Principal Investigator and the King's Interpreter through e-mail, Facebook, or video-messaging. As compensation for taking part in the study, each participant received a total of $20.00.

Materials

Demographic Questionnaire. Demographics were collected through four forced-choice questions about age, gender, highest level of education, and first and/or preferred language.

W**echsler Abbreviated Scale of Intelligence.** A measure of nonverbal intelligence was obtained using the Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2011). This abbreviated measure consists of four-subtests including: Vocabulary and Similarities which forms the Verbal Comprehension Index (VCI) as well as Block Design and Matrix Reasoning which forms the Perceptual Reasoning Index (PRI). For purposes of this study, nonverbal intelligence was assessed in the Deaf participants by administering only the Block Design and Matrix Reasoning subtests. Block Design consisted of having participants re-create a two-dimensional red-and-white geometric design presented in the Stimulus Book. This subtest evaluated non-verbal concept formation, fluid intelligence, coordination, and visual and perceptual organization. There are a total of 13 stimuli tasks, each with a specified time limit and number of available points awarded for completion. For items 1 to 4, successful re-creation of the design on the first trial awarded two points, while on the second trial only one point is awarded. For items 5 to 13, successful re-creation can be awarded between four and seven points depending on how quickly the individual completed the item. Two consecutive failures on the items resulted in discontinuation of the subtest. The Matrix Reasoning subtest consisted of 30 incomplete visual matrices presented in the Stimulus Book. This subtest assessed fluid and visual intelligence, spatial ability and perceptual organization. Participants were required to choose one item from a selection of five that would accurately complete the matrix. One point was awarded for each correct item and the task was discontinued after three consecutive failures. Administration of these subtests took approximately 15 minutes each.

Test of Memory Malingering. Following the WASI-II**,** The Test of Memory Malingering (TOMM) (Tombaugh, 1996), was used to determine the validity of the measure amongst Deaf individuals who use ASL. This is a 50-item forced-choice visual recognition task designed to determine the amount of mental effort an individual is exerting during testing. The measure included two learning trials where the individual were shown 50-target pictures of common objects one at a time for 3 seconds each at 1 second intervals. The individual was then asked to select the correct picture that they remembered seeing during the learning trial. During the Retention Trial, the individual was asked to identify the correct target pictures, without the stimuli pictures being re-administered. Cut-off scores normed on adult hearing samples have been determined to be 45 on Trial 2 or the Retention Trial. Administration of the TOMM took approximately 15 minutes. A 15 minute delay occurred prior to the administration of the Retention Trial.

Mini Mental State Examination: ASL. The Mini Mental State Examination: ASL (MMSE: ASL) (Chovaz & Core, in progress), was administered as a brief screening test to assess mental status. This measure was administered after the two learning Trials of the TOMM to serve as a delay before the Retention Trial. The MMSE:ASL is the ASL version of the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) and is a brief questionnaire used extensively in clinical and research settings to measure cognitive impairment. The MMSE:ASL is an 11-item tool that assesses orientation, registration, attention and calculation, recall, and language. Correct completion of each item results in a score of 1, and the assessments maximum score is 30. Cognitive impairment is indicated when individuals score a 26 or lower. The MMSE:ASL (Chovaz & Core, in progress) is more appropriate to use with Deaf individuals using ASL, as it does not rely on knowledge of the English language. The MMSE:ASL is a video tool and was presented to participants on a computer to maintain standardization. An ASL interpreter was present to interpret and record participant's signed responses to the questions. The MMSE:ASL took approximately 15 minutes to administer.

Procedure

Participants learned about the study through an information sheet as well as an ASL video advertisement posted on social media. The majority of the testing, with a few exceptions, was conducted at King's University College in-person by a trained thesis student and ASL interpreter. One participant required testing to take place at their home. Three participants completed testing at a library. The consent form was interpreted for the participants and all provided consent to take part in the study. Further instructions throughout testing were read in English by the thesis student and interpreted by the ASL interpreter. Testing began with a brief demographic questionnaire. Following this, the WAIS-II was administered beginning with the Block Design subtest. Once the participant completed all 13-items or met the criterion to discontinue, the Matrix Reasoning subtest was then conducted. When the participant completed all 30-items or met the criterion to discontinue, the instructions for the TOMM were provided for

Trial 1 to begin. Following the completion of Trial 1, Trial 2 of the TOMM was conducted. A 15-minute delay was required before the administration of the Retention trial. During this time, the MMSE:ASL was administered. After testing was completed with all three measures, each participant was provided with a debriefing form that was interpreted into ASL. Participants were thanked for their time and were provided with $20.00 as compensation for taking part in the research study.

Results

To determine how participants compared to norms found within the WASI-II manual, each Block Design and Matrix Reasoning raw score was calculated and matched with the appropriate *T*-score according to the participant's age group. The participants performed with a mean score of $M = 49.4$, $SD = 8.1$, on the Block Design subtest. On the Matrix Reasoning subtest, participants performed with a mean score of $M = 51.4$, $SD = 5.9$. To compare these scores to where they would fall on the Subtest *T* Score Profile, the highest score possible to receive on the Block Design and Matrix Reasoning subtests would be 80. These scores were then combined to determine the PRI of the participants. It was found that the sample's score on the PRI with a 95% confidence interval of 93 to 107, was $M = 100.4$, $SD = 9.5$ (*Figure 1*). The sample percentile on the PRI was $M = 50.4$. This places the sample's performance ability for non-verbal intelligence in the Average range.

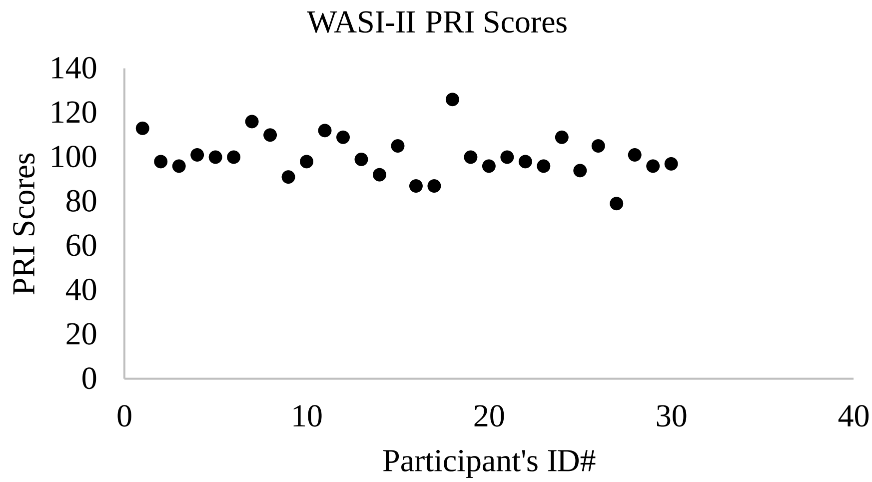

Figure 1. PRI Scores across participants.

The participants obtained high scores on all three trials of the TOMM. One participant scored below the cut-off on Trial 1, with a score of 44. No participants scored below the cut-off on Trial 2 or Retention, and the lowest score was 49.

All participants in the study met the cut-off score of 26 on the MMSE:ASL and the average score was $M = 29$ (Figure 2). Only two participants scored a 26 while 17 achieved a perfect score of 30. Refer to Table 1 for means, standard deviations, and ranges of scores.

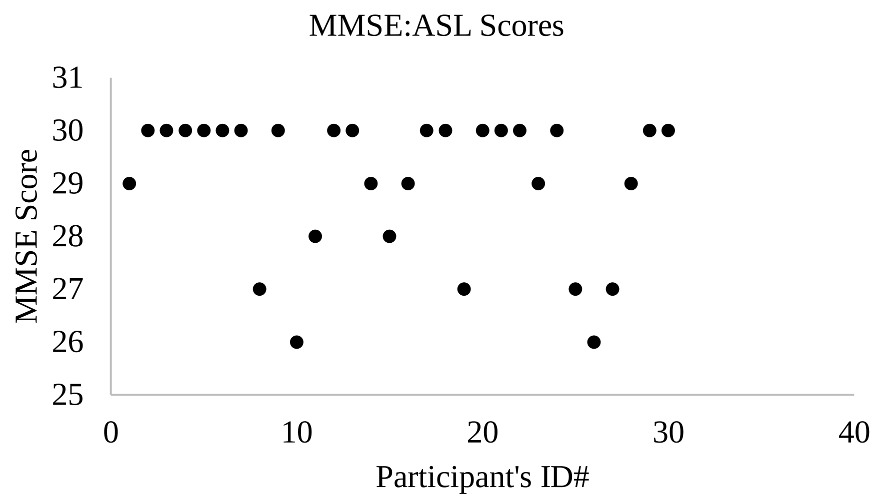

Figure 2. MMSE:ASL Scores across participants.

Table 1

Means, Standard Deviations, and Ranges for WASI-II PRI, TOMM Trials 1, 2, Retention and MMSE:ASL

	M	SD	Range
WASI-II PRI	100.4	9.5	79-126
TOMM Trial 1	48.1	1.8	44-50
TOMM Trial 2	49.9	.25	49-50
TOMM Retention	49.9	.18	49-50
MMSE:ASL	29	1.4	26-30

Discussion

The current study aimed to determine whether the TOMM is a valid measure to use with culturally Deaf individuals who use ASL and to provide normative data on its use within this sample. We examined whether participants were able to achieve the same cut-off score that has been normed for use in both clinical cognitively impaired and non-clinical cognitively intact hearing samples. Two decision rules were used to interpret TOMM scores to indicate malingering: scoring lower than chance on any trial and scoring lower than the cut-off on Trial 2 or the Retention Trial (Tombaugh, 1996). No participants scored lower than chance on any trial, as participants did not have a motive to malinger. It was ensured that participants were not involved in litigation or had any outside pressure to seek secondary gain by taking part in the study. In addition, we found that no participants scored lower than the cut-off for Trial 2 or the Retention Trial on the TOMM.

The TOMM requires that explicit feedback be provided to examinees during trials so that response accuracy may increase (Tombaugh, 1996). We found that response accuracy increased on subsequent trials, from an average score of 48.1 in Trial 1 to an average of 49.9 in both Trial 2 as well as the Retention Trial. These results suggest that culturally Deaf individuals who use ASL are able to perform just as adequately on the TOMM as hearing individuals. In other words, the TOMM can be considered a valid measure to use with this group of individuals.

We also aimed at establishing a non-clinical Deaf sample by using measures to indicate that all participants were cognitively intact. The sample displayed an average score in non-verbal intelligence on the WASI-II, which would align with performance expected to be found within a hearing sample (Wechsler, 2011). Non-verbal intelligence was assessed over verbal intelligence as the literature outlines that Deaf individuals may lag behind hearing individuals in English literacy abilities. Specifically, it has been found that 50% of deaf students graduate with a fourth grade reading level or less, while 30% leave school functionally illiterate (Mayer, 2007). Thus, it was a rational decision to assess intelligence in a way that did not tap into the participant's knowledge of spoken English. On the MMSE:ASL cognitive screener, all participants passed with the majority attaining a perfect score. Overall, it was ensured that the sample was cognitively intact to control for and avoid other possible explanations for potential differences found in performance on the TOMM.

Performance on the TOMM did not seem to be influenced by the presence of an ASL interpreter. There are two potential explanations for this. The first is that the ASL interpreter has experience and knowledge of mental health practices when working with culturally Deaf individuals. Furthermore, the interpreter used in the study had met with both a clinical psychologist and neuropsychologist prior to testing to discuss the importance of maintaining standardization. A pilot assessment also took place with the ASL interpreter, using another ASL interpreter as a mock participant while testing took place. This was done to ensure clarity of the translated instructions during testing. This meant that testing completed with each participant was highly standardized, as instructions were provided in the same way by the ASL interpreter.

In reality, not all sign language interpreters are experienced in mental health assessments (du Feu & Chovaz, 2014). The literature outlines the importance of having an ASL interpreter be aware of culturally Deaf practices to adjust the information in a way that makes it accessible in the context of the culture (Hill-Briggs et al., 2007). Having a lack of knowledge in Deaf culture as well as in mental health assessments while interpreting could lead to misunderstanding instructions, increasing the risk for inadequate translation into ASL. Neuropsychologists are cautioned to carefully ensure that the ASL interpreter hired for the assessment has knowledge in areas of Deaf culture, mental health assessments, as well as an opportunity to review the standardization protocols with the clinician prior to meeting with the patient.

The second reason why the ASL interpreter may not have impacted test scores, is that the performance on the assessments did not have any consequences for the participants. According to the social facilitation theory that underlies the third-party observer effect, performance increases when the task is easy or familiar, while performance decreases when a task is difficult or unknown (Platania & Moran, 2001). As the participants were not in a situation where the results had any serious implications, there was no pressure to perform in a certain way. Experiencing a lack of pressure may have suppressed the drive or arousal in participants to perform in a certain way although the tasks were novel. This could have potentially made the tasks appear easier to the participants than they may have to a real patient during a neuropsychological assessment. In a real neuropsychological assessment, the scores of the patient are applied in numerous ways including: determining cognitive capacities of brain injured patients, monitoring neuropsychological status of patients who have undergone surgical intervention, or in medicolegal situations such as trauma in motor vehicle accidents (Tranel, 2008). It would be suspected that the pressure for performance in these situations may have a greater impact on test scores than participating in a research study.

Performance on the TOMM also did not seem to be influenced by a lack of semantic categorization. It was expected that due to a handful of images presented in the TOMM that did not directly translate into ASL, Deaf individuals may have had trouble recalling these images. However, according to the scores on the TOMM this was not the case. An explanation for this phenomenon is that a vast majority of the sample indicated fluency in English or bilingualism in ASL and written English. To be exact, when asked which language participants used on a daily basis along with ASL, a total of eight reported spoken English. When asked whether participants attended a Provincial School for the Deaf, a total of 12 responded “No”. This means that these individuals were likely taught predominantly in spoken English during their education along with exposure to ASL. It was also unclear which language the participant had been exposed to first – English or ASL. Findings in the literature suggest that unimodal bilinguals (use of two languages) can enhance or hinder how linguistic systems are utilized and learned in various cognitive processes including: executive functioning, nonverbal processes, working memory, and semantic memory (Knoors & Marschark, 2012).

Using semantic categorization to recall the objects on the TOMM requires that the individual has the appropriate vocabulary in their language. Research suggests that bilinguals typically have smaller vocabularies than monolinguals but stronger executive control processes which involve controlling attention, working memory, and monitoring sets of stimuli (Bialystok & Craik, 2010). Since the TOMM uses everyday objects, it is likely that the participants had previous exposure allowing the development of appropriate vocabulary labels in English, even if no sign exists for that object. In fact, it was noticed during testing that some participants would voice the labels of the objects on the TOMM in English, although not all had a direct sign to match. Furthermore, having enhanced executive control could also benefit the participant performance on the TOMM as it requires maintaining attention and encoding the objects into working memory. Thus, our findings suggest that the non-verbal component of the TOMM is a valid way to measure the amount of effort provided by participants during testing. This suggested that the cognitive processes involved in language did not appear to impact performance.

Limitations, Implications and Future Directions

There are various limitations in this study. Firstly, a major limitation in this study is the small sample size. Having a larger sample size would increase the power of our findings. This would make clinicians more confident in the validity of the test to use and accurately interpret scores with Deaf individuals during an assessment. Secondly, the need for greater control on participant inclusion criteria was also a limitation. Two participants included in the analyses suffered from visual impairments that were not objectively examined to determine whether or not the impairment had an influence on performance. As these two participants performed well during the assessments, it was assumed that the visual impairments did not have any effect. Using an objective way to determine this would have made the researchers feel more confident in their abilities to rule this factor out in potentially impacting performance. Lastly, the participants in this study were all closely known to the ASL interpreter. This made it unclear whether there really was an effect of having an interpreter present as all participants had met or worked with the ASL interpreter previously. We could have used another ASL interpreter and assigned participants into two groups (known to ASL interpreter or unknown) during the assessments. This could help us determine whether differences existed between groups who knew the interpreter versus those who did not. Since the same interpreter was used throughout all assessments, it cannot be entirely ruled out that the third party observer effect does not hold.

This study adds to the gap in the literature regarding the use of the TOMM with Deaf individuals who use ASL. Clinicians are able to use this information and apply it to their practice with Deaf patients. They may now feel more confident when assessing a Deaf patient with a commonly used PVT, the TOMM. Clinicians can interpret the Deaf patient’s scores as reflecting the amount of effort the patient is exerting on the task, rather than indicating a difference in performance due to the existing language barrier. Scores that fall below the cut-off with Deaf individuals can be interpreted as evidence of poor or incomplete effort, rather than a false positive unless the patient presents with evidence of a serious cognitive disorder, such as dementia or a psychotic disorder (Iverson et al., 2007). According to what has been found in this study, the TOMM therefore does not need to be revised in its administration or image content to be made more appropriate for Deaf individuals who use ASL.

Future research should focus on the development of bilingual norms within neuropsychological assessments rather than only monolingual. A vast majority of neuropsychological tests and batteries have not yet been validated to use with Deaf populations. Adding this valuable information to the literature can help clinicians adequately assess Deaf clients and prevent inaccurate diagnoses which can negatively impact patient care. In conclusion, this study’s findings can be directly applied in neuropsychological practice regarding the assessment of Deaf individuals. Deaf individuals are known to have a greater neurological risk, particularly if the deafness is of non-genetic causes and it is known that people with central nervous system disorders also have an increased risk for mental health problems (du Feu & Chovaz, 2014). This increased risk for neurological disorders amongst Deaf individuals makes it likely that neuropsychologists will need to assess a Deaf patient throughout their practice. It is important that these individuals are treated in the same manner as others regardless of their ability to hear.

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