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# The Effect of Test Difficulty on Perceived Memory Performance

Phoebe S. Bean

# THE EFFECT OF TEST DIFFICULTY ON PERCEIVED MEMORY PERFORMANCE

By

Phoebe Shannon Bean

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Approved by:

Scott Whittenburg, Dean of the Graduate School
Graduate School

Stuart Hall, Ph.D., Chair
Department of Psychology

Allen Szalda-Petree, Ph.D.
Department of Psychology

Annie Sondag, Ph.D.
School of Public and Community Health Sciences

Bean, Phoebe, M.A., Fall 2021 Clinical Psychology

The Effect of Test Difficulty on Perceived Memory Performance

Chairperson: Stuart Hall, Ph.D.

Neuropsychological testing is a critical element of the assessment and treatment of a host of neurological disorders, such as Alzheimer's Disease, stroke, and traumatic brain injury. Certain non-neurological variables may also affect an individual's test performance. Such secondary factors may include current psychiatric issues, chronic pain, sleep, and the effort put forth during testing. Little is known, however, about the effect the testing process itself has on people's actual and perceived cognitive abilities. For example, the process of undergoing memory testing may, through a variety of mechanisms, influence memory performance and impact the person such that their view of their memory function changes. To effectively assess and treat patients, it is necessary to understand the influence our assessment methods have on patients' memory test scores and the extent to which the assessment experience alters their self-concept. Thus, this project examined the effects of test difficulty on self-reported memory ability. A sample ($n$ = 59) of undergraduate students and healthy older adults took two standardized neuropsychological tests of memory with differing levels of difficulty and rated their memory abilities at baseline and after each test. It was hypothesized that self-reported memory abilities would be higher after taking the easy test, and lower after taking the hard test. The results of this study may help clinicians better understand the impact their assessment techniques may have on examinees and how results from neuropsychological evaluations may be best used to help individuals make appropriate adjustments to their memory difficulties.

# Introduction

Neuropsychological testing is instrumental in the assessment of cognitive functioning, from conditions such as pediatric traumatic brain injury (TBI) and learning disorders to Alzheimer's Disease and schizophrenia (Harvey, 2012; Kirkwood et al., 2017; Silver et al., 2006; Weintraub et al., 2012; Reichenberg, 2010). The role of a neuropsychologist in the context of assessment is varied, but typically includes the interpretation and synthesis of patient interview data, third party reports, and test results into a comprehensive picture of the patient's pre- and post-morbid functioning, both cognitively and behaviorally (Clinical Neuropsychology, 2020). Just as a school psychologist may utilize a variety of achievement and intelligence-based tests, a neuropsychologist has countless standardized tests to choose from that tap into distinct cognitive domains such as executive function, attention, processing speed, and memory, as well as subdomains (e.g., long-term memory and recognition memory; Battista et al., 2017). These tests are often highly sensitive to slight changes in cognitive functioning and contribute invaluable data toward the greater clinical picture of a given patient (De Jager et al., 2003).

Neuropsychological testing outcomes are also vulnerable to the effects of factors not related to the neurological pathology present. Such secondary factors are ulterior, often inconspicuous non-neurological factors that may compromise the accuracy and validity of patients' scores. Examples of such secondary factors include quality of sleep, depression, pain, medications, effort, and the individual's expectations about their ability to do the test (Waters & Buck, 2011; Kuperberg & Heckers, 2000; Zacny, 1995; Scott et al., 2015). In order to assess and diagnose patients with accuracy, it is important to consider what secondary factors may contribute to each patient's neuropsychological profile.

## Secondary Factors in Neuropsychological Assessment

***Depression***

Depression has a robust presence in the general population; according to the National Institute of Mental Health (NIMH; Major Depression, 2019), an estimated 7.1% of adults and 13.3% of adolescents in the United States had at least one major depressive episode in 2017. Due to the high rates of Major Depressive Disorder (MDD) in the general population, depression has been widely studied as a secondary factor for cognitive performance (McDermott & Ebmeier, 2009). In addition to its high base rate in the general population, the onset of neurological events can also lead to depression. The reality is that many people who experience neurological deficits due to TBI, stroke, or degenerative disease also experience subsequent depressive symptoms related to their diagnoses; depression is the most frequent psychological complication of stroke (Klinedinst et al., 2013) and it is estimated that one in six people with a diagnosis of dementia also suffers from major depressive disorder (Ellison, 2020). Research indicates that people suffering from depression, whether premorbid in origin or as a result of a neurological events, perform worse on tasks of episodic memory, executive function, and processing speed compared to people without diagnoses of depression (Ellison, 2020; Klinedinst et al., 2013; McDermott & Ebmeier, 2009). Data also suggest that the degree to which depressed patients are cognitively impaired on tasks that measure the aforementioned cognitive domains is correlated with the severity of depressive symptoms; one such study, conducted by Austin et al. (1992), found a relationship between impairment of cognitive function and severity of symptoms on tests of memory and verbal fluency. Furthermore, cognitive functions are more impaired in people with treatment-resistant depression when compared to patients whose depression responds to treatment (Yu et al., 2015). Due to the effects of depressive symptoms on cognitive functions and the high comorbidity of depression and neurological disease, it is essential for the neuropsychologist to investigate what effects depression has, if any, on a given patient's cognitive performance during testing.

***Chronic Pain***

Not unlike depression, a number of patients seeking a neuropsychological evaluation may be experiencing chronic pain that is unrelated to their neurological injury. Dick and colleagues (2002) assessed three different groups of chronic pain patients to investigate whether individuals with fibromyalgia, rheumatoid arthritis, or musculoskeletal pain exhibited deficits in attentional functioning compared to pain-free controls. The researchers found that, unlike the control group, all three groups of chronic pain patients had impaired attentional functioning regardless of diagnosis; similarly, other studies have indicated that patients with multiple sclerosis (MS) and stroke also commonly present with chronic pain (Rao, 2008; O'Donnel et al., 2013). These data suggest that a person participating in a neuropsychological assessment, who is also experiencing chronic pain of any origin or cause, may perform poorly on a variety of cognitive tasks; indeed, the neuropsychological literature has identified chronic pain as yet another secondary factor that must be examined within the context of cognitive functioning during an evaluation, particularly in relation to attention, memory, and executive functioning (Spindler et al., 2018). For example, patients who sustain a TBI often experience pain due to orthopedic injuries (Sherman et al., 2006). Pain is often times part of the clinical picture; patients with neurological disorders other than TBI, such as multiple sclerosis (MS), stroke, and Parkinson's Disease, are likely to experience pain related to their diagnoses. As such, it is not uncommon for patients seeking a neuropsychological evaluation to simultaneously be experiencing chronic pain. When considering the estimation that roughly half of people with chronic pain do not receive adequate pain management (Moriarty et al., 2011), neuropsychologists who are evaluating patients with

TBI, MS, stroke, and other neurological disorders should expect to assess many patients with chronic pain and understand its likely interference, in varying degrees, with cognitive functioning.

***Medications***

Neuropsychologists frequently evaluate patients who are taking prescription medications and, as health professionals, must understand how these medications affect test performance. Most psychoactive medications are known to alter cognition in a variety of ways, whether in the short-term or long-term, or both. Medications that have been shown to affect cognitive functioning include anticholinergics, antipsychotics and mood stabilizers, opiate pain medications, and sedatives (Shinohara & Yamada, 2016; Harvard Health Publishing, 2014; Nevado-Holgado et al., 2016). Drugs prescribed for neurological disorders such as antiepileptics act on the central nervous system by either altering the electrical activity in neurons or altering chemical transmission between neurons, in order to curtail excessive rapid firing during seizures and prevent them from spreading to other areas in the brain (Park & Kwon, 2008). Unfortunately, side effects of these often life-saving drugs often have significant effects on cognitive performance, including verbal fluency, attention, processing speed, and memory (Antiepileptic Medications, 2020; Barr, 2019; Ijiff & Aldenkamp, 2013). Benzodiazepines, a class of medications that target anxiety, have been shown to negatively affect cognition in patients who use it as a long-term treatment; in a meta-analysis of studies that examined the side effects of benzodiazepines, Stewart (2005) found not only that cognitive deficits were present in patients who were treated long-term with benzodiazepines compared to normal controls, but also that these deficits remained even after patients withdrew from treatment. In many cases, the use of specific medications should alert the medical provider to the potential for impaired cognitive performance; however, this is not always the case. In some instances, as is the case with the long-term usage of benzodiazepines, the patient may no longer be taking a given medication but may still be experiencing its negative cognitive effects. It is imperative for a neuropsychologist to gather the patient's relevant history data during the clinical interview, as well as current medications with scheduled dosage information. Only if the neuropsychologist has this information can they make a determination about whether or not medications were a factor in the patient's cognitive functioning on testing, and to what degree.

***Sleep***

Although the number of hours of sleep needed varies considerably between individuals, no human is exempt from the need for sleep (Shneerson, 2000). Unfortunately, prolonged wakefulness is a widespread phenomenon in today's society; there is pressure to work longer hours, some jobs require sleep restriction or inconsistent shift work (e.g., emergency department nurses who work some days and some nights), and many people suffer from sleep disorders, such as insomnia or sleep apnea (Alhola & Polo-Kantola, 2007; Fulda & Schulz, 2001). Regardless of the cause, poor sleep quality or sleep deprivation can have detrimental effects on cognition. A meta-analysis conducted by Fulda and Schultz (2001) found that patients with sleep-related breathing disorders performed at an impaired level during driving simulations compared to controls and produced poorer scores on measures of attention. The literature suggests that sleep deprivation affects, to varying degrees, someone's ability to perform well on common day-to-day tasks involving alertness, attention, vigilance, perception, memory, and executive functions (Killgore, 2010; Suni, 2020). Given the fact that roughly 70 million people in the United States suffer from chronic sleep problems (Centers for Disease Control and Prevention, 2017), neuropsychologists are likely to encounter many patients who are not getting the quality of sleep they need and, consequently, their performance on cognitive testing may be altered. In addition to the high base rate of sleep problems in the general population, neurological patients also often experience sleep disturbances related to their diagnoses. For example, up to 70% of individuals who recently sustained a TBI experience sleep disturbance, most commonly due to insomnia (Viola-Saltzman & Watson, 2012). Other neurological conditions such as Alzheimer's Disease, stroke, brain tumors, and schizophrenia, to name a few, are also commonly associated with co-occurring sleep disturbance and subsequent cognitive impairment (Treatments for Sleep Changes, 2021; Hermann & Bassetti, 2009; Armstrong et al., 2017; Kaskie et al., 2017). Clearly, neuropsychologists need to assess for quality of their patients' sleep when interpreting test scores and making recommendations.

***Effort***

Yet another unique factor that has gained a lot of attention in the neuropsychological literature is effort. Within the context of assessments, effort describes an examinee's approach to testing and is defined as an "investment in performing at capacity levels" (Bush et al., 2005; p. 420); in other words, effort refers to someone's attempt to perform at his or her best. The effort put forth during cognitive tests can affect an examinee's objective performance to varying degrees and can alter the accuracy of the data with which the neuropsychologist is basing his or her interpretations and recommendations. Someone may intentionally or unintentionally exert less effort on a test for a variety of reasons; for example, disinterest in the evaluation, poor rapport between the examinee and examiner, fatigue, or psychological disorders, to name a few. In general, someone who does not put forth good effort during a neuropsychological assessment is likely to do poorly on the tests, which has potentially immense implications for legal settlement outcomes, treatment plans, and self-concept (Bigler, 2014). Thus, effort is a secondary factor in neuropsychological assessment that deserves attention. There are a variety of indicators to help the neuropsychologist identify poor effort during an evaluation. The examiner often takes detailed notes about the examinee's behavior throughout testing, such as body language, comments, cooperativeness, and rate of speech, to name a few. If an examinee begins a test and states, "I'm horrible at this type of task," the examiner should add a note to their behavioral observations and be wary of potential effort problems. Furthermore, certain types of responses or patterns on standardized neuropsychological tests, such as patterns that are inconsistent with the deficits associated with the injury, inconsistencies in performance across tests that measure similar cognitive abilities, and scores that violate principles of learning can be suggestive of dissimulation (Bush et al., 2005; Lezak et al., 2004; Rogers, 2008). In addition to utilizing behavioral observations and examining patterns of scores after the assessment is complete, neuropsychologists frequently include performance validity tests (PVTs) in their test batteries as a way to determine whether the examinee put forth enough effort to deem their test results valid. Most PVT measures, whether standalone tests or embedded in other standardized tests, utilize a cut-score approach in which performance above a certain score reflects a "valid" performance and performance below the cut-off score reflects an "invalid" performance (Bigler, 2014). These validity indicators help neuropsychologists determine the overall validity of the data gathered during testing, but there is variability across tests so other means of assessing effort are often helpful. Evidence in the literature that suggests that effort can account for over half of the overall variance in neuropsychological test batteries (Green et al., 2001); as such, effort is a secondary factor that needs to be evaluated in the context of examinee performance during neuropsychological assessments.

***Expectations***

An interesting phenomenon that has been more recently looked at in the field is the impact of expectations on neuropsychological performance. One way that psychologists investigate the impact of expectations is through stereotypes, which are expectations about how a group will behave. Stereotype threat is a phenomenon in which exposure to specific stereotypes reduces the performance of members in the stereotyped group (Steele, 1997; Spencer et al., 1999). Research has found that exposure to stereotype threat reduces academic performance of students from low socioeconomic backgrounds (Croizet & Claire, 1998), math performance of white males compared to Asian males (Stone et al., 1999), and academic performance of Hispanics (Gonzales et al., 2002).

Research that examined the cognitive functioning of older adults suggested that mere exposure to age-based stereotype threat impacted the older adults' cognitive performance on neuropsychological tests of processing speed, memory, attention, and executive function (Rabin et al., 2016; Lamont et al., 2015). The literature also suggests that many older adults experience dementia worry, often considered a version of age-based stereotype threat, that affects expectations (Kessler et al., 2012; Caughie et al., 2021), which may have an impact on how older adults rate their perceived cognitive functioning. In addition, the research also shows that simply calling older adults' attention to their age can impact the way they perform on cognitive tests. Conversely, younger adults may not be as worried about their memory, which could result in less susceptibility to changes in their self-perceptions and objective performance. Therefore, age may be considered yet another secondary factor housed under expectations that should be examined in the context of going through a neuropsychological evaluation.

In addition to operating in racial, gender, and age groups, the literature also suggests that stereotype threat operates in neurological populations (Suhr & Gunstad, 2002; Suhr & Gunstad, 2005; Madathil, 2013). In fact, the activation of stereotype threat in neurological populations is currently of particular focus in the field of neuropsychology; in this line of research, stereotype threat is often referred to as diagnosis threat. For example, individuals in a study who had previously been diagnosed with mild traumatic brain injury (mTBI) but had fully recovered were either primed with a stereotype about mTBI before taking cognitive tests or simply asked to complete testing to the best of their ability; participants in the experimental group performed significantly worse on tests measuring memory and general intellect, cognitive entities widely believed by the general population to be compromised after experiencing head trauma (Suhr & Gunstad, 2002). In another study that examined diagnosis or stereotype threat in adults with Attention-Deficit/Hyperactivity Disorder (ADHD), participants who were explicitly told they were selected on the basis of their ADHD diagnosis performed worse on tests of intelligence, memory, and attention when compared to controls (Madathil, 2013). Because the manipulation of the study was centered on the diagnosis of a neurological disease, the term diagnosis threat is often used in the place of stereotype threat.

Clearly, the research supports that stereotype threat is at play in a number of groups of people, such as people who have sustained mTBI. Because stereotype threat is, in a way, a self-evaluation of and expectation for one's performance, it is reasonable to wonder whether one's own expectations of their performance may change throughout a battery of tests. In spite of decades of research in clinical neuropsychology, there is essentially no research examining how the experience of taking cognitive tests impacts the individuals taking the tests – including how they view their cognitive abilities. For example, a sense of doing well on one given test in a neuropsychological battery may lead a patient to have higher expectations of themselves for subsequent tests administered. Conversely, experiencing a sense of doing poorly on a test may result in lowered expectations about performance that may contribute to lowered performance on subsequent tests. To our knowledge, the sole piece of research addressing any issue related to the examinee's experience was Bennett-Levy et al. in 1994; the researchers sent a questionnaire to individuals with TBI who had undergone a neuropsychological evaluation in the last six months. Responses showed that 47% felt that the results from the assessment changed the way they viewed their cognitive abilities while 53% felt that it did not change the way they viewed their abilities. While these data are informative about retrospective perceptions of undergoing neuropsychological testing, they do not speak to the individual's experience in real time, during the assessment itself. In order to effectively assess and treat neurologically impaired individuals with cognitive deficits, it is necessary to understand the influence our assessment methods have on patients' expectations and the extent to which the assessment experience impacts test scores. Although the effects of stereotype threat and expectations on overall cognitive performance are becoming better understood, there is no research that examines how someone's perception of either doing well or doing poorly on a test may change a patient's expectations of how they are going to perform on the next test. In other words, how expectations may change *during* a neuropsychological evaluation, how those expectations may change from test to test, and how this alteration of perceived performance may affect their performance on the overall battery of tests.

This study will use tests of memory deemed to have widely differing levels of difficulty in order to examine this gap in the literature. Research suggests that confidence in one's memory is extremely flexible and that self-evaluations may actually reflect the difficulty of the memory task rather than one's actual memory abilities (Saucier & Gaudette, 2001). However, other research indicates that self-ratings of memory performance are related to actual performance on memory tasks (Rickenbach et al., 2015). More research on subjective assessments of memory abilities, as well as how that relates to objective performance, is clearly needed.

The present study aims to address the serious gap in the literature by examining the effect of test difficulty on examinees' self-reported cognitive abilities, specifically within the cognitive domain of memory. Participants will be asked to rate their memory ability after each test administered. In addition, participants will be divided into young and older adult groups to explore whether age impacts self-perceived memory abilities.

After thoroughly reviewing the literature and to the best of our knowledge, to ask an individual to rate their cognitive function after each test they take during the course of a battery of neuropsychological tests has never before been done. Due to standardized administration issues, shear time spent conducting the evaluation, and unknown impacts of interrupting the testing process, the only way to study this particular question is in an experimental, non-clinical setting. Querying participants about their perceived memory abilities after completing tests with varying degrees of difficulty – a unique feature of this study – will allow us to investigate whether or not their subjective sense of memory ability fluctuates throughout the assessment and whether or not perceived abilities relates to actual, objective performance on the given tests.

## Hypotheses

1) Participants' scores on the SRMAS at baseline will be significantly higher than scores post-SRT.
2) Participants' scores on the SRMAS at baseline will be significantly lower than scores post-TOMM.

3) Participants' scores on the SRMAS post-TOMM will be significantly higher than scores post-SRT.
4) Older adults will rate their memory lower compared to younger adults at baseline.
5) Older adults will rate their memory lower compared to younger adults post-TOMM.
6) Older adults will rate their memory lower compared to younger adults post-SRT.

## Method

### Participants

Participant data from an existing dataset were used for this study. Two separate groups of participants were recruited for the present study: one group of healthy older adults (over the age of 65) and one group of healthy younger adults (between the ages of 18-24). The inclusion of two age groups allowed us to examine whether there are significant differences between perceived memory abilities in healthy younger adults and healthy older adults. The data from both groups were compiled into a secure dataset.

Older adult participants were recruited through newspaper advertisements posted in a local Missoula, MT newspaper. Participants were at least 65 years old and did have any current or past neurological concerns, other than mTBI, which was determined through a series of initial screening questions administered via telephone (see Appendix A). Participation was voluntary. Participants received ten dollars for their participation in this study.

Younger adult participants were recruited through the SONA platform, which targets undergraduate psychology students at the University of Montana. Participants were between the ages of 18 and 24 years old and did not have any current or past neurological concerns, other than mTBI, which was determined through a demographic and health questionnaire.

Participation was voluntary. Per departmental and Institutional Review Board policy, participants received two research credits toward a course of their choice for their participation.

## Materials

### *Demographic and Health Questionnaire*

The Demographic and Health Questionnaire was used to obtain relevant participant information including age, gender, ethnicity, years of education, psychiatric and neurological history, and behavioral health habits (see Appendix B). Medication information was also gathered.

### *Self-Reported Memory Abilities Scale*

A self-reported memory abilities scale (SRMAS; see Appendix C) was administered before any testing, to establish baseline, and once again after taking each standardized memory test. The instructions for filling out the 10-point Likert scale consisted of a sentence, “Please rate your memory abilities in general,” with 1 meaning poor and 10 meaning excellent.

### *Manipulation Check Questionnaire*

A manipulation check questionnaire was administered to check participants’ understanding of the study instructions (see Appendix D). Participants ranked how much effort they put forth during the testing process and how successful they believed they were in following instructions using a 10-point scale.

### *Neuropsychological Measures*

Neuropsychological measures included were determined based upon their common use in neuropsychological practice and their validity in assessing memory, executive function, processing speed, and motor skills. Based on clinical judgement, two memory tests were selected for the study; one that would be experienced as very easy, and another that would be experienced as very difficult. Data were collected to verify whether these assumptions were correct or not.

### *Buschke's Selective Reminding Test*

The Selective Reminding Test (SRT) is a test of memory that differentiates between retention, storage, and retrieval. The 12-trial version takes much longer than other popular memory tests used in neuropsychological batteries, making it susceptible to patient fatigue and frustration (Lezak, Howieson, Bigler, & Tranel, 2012). The SRT has been shown to be highly valid and reliable as a test of memory (Buschke, 1973; Beatty et al., 1996; Clerici et al., 2017). The SRT was chosen as the "hard" memory test based on ratings of test difficulty from pilot data from other research in our lab (Bean & Hall, unpublished).

### *Test of Memory Malingering*

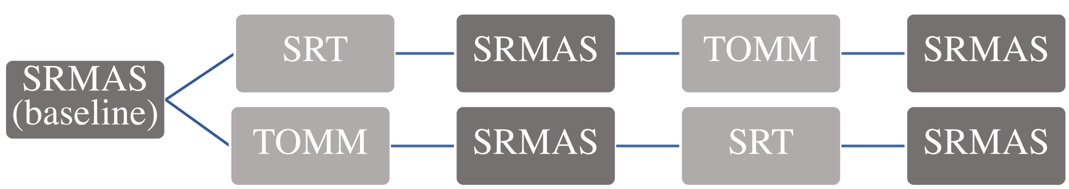
The Test of Memory Malingering (TOMM) has face validity as a memory test but is, in fact, a measure of performance and symptom validity (i.e., effort test). The TOMM is relatively unaffected by age, education, or moderate cognitive impairment; cognitively impaired older adults typically score in the 90% range, and the test has low probability of eliciting patient fatigue or frustration (Lezak et al., 2012). The TOMM was chosen as the "easy" memory test based on ratings of test difficulty from pilot data from other research in our lab (Bean & Hall, unpublished).

## Procedure

Study approval was obtained from the Montana Institutional Review Board prior to participant recruitment. Following recruitment, participants in the older adult group were contacted via telephone to schedule testing and complete the initial phone screener. Participants in the younger adult group signed up for testing through the online SONA platform. At the onset of the study, participants were provided with an informed consent form, indicating the nature and potential risks of the study. Participants were informed that they may voluntarily withdraw from the study at any time, without penalty, and that their data would be deidentified and stored in locked filing cabinets. Assessment was conducted by the researcher and trained undergraduate research assistants. All participants began by rating their self-reported general memory abilities on a 10-point Likert scale before testing commenced. In an attempt to eliminate potential order effects, participants took the TOMM and SRT tests in a counterbalanced order. All participants completed the self-report memory questionnaire again following each test. At the conclusion of testing, participants were provided with the manipulation check and completed the demographic and health questionnaires.

**Figure 1**

*Procedural Order of Self-Reported Memory Abilities Scale and Memory Tests*




## Data Analysis

Objective performance was evaluated using raw or mean scores on each measure and compared to normative data. SRMA data was analyzed using paired samples *t*-tests and independent samples *t*-tests.

## Results

### Demographic Information

Demographic information is provided in Table 1. A total of 59 subjects completed the neuropsychological measures and questionnaires; 27 participants in the young adult group and 32 in the older adult group (see Table 1). No participants were excluded due to screening criteria. Fifty-nine participants were therefore included in the analyses. Of these participants, 13 (22%) were male and 46 (78%) were female. Fifty-four participants identified as Caucasian (91.5%), two identified as Asian (3.4%), one identified as Hispanic (1.7%), and one identified as multiracial (1.7%). Participants in the young adult group ranged in age from 18-24, while participants in the older adult group ranged in age from 66-88. Chi-squared analysis for gender revealed significant differences between the young and older adult groups, $\chi 2$ (1, $N$ = 59) = 6.199, $p$ = .013.

**Table 1**

*Demographic Characteristics of the Study Groups*

| | **Young Adult Group (N=27)** | **Older Adult Group (N=32)** |
|---|---|---|
| Age | $M$ = 19.6 (± 1.7) | $M$ = 76.0 (± 6.5) |
| Male | 7.1% | 34.4% |
| Caucasian | 88.5% | 96.9% |
| Some College (or more) | 100% | 96.2% |

### Comparing Objective Performance to Normative Data

Subject test scores were compared to appropriate normative data to determine whether our participants' performance on testing was average.

***Selective Reminding Test***

Performance on the SRT for each study group was compared to normative data (Zalonis et al., 2009). Mean total sum recall scores were used to make comparisons. Older participants in the present study performed at approximately three-quarters of a standard deviation above the mean, on average, compared to normative data; conversely, young adults performed approximately half a standard deviation below the mean compared to normative data (see Table 2).

**Table 2**

*SRT Performance Compared to Normative Data*

| | Mean Total Sum Recall | Normative Data (Zalonis et al., 2009) |
|---|---|---|
| Young Adults | 114.2 (± 9.2) | 117.0 (± 7.2); 18-29 years old |
| Older Adults | 95.1 (± 21.2) | 82.4 (± 17.0); 60-69 years old |
| | | 78.7 (± 14.5); 70-83 years old |

The older adults in the present study did indeed score lower on this test than younger adults, which is to be expected considering cognitive decline that comes with normal aging (National Institute on Aging, 2020).

***Test of Memory Malingering***

Performance on the TOMM for each study group was compared to normative groups (Teichner & Wagner, 2004). Mean combined scores obtained from Trials 1 and 2 on the TOMM were used to make comparisons (see Table 3). As described previously, the TOMM is a measure of performance validity (i.e., effort test) but has face validity as a memory test. Even in cognitively impaired older adults, patients typically score in the 90% range and clinicians typically expect neuropsychological patients to perform well on the TOMM (Lezak et al., 2012). The mean score obtained on the TOMM was 49.419 for young adults and 49.697 for older adults. Given that each trial only contains 50 items, with the highest possible combined mean score of 50, it is clear that our obtained mean scores for both age groups are nearly perfect and are well above empirically established cutoffs for healthy adults.

**Table 3**

*TOMM Performance Compared to Normative Data*

| | Mean of Trials 1 and 2 | Normative Data (Teichner & Wagner, 2004) |
|---|---|---|
| Young Adults | 49.4 (± 0.6) | 48.55 (normal adults) |
| Older Adults | 49.7 (± 0.4) | 48.55 (normal adults) |

## Self-Reported Memory Abilities

### *Combined Self-Reported Memory Ability Scores*

Self-reported memory abilities data was analyzed using three matched *t*-tests to compare all participants' SRMA scores at baseline to post-memory tests. A third comparison examined performance between groups after each memory test. There was a significant difference between SRMA scores at baseline ($M$ = 6.4, $SD$ = 1.3) and post-TOMM ($M$ = 7.4, $SD$ = 1.5), $t(58)$ = 6.450, $p$ < .001; $d$ = 1.231 (see Table 4). There was a significant difference between SRMA scores at baseline (M=6.4, SD=1.3) and post-SRT (M=4.7, SD=1.6), $t(58)$ = 8.450, $p$ < .001; $d$ = 1.494. There was a significant difference between SRMA scores post-TOMM ($M$ = 7.4, $SD$ = 1.5) and post-SRT ($M$ = 4.7, $SD$ = 1.6), $t(58)$ = 10.265, $p$ < .001; $d$ = 2.003. A one-way ANOVA revealed no order effects were present ($F(1, 57)$ = .896, $p$ > .05; $\eta^2$ = .006).

In other words, following the easy test (TOMM), SRMA ratings were significantly higher than at baseline, and after completing the difficult memory test (SRT), SRMA scores were statistically significantly lower than at baseline. In addition, comparing ratings between the two tests yielded statistically significant results.

**Table 4**

*Matched t-Tests Results for SRMA Scores*

| Baseline | TOMM | SRT | *t* | *p* | *d* |
|---|---|---|---|---|---|
| *M* = 6.4 (± 1.3) | *M* = 7.4 (± 1.5) | | 6.450 | < .001 | 1.231 |
| *M* = 6.4 (± 1.3) | | *M* = 4.7 (± 1.6) | 8.450 | < .001 | 1.494 |
| | *M* = 7.4 (± 1.5) | *M* = 4.7 (± 1.6) | 10.265 | < .001 | 2.003 |

***Group Comparisons for Self-Reported Memory Ability Scores***

Score differences on the SRMAS between age groups were analyzed using separate independent samples *t*-tests (see Table 5). There was not a significant difference between young (*M* = 6.3, *SD* = 1.2) and older adults' (*M* = 6.4, *SD* = 1.4) SRMA at baseline, $t(57) = -.213$, $p > .05$; $d = -.056$. There was not a significant difference between young (*M* = 7.4, *SD* = 1.3) and older adults' (*M* = 7.4, *SD* = 1.7) SRMA post-TOMM, $t(57) = .171$, $p > .05$; $d = .045$. There was not a significant difference between young (*M* = 4.9, *SD* = 1.9) and older adults' (*M* = 4.6, *SD* = 1.4) SRMA post-SRT, $t(57) = .841$, $p > .05$; $d = .220$.

**Table 5**

*Age Group Comparisons*

| | Young Adults | Older Adults | *t* | *p* | *d* |
|---|---|---|---|---|---|
| Baseline | *M* = 6.3 (± 1.2) | *M* = 6.4 (± 1.4) | -.213 | > .05 | .056 |

| | | | | | |
|---|---|---|---|---|---|
| Post-TOMM | *M* = 7.4 (± 1.3) | *M* = 7.4 (± 1.7) | .171 | > .05 | .045 |
| Post-SRT | *M* = 4.9 (± 1.9) | *M* = 4.6 (± 1.4) | .841 | > .05 | .220 |

## Discussion

The central hypothesis of the present study was that test difficulty impacts perceived memory abilities. As predicted by this hypothesis, participants' self-reported abilities indeed fluctuated depending on test difficulty. These results increase our understanding of the examinee's subjective experience during a neuropsychological evaluation. Only one other study that we know of has investigated the examinee's appraisal of cognitive abilities but was done so at least six months after the completion of the evaluation; according to Bennett-Levy et al. (1994), roughly one-half of respondents retrospectively reported that the neuropsychological examination affected the ways in which they perceived their cognitive abilities. The authors did not report which cognitive domains were affected (if participants were asked specifically about them), nor did they report directionality of changed perceptions (i.e., positive or negative). Not until the present study has the examinee's experience been studied *during* an evaluation – as the testing process unfolds. It is worth noting we have shown that people's rating confidence about their memory can change while undergoing assessment. We do not know if these changes affected their performance on the tests or whether they would affect their performance on subsequent tests in a full neuropsychological battery. At the individual level, self-assessment of memory abilities may be relatively stable, may be something that changes frequently during an evaluation, or may fluctuate at first and then gradually stabilize as a function of further exposure to successful and unsuccessful experiences.

As such, these data add further evidence to past literature suggesting that confidence in one's memory is variable and independent from one's actual memory performance (Saucier & Gaudette, 2001). Although some research suggests that confidence and cognitive test performance are correlated (Rickenbach et al., 2015; Stankov et al., 2013), there is a growing body of literature that indicates that confidence does not accurately predict or correlate to objective performance on cognitive tests (Stankov & Lee, 2008; Pallier et al., 2010; Fine & Nevo, 2008; Harrison et al., 2005). The data from the present study suggest that despite average or above average performance on memory tests, examinees' confidence in their own memory abilities changes depending on the level of difficulty of a given memory test.

Neuropsychological assessments are often tailored to each individual patient, and for good reason. Two people with brain lesions may suffer from surprisingly distinct cognitive and behavioral deficits and, as such, require specific investigations into their relative cognitive strengths and weaknesses via different tests. Indeed, one of the field's greatest assets is the customized nature of the assessments that are given. Given the flexible nature of assessments, it is important to note that little information is known about how the assessment process itself affects patients' perceived and objective functioning. Although neuropsychological test batteries differ across clinicians and institutions, it is reasonable to assume that examinees will find some tests more or less challenging relative to other tests administered. The results from the present study provide novel evidence that examinees' confidence in their memory, within the parameters of the methodology used, are highly subject to alterations of perceived memory abilities. Notably, participants were asked not to rate their memory performance on a specific test, but rather to rate their memory abilities *in general*. Even with such specific wording, participants still rated their memory abilities differently depending on how cognitively demanding each test was. Given that examinees' expectations of their memories were shown to change throughout testing, it is important for neuropsychologists and psychometrists to understand how examinees are self-evaluating during evaluations and consider the potential implications.

The literature clearly shows that several groups (e.g., TBI, cancer, certain demographic characteristics) are at risk of stereotype threat, impacting assessment results (Suhr & Gunstad, 2002; Suhr & Gunstad, 2005; Madathil, 2013; Steele, 1997; Spencer et al., 1999; Trontel et al., 2013). When a person's attention is called to some personal feature (i.e., a stereotype), this often impacts their expectations, followed by potential changes in performance. An examinee's own sense of their memory abilities is, in a way, like an expectation; a sense of doing well on one given test in a neuropsychological battery may lead the examinee to have higher expectations of themselves for subsequent tests administered. Conversely, someone may take a particularly challenging test and lower their expectations. Given the existing research, it is possible that an examinee's experience of different tests may affect their expectations for performance. In the present study, the cognitive demands and associated frustration of the SRT as noted in previous research may have lowered expectations, such that participants' perceptions of their abilities decreased (Lezak et al., 2012). Conversely, the experience of taking an easy test (TOMM) may have served to enhance their expectations of themselves.

The implications of expectations and stereotype threat are not to be overlooked. Indeed, expectations appear to play a significant role in the experiences of many individuals who undergo neuropsychological assessments. Not only can the fear of underperforming based on demographic information affect perceived cognitive functioning (e.g., gender, race, etc.), it can also have lasting effects on overall functioning and health (Gonzales et al., 2002; Croizet & Claire, 1998). For example, stereotype threat has been shown to have pervasive health implications such as decreased self-efficacy, increased stress and anxiety, and the induction of biological and physiological changes in the brain as seen in neurodegenerative disease (Levy et al., 2016; Trontel et al., 2013).

Additionally, it is critical to also consider how self-evaluations, as assessed in the present study by changes in SRMA scores, may impact rapport and attitudes long after the examination is over. Clinically, arguably one of the most important components of a neuropsychological evaluation is rapport development and maintenance (Delis et al., 2001; Wechsler, 2008). Positive rapport between the neuropsychologist and the examinee often improves chances for a successful outcome – an accurate measurement of the person's true cognitive abilities. Barnett et al. (2017) conducted a study that examined the impact of rapport on neuropsychological test performance and found that poor rapport negatively affected objective performance on tests of verbal fluency and fine motor tasks. Barnett et al. (2020) also later found that participants in a high rapport condition took less time to complete the D-KEFS Color-Word Interference Test compared to individuals in the low rapport condition. An examinee who feels comfortable and safe with the examiner is more likely to put forth better overall effort during testing, adhere to treatment recommendations, and communicate more openly (Prigatano & Pliskin, 2014; Thompson, 2017). Given the importance of developing a positive examinee-examiner relationship, it is reasonable to wonder whether test difficulty may play a role in the maintenance of rapport. It may be worthwhile for healthcare providers administering neuropsychological tests to make note of an examinee's experience, monitor any potential distress associated with challenging tests, and reestablish rapport prior to administering any subsequent tests.

Surprisingly, our results did not support our second set of hypotheses related to young adult versus older adult differences in SRMA ratings. In contrast to what we predicted, young adult and older adults SRMA scores were not different from one another. One potential explanation for these data relates to the convenience sample utilized. The older adult group consisted of high functioning, very educated individuals (see Tables 1 and 2). Sometimes these individuals are referred to as “super agers” because they perform well above the norm (National Institute on Aging, 2020; Gefen et al., 2014). Indeed, our data show that older adult participants performed at least three-quarters of a standard deviation above the normative data. These participants may have been immune to age-related stereotype threat, such as dementia worry, so it is possible they were less subject to severe shifts in perceived memory ability compared to a more average group of older adults (Caughie et al., 2021). Had a more average group of older adults been sampled, the data might have been consistent with our second set of hypotheses. Although the older adult group did not differ from the young adult group, the pattern of results is the same; participants, regardless of age, experienced changing SRMA scores. These scores systematically changed with tests based on perceived test difficulty.

**Future Research**

The data suggest that perceived memory ability changes throughout neuropsychological testing. Whether this type of effect exists across other cognitive domains is not yet known. Future research which examines potential changes in perceived executive function, attention, and visual-spatial abilities may increase our understanding of a more balanced neuropsychological test battery.

Furthermore, some patient groups might be more susceptible to a negative testing experience. These different clinical groups may be more or less vulnerable to having a sense that they did poorly or well on any given test. For example, people with depression are more likely to engage in self-criticism (Blatt et al., 1982); having a negative testing experience may induce higher levels of self-criticism, which could have an impact on future recommendation adherence. Negative testing experiences may also affect one's sense of self; whether this type of disruption is transitory or long-term remains to be seen. This phenomenon could affect a wide range of individuals undergoing neuropsychological evaluations; other groups that may differ from one another in terms of perceived cognitive functioning and expectations include people with mTBIs, bipolar disorder, schizophrenia, stroke, anxiety, and diabetes. Given that there are patient characteristics that can make a difference on performance, it would be useful for future research to examine how our assessment techniques affect patient groups differently and discover what techniques or approaches may work better for one group over another.

At this point in time, we do not know whether or not changes in an examinee's memory confidence relates to rapport. Clinically, it may be important to investigate whether any potential adverse effects of taking a particularly challenging test can be remedied or prevented by the examiner. For example, it may be helpful to give the examinee a set point and explain the difficulty level (e.g., "Lots of people have difficulty with this test – you're probably doing better than you think."). It is possible that, throughout the course of the test battery (which frequently takes five hours to complete), any negative effects of taking challenging tests do not last, but no research to date has explored this component of the assessment process.

**Limitations**

Limitations of this study include selection bias, potential carry-over effects, and length of neuropsychological test battery. Due to the voluntary nature of this study and the use of both newspaper and SONA recruitment, selection bias may have occurred. The sample of participants overall contained more women; it is possible that there are gender differences in vulnerability to changing memory confidence. Additionally, the sample of participants contained more

Caucasians, and more highly educated individuals than the national average. Although the order of tests administered was counter-balanced and no order effects were found, this study also had a great potential for carry-over effects in that each participant's rated self-reported memory abilities could have been influenced by prior ratings. Participants in the current study only completed two standardized neuropsychological measures, which took them approximately 30 minutes to complete; during a typical evaluation, neuropsychological test batteries often last between three and five hours. Although the length of a clinical evaluation can vary (typically between 3-5 hours), it is hard to imagine a neuropsychological assessment that would utilize only two tests and take only 30 minutes to complete as was the case in the present study. For example, in one normative study, more than 50 test scores were obtained for one neuropsychological test battery (Heaton, 2004). In addition, there is artificiality in asking examinees to rate their memory after each test; drawing attention to an examinee's perception may affect their performance, but there is very little known about this in the field. It is possible that asking in and of itself might impact test data.

**Conclusion**

The results of this study highlight the fact that people's perceived memory functioning is highly subject to change depending on test difficulty and expectations that taking the test creates. This change in self-concept can alter expectations about performance on subsequent tests and may also affect rapport between the examinee and examiner. Surprisingly, the same pattern of data was found across age groups; in other words, older adults were no more susceptible to fluctuating perceptions about memory abilities than young adults. It is important to note that these results were found only after two measures, not within the context of a complete neuropsychological battery; it remains to be seen what would happen in a more traditional test battery. In order to accurately interpret test results and treat patients, clinicians must consider the effects of secondary factors on test performance and expectations. These data provide a foundation for forthcoming investigations into the examinee's experience during neuropsychological evaluations.

**References**

Alhola, P. & Polo-Kantola, P. (2007). Sleep deprivation: Impact on cognitive performance. *Neuropsychiatric Disease and Treatment, 3*(5), 553-567. PMID: 19300585

Armstrong, T., Shade, M., Breton, G., Gilbert, M., Mahajan, A., Scheurer, M., Vera, E., & Berger, A. (2017). Sleep-wake disturbance in patients with brain tumors. *Neuro-Oncology, 19*(3), 323-335. doi: 10.1093/neuonc/now119

Austin, M., Ross, M., Murray, C, O'Carroll, R., Ebmeier, K., & Goodwin, G. (1992). Cognitive function in major depression. *Journal of Affective Disorders, 25*(1), 21-29. http://dx.doi.org.weblib.lib.umt.edu:8080/10.1016/0165-0327(92)90089-O

Barnett, M., Parsons, T., Reynolds, B., & Bedford, L. (2017). Impact of rapport on neuropsychological performance. *Applied Neuropsychology: Adult, 25*(3). https://doi.org/10.1080/23279095.2017.1293671

Barnett, M., Sawyer, J., & Moore, J. (2020). An experimental investigation of the impact of rapport on Stroop test performance. *Applied Neuropsychology: Adult. https://doi.org/10.1080/23279095.2020.1828081*

Barr, W. (2019). Understanding the cognitive side effects of antiepileptic drugs: Can functional imaging be helpful? *American Epilepsy Society, 19*(1), 22-23. https://doi.org/10.1177/1535759718822032

Battista, P., Salvatore, C., & Castiglioni, I. (2017). Optimizing Neuropsychological Assessments for Cognitive, Behavioral, and Functional Impairment Classification: A Machine Learning Study. *Behavioural neurology*, *2017*, 1850909. https://doi.org/10.1155/2017/1850909

Bennet-Levy, J., Klein-Boonschate, M. A., Batchelor, J., McCarter, R., & Walton, N. (1994). Encounters with Anna Thompson: The consumer's experience of neuropsychological assessment. *Clinical Neuropsychologist, 8*(2), 219-238. doi: 10.1080/13854049408401559

Bigler, E. (2014). Effort, Symptom validity testing, performance validity testing and traumatic brain injury. *Brain Injury, 28*, 1623-1638. doi: 10.3109/02699052.2014.947627

Blatt, S. J., Quinlan, D. M., Chevron, E. S., McDonald, C., & Zuroff, D. (1982). Dependency and self-criticism: Psychological dimensions of depression. *Journal of Consulting and Clinical Psychology, 50*(1), 113–124. https://doi.org/10.1037/0022-006X.50.1.113

Bush, S., Ruff, R., Troster, A., Barth, J., Koffler, S., Pliskin, N., Reynolds, C., & Silver, C. (2005). Symptom validity assessment: Practice issues and medical necessity. *Archives of Clinical Neuropsychology, 20*(4), 419-426.

Caughie, C., Bean, P., Tiede, P., Cobb, J., McFarland, C., & Hall, S. (2021). Dementia worry and neuropsychological performance in healthy older adults. *Archives of Clinical Neuropsychology, 36*(1), 29-36. https://doi.org/10.1093/arclin/acaa057

Centers for Disease Control and Prevention. (2017). Sleep and sleep disorders. Retrieved on January 18, 2021 from https://www.cdc.gov/sleep/about_us.html#:~:text=About%2070%20million%20Americans%20suffer,costs%2C%20and%20lost%20work%20productivity.

Clinical neuropsychology. (2020). *American Psychological Association*. Retrieved November 23, 2020 from https://www.apa.org/ed/graduate/specialize/neuropsychology.

Croizet, J.C. et al. (2004). Stereotype threat undermines intellectual performance by triggering a disruptive mental load. *Personality Social Psychology Bulletin, 30,* 721-31.

De Jager, C., Hogervorst, E., Combrink, M., & Budge, M. (2003). Sensitivity and specificity of neuropsychological tests for mild cognitive impairment, vascular cognitive impairment and Alzheimer's disease. *Psychological Medicine, 33*(6), 1039-1050. doi:10.1017/S0033291703008031

Delis, D., Kaplan, E., & Kramer, J. (2001). *Delis-Kaplan Executive Function System (D-KEFS)*. APA PsycTests. https://doi.org/10.1037/t15082-000

Dick, B., Eccleston, C., & Crombez, G. (2002). Attentional functioning in fibromyalgia, rheumatoid arthritis, and musculoskeletal pain patients. *Arthritis & Rheumatism, 47*(6), 639-644. https://doi.org/10.1002/art.10800

Ellison, J. (2020). Dementia and depression. *BrightFocus Foundation*. Retrieved January 18, 2021 from https://www.brightfocus.org/alzheimers/article/dementia-and-depression.

Fulda, S. & Schulz, H. (2001). Cognitive dysfunction in sleep disorders. *Sleep Medicine Reviews, 5*(6), 423-445. https://doi.org/10.1053/smrv.2001.0157

Gefen, T., Shaw, E., Whitney, K., Martersteck, A., Stratton, J., Rademaker, A., Weintraub, S., Mesulam, M. M., & Rogalski, E. (2014). Longitudinal neuropsychological performance of cognitive SuperAgers. *Journal of the American Geriatrics Society*, *62*(8), 1598–1600. https://doi.org/10.1111/jgs.12967

Gonzales, P., Blanton, H., & Williams, K. (2002). The effects of stereotype threat and double-minority status on the test performance of Latino women. *Personality and Social Psychology Bulletin, 28*(5), 659–670. https://doi.org/10.1177/0146167202288010

Green, P., Rohling, M. L., Lees-Haley, P. R., & Allen III, L. M. (2001). Effort has a greater effect on test scores than severe brain injury in compensation claimants. *Brain Injury, 15* (12), 1045-1060.

Harrison, M., Morris, K., Horton, R., Toglia, J., Barsky, J., Chait, S., Ravdin, L., & Robbins, L. (2005). Results of intervention for lupus patients with self-perceived cognitive difficulties. *Neurology, 65*(8). doi: https://doi.org/10.1212/01.wnl.0000180938.69146.5e

Harvard Health Publishing. (2014). Is your medication affecting your thinking skills? *Harvard Health Letter*. Retrieved on March 2, 2021 from https://www.health.harvard.edu/mind-and-mood/is-your-medication-affecting-your-thinking-skills.

Harvey P. D. (2012). Clinical applications of neuropsychological assessment. *Dialogues in Clinical Neuroscience*, *14*(1), 91–99. https://doi.org/10.31887/DCNS.2012.14.1/pharvey

Heaton, R. K. (2004). Revised comprehensive norms for an expanded Halstead-Reitan battery: Demographically adjusted neuropsychological norms for African American and Caucasian adults, professional manual. *Psychological Assessment Resources*.

Hermann, D., & Bassetti, C. (2009). Sleep-related breathing and sleep-wake disturbances in ischemic stroke. *Neurology, 73*(16), 1313-1322. do: https://doi.org/10.1212/WNL.0b013e3181bd137c

Ijff, D., & Aldenkamp, A. (2013). Cognitive side-effects of antiepileptic drugs in children. *Handbook of Clinical Neurology, 111,* 707-718. doi: 10.1016/B978-0-444-52891-9.00073-7.

Kaskie, R., Graziano, B., & Ferrarelli, F. (2017). Schizophrenia and sleep disorders: links, risks, and management challenges. *Nature and Science of Sleep, 9*, 227-239. doi: 10.2147/NSS.S121076

Kessler, E.-M., Bowen, C. E., Baer, M., Froelich, L., & Wahl, H.W. (2012). Dementia worry: A psychological examination of an unexplored phenomenon. *European Journal of Ageing*, *9*, 275–284. doi:10.1007/ s10433-012-0242-8

Killgore, W. (2010). Effects of sleep deprivation on cognition. *Progress in Brain Research, 185*, 105-129. https://doi.org/10.1016/B978-0-444-53702-7.00007-5

Kirkwood, M., Peterson, R., Baker, D., & Connery, A. (2017). Parent satisfaction with neuropsychological consultation after pediatric mild traumatic brain injury. *Child Neuropsychology, 23*(3), 273-283. doi: 10.1080/09297049.2015.1130219

Klinedinst, N. J., Dunbar, S. B., & Clark, P. C. (2012). Stroke survivor and informal caregiver perceptions of poststroke depressive symptoms. *The Journal of Neuroscience Nursing: Journal of the American Association of Neuroscience Nurses*, *44*(2), 72–81. https://doi.org/10.1097/JNN.0b013e3182477944

Kuperberg, G., & Heckers, S. (2000). Schizophrenia and cognitive function. *Current Opinion in Neurobiology, 10*(2), 205-210. https://doi.org/10.1016/S0959-4388(00)00068-4.

Lamont, R. A., Swift, H. J., & Abrams, D. (2015). A review and meta-analysis of age-based stereotype threat: Negative stereotypes, not facts, do the damage. *Psychology and Aging*, *30*, 180–193. http://dx.doi.org/10.1037/pag0000269

Lezak, M., Howieson, D., Bigler, E., & Tranel, D. (2012). *Neuropsychological Assessment* (5th ed.). New York, NY: Oxford University Press.

Madathil, R. (2013). Diagnosis threat in adults with attention deficit hyperactivity disorder. *Graduate Student Theses, Dissertations, & Professional Papers. 318. https://scholarworks.umt.edu/etd/318*

Major depression. (n.d.). *National Institute of Mental Health*. Retrieved March 08, 2021, from https://www.nimh.nih.gov/health/statistics/major-depression.shtml

McDermott, L., & Ebmeier, K. (2009). A meta-analysis of depression severity and cognitive function. *Journal of Affective Disorders, 119*(3), 1-8. https://doi.org/10.1016/j.jad.2009.04.022.

Moriarty, O., McGuire, B., & Finn, D. (2011). The effect of pain on cognitive function: A review of clinical and preclinical research. *Progress in Neurobiology, 93*(3), 385-404. https://doi.org/10.1016/j.pneurobio.2011.01.002.

National Institute on Aging (2020). *Cognitive super agers defy typical age-related decline in brainpower*. National Institutes of Health. https://www.nia.nih.gov/news/cognitive-super-agers-defy-typical-age-related-decline-brainpower

Nevado-Holgado, A., Kim, C., Winchester, L., Gallacher, J., & Lovestone, S. (2016). Commonly prescribed drugs associate with cognitive function: A cross-sectional study in UK Biobank. *BMJ Open, 6*(11). doi: 10.1136/bmjopen-2016-012177

O'Donnel, M., Diener, H., Sacco, R., Panju, A., Vinisko, R., & Yusuf, S. (2013). Chronic pain syndromes after ischemic stroke. *Stroke, 44*(5), 1238-1243. https://doi.org/10.1161/STROKEAHA.111.671008

Pallier, G., Wilkinson, R., Danthiir, V., Kleitman, S., Knezevic, G., Stankov, L., & Roberts, R. (2001). *The Journal of General Psychology, 129*(3), 257-299. 10.1080/00221300209602099

Park, S., & Kwon, S. (2008). Cognitive effects of antiepileptic drugs. *Journal of Clinical Neurology, 4,* 99-106. doi: 10.3988/jcn.2008.4.3.99

Prigatano, G. & Pliskin, N. (2014). *Clinical neuropsychology and cost outcome research*. Routledge.

Rabin, L., Paolillo, E., & Barr, W. (2016). Stability in test-usage practices of clinical neuropsychologists in the United States and Canada over a 10-year period: A follow-up survey of INS and NAN members. *Archives of Clinical Neuropsychology*, 32(3), 206–230. https://doi.org/10.1093/arclin/acw007

Rao, S. (2008). Neuropsychology of multiple sclerosis: A critical review. *Journal of Clinical and Experimental Psychology, 8*(5), 503-542. https://doi.org/10.1080/01688638608405173

Reichenberg A. (2010). The assessment of neuropsychological functioning in schizophrenia. *Dialogues in Clinical Neuroscience*, *12*(3), 383–392. https://doi.org/10.31887/DCNS.2010.12.3/areichenberg

Rickenbach, E. H., Agrigoroaei, S., & Lachman, M. E. (2015). Awareness of Memory Ability and Change: (In)Accuracy of Memory Self-Assessments in Relation to Performance. *Journal of population ageing*, *8*(1-2), 71–99. https://doi.org/10.1007/s12062-014-9108-5

Rogers, R. (Ed.). (2008). Clinical assessment of malingering and deception (3rd ed.). New York: Guilford Press.

Saucier, D., & Gaudette, N. (2001). Actual memory ability significantly predicts self-evaluations of memory. *Expert Evidence, 8*(1), 3-14. doi:http://dx.doi.org.weblib.lib.umt.edu:8080/10.1023/A:1012244118359

Scott, S. B., Graham-Engeland, J. E., Engeland, C. G., Smyth, J. M., Almeida, D. M., Katz, M. J., Lipton, R. B., Mogle, J. A., Munoz, E., Ram, N., & Sliwinski, M. J. (2015). The effects of stress on cognitive aging: Physiology and emotion (ESCAPE) project. *BMC Psychiatry*, *15*, 146. https://doi.org/10.1186/s12888-015-0497-7

Sherman, K., Goldberg, M., & Bell, K. (2006). Traumatic brain injury and pain. *Physical Medicine & Rehabilitation Clinics, 17*(2), 473-490. https://doi.org/10.1016/j.pmr.2005.11.007

Shinohara, M., & Yamada, M. (2016). Drug induced cognitive impairment. *Brain Nerve, 68*(4), 421-428. doi: 10.11477/mf.1416200415

Shneerson, J. (2000). *Handbook of sleep medicine*. Blackwell Science. https://doi.org/10.1016/S0960-8966(00)00211-X

Side effects of antiepileptic medications. (n.d.). *Epilepsy Action Australia*. Retrieved February 6, 2021 from https://www.epilepsy.org.au/

Silver, C., Blackburn, L., Arffa, S., Barth, J., Bush, S., Koffler, S., Pliskin, N., Reynolds, C., Ruff, R., Troster, A., Moser, R., & Elliot, R. (2006). The importance of neuropsychological assessment for the evaluation of childhood learning disorders. *Archives of Clinical Neuropsychology, 21*(7), 741-744. https://doi.org/10.1016/j.acn.2006.08.006

Spencer, S.J., Steele, C.M., & Quinn, D.M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology, 35,* 4-28.

Spindler, M., Koch, K., Borisov, E., Ozyurt, J., Soros, P., Thiel, C., & Bantel, C. (2018). The influence of chronic pain and cognitive function on spatial-numerical processing. *Frontiers in Behavioral Neuroscience, 12*(165). doi: 10.3389/fnbeh.2018.00165

Stankov, L. & Lee, J. (2008). Confidence and cognitive test performance. *Journal of Educational Psychology, 100*(4), 961–976. https://doi.org/10.1037/a0012546

Stankov, L., Morony, S., & Lee, Y. P. (2013). Confidence: The best non-cognitive predictor of academic achievement? *Educational Psychology, 34*(1). doi: 10.1080/01443410.2013.814194

Steele, C.M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52,* 613-29.

Stewart, S. (2005). The effects of benzodiazepines on cognition. *Journal of Clinical Psychiatry, 66,* 9-13. PMID: 15762814.

Stone, J., Lynch, C>, Sjomeling, M., & Darley, J. (1999(. Stereotype threat effects on Black and White athletic performance. *Journal of Personality and Social Psychology, 77*(6), 1213-1227. https://doi.org/10.1037/0022-3514.77.6.1213

Suhr, J. A., & Gunstad, J. (2002). “Diagnosis threat”: The effect of negative expectations on cognitive performance in head injury. Journal of Clinical and Experimental Neuropsychology, 24, 448–457. doi:10.1076/jcen.24.4.448.103912187458

Suhr, J. A., & Gunstad, J. (2005). Further exploration of the effect of “diagnosis threat” on cognitive performance in individuals with mild head injury. *Journal of the International Neuropsychological Society, 11*, 23-29. DOI:10.1017/S1355617705050010

Suni, E. (2020). How lack of sleep impacts cognitive performance and focus. *Sleep Foundation*. Retrieved on March 11, 2021 from https://www.sleepfoundation.org/sleep-deprivation/lack-of-sleep-and-cognitive-impairment

Teichner, G., & Wagner, M. (2004). The Test of Memory Malingering (TOMM): Normative data from cognitively intact, cognitively impaired, and elderly patients with dementia. *Archives of Clinical Neuropsychology, 19*, 455-464. doi:10.1016/S0887-6177(03)00078-7

Thompson, N. (n.d.). *What is rapport and why is it so important?* ACE Blog. Retrieved November 1, 2021, from https://www.acefitness.org/fitness-certifications/ace-answers/exam-preparation-blog/2473/what-is-rapport-and-why-is-it-so-important/

Treatments for sleep changes. (2021). *Alzheimer's Association*. Retrieved on March 2, 2021 from https://www.alz.org/alzheimers-dementia/treatments/for-sleep-changes

Trontel, H., Hall, S., Ashendorf, L., & O'Connor, M. (2013). Impact of diagnosis threat on academic efficacy in mild traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology, 35*(9), 960-970. doi: 10.1080/13803395.2013.844770

Viola-Saltzman, M., & Watson, N. (2012). Traumatic brain injury and sleep disorders. *Neurologic Clinics, 30*(4), 1299-1312. doi: 10.1016/j.ncl.2012.08.008

Waters, F., & Bucks, R. (2011). Neuropsychological effects of sleep loss: Implication for neuropsychologists. *Journal of the International Neuropsychological Society, 17*(4), 571-586. doi:10.1017/S1355617711000610

Wechsler, D. (2008). *Wechsler Adult Intelligence Scale--Fourth Edition (WAIS-IV)* [Database record]. APA PsycTests. https://doi.org/10.1037/t15169-000

Weintraub, S., Wicklund, A. H., & Salmon, D. P. (2012). The neuropsychological profile of Alzheimer disease. *Cold Spring Harbor Perspectives in Medicine*, *2*(4). https://doi.org/10.1101/cshperspect.a006171

Yu, Y., Yang, D., & Zhao, J. (2015). The cognitive function in treatment-resistant depression. *Chinese Journal of Clinical Psychology, 23*(1), 101-103. Retrieved from https://search-proquest-com.weblib.lib.umt.edu:2443/docview/1689322727?accountid=14593

Zacny, J. P. (1995). A review of the effects of opioids on psychomotor and cognitive functioning in humans. *Experimental and Clinical Psychopharmacology, 3*(4), 432–466. https://doi.org/10.1037/1064-1297.3.4.432

Zalonis, I., Kararizou, E., Christidi, F., & Kapaki, E. (2009). Selective Reminding Test: Demographic predictors of performance and normative data for the Greek population. *Psychological Reports, 104*(2), 593-607. doi: 10.2466/PR0.104.2.593-607

## Appendix A

## Initial Phone Screening Script

Hi ________________,

My name is _______ and I'm calling from the Memory and Executive Function Lab at the University of Montana. I'm calling you regarding your interest in taking part in our research. Is this a good time to talk?

I'd like to take just a few minutes to discuss some of what we do in the lab. One of our primary goals is to better understand how thinking and memory might change with age. To do that, we are attempting to establish relationships with people in the community. We're asking people to come into the Psychology Clinic on campus for a few sessions. The first session will take less than 30 minutes and you'll be asked to complete a series of paper and pencil tasks of things like attention and memory.

Does that sound like something you would be interested in doing with us?

(If so, proceed to following questions)

**Phone screen**

Have you ever been diagnosed with epilepsy?

Have you ever had a stroke?

Have you been diagnosed with dementia?

Have you ever lost consciousness for more than 30 minutes?

How much alcohol do you drink currently?

Are you currently taking antidepressants or are you currently engaged in treatment for depression?

## Appendix B

## Demographic and Health Questionnaire

Date ____________ Age ______ Gender ____________ Ethnicity ________________________

1. Were there any known difficulties with your birth? Yes No

   If YES, describe: ____________________________________________________________

2. Do you have a vision problem that requires corrective lens wear (e.g., glasses)? Yes No

3. Is English your first language? Yes No

   If NO, what was your first language? ____________________________________________

   At what age did you learn English? ______________________________________

**Education**

4. Did you ever have to repeat any grades? Yes No

5. Were you ever placed in special education classes for learning difficulties? Yes No

6. Have you ever been diagnosed with a learning disability by a professional? Yes No

   If YES, describe: ____________________________________________________________

7. How many years of education have you completed?

   a. Elementary school education

   b. High school graduate

   c. Some college

   d. College graduate

   e. Graduate degree

   Please indicate type of degree obtained, if any: __________________________________

**Medical and Health History**

8. Have you ever been diagnosed with any serious medical condition? Yes No

If YES, please list: ____________________________________________

____________________________________________

9. Are you currently receiving treatment for a serious medical condition? Yes No

If YES, please list: ____________________________________________

____________________________________________

10. Does your family have any history of dementia (including Alzheimer's)? Yes No

If YES, please list: ____________________________________________

____________________________________________

11. Are you currently experiencing significant problems with your mood (such as anxiety and/or depression) or any other psychiatric condition? Yes No

If YES, please list: ____________________________________________

12. Are you currently receiving treatment for your mood (such as anxiety or depression or any other psychiatric condition? Yes No

13. Have you ever felt you should cut down on your drinking/drug use? Yes No

14. Have you ever been annoyed by people who criticize your drinking/drug use? Yes No

15. Have you ever felt bad or guilty about your drinking or drug use? Yes No

16. Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover? Yes No

**Head Injury History**

17. Have you ever experienced a concussion or brain injury? Yes No

-------------------------------------------IF **NO**, STOP HERE-------------------------------------------

18. Were you knocked unconscious? Yes No

If YES, how long were you unconscious? (circle one)

1. Less than 1 minute
2. 1-30 minutes
3. More than 30 minutes

19. Do you remember the events before or after your head injury? Yes No

If NO, how long of a time period were you unable to remember?

1. A few seconds
2. Less than 5 minutes
3. Less than 30 minutes
4. 30 to 60 minutes
5. More than 60 minutes

20. If you were given a diagnosis by a medical professional, please list: ____________________

## Appendix C

## Self-Reported Memory Abilities Scale

In general, how would you rate your memory abilities (with 1 being poor and 10 being excellent)?

1 2 3 4 5 6 7 8 9 10

## Appendix D

## Manipulation Check Questionnaire

Please answer the questions below. Your honest answers are important.

1. Did you understand the instructions provided in this study?

   Yes ___ No ___

2. Circle the number that best describes how hard you tried to follow the instructions you were given:

   1 2 3 4 5 6 7 8 9 10

   didn't try at all tried moderately hard tried very hard

3. Circle the number that best describes how successful you think you were in producing the results asked of you in the instructions of the study:

   1 2 3 4 5 6 7 8 9 10

   unsuccessful moderately successful very successful