Public Perceptions of Traumatic Brain Injury:
Knowledge, Attitudes, and the Impact of Education

A DISSERTATION SUBMITTED TO THE FACULTY OF THE
UNIVERSITY OF MINNESOTA
BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

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May 2015

Acknowledgements

Carrying out this project from its inception to completion was a huge under-taking which I could not have even dreamed of accomplishing without the invaluable help of faculty, colleagues, family, and friends.

First, I wish to offer my sincerest gratitude to my advisers Dr. Mary Kennedy and Dr. Benjamin Munson for their expertise, direction, and support. Although my ideas and interests evolved considerably over the course of my studies, my advisers encouraged me to think outside the box and helped me find a focus of study that was a perfect fit for my interests. I also wish to thank my committee members, Dr. Mark DeRuiter and Dr. Peter Watson for their support and guidance throughout this process.

I am deeply grateful for everyone involved in making the Driven to Discover (D2D) Building a smashing success, especially Amanda Kabbage, Dr. Logan Spektor, and Dr. Ellen Demerath. Without their vision for the D2D program and countless hours of planning, this study would not have been possible.

Additionally, my thanks go out to everyone who helped with the technical aspects of this study: Andrew Sell with CLA Research Support Services for his assistance programming the online survey; Lindsey Dietz and Felipe Acosta from the CLA Statistical Consulting Service for their advice on coding and analyses; Jon Dahlin for helping create the educational video; and the Academic Health Center Office of Communications for generously allowing me to use their video as part of my study.

I also owe a debt of gratitude to the Brain Injury Alliance of Minnesota, especially David King, for collaborating with me on this project to achieve my goal of conducting a study that not only broadened our scientific understanding of the topic, but also served as a means of community outreach. Furthermore, I am humbled by the generosity of the individuals who shared their time and stories for the educational video: Mike Maroney, Kacie Carlsted, Kenneth Brown, and Pat Winick.

I also wish to thank my colleagues and friends in the NeuroCognitive Communication Lab. Special thanks go to Katy O’Brien for her assistance with the educational video and Dr. Miriam Krause and Jocelyn Yu for help with data collection.

Last, but certainly not least, I owe so much to my closest friends and family: My husband, Matthew McGrane for patiently listening whenever I needed a sounding board, letting me use him as a “guinea pig” for my measures, and for doing everything he possibly could to make my life easier and happier while I worked; my parents and brothers for their love and unwavering faith in me throughout the years; and my “smart cookies” Patti Hollingsworth, Mina Syrika, and Hyunju Chung for many years of encouragement, laughter, and friendship.

This research was supported by the National Center for Advancing Translational Sciences of the National Institutes of Health Award Number UL1TR000114, awarded through the Clinical and Translational Science Institute at the University of Minnesota. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Abstract

Background: There are currently over 5 million Americans living with disabilities resulting from traumatic brain injury (TBI; Faul, Xu, Wald, & Coronado, 2010). Despite this high prevalence, previous research suggests that the public lacks adequate knowledge about TBI and endorses negative attitudes towards individuals with TBI (e.g., Ralph & Derbyshire, 2013). As a result, researchers have called for initiatives to heighten public awareness and provide education about brain injury. However, there is little research on whether such initiatives are effective. In addition, research documenting recent changes in public knowledge and attitudes about brain injury in the United States are lacking.

Purpose: This dissertation has four primary goals: 1) To determine the level of knowledge about TBI among the general population and to identify predictors of knowledge, 2) To describe attitudes about TBI endorsed by the general public, to determine their relationship with knowledge, and identify predictors of attitudes, 3) To determine the relationship between attitudes and intended behaviors, and 4) To determine if an educational video will result in improved knowledge about brain injury, more favorable attitudes towards individuals with TBI, or differing intended behavior.

Method: This study employed a between-groups design to evaluate public perceptions of TBI among the general public and to evaluate the impact of an educational video. A total of 392 members of the general public were randomly assigned to a control or experimental group. All participants completed a series of 4 measures: a background questionnaire containing items about demographics and prior experience with TBI, a modified version of the Common Misconceptions about TBI questionnaire, a modified version of the Multidimensional Attitude Scale, and two questions relating to intended information-seeking behaviors. Prior to completing the final three measures, participants in the experimental group viewed an educational video about TBI. Participants in the control group viewed an unrelated video.

Results: Results indicated that the general public endorses a number of misconceptions about TBI, but harbors largely favorable attitudes towards individuals with TBI. On the whole, few variables related to demographic characteristic or prior TBI experiences predicted knowledge and attitudes. Similarly, only relatively weak associations between knowledge, attitudes, and intended behavior emerged. Participants who viewed the educational video demonstrated higher TBI knowledge, but did not display more favorable attitudes than participants who viewed the unrelated video.

Implications: Results from this study support continued efforts to educate the public about TBI. Furthermore, continued research on public knowledge, attitudes, and behavior is needed.

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Introduction

Each year, it is estimated that more than 2 million people in the United States sustain a traumatic brain injury (TBI). Furthermore, it appears that the incidence of documented TBIs is increasing. Centers for Disease Control and Prevention (CDC) reports indicate a 21% increase in the incidence of TBI from the period of 1995-2001 to the period from 2002-2006 (Faul et al., 2010; Langlois, Rutland-Brown, & Thomas, 2004). It is further estimated that there are over 5 million Americans currently living with disabilities resulting from a TBI (Faul et al., 2010).

According to the CDC, a TBI is defined as “a bump, blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain.” Traumatic brain injuries can be classified based on the severity of the initial injury, ranging from mild to severe. Mild injuries, also called concussions, typically involve a short duration of post-traumatic amnesia, short duration or no loss of consciousness, and higher initial scores on the Glasgow Coma Scale (GCS), a neurological scale to measure consciousness (Teasdale & Jennett, 1974). Conversely, moderate and severe injuries involve a longer duration of post-traumatic amnesia, longer loss of consciousness, and lower scores on the GCS. Importantly, however, the severity of injury is not necessarily equivalent to the severity of impairments that result from the injury. Indeed, even mild injuries can result in severe consequences. Furthermore, mild injuries sometimes require a prolonged recovery period and can result in life-long challenges.

Common signs and symptoms arising from TBI include physical impairments such as headaches, decreased coordination, visual changes, and problems with balance (Kushner, 1998; NINDS, 2002). In addition, cognitive changes such as impaired memory, attention, reasoning, and executive function are commonly reported (e.g., Draper & Ponsford, 2008). These cognitive changes can result in communication problems such as difficulty maintaining or selecting conversational topics, taking turns in conversation, and interpreting abstract or figurative language. Finally, individuals with TBI may demonstrate difficulty with emotional regulation (i.e., the process of initiating, understanding, and managing emotional states) resulting in problems such as anxiety, agitation, and depression (Draper, Ponsford, & Schönberger, 2007) . These signs and symptoms (especially those related to cognition and emotional regulation) are often referred to as “hidden” impairments because they are not immediately obvious to an outside observer.

In the past few decades, much work has been done with regard to increasing awareness of TBI among the general public. This is especially true in the past decade, with an increase in campaigns to decrease sports related head injuries and as the nation attempts to cope with the thousands of soldiers returning from combat with blast related injuries (see the *National Graphic* article “The Invisible War on the Brain” for a recent example; Alexander, 2015). The implicit assumption behind such campaigns is that the general public lacks adequate awareness and/or knowledge about brain injury. In fact, due to the presumed lack of public awareness about TBI, along with its high incidence and the hidden nature of many of its signs and symptoms, TBI has been referred to as a "silent epidemic" (Faul et al., 2010).

For several reasons, it is important that the general public have at least a basic understanding about brain injury and the recovery process. First, knowledge of brain injury and its sequelae are important for prevention efforts. Secondly, knowledge is an important component for increasing support for individuals recovering from brain injury. Additionally, it is possible that an inadequate amount of knowledge may lead to negative assumptions, beliefs, and attitudes towards individuals with brain injury which could result in social stigma and prejudice.

The structure of this dissertation is as follows. The first section presents a review of relevant literature detailing the findings of the previous three decades of research investigating public perceptions of TBI. This body of research can be broadly categorized into two primary domains: studies investigating the public's *knowledge* of brain injury and studies examining public *attitudes* towards brain injury. Each of these domains will be reviewed separately. In addition, evidence on how to improve public knowledge and attitudes will be discussed. After this review of literature, the next section presents the results of an experimental study that describes public perceptions of TBI in Minnesota and evaluates the effect of providing public education about brain injury.

Background

Public Knowledge about Traumatic Brain Injury

Common misconceptions. The first systematic analysis of public knowledge about brain injury was conducted by Gouvier, Prestholdt, and Warner (1988) in response to growing concerns about head injury misconceptions among individuals with brain injury and their families. Based on anecdotal evidence, the authors cautioned that these misconceptions "often interfere with enlisting cooperation between families and professionals in the management of head injury patients" (p. 332-333). To further evaluate the nature of these misconceptions, the authors developed a survey containing 25 statements about seat belts, brain damage, amnesia, recovery, and unconsciousness. Participants were recruited from a Louisiana shopping mall and asked to indicate whether the statements were true, probably true, probably false, or false. Researchers then calculated the "percent misconception" for each item, which reflected the percentage of the sample that answered the statement incorrectly. As predicted, results showed a high degree of misconception about brain injury among the general public, especially on items relating to amnesia, recovery, and unconsciousness (with misconception rates of 55%, 50%, and 45%, respectively). The item with the highest misconception rate (at roughly 82%) was the incorrect notion that after a head injury, "people can forget who they are and not recognize others, but be normal in every other way" (p. 336).

In the three following decades, this survey (or modifications thereof) became the standard instrument to measure knowledge about brain injury among the public. Numerous researchers have added, removed and rephrased individual items, adjusted the instructions, and/or translated the items into different languages. It should also be noted that while some studies using this survey specifically referred to traumatic brain injury, others used the terms “acquired brain injury, “head injury,” or simply “brain injury.” For convenience, the term “brain injury” will be used in the following review. These modified versions have been used to assess knowledge among the general public in a variety of geographic regions (see Tables 1 and 2 for an overview of each of the studies discussed in the following sections). For example, researchers have administered variations of the survey to members of the general public in Great Britain (Chapman & Hudson, 2010), Turkey (Maviş & Akyıldız, 2013), and South Africa (Pretorius & Broodryk, 2013). Similarly, additional studies investigated knowledge in other parts of the U.S. (e.g., Guilmette & Paglia, 2004; Hux, Deuel-Schram, & Goeken, 2006; O’Jile et al., 1997; Willer, Johnson, Rempel, & Linn, 1993).

Taken together, results of these follow-up studies largely replicated Gouvier et al.’s (1988) findings in that the public holds many misconceptions about brain injury. However, results do suggest that there may have been some improvement over time. For example, Guilmette and Paglia (2004) compared results from their sample to that of earlier studies. On the whole, they found no evidence for a reduction in misconception over time. However, when they analyzed individual items, several items did have lower misconception rates that those reported in the original Gouvier et al. (1988) study. These items tended to relate to mild brain injury (e.g., “A head injury can cause brain damage even if the person is not knocked out.”), leading the authors to hypothesize that increased media coverage of sports-related concussions may have helped improve public knowledge. Hux et al., (2006) also compared their results with those of previous studies, although they only used descriptive statistics. Overall, they found a reduction in the amount of misconception compared to the original Gouvier et al. sample. Nevertheless, some items did not show improvement, and others actually had a lower accuracy rate in the later study. Across time, several items were consistently answered incorrectly. These included the incorrect beliefs that complete recovery from a severe brain injury is possible if someone wants it bad enough, that recovery depends primarily on how hard one works, and that someone can have complete amnesia but be “normal” in every other respect. In addition, one item related to the definition of a coma (“People in a coma are usually not aware of what is going on around them.”) also proved challenging for participants across time and geographic regions.

Modifications of the Gouvier et al. (1988) survey have also been used to examine brain injury misperceptions among targeted populations, such as people with personal experience with brain injury or working in professions in which they are likely to encounter individuals with brain injury. For example, modified versions of the survey have been administered to assess knowledge among football coaches (Guilmette, Malia, & McQuiggan, 2007), educators (Farmer & Johnson-Gerard, 1997; Linden, Braiden, & Miller, 2013); school psychologists (Hooper, 2006a), speech-language pathology students (Evans, Hux, Chleboun, Goeken, & Deuel-Schram, 2009) nursing students (Ernst, Trice, Gilbert, & Potts, 2009), rehabilitation providers (Farmer & Johnson-Gerard, 1997), correctional health care professionals (Yuhasz, 2013), military veterans (Block et al., 2014), ethnic minorities with brain injury (Pappadis, Sander, Struchen, Leung, & Smith, 2011), and family members of individuals with brain injury (Springer, Farmer, & Bouman, 1997).

In general, results indicated even individuals with some degree of personal and/or professional experience with brain injury hold many misconceptions. The items with the highest misconception rates among the general public were also challenging for these special populations. For example, a large number of participants incorrectly believed that people with brain injury can forget who they are but be otherwise completely normal, with misconceptions rates of 60% among school based psychologists, 88% among advanced nursing students, 65% among educators, and 73% among correctional health care professionals. Many participants also had misconceptions about the feasibility of complete recovery after severe brain injury, the increased risk of subsequent injury after an initial injury, and the definition of "coma." In contrast, other items had relatively low misconception rates, especially among individuals with occupational experience with brain injury. For example, health care professionals and students had relatively good knowledge about certain items related to the timeline of recovery and the possibility of behavioral or emotional consequences of brain injury.

Knowledge of brain injury outcomes and significance. Although the majority of research on public knowledge of brain injury used variations of the Gouvier et al. (1988) survey to examine brain injury misconceptions, researchers have also examined the public's knowledge of the outcomes and significance of brain injury using other survey instruments, interviews and/or qualitative methods. For example, McKinlay, Bishop, and McLellan (2011) developed a set of ten true false items related to concussion. Participants included adults with and without a history of brain injury in New Zealand. Results indicated considerable confusion among the public about the relationship between the terms “head injury,” “brain injury,” and “concussion.” Additionally, there was some uncertainty regarding whether a direct blow to the head is required to cause a concussion and whether “being knocked out” constitutes a concussion. Conversely, the authors reported relatively good knowledge that concussion symptoms can be long-lasting and can manifest several hours after the initial injury.

Vaughn, Frank, Leach, O’Neal, and Sylvester (1994) conducted telephone interviews with over 1000 residents of Missouri. Questions related to the perceived severity of brain injury, knowledge of symptoms, and estimated cost of rehabilitation. Results suggested that participants had good knowledge that brain injury reflects a serious health issue, especially among those who reported knowing someone with brain injury. Interestingly, participants with lower education levels identified more brain injury symptoms than those with higher educational attainment. However, because interviewers only asked about correct symptoms (rather than including “foils”), this finding is difficult to interpret.

Using a different approach, Swift and Wilson (2001) interviewed individuals with brain injury, family members, and non-medical “rehab professionals” about their *perceptions* of the level of brain injury knowledge among the general public and health care workers. This latter group of “rehab professionals” was not well defined, but appears to consist of paid caregivers or respite workers without any kind of degree in rehabilitation therapy or medicine. Interviews were analyzed qualitatively, and results indicated that participants believed that the general public and health care practitioners have poor understanding about brain injury recovery, diversity of symptoms (especially with regard to cognitive and behavioral symptoms), and the distinction between brain injury and other disorders such as mental illness. In a similar study, Simpson, Mohr, and Redman (2000) interviewed individuals with TBI and their families about their understanding of brain injury rehabilitation and their impressions about the public's understanding of brain injury. Specifically, the authors were interested in brain injury knowledge among minority populations, and all participants were Italian, Lebanese, or Vietnamese immigrants living in Australia. Researchers concluded that there was a wide range of knowledge of brain injury rehabilitation among the participants, with some showing "sophisticated knowledge" and others demonstrating limited understanding of recovery and the rehabilitation process. In addition, participants reported that the general public of their ethnic/cultural group has a general lack of brain injury understanding. Participants in all three groups suggested that the distinction between mental illness and brain injury is not well-understood, and that brain injury is associated with significant social stigma and shame.

Several additional studies explored public knowledge of brain injury using quasi-experimental designs. Aubrey, Dobbs, and Rule (1989) designed a series of two studies using a vignette describing a man involved in a rear-impact car crash. In the first study, participants read a vignette detailing the accident. Half of the participants read a vignette in which the man did not hit his head, but experienced a ten minute loss of consciousness from a whiplash injury. The other half read the same vignette, except that the man had a whiplash injury but did not lose consciousness. Participants then rated the likelihood that certain physical, cognitive, affective, and distractor (i.e., not associated with brain injury) symptoms would occur. The results indicated that participants judged all outcomes as more likely when the man had a loss of consciousness. In addition, while participants had a good understanding of the physical symptoms that can result from brain injury, they judged the cognitive symptoms and distractor symptoms as equally likely. This suggests a lack of understanding about the range of cognitive symptoms that can occur, even from a mild brain injury. Furthermore, participants were asked to judge the likelihood of several participation-level outcomes. In general, participants believed that the injury was unlikely to result in social or financial problems, despite evidence that suggests even mild TBI can cause these types of challenges.

In the second experiment, participants again read a vignette describing the same car crash. In one version, the man did not lose consciousness, but did hit his head against the window. In the other condition, he had a whiplash injury, but did not hit his head. Participants were asked to judge the speed with which the car must have been hit in order to cause a variety of symptoms. Results paralleled the first study, in that lower speeds were deemed sufficient to cause physical symptoms. However, participants believed that the car must have been struck at much higher speeds to cause brain damage, cognitive symptoms, or participation-level problems. In general, speeds were higher in the whiplash condition, indirectly indicating that participants believed the man would be less likely to experience these problems without a direct blow to the head (Aubrey et al., 1989).

In the second experimental study to examine public knowledge about brain injury, Mackenzie and McMillan (2005) used a vignette to elicit expected symptoms of mild TBI from the public, medical doctors, and individuals with brain injury. The vignette detailed a man who suffered loss of consciousness for several minutes and brief post-traumatic amnesia after a car accident. The vignette stated that he felt fine the next morning, was released from the hospital, and returned to his doctor a month later for a check-up. The researchers asked participants to identify any symptoms they would expect the man to report to his doctor. First, the participants listed these symptoms independently. Next, they completed a checklist containing possible symptoms. Half the participants completed a checklist with only real TBI symptoms; the other half completed the same checklist with foil items included. Results indicated that participants (especially those in the general public group) expected the man to experience very few symptoms. Participants from the general public only generated one correct brain injury symptom, on average. However, using the checklist, they did identify more “real” symptoms than “foil” symptoms. Interestingly, participants identified more cognitive and emotional symptoms than physical symptoms.

Impact of participant characteristics on brain injury knowledge. Many of the studies reviewed above also investigated whether various demographic variables, such as gender, age, and education level, were associated with better knowledge. Overall, there is little evidence that these demographic variables impact public knowledge in a consistent and straight-forward manner (Ralph & Derbyshire, 2013). While some studies showed significant effects of participant characteristics on specific items, the results from other studies or for different items were sometimes in opposite directions. The reason for these inconsistent findings is not clear. However, it is possible that differences in how these demographic and experience variables were coded and analyzed may have influenced results. For example, across studies, education level was typically treated as a categorical variable. However, the educational categories used in the analyses differed across studies. While some studies compared participants with and without high school degrees, others compared participants based on whether they had obtained college or even doctoral degrees. Furthermore, although certain studies evaluated the effect of education level on individual items, others only considered its effect on aggregated scores. Therefore, the fact that several of the studies reported significant effects of education level (e.g., Pappadis et al., 2011; Chapman & Hudson, 2010; Vaughn et al., 1994) while others did not (e.g., Guilmette & Paglia, 2004; Hooper, 2006) is very difficult to interpret. As a final complicating factor, even when the same instrument was used measure public knowledge, slight modifications in the wording of items and differences in scoring paradigms may have also resulted in these inconsistent results.

Personal experience with TBI. Several studies examined whether personal experience (having a brain injury or knowing someone with a brain injury) was associated with increased knowledge or decreased misconception. Again, the results were equivocal; some studies revealed no impact of personal experience on knowledge (e.g., Chapman & Hudson, 2010; Ernst et al., 2009; Gouvier et al., 1988), while others concluded that personal experience was associated with better knowledge (e.g., Hux et al., 2006; Linden et al., 2013; O'Jile et al., 1997). Even when results indicated a link between personal experience and knowledge, the magnitude of the effect was small. For example, Guilmette and Paglia (2004) noted that individuals with personal experience outperformed the rest of the sample on only a single item. Similarly, Springer et al., (1997) reported that although individuals with personal experience did better than the rest of the sample on four items, they actually did worse on two other items. One potential explanation for these inconsistent findings is that the concept of “personal experience” with brain injury is vague and was poorly described in many of the studies. As a result, the degree and nature of personal experience with brain injury likely varied considerably across both participants and studies. Therefore, this dichotomous variable (personal experience versus no personal experience) may not be sensitive enough to detect meaningful differences in knowledge.

Professional experience with TBI. Although it is not clear whether having personal experience with brain injury is associated with better knowledge, there is relatively strong evidence that individuals with extensive professional experience in brain injury demonstrate greater knowledge than the general public. For example, among all the studies on brain injury misconceptions, health care professionals who were experienced in brain injury rehabilitation demonstrated the most accurate knowledge (Farmer & Johnson-Gerard, 1997). Football coaches also had very high accuracy on the small set of items related to mild brain injury administered by Guilmette et al. (2007). Likewise, educators who had taught a child with brain injury demonstrated better knowledge than those who had no similar teaching experience (Linden et al., 2013). Individuals working in occupations related to TBI (though not necessarily having any direct professional experience) demonstrated less knowledge than these “experts,” but still tended to outperform the general public. For example, Yuhasz (2013) determined that misconception rates for health care professionals working with inmates in the correctional system (where the incidence of TBI is disproportionately high) were significantly lower than that of the general population samples in four prior studies. Similarly, nursing students, graduating speech-language pathology students, and education professionals all demonstrated fewer misconceptions than the general public (Evans et al., 2009; Ernst et al., 2009; Farmer & Johnson-Gerard , 1997) and general practitioners were able to identify more brain injury symptoms than individuals without medical training (Mackenzie & McMillan, 2005).

Conclusions. Considering all the literature on public knowledge about brain injury, it is clear that while the public generally acknowledges the serious nature of brain injury, understanding of more specific details about recovery and consequences is lacking. A recent systematic review by Ralph and Derbyshire (2013) came to a similar conclusion. Their review examined only the subset of the literature with samples consisting of members of the public (i.e., not members of special populations such as veterans or specific occupations). Based on their analysis, the authors concluded that "although public knowledge of ABI [acquired brain injury], particularly of mild brain injury, may have increased since the initial study in 1988, the public continue to endorse a number of misconceptions" (p. 11). They further point out that two of the potentially most harmful misconceptions are that recovery speed is dependent on effort, and that all survivors can achieve a complete recovery, even with severe injuries. They caution that while this view may be adaptive for individuals recovering from brain injury, it may also result in public assumptions that "those who continue to experience prolonged difficulties are understood to be responsible and almost ‘deserving’ of these difficulties” because they are “lazy” or not exerting enough effort in the recovery process (p. 11).

As a result of these widespread misconceptions, nearly every one of the studies reviewed here concluded that future education is needed. Ralph and Derbyshire (2013) specifically called for public education relating to the process of recovery, the heightened risk of subsequent injury after an initial brain injury, and the cognitive, emotional and social consequences of brain injury. Likewise, studies addressing more specific populations also stressed increased targeted education about brain injury, such as training on the ramifications of brain injury for educators (Linden et al., 2013), athletic coaches (Guilmette, Malia, & McQuiggan, 2007), and students in health care fields (Ernst et. al., 2009; Evans et al., 2009). In summary, the following quotation from Hux et al. (2006) provides a clear justification of the need for better public understanding of TBI:

> [E]ducation of the general public is paramount. Only after people understand the seriousness and pervasiveness of the problem are they likely to support prevention efforts and rehabilitation services across all stages of recovery. Without an accurate perception among lay people about the types of problems caused by acquired brain injury and the recovery process survivors experience, decisions about health care funding and available services are likely to fall short of actual needs. Only with greater public awareness of the reality of what life is like following brain injury is there hope that the substantial health care and social service changes needed to foster maximum recovery among all survivors will emerge in coming years. (p. 553)

Public Attitudes about Brain Injury

Theoretical basis for attitude research. The study of attitudes has a long history in the field of social psychology, beginning in the early part of the twentieth century and continuing to the present day. Psychologists first became interested in researching people's attitudes because of their presumed relationship with behavior. Research on attitudes intensified in the mid-twentieth century during the civil rights movement due to the assumption that negative attitudes about racial minority groups would result in harmful behaviors, such as discrimination. If these negative attitudes about racial minorities could be changed, theorists argued that discrimination and societal prejudice might be reduced.

Despite the long history of research on attitudes, the concept of "attitude" is complex and can be defined differently depending on one's theoretical perspective. On a basic level, however, an attitude can be defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993). This entity is referred to as an "attitude object." Attitude objects can include any number of entities, including a specific person, groups of people, events, policies, or even behaviors (Albarracin, Wei Wang, & Noguchi, 2008; Ajzen & Cote, 2008). The crucial part of this definition is the notion of evaluation. An attitude is not simply knowledge about an attitude object. Although one's attitude is often related to one's knowledge, and knowledge can help form attitudes, they are distinct concepts. Attitudes are viewed as a "tendency or state internal to the person" which "biases or predisposes a person toward … favorable responses if the attitude is positive and toward unfavorable responses if the attitude is negative" (Eagly, 1992, p. 694). Because they are internal to an individual person, attitudes are considered "latent variables" that cannot be directly observed. Instead, researchers must infer an underlying attitude based on an observable response (Ajzen, 1989).

Three types of observable responses have been described in the attitude psychology literature: cognitive, affective, and behavioral responses. Cognitive responses refer to a person’s stated belief about an attitude object. For example, if a person expressed a belief that individuals with brain injury are dangerous, this could be interpreted as a cognitive response to his or her underlying negative attitude. Affective responses relate to the feelings experienced when someone encounters an attitude object. If someone reported feelings of discomfort or demonstrated physiological signs of stress in response to interacting with someone with TBI, we might infer that they hold negative attitudes towards individuals with TBI. Finally, behavioral responses are observable behaviors related to an attitude object. To illustrate, if someone held positive attitudes towards individuals with TBI, they might seek out opportunities to interact with someone with brain injury or donate to organizations that support people with brain injury. In addition, researchers also include self-reported *intentions* to behave in a certain way as a type of behavioral response. Because behavioral intentions are thought to be a strong predictor of actual behavior and are much easier to measure in a laboratory setting, they are often used in place of actual behavior in attitude psychology research. It should also be noted that instead of simply being outward manifestations of internal attitudes, it has also been argued that these three types of responses are actually distinct components of the internal attitude itself (Rosenberg & Hovland, 1960). According to this interpretation, a combination of one’s cognition, affect, and behavior in relation to an attitude object actually make up the attitude. Regardless of which theoretical perspective is adopted, it is critical that all research on attitudes consider these three attitude components/responses (Eagly & Chaiken, 1993).

Another important distinction to consider is the notion of explicit versus implicit attitudes. Explicit attitudes include those of which individuals are consciously aware and can therefore report or rate on some kind of scale. Implicit attitudes, on the other hand, are those about which people are not consciously aware. These types of attitudes can operate automatically without volitional control, intent, or attentional resources (Bargh, 1994; Devos, 2008). Measurement of implicit attitudes is inherently challenging. Because these attitudes are outside of conscious processing and control, participants cannot explicitly endorse them on a scale or survey measure. As a result, researchers have devised a number of "indirect" measures to assess these types of attitudes. The most common of these, the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) has been used extensively to measure implicit attitudes about various social constructs including race, disability, and gender. A full explanation of this instrument is beyond scope of this paper. Briefly, however, the test measures how strongly participants associate a concept with a particular positive or negative attribute. The strength of these associations is measured by evaluating the amount of time it takes participants to complete a set of categorization tasks under different conditions. Further information about the mechanics of this test can be found in Greenwald et al. (1998). Other researchers have employed other kinds of implicit measurement tools such as physiological indictors or priming tasks.

The precise relationship between explicit and implicit attitudes is not well understood. For example, some researchers argue that implicit and explicit attitudes towards the same attitude object are completely distinct (e.g. Greenwald & Banaji, 1995). Therefore, they would argue that it is possible that individuals may hold explicit and implicit attitudes toward the same attitude object that are of opposite valence or of differing strength. Conversely, other researchers contend that implicit and explicit attitudes are connected, but reflective of different types of cognitive processing (e.g., Fazio, 1989). Under this view, attitudes revealed using an implicit task reflect automatic processing that is not influenced by conscious thought. Attitudes revealed using an explicit task, on the other hand, are those that are shaped by conscious thought. In fact, this is one of the primary criticisms of explicit measures. Even if individuals hold a negative attitude toward an attitude object, they may be not be willing to outwardly express it due to normative pressures and concerns regarding the social desirability of these views. In other words, even if individuals hold negative attitudes towards someone with a brain injury, they may not be willing to divulge them to a team of researchers because it makes them look bad.

This distinction between explicit and implicit attitudes (and one's theoretical perspective) has important implications for deciding how to measure attitudes. First, if one adopts the viewpoint that implicit attitudes are connected, the sensitivity of the attitude object is an important issue. For example, racial attitudes are much more culturally sensitive than attitudes towards one's favorite color. In general, attitudes towards sensitive issues are much more likely to be shaped by social desirability concerns than attitudes towards less sensitive issues. As a result, if a researcher wanted to measure sensitive attitudes in a way that is unlikely to be affected by normative pressures, an implicit task would be appropriate. One the other hand, it would be less helpful to measure attitudes about non-sensitive issues using an implicit task.

A second consideration in deciding how to measure attitudes is the issue of attitude-behavior correspondence. As discussed earlier, one of the primary reasons to study attitudes is because they are thought to be predictive of behavior. Unfortunately, there is considerable variability in the research literature as to the degree to which attitudes predict behavior, with some studies showing a strong relationship between attitudes and behavior and others finding no relationship at all. Results of a recent meta-analysis suggest that this relationship between attitudes and behavior is relatively weak overall, with explicit attitude measures resulting in slightly stronger correlations than implicit attitude measures (r = 0.361 and r = 0.274, respectively; Greenwald, Poehlman, Uhlmann, & Banaji, 2009). However, Greenwald et al. reported that for highly sensitive attitude objects, the correlation between attitudes and behavior was higher for implicit measures (r = 0.25) than for explicit measures (r = 0.13). Again, these findings suggest that explicit attitude measures may be more appropriate for attitudes about less sensitive attitude objects while implicit measures are better suited to study attitudes towards highly sensitive attitude objects.

As a result of the considerable body of literature from the attitude psychology field, researchers in the health sciences have increasingly turned to studying both explicit and implicit attitudes towards individuals with disabilities. The rationale for conducting this type of research closely aligns with the original motivation to study attitudes. Just as much of the early attitude psychology research grew out of concerns of racial discrimination and prejudice, negative public attitudes about individuals with disability might result in discrimination or other negative behavior towards people with disabilities. Furthermore, negative attitudes among medical professionals or educators may lead to adverse outcomes which limit overall health or opportunities for success. Overall, most of this newer work relates to attitudes towards individuals with mental illness and/or physical impairments, and results indicate a great deal of public stigma attached to these disabilities. In addition, a small number of studies have examined public attitudes towards individuals with brain injury. The following two sections will review the existing literature on both explicit and implicit attitudes towards individuals with brain injury.

Explicit attitudes about brain injury. The vast majority of studies on brain injury attitudes utilized explicit attitude measures. Two of these studies employed a survey methodology. Linden and Crothers (2006) administered a 20-item survey regarding beliefs (i.e., cognitive responses) about people with brain injury to members of the general public and university students. Survey items included statements such as “People with brain injury can be… (e.g., violent, unpredictable, caring)” and “People with brain injury are… (e.g., proud, confused, demanding).” Respondents rated each item on a 5-point scale based on their level of agreement. Researchers also examined the effect of the demographic variables of socio-economic status, gender, and age on responses. Overall, participants endorsed a substantial amount of negative attitudes about people with brain injury. The university students tended to endorse slightly more positive attitudes. This was especially true when the characteristic to be rated was positive (e.g., “People with brain injury can be caring”). On the other hand, when the characteristic was phrased negatively (e.g. “People with brain injury can be violent”), the general public had more favorable attitudes. Nevertheless, members of the general public demonstrated high disagreement with statements that people with brain injury can be “useful” or “productive” members of society. No effect of gender or socio-economic status was found.

In a similar study, Linden, Rauch, and Crothers (2005) administered a 40-item survey, adapted for use in brain injury research from the Community Attitudes towards Mental Illness Scale. The instrument contained statements related to positive attitudes (i.e., benevolence and community ideology) and negative attitudes (authoritarianism and social restriction). High school students rated each statement on a 5-point scale according to their level of agreement. Although researchers suggested that attitudes were generally positive, mean scores suggest a trend towards negative views on all four domains. Interestingly, females had more negative attitudes on all domains than males.

A single study examined brain injury attitudes using a qualitative design. Linden and Boylan (2010) interviewed adults regarding attitudes about brain injury (and some questions on knowledge). Results indicated that participants had mainly negative perceptions towards people with brain injury. However, most reported positive perceptions when asked how *other* people perceive individuals with brain injury. Some of the negative perceptions related to sympathetic concerns (“sad”) while others reflected more prejudicial views (e.g., people with brain injury “can’t think for themselves”).

When it came to the role of the social world, participants reported favorable attitudes, suggesting that society should help individuals with brain injury and that efforts to increase awareness of brain injury are needed. Finally, the authors reported that participants had good knowledge about the causes and symptoms of brain injury. Interestingly, participants even demonstrated good understanding of "hidden" symptoms such as cognitive, social, and emotional challenges.

A number of quasi-experimental studies also examined attitudes about brain injury. Crothers, Linden, and Kennedy (2007) explored the attitudes of elementary and middle school children towards brain injury. They provided children with a vignette describing a hypothetical boy with brain injury and asked participants to complete the "Friendship Activity Scale," which contains behavioral intention questions relating to how likely the participant would be to engage in various friendship activities (e.g., "say hello" to "invite over to one's house"). Females had more positive attitudes towards friendship than did the males, although this difference narrowed with age. Older girls were less open to friendship with someone with brain injury than younger girls, while the opposite pattern was true for boys.

Using a between-groups design, McKinlay et al., (2011) examined the difference in public attitudes depending on whether the term "head injury" versus "brain injury" was used to describe someone's injury. Participants were all from New Zealand and were assigned to a "head injury" or "brain injury" condition. Half of the participants rated the likelihood that they would associate a set of 15 attributes with "brain injury." The other half completed the task with respect to a "head injury." These attributes included positive items such as “kind,” “hard-working,” and “trustworthy” and negative items such as “irritable,” “greedy,” and “negative.” Although this task most closely resembles a test of attitudes, one limiting factor is that some of the negative attributes constituted actual symptoms of TBI. Therefore, high ratings on these items could indicate good knowledge of symptoms, rather than negative attitudes. For example, participants associated the term “distractible” with brain injury at a high rate, suggesting good knowledge that distractibility is a common symptom of TBI. Results indicated that participants were more likely to associate the word “negative” with brain injury compared to head injury. Conversely, participants rated the words “kind,” “eager,” and “diligent” more highly in the “brain injury” condition. These results suggest that terms used to describe a TBI may activate different types of attitudes among the general public.

Three additional studies explored attitudes about brain injury in the context of the etiology of the injury and whether the person was to blame for the injury. Each of these studies employed the use of multiple vignettes describing hypothetical patients. The vignettes detailed the etiology of the brain injury and/or whether the patient was to blame for it. Attitudes were measured using the Prejudice Evaluation Scale, which measures beliefs (i.e., cognitive responses) about the hypothetical patient, and the Social Integration Scale, which measures the likelihood that a respondent will interact socially with the person in the vignette (i.e., behavioral responses). Redpath and Linden (2004) and Linden, Hanna, and Redpath (2007) included university students and members of the general public while Redpath et al. (2010) studied medical doctors, nurses, and trainee doctors and nurses. Taken together, the results of these three studies suggest that people tend to have more negative attitudes towards people with brain injury when they are in some way at fault for the injury, regardless of the etiology. In addition, women tended to have less prejudicial attitudes than men (Linden et al., 2007). Strangely, members of the general public tended to endorse more negative beliefs, but were also more likely to desire social interaction with people with brain injury than were university students (Linden et al., 2007). Work experience also impacted attitudes. Descriptively, medical doctors had the most negative attitudes, followed in descending order by nurses, trainee doctors, and trainee nurses. For qualified nurses and doctors, as negative beliefs increased, participants also indicated less desire for social interaction and less intention to help patients with brain injury.

Attitudes toward brain injury have also been examined using the notion of "attribution error" in relation to the visibility of brain injury. McClure (2011) states that attribution errors occur when people attribute symptoms of brain injury to some other cause (e.g., personality or a life phase, such as adolescence). Although attribution error, in itself, is not an attitude, McClure points out that these incorrect beliefs may result in negative attitudes and social stigma. McClure, Buchanan, McDowall, and Wade (2008) and McClure, Patel, and Wade (2011) each developed a vignette describing a boy who acquired a TBI at the time of becoming an adolescent. This vignette detailed four negative behaviors: excessive sleeping, lack of motivation, lack of self-confidence, and easily angered. In both studies, the vignette was paired with either a picture of an adolescent boy with no physical markers of injury or the same picture edited to contain a craniotomy scar. Between the two studies, undergraduate participants estimated the severity of the injury, time since injury, and the likelihood that each of the four behaviors would persist for at least five years. Additionally, they rated the likelihood that each of the four behaviors was attributable to brain injury and/or adolescence. Results indicated that when the injury was invisible, participants were more likely to attribute problem behaviors to adolescence instead of brain injury. They also rated the injury as less severe and less recent. Furthermore, when participants attributed behaviors to adolescence, they did not expect them to persist. This suggests that the public "down-plays" the effects of brain injury because the symptoms are "hidden" and may have unrealistic expectations about recovery due to this misattribution of symptoms to normal developmental processes.

Implicit attitudes about brain injury. There exists a single study that assessed implicit attitudes about TBI. McLellan, Bishop, and McKinlay (2010) conducted a study designed to compare implicit and explicit attitudes about people with brain or head injury versus people with a limb injury. Participants included 103 members of the general public in New Zealand. To measure explicit attitudes, McLellan et al. created a scale containing a set of 10 polar characteristics (e.g., intelligent vs. stupid, trustworthy vs. suspicious, honest vs. deceptive, etc.). Participants completed the scale under two conditions: once in response to a hypothetical man with a limb injury and once in response to a hypothetical man with a brain/head injury. Half of the participants were told the hypothetical person had a "head injury", while the other half were told it was a "brain injury." The participants rated these two hypothetical men on each of the 10 characteristics using a 7-point scale. To measure implicit attitudes, McClellan et al. designed an IAT to test the strength of implicit associations between brain/head injury and the same characteristics used in the explicit measure.

Results on the explicit measure indicated that participants endorsed more negative attitudes towards the hypothetical man with brain/head injury than the man with a limb injury. Specifically, participants perceived the hypothetical man with brain injury to be less “mature, intelligent, flexible, polite, and employable” than the man with a limb injury (McLellan et al., p.708). Furthermore, participants endorsed more negative attitudes when the term “brain injury” was used instead of “head injury.” Familiarity with brain injury, however, appeared to lessen this effect; individuals who reported either having a brain injury or knowing someone with a brain injury expressed more positive attitudes toward the man with brain injury than participants without this experience. Results for the implicit attitude measure were similar. As with the explicit measure, individuals without any personal experience with brain injury demonstrated more implicit bias against the man with brain/head injury than the man with a limb injury. However, individuals with personal experience with brain injury did not demonstrate a statistically significantly greater degree of implicit bias against the man with brain/head injury compared to the man with a limb injury. Regardless of personal experience, there was also no difference in implicit attitudes depending on whether the term “brain injury” or “head injury” was used.

The finding that negative explicit attitudes were more prevalent in this sample is important for several reasons. First, McLellan et al. (2010) argued that these negative attitudes “are not necessarily underpinned by an automatic or deep-seated bias, but rather are due to an openly held belief that brain injuries result in personality changes or deficits that render a person as less desirable" (p. 708). Because participants openly expressed explicit negative attitudes (both in this study and in the studies described in the previous section), it also suggests that brain injury may not be a highly sensitive attitude object.

Improving Knowledge and Changing Attitudes

As mentioned earlier, one of the fundamental reasons for studying knowledge and attitudes about brain injury is to identify and characterize the nature of misconceptions and negative attitudes about TBI so that efforts can be taken to improve knowledge and promote more positive attitudes. The body of literature reviewed above clearly shows that the general public holds a number of incorrect beliefs and some degree of negative attitudes about TBI. However, it is less clear *how* these misconceptions and negative attitudes can be improved.

There is some evidence from the brain injury literature that education is effective in improving knowledge. While *general* education level has not been shown to consistently correlate with knowledge (Ralph & Derbyshire, 2013), there is reason to believe that more *focused* education may be effective at improving TBI knowledge. For example, Evans et al. (2009) determined that TBI knowledge was better among current students and recent graduates of a speech language pathology graduate program compared to the general public. Similarly, Guilmette et al. (2007) concluded that high school football coaches had relatively good knowledge about mild TBI. Eighty percent of the sample reported receiving education about concussion from coaching associations and the vast majority of coaches indicated that this education was either “moderately” or “very” helpful. On the other hand, other studies did not find significant effects of focused education on TBI knowledge. For example, Hooper (2006) and Linden et al. (2013) found no evidence that previous coursework or continuing education on TBI was associated with better knowledge among school psychologists or educators, respectively. Similarly, neither having a TBI nor knowing someone with a TBI (both of which would presumably involve receiving TBI education) has been consistently demonstrated to correlate with higher knowledge.

Only a single experimental study specifically examined the impact of providing education about brain injury to the public. Garcia, Sellers, Hilgendorf, and Burnett (2013) developed a 60 minute educational program entitled “*TBIoptions:* Promoting Knowledge,” which included information about the impact, causes, and consequences of TBI. The program also provided information on external TBI resources and the importance of social support for the recovery process. Information was provided both through a lecture format and video vignettes of individuals with TBI discussing their injuries and symptoms. Participants included 44 members of the general public in Kansas, who completed the program either online or in person. Participants completed a pre- and post-test measure to examine the impact of the program. This measure consisted of two parts. First, participants self-reported their level of knowledge of five domains using a Likert scale. These domains included the following: 1) the causes and definition of TBI, 2) Physical, cognitive, emotional, and behavioral impacts, 3) how TBI changed relationships, activities of daily living, and work, 4) the importance of community or individual support for recovery, and 5) familiarity with the external resources provided in an online directory. Participants were also asked write answers to three questions about the impact of TBI and ways in which the community could provide support to individuals with TBI.

Results indicated that participants' self-reported knowledge about each of the five domains was significantly higher after completing the program, regardless of whether they did it online or in person (Garcia et al., 2013). Qualitative analyses of the written responses indicated that many participants wrote about the cognitive, social, and emotional consequences of TBI. Additionally, the difficulty of relearning skills and adapting to a "new normal" also emerged as themes in the responses. These results suggest a positive impact of this educational program. However, it should be noted that the pre- and post-test measures did not include any quantitative items on TBI knowledge. Therefore, although participants *believed* they were more knowledgeable about TBI after completing the program, it is not clear whether an objective knowledge measure would have revealed similar improvement.

There is even less evidence from the TBI literature to suggest how to improve negative attitudes about brain injury. McLellan et al. (2010) found evidence individuals who knew someone with TBI demonstrated more favorable explicit and implicit attitudes towards individuals with TBI. Furthermore, because they found that negatives attitudes about brain injury were primarily explicit, they speculated that they may also be "more easily open to education, communication, and therefore amelioration" (p. 708). This finding is in line with studies from the mental illness literature which also suggest that familiarity with someone with mental illness is associated with greater tolerance and more positive attitudes (e.g., Angermeyer & Dietrich, 2006; Brockington, Hall, Levings, & Murphy, 2000; Corrigan, Edwards, Qreen, Thwart, & Perm, 2001). Conversely, Redpath et al. (2010) demonstrated that more experienced health care professionals actually reported more negative attitudes towards individuals with brain injury than less experienced professionals. Moreover, although Linden and Boylan (2010) did not specifically examine the effect of TBI experience on attitudes, they did find evidence for negative public attitudes about people with brain injury. In interpreting their findings, they hypothesized that one reason for these attitudes might be that participants were exposed to educational campaigns aimed to reduce drunk driving. To discourage drinking and driving, these advertisements portrayed accident victims in a highly negative light. Therefore, it is possible that attempts to educate the public may have inadvertently increased negative attitudes towards brain injury.

Despite the paucity of evidence on how to change attitudes about brain injury, research from other disciplines can provide some guidance. In the social psychology literature, three methods to reduce negative attitudes have been commonly reported: protest, education, and contact (Corrigan & Penn, 1999). Protest is defined as an attempt that aims to suppress negative attitudes or behaviors against a stigmatized group. This kind of approach is designed to “highlight the injustice of specific stigmas and lead to a moral appeal for people to stop thinking that way” (Corrigan, 2004, p.115). Provision of education involves presenting information that disputes negative stereotypes. Finally, inter-group contact involves placing individuals of a majority group and individuals(s) of a stigmatized group in direct contact with one another. This method of stigma reduction was described at length by Allport (1954), and the notion that contact was an effective means to reduce prejudice was termed the “Contact Hypothesis.” According to the Contact Hypothesis, negative attitudes about a stigmatized group are best reduced when individuals of two groups are able to interact with one another. In order to reduce negative attitudes, Allport qualifies that certain conditions must be met for this interaction to be effective. For example, this interaction must involve cooperation on an activity, in which both individuals have equal status and a shared goal.

Each of these three methods has been studied extensively in social psychology research to examine prejudice reduction against racial and ethnic minorities. In addition, stigma reduction techniques have also been applied to attitudes about mental illness. Although mental illness and TBI are distinct disorders, there are several important similarities. Both are “hidden,” in that their symptoms may not be readily apparent to the public. In addition, considerable public misconception and negative attitudes exists about both TBI and mental illness. As a result of this combination of “hidden” impairment, misconception, and negative attitudes, individuals with either brain injury or mental illness may feel isolated from society or believe that their problems are not understood by others. In a systematic review of the literature on stigma reduction methods in mental illness and social psychology, Corrigan and Penn (1999) observed that there is limited evidence to support protest as a means to reduce negative attitudes about mental illness. In addition, they noted that it is even possible for protest to result in “rebound” effects in which the mental effort of suppressing a stereotype may actually result in increased expression of negative attitudes. In contrast, Corrigan and Penn concluded that both education and contact may be better able to reduce stigma about mental illness. Likewise, in another systematic review of literature, Couture and Penn (2003) concluded that contact “tends to reduce stigmatizing views of persons with a mental illness” (p. 291).

Several other studies on the role of education and contact in reducing stigma about negative attitudes are particularly relevant to the current project. Corrigan et al. (2002) showed 10 minute presentations on mental illness to community college students. Presentations focused either on education (a presenter contrasted myths with facts) or contact (a presenter with mental illness told his/her personal story). In addition, a control group viewed a presentation that did not deal with mental illness. Participants completed attitude measures before the presentation, after the presentation, and one week later. In addition, they were given the opportunity to donate to a mental illness charity to measure helping behavior. Results indicated that both contact and education were effective in changing attitudes. However, attitude change persisted longer in the contact condition. In addition, participants in the contact condition donated more money to the charity.

In a follow-up study, Reinke, Corrigan, Leonhard, Lundin, and Kubiak (2004) again showed 10 minute presentations to community college students. Presentations included contact with someone with mental illness either directly (a presenter with mental illness told his story, in person) or indirectly (a filmed version of the same presentation). In addition, a control group viewed a presentation unrelated to mental illness. All participants completed a pre- and post-presentation measure of their attitudes. Results indicated that contact was effective in improving attitudes. Importantly, researchers found that indirect (i.e. video-taped) contact was equally as effective as direct contact. Finally, in a third study, Corrigan, Larson, Sells, Niessen, and Watson (2007) used a similar methodology to contrast attitude change in two conditions: filmed education (a 10 minute video of an educational presentation) and indirect contact (a 10 minute video of an individual with mental illness telling his personal story). Researchers determined that the indirect contact condition was more effective in improving attitudes than the filmed education condition.

Considering the results of all these studies together, several hypotheses can be made. First, it appears likely that education will be effective in improving TBI knowledge. However, to improve attitudes, contact may have a stronger effect. Additionally, providing contact indirectly using a video should not eliminate its effectiveness. Therefore, presenting a film containing both education about TBI and clips of individuals with TBI talking about their personal experiences may be an effective means to improve both public knowledge and attitudes about brain injury.

Overview and Research Aims of the Current Study

This dissertation builds upon the previous literature on public knowledge and attitudes about brain injury. The project employed a between-subjects design to examine public knowledge and attitudes about brain injury and to determine the impact of a brief educational video. Participants were randomly assigned to either the control group or the experimental group. In both groups, participants answered a variety of questions related to their background and then watched a brief video. Next, they completed a series of instruments to measure their knowledge about TBI, attitudes towards individuals with TBI, and intended information-seeking behaviors. Participants in the experimental group watched a mini-documentary that contained education about TBI, including information about etiology, prevalence, consequences, and recovery. In addition, the video contained indirect contact in the form of clips of individuals with brain injury talking about their experiences. Participants in the control group watched a video that was unrelated to brain injury.

Analyses focused on describing TBI knowledge and attitudes in each group and in determining the relationship between knowledge, attitudes, and behavioral intentions. In addition, the effectiveness of the educational video in improving TBI knowledge and attitudes among the general public was assessed by comparing performance on all measures across the two groups. The specific aims and hypotheses of the project are outlined below:

1) To determine the level of knowledge about TBI among the general population.
    a. Report descriptive statistics for the control group's performance on the Common Misperceptions about TBI Questionnaire-modified (CM-TBIm) and interpret these findings in relation to findings of previous research. Hypotheses: In line with previous research, the general public will endorse misconceptions about brain injury at a relatively high rate. Specifically, participants will have most difficulty with CM-TBIm items related to recovery, unconsciousness, and memory impairment. Given recent media

attention to the serious nature of concussions, this sample will demonstrate reasonably good knowledge on items related to mild TBI.

   b. Identify predictors of higher TBI knowledge using demographic and background experience variables (e.g., age, education level, gender, prior TBI history, family/friend with history of TBI, professional experience with TBI) to predict CM-TBIm scores.

      Hypotheses: Because results from previous studies have led to inconclusive results regarding the impact of demographic variables on TBI knowledge, it is likely that age, education level, gender, and place of residence will not predict better TBI knowledge. However, previous TBI, having an immediate family member with TBI, or professional experience with TBI should be associated with better knowledge. However, having a friend or more distant family member will be a weaker (or non-significant) predictor of knowledge.

2) To describe attitudes about TBI endorsed by the general public and to determine their relationship with knowledge.
   a. Report and interpret descriptive statistics for the control group's performance on the modified Multidimensional Attitude Scale (MASm).

      Hypothesis: The sample in the current study will likely endorse some degree of negative attitudes about people with TBI on the MASm. The degree of negative attitudes may differ across cognitive, affective, and behavioral items contained on the scale. Unfortunately, it will not be possible to make direct comparisons to previous studies since they used different attitude measures. However, qualitatively, it is possible that this sample may express less negative attitudes than these previous samples as a result of the recent increase in public awareness campaigns.

    b. Identify predictors of more positive attitudes using demographic and background experience variables (e.g., age, education level, gender, prior TBI history, family/friend with history of TBI, professional experience with TBI) and brain injury knowledge (i.e., CM-TBIm scores).
       Hypotheses: Knowledge about brain injury will emerge as a significant predictor of attitudes, such that greater knowledge is associated with more favorable attitudes. While personal or friend/family history of TBI should also be predictive of more favorable attitudes, professional experience and the demographic variables are less likely to predict attitudes in a clear and consistent manner.

3) To determine the relationship between attitudes and intended behaviors.
    a. Identify whether more positive attitudes are predictive of a greater likelihood of participants expressing interest in engaging in a set of information-seeking behaviors.
       Hypothesis: Participants with more favorable attitudes will also express more interest to engage in information-seeking behaviors.

4) To determine whether exposing participants to a brief educational video will result in improved knowledge about brain injury, more favorable attitudes towards individuals with TBI, or differing intended information-seeking behavior.
    a. Compare the performance of the control group and experimental group on the CM-TBIm, MASm, and information-seeking behavior questions. Identify whether group assignment is a significant predictor of scores on each of these measures.

       Hypotheses: Individuals in the experimental group (who viewed the educational video) will demonstrate better knowledge than the control group. Similarly, they will demonstrate more favorable attitudes, although the effect size might be smaller or only significant for certain factors of the MASm. There is little evidence from the previous literature to suggest whether individuals in the experimental group will express greater interest in engaging in information-seeking behaviors. It is possible that participants who were exposed to some education about TBI will also desire additional information. It is also possible that participants in the control group (who did not receive any education) will be more interested in learning more about TBI as a consequence of participating in the study.

Methods

Recruitment and Eligibility Criteria

Participants were recruited at the 2014 Minnesota State Fair in the Driven to Discover Building. This building was a dedicated research facility at the fair, supported by the University of Minnesota School of Public Health, Medical School, College of Food Agricultural and Natural Resources, and the Office of the Vice President for Research. Building organizers selected a total of 30 studies from a range of disciplines to conduct research at the fair. To publicize the building, a brief summary of each study and participant eligibility criteria were posted on the Driven to Discover Building website in advance of the fair. Entry into the building was open to all fair attendees and building staff were present to explain the purpose of the building and, if desired, to assist participants in finding a study for which they were interested and eligible. The current study recruited participants over a period of eight days at the fair in a booth in this research building. Potential participants approached the booth and a member of the research team provided a brief explanation of the purpose of the study and the research tasks. Research staff also discussed eligibility criteria and began the consent process for any interested participants.

Eligibility requirements were deliberately broad to increase the likelihood that the sample would reflect the typical variability within the general population of Minnesota. To be eligible, participants needed to be at least 18 years old, have adequate vision or hearing to enable them to complete study tasks and view/listen to a closed-captioned video, and speak English as their primary language. Individuals with a history of learning disabilities, neurologic impairment, or TBI were not excluded from participation, but were asked to disclose this information anonymously on the survey. The age criterion was selected to eliminate the need to control for developmental differences in language, reading, and grade level in children. No participants were deemed ineligible prior to participation due to hearing or visual impairment. However, data from several participants with self-reported reduced hearing and/or vision were not included in the final analysis. This will be discussed in greater detail in the following section. In addition, several individuals voluntarily choose not to participate due to anticipated difficulty reading survey tasks or hearing the video.

The primary language criterion proved a difficult theoretical concept for participants. For the purposes of this study, “primary” language was defined as one which the participant uses at least half the time and in which the participant feels comfortable and fluent. Importantly, we did not require that participants speak English as a native language. Nevertheless, bilingual participants demonstrated difficulty determining whether they could consider English to be a primary language. As a result, members of the research team occasionally asked participants additional questions related to their fluency and the frequency with which they use English. If participants indicated fluency and frequent use of English and appeared to understand the consent materials and task instructions, they were allowed to participate. Consequently, several participants were deemed eligible to participate, but still indicated on the demographic questionnaire that English was not their primary language.

Participants

A total of 402 participants were recruited. However, data from 10 participants was excluded for various reasons. As a result, 392 participants were included in the final sample. The most common reason for excluding participants from analysis was inability to complete the experimental tasks. Please see Table 3 for more specific information regarding the reasons for excluding certain participants' data. Of these 392 participants, 195 were randomly assigned to the control group and 197 were assigned to the experimental group. Two simple one-way analyses of variance were conducted to compare the participants in each group on key demographic variables. Age was similar in each group with a mean of 43.24 for the control group and 43.52 for the experimental group ($t = -0.159$, $p = 0.874$). Similarly, education level did not differ between the groups with a mean of 16.40 and 16.19 years for the control and experimental groups, respectively ($t = 0.775$, $p = 0.439$). Further information regarding the age and education level of the sample is shown in Table 4.

To determine whether the two groups differed in terms of the categorical demographic and experience variables, a set of chi-square analyses was conducted. No group differences were found with respect to gender (i.e., male, female, non-specified; $\chi^2 = 2.887$, $df = 2$, $p = 0.24$), place of residence (i.e., urban, rural, suburban; $\chi^2 = 0.724$, $df = 2$, $p = 0.70$), alcohol consumption ($\chi^2 = 0.146$, $df = 1$, $p = 0.70$), history of learning disability ($\chi^2 = 0.137$, $df = 1$, $p = 0.711$), or history of neurological impairment ($\chi^2 = 0.433$, $df = 1$, $p = 0.51$). Participants in each group also had similar background in terms of personal history of concussion ($\chi^2 = 3.420$, $df = 2$, $p = 0.18$), family/friend history of brain injury ($\chi^2 = 1.559$, $df = 1$, $p = 0.21$), and professional experience with brain injury ($\chi^2 = 0.572$, $df = 1$, $p = 0.45$). Due to the small number of participants, statistical comparisons were not appropriate to assess for group differences with respect to primary language and personal history of moderate or severe brain injury. However, a brief inspection of the data indicates no group differences on these variables; each group contained 5 participants with a self-reported primary language other than English and 7 participants with a history of moderate or severe brain injury. Please see Table 5 for a full summary of the demographic characteristics of the entire sample and of each group and Table 6 for a description of the participants' experience with brain injury, learning disability, and other neurological disorders.

Procedural Overview

The procedures used in this study were approved by the Institutional Review Board at the University of Minnesota. All research tasks were conducted on the premises of the Driven to Discover Building at the 2014 Minnesota State Fair. Participants first completed the informed consent process. A research assistant initiated this process by briefly explaining the purpose, tasks, risks, benefits, and voluntary nature of the study. Interested participants were then offered the opportunity to begin the study. If they chose to participate, they were quasi-randomly assigned to either the control or experimental group, and the remainder of the consent process was conducted as part of the experiment, itself.

Participants completed the experiment using either an online or paper survey. The online version was presented using Qualtrics online survey software, programed by the

College of Liberal Arts – Office of Information Technology (CLA-OIT) Survey Services Center at the University of Minnesota. Separate versions of the survey were created for participants in the control group and for those in the experimental group. Participants completed the survey using a laptop computer or an iPad. Although the vast majority of participants completed the survey electronically, 13 participants used a paper version (seven in the control group and six in the experimental group). The paper version was used when participants indicated low comfort level with electronic devices or during busy periods of recruitment when all of the computers and iPads were already in use. Data from the electronic survey were automatically recorded by the Qualtrics software and were then compiled into a single data spreadsheet by the CLA-OIT Survey Services Center. Data from the paper surveys were entered manually and then added to this spreadsheet.

The survey consisted of six parts: 1) completion of the consent process, 2) a background questionnaire, 3) a short video, 4) an instrument to measure knowledge about TBI, 5) an instrument to measure attitudes towards individuals with TBI, and 6) two questions related to intended information-seeking behaviors. To complete the consent process, the consent form was displayed as the first page of the survey. Participants read the form and answered a set of three questions to ensure comprehension of the information. After answering these questions correctly, a survey question asked participants whether they agreed to participate. Selection of “yes” for this item constituted informed consent and allowed participants to access the remainder of the survey. See Appendix 1 for the full text of the consent form.

All participants completed the background questionnaire immediately after providing consent. Participants then viewed one of two videos which were embedded into the electronic survey: an educational video about TBI for those in the experimental group or a video unrelated to TBI for participants in the control group. Participants who completed the paper survey were prompted to alert a research assistant after finishing the background questionnaire. The research assistant then aided the participants in watching the videos on a laptop computer. Participants listened to the audio using headphones and were instructed on how to adjust the volume. In addition, closed captioning was available for participants with hearing impairments or who requested it due to difficulty hearing the audio.

Once they finished watching the video, participants completed the knowledge and attitude measures. The order of these tasks was counter-balanced such that half of the participants did the knowledge measure first and the other half did the attitude measure first. Finally, all participants answered the two questions on intended information-seeking behaviors. All of these tasks will be discussed in greater detail in the following sections. After completing the entire study, participants were compensated with a drawstring backpack. In addition, participants were given the opportunity to sign up for free electronic newsletters from the Brain Injury Alliance of Minnesota and to receive free educational materials about TBI.

Experimental Measures

Background questionnaire. Each participant completed a set of questions related to his or her background. A full list of these items can be found in Appendix 2.

Five of these items relate to basic demographic information, including age, education level, gender, place of residence, and zip code. Four additional items were included to allow for statistical control of a variety of variables that could impact the participants' ability to complete the survey. These items included whether participants had any history of learning disability or other neurological impairment. In addition, because data collection was conducted at the state fair, participants were asked to disclose the amount of alcohol they had recently consumed so that intoxicated participants could be excluded. Finally, participants indicated whether they considered English to be their primary language.

The last questions included on the background questionnaire related to participants' experience with brain injury. Participants first indicated whether they had ever had a concussion or a more severe brain injury. Next, participants answered questions relating to whether any immediate family, extended family, or close friends had ever had a brain injury. Additionally, they indicated whether they had any professional experience working with individuals with brain injury. Although the text of each item refers to "brain injury" rather than "traumatic brain injury," a research assistant informed participants during the consent process that the study was specifically interested in their experiences with TBI.

TBI knowledge questionnaire. Knowledge about TBI was assessed using a modified version of the Common Misperceptions about TBI questionnaire (CM-TBI). The precursor to the CM-TBIm was developed by Gouvier et al., (1988) and was adapted into its current form by Springer et al. (1997). The measure consists of 40 true or false statements about brain injury, and participants indicate their level of agreement with each statement. Nearly every published study on brain injury knowledge has used either the entire CM-TBI or a modification of it.

Although this measure has been the standard to measure TBI knowledge over time, this questionnaire has limitations. The most important limitation is that a number of researchers have expressed concerns about the ambiguity of certain items. For this reason, Willer et al. (1993) selected only a set of nine of the original items that a group of neuropsychologists considered least ambiguous. Similarly, Springer et al. (1997) selected 24 items they judged to be least ambiguous and then modified the wording to improve clarity. Farmer and Johnson-Gerard (1997) administered these same items to a sample of rehabilitation professionals, many of whom specialized in TBI. Despite the changes to improve clarity, several items still had relatively high misconception rates among these experienced professionals. The authors suggested that one explanation for the high misconception rates might be persistent ambiguity with the wording of these items.

To assess the validity and structure of the CM-TBI, Linden et al. (2013) conducted a factor analysis of the instrument. Results suggested that the CM-TBI contains four factors related to recovery, brain injury sequelae, insight, and hidden injury, instead of the original 5-factor structure. Furthermore, they suggested dropping 20 items that did not load onto any of these factors. Interestingly, many of the dropped items were those that previous studies suggested may be ambiguous. Inspection of each item on the CM-TBI reveals that one possible reason for this ambiguity is that some of the items could be answered differently depending on whether a respondent considered an uncomplicated mild TBI versus a moderate or severe injury (e.g., “recovery from a brain injury is usually complete in 5 months;” “when people are knocked unconscious, most wake up shortly with no lasting effects”).

For this study, CM-TBI was modified to attempt to compensate for these ambiguity issues. Despite Linden et al.’s (2013) suggestions to drop 20 specific items, items were selected from the full version of the CM-TBI. Because Linden et al.’s factor analysis was based on a sample of educators in Great Britain, it is not clear whether results would generalize to the general public of the United States. Furthermore, Linden et al. modified the CM-TBI for pediatric TBI. Therefore, it is not certain if the same factor structure would hold for the adult version of the TBI. To reduce ambiguity, questions were divided according to whether they apply to TBI in general or to moderate or severe TBI only. Those items deemed most ambiguous based on previous research and subjective impression were eliminated. Additionally, other items were eliminated to reduce the amount of time it took participants to complete the study. These dropped items included those deemed redundant or that had low misconception rates in previous studies.

The modified version of the CM-TBI (termed the “CM-TBIm”) containing 20 items, can be found in Appendix 3. A screenshot of selected items is shown in Figure 1. This figure also displays the response method participants used. As per Linden et al.'s (2013) suggestion, participants used a 5-point scale (true, probably true, don’t know, probably false, false) to respond to each item. The inclusion of a “don’t know” option eliminated the need for participants to guess if they are unsure of the correct answer and allowed for analysis of both accuracy and certainty.

Attitude questionnaire. To measure attitudes about TBI, participants completed a modified version of the Multidimensional Attitudes Scale Towards Persons with Disabilities (Vilchinsky, Werner, & Findler, 2010). This scale was originally developed to assess attitudes towards individuals with physical disabilities. It consists of a brief vignette, which describes a social situation in which a hypothetical person (“Michelle” or “Joseph”) is out to lunch with friends. The vignette states that a person in a wheelchair joins the group. Michelle/Joseph is introduced to this new person. Next, the rest of the group leaves, leaving only Michelle/Joseph and the person in the wheelchair together at the table.

The instrument prompts participants to imagine this situation, and then rate the likelihood that Michelle/Joseph would experience a set of 22 affective, cognitive, and behavioral responses toward the person in a wheelchair. For the affective component of the scale, respondents rate the likelihood that Michelle/Joseph would experience twelve different affective states related to various negative feelings (e.g., depression), emotional stress (e.g., tension) and positive feelings (e.g., calmness). The cognition component of the scale consisted of 5 statements about the person with disability (e.g., “S/he seems to be an interesting guy/girl.”). Respondents again rate their level of agreement with each statement. Finally, for the behavior section of the scale, respondents rate the likelihood that Michelle/Joseph would take each of five different actions (e.g., read the newspaper, move away, find an excuse to leave). The original version of the MAS employed 5-point Likert Scales for each of the items.

This scale was chosen for several reasons. First, because there is no standard instrument to measure attitudes about TBI, it was necessary to critically review all of the available scales (including those adapted for TBI and those used to study attitudes towards disability more generally) to determine the most appropriate instrument for the purposes of this study. Unfortunately, each of the attitude measurement scales used in previous research on attitudes towards brain injury suffer from significant limitations. For example, some of the scales contained items so extreme that they lack sensitivity to more subtle negative attitudes and/or are likely to be very susceptible to response bias from normative pressures. To illustrate, Redpath and Linden (2004) used an adaptation of the Prejudice Evaluation Scale, which was originally developed to measure attitudes about individuals with AIDS (Kelly, St. Lawrence, Smith, Hood, & Cook, 1987). The adapted instrument asked participants to rate their agreement with items such as "[a hypothetical man with brain injury] deserved to die" and "suicide might be the best solution for [the hypothetical man with brain injury]" (Redpath & Linden, p. 869). Other scales included items that confound information about brain injury attitudes with information about brain injury knowledge. Linden and Crothers' (2006) scale contained the following items: "People with brain injury can be confused," "People with brain injury can be unpredictable," and "People with brain injury are a danger to themselves." High levels of agreement with these types of items certainly could indicate negative attitudes about individuals with brain injury. However, it is also true that people with severe brain injuries (especially in the acute stages) might be confused and/or unpredictable due to poor emotional regulation and impaired executive functions. If these impairments are severe enough, it is also possible that individuals may require some degree of supervision for their own safety. Therefore, it is difficult to determine whether high agreement on these items indicates good knowledge about more severe symptoms of TBI versus negative attitudes towards people with TBI. Still other measures lacked a referent or context in which participants made their ratings (e.g., a hypothetical case or vignette). Without this context, participants could have been rating vastly different things (e.g., a specific person they knew with brain injury, a public figure with brain injury, a media portrayal of brain injury, etc.) Therefore, it is uncertain whether the results accurately represent public attitudes of brain injury, as a whole.

Because of these limitations with scales previously used to study attitudes towards brain injury, it was necessary to adapt a scale designed for use with other populations. There are a multitude of different scales available for measuring attitudes towards individuals with disability. However, many of these measures lack sound psychometric properties (Findler, Vilchinsky, & Werner, 2007) and theoretical rationale. For example, many scales commonly used in disability attitude research are univariate, in that they do not contain items designed to assess each of the three components of an attitude. In addition, other scales commonly include items that are either very extreme or cannot be easily adapted for use with attitudes about TBI. For example, the “Attitudes Towards Disabled Persons” scale (Yuker, Block, & Younng, 1966), one of the most commonly used measures, asks respondents to rate how likely they agree with the following statement: “disabled people do not become upset any more easily than non-disabled people.” If respondents report that they disagree, it is viewed as an indication of negative attitude. However, because difficulty with emotional regulation is commonly associated with TBI, the validity of this item (and others like it) would be suspect.

The Multidimensional Attitudes Scale Towards Persons with Disabilities (MAS) avoids many of these limitations. It is a multidimensional scale with adequate internal consistency, face validity, and construct validity (Findler et al., 2007; Vilchinsky et al., 2010) and contains items easily adaptable for TBI. The items also describe more subtle types of negative attitudes, such as feelings of tension or shyness. As a result, participants may feel less pressure to respond in a socially acceptable manner and responses may therefore be less prone to bias. In addition, the measure is an “indirect” measure, in that respondents are not asked to directly rate their own emotions, thoughts, and behaviors. Instead, they have to “project” their attitudes onto a hypothetical third person (i.e., Michelle or Joseph). In a review of various attitude measurement scales, Antonak & Livneh (2000) suggest that this type of task has a considerably lower likelihood of “conscious response distortion” and therefore is less biased than direct measures in which participants report their own attitudes (p. 216). Nevertheless, the measure does require participants to consciously reflect on each response, so it is not truly a measure of implicit attitudes. However, because McLellan et al. (2010) found evidence that the public demonstrated more negative *explicit* versus *implicit* attitudes towards brain injury, it was not deemed necessary to use a truly implicit task, such as the IAT. Furthermore, the vast majority of the previous literature employed only explicit measures and still found evidence of negative attitudes. Therefore, it is reasonable to assume that attitudes towards individuals with brain injury are not highly sensitive, and therefore appropriate to measure explicitly.

The original version of the scale was modified in several important ways for the current study. First, the vignette was changed to describe someone with a TBI, rather than someone in a wheelchair. Secondly, the gender of the hypothetical person was matched to the gender of the participant, so that the vignette described a same-sex interaction for all participants. In addition, a “gender-neutral” vignette was developed for participants who chose not to provide their gender. A third modification related to the response method. Rather than using the original 5-point Likert scales, participants used a visual analog scale (shown in Figure 2), to allow for increased response specificity. Finally, subtle modifications to the instructions and wording of several items were made to increase their relevance for the population of interest. For example, the behavioral item “Dwell on reading the newspaper or *talking* on a cell phone” was changed to “Dwell on reading the newspaper or *using* a cell phone” to allow for the possibility that participants might use other cell phone applications. See Appendices 4, 5, and 6 for the modified versions of the MAS used in this study for female participants, male participants, and participants who did not specify their gender.

Intended information-seeking behavior questions. For the final measure, participants answered two questions about their intended behavior. First, participants were asked if they would like to receive additional educational materials to learn more about TBI. Secondly they were asked if they would like to sign up to receive free newsletters from the MN Brain Injury Alliance. These newsletters contain education about brain injury as well as information about how to get more involved in brain injury advocacy. It should be noted that these questions referred only to the *intention* to receive education or sign up for the newsletters. Although participants were given the opportunity to actually take more information and sign up for the newsletters after finishing the survey, their responses on the survey (not their actual behaviors) were the scored measures. Because behavioral intentions are thought to be strong predictors of actual behaviors (Fishbein & Ajzen, 1975), they are commonly used in attitude research as a proxy for measuring actual behavior. In the current study, it would have been difficult to keep accurate records of participants' actual information-seeking behavior in the context of a busy state fair building.

Videos

Educational video. The educational video was developed specifically for the current project. Based on the literature reviewed regarding improving knowledge and changing attitudes, the video consisted of a combination of education about brain injury and indirect contact with individuals with TBI. To select the information to include in the video, a three step process was used. First, the findings and recommendations of the body of literature on public knowledge about brain injury were reviewed. For each study, the items/topics for which participants demonstrated the lowest accuracy were identified. Next, these items were compared across studies to create an aggregated list of the most consistently challenging items/topics. Unfortunately, because the video needed to be kept to a relatively short duration, it was not possible to include education about each of these items. Therefore, the third step was to analyze this list to identify a smaller set of the most critical items. Although this task was inherently subjective, the most critical topics were those for which widespread misinformation was judged to be most deleterious for individuals with TBI. These topics centered on 5 themes: definition of TBI (including "concussion" and explanation of severity levels), prevalence/incidence, coma, brain injury consequences (especially "hidden" consequences), and recovery.

After identifying these themes, interviews were conducted with two TBI experts and four individuals with TBI. Each interview was conducted by the first author and a professional videographer. The TBI experts were asked factual and opinion questions directly relating to each of the five themes. Interviews with the individuals with TBI were less structured to allow the individuals to tell their own brain injury "stories." However, a basic set of questions and prompts was developed to help guide the interviews as needed. See Appendix 7 for a list of these questions. Once all six interviews were completed, the footage was edited to select excerpts that best addressed the five themes. In addition, some additional information was presented in text format embedded into the video. Some of the information contained in this video directly addressed specific items on the CM-TBI. Other information, however, only indirectly related to CM-TBI items or did not relate specifically to any of the CM-TBI items. The final version of the video was approximately six minutes and twenty seconds. This video is available online at the link presented in Appendix 8.

Control video. The control video used in this study was one developed by the University of Minnesota Academic Health Center (and used with its permission). It was filmed at the Minnesota State Fair and discusses exercise and healthy eating choices. This video was selected for several reasons. First, the video is engaging and relates both to the university and the state fair, thus increasing the likelihood that participants would watch the entire video. It is also approximately the same length as the TBI video, to control for any confounding effects of fatigue or depleted attentional resources. Most importantly, the video is completely unrelated to TBI (or any other disability). Therefore, it is unlikely that it would affect participants' responses on any of the other experimental tasks. See Appendix 8 for a link to this video.

Analyses

CM-TBIm scores. Raw scores on the CM-TBIm were calculated for each item and for each participant using the conventions described in Linden et al. (2013). Using this system, each item was assigned a score of 1-5 (1= true, 2 = probably true, 3 = don't know, 4 = probably false, 5 = false) based on the participant's responses. To calculate *participant scores*, true items were then reverse scored, such that a score of "4" or "5" always indicated a correct response. Scores on each of the 20 items were summed to create a total score for each participant. Total scores range from 20-100, with low scores indicating poor knowledge and high scores indicating good knowledge about TBI. This scale also takes participants' confidence in their answers into account. For example, a participant who answered correctly, but less confidently (i.e., a "4"), to all items would have a total score of 80. A participant who confidently answered all items correctly (i.e., a score of "5") would have a total score of 100. Similarly, a participant who confidently answered all items incorrectly would have a total score of 20. A participant who less confidently answered all items incorrectly would be given a score of 40. To calculate *item scores*, participants' responses were recoded using a 3-point scale: correct (scores of "4" and "5"), uncertain (score of "3"), and incorrect (scores of "1" and "2"). The average percent correct, uncertain, and incorrect for each item were then calculated.

MASm scores. Raw scores on the MASm consisted of integer numbers between 0 and 101, corresponding to the location to which participants moved the slider on the VAS scale on the computer screen. Alternatively, for those participants who completed the MASm on paper, the raw score corresponded to the location of the participants' responses on the VAS line, measured in millimeters. Preliminary analyses of the MASm responses revealed a substantial amount of missing data, which was not the case for the other measures. Upon further inspection, it became clear that these missing data were likely the result of an oversight in the creation of the electronic survey. The default setting of the slider on the VAS line was at the "0" point (labeled "Not at all" on the survey). To rate the item as anything more that "not at all," participants needed to move the slider to the left. However, if they intended to rate the item as "not at all," it was not necessary to move the slider. Therefore, these responses were coded as missing data by the survey program, because the participant did not move the slider. As a result of this issue, true missing data and these "not at all" responses were conflated.

To address this problem, an algorithm was created to determine whether responses coded as missing data likely reflected actual missing data versus "Not at all" responses. Figure 3 displays a decision tree illustrating this algorithm. First, if a given participant did not move the slider for over 66% of the items on the entire MASm, all of the missing items were coded as true instances of missing data. Similarly, if a participant did not move the slider for at least 3 of the 12 items on the emotion subscale, all missing responses were coded as missing data. This criterion was developed because this scale consisted of nine negative affect items and three positive affect items. Therefore, it was reasonable to assume that participants might move the slider for the positive items, but respond “not at all” to all nine of the negative items.

A similar rule was not possible for the cognition and behavior subscales, because the subscales only contained items with the same valence (i.e., positive items for the cognition subscale and negative items for the behavior subscale). Therefore, it was plausible that participants could answer “not at all” to all of the items on a given subscale. Therefore, a two part rule was employed. First, if participants had all missing data for *either* the cognition or behavior subscale, they needed to move the slider for at least two items on the opposite subscale. In addition, the general pattern of responses needed to make sense. For example, if the participant intended to respond “not at all” to all of the positive cognition items, it would follow that participants would likely rate the negative behavior items more highly. Although this procedure still resulted in a greater proportion of missing data for the MAS than for the other measures, it did result in a large amount of MASm data being retained, overall. Prior to applying the algorithm, approximately 24% of the data was coded as missing. After using the algorithm, only about 4% of the data was coded as missing. This is much more in line with the percent missing data for the CM-TBIm items and intended information-seeking behavior questions (0.6% and 0.3% missing data, respectively).

Following analysis of the missing data, a series of additional measures were taken to prepare the MASm data for analysis. Because the VAS line was a different length on the electronic versus paper survey, raw scores were standardized by transforming them to the proportion of the line corresponding to the participants' responses. Next, items reflecting positive attitudes (i.e., calmness, relaxation, serenity, and each of the cognition items) were reverse scored for consistency with the other items. As a result, transformed scores ranged from 0 to 1, with scores less than 0.5 corresponding to more favorable attitudes and scores above 0.5 corresponding to more negative attitudes. These transformed scores were then used in two ways for the subsequent analyses. First, mean scores were calculated for each of the 22 items on the MASm for each group. Secondly, the raw scores were submitted to an exploratory factor analysis to further examine the structure of the instrument and to reduce the data from the 22 items into a smaller, more manageable, number of factors for use in regression analyses.

The most recent version of the MAS is purported to contain five principle components relating to negative affect, interpersonal stress, calm, positive cognitions, and distancing behaviors (Vilchinsky et al., 2010). However, it was not clear whether these factors would hold for the modified version used in this study. As a result, a maximum likelihood exploratory factor analysis using promax rotation with five factors was conducted. Although orthogonal rotation is used more commonly-used in factor analyses in the social sciences, it does not allow factors to be correlated with one another. Conversely, promax rotation is a form of oblique rotation, which allows for correlated factors. Osborne and Costello (2005) argue that oblique rotation is more appropriate for behavioral data, since it is unlikely that the data can be “partitioned into neatly packaged units that function independently of one another” (p.3).

To determine the number of factors to extract, a scree test and parallel analysis were employed. The scree test produces a graph that displays the eigenvalues of the correlation matrix plotted in descending order. To determine the optimal number of factors to extract, it is necessary to locate the point at which the resulting curve flattens out. The number of factors to extract is equivalent to the number of points above this point (Osborne & Costello, 2005). Using parallel analysis, the eigenvalues of the data are compared with eigenvalues produced from completely random data sets. The optimal number of factors to extract is defined as the number of factors for which the eigenvalues are greater than what would be predicted from the random data (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Figure 4 shows the scree plot with a superimposed parallel analysis. Examination of the scree plot indicates that the curve appears to flatten out at the sixth point, suggesting that five factors should be extracted. The red dotted line in the plot corresponds to the expected eigenvalues that would be obtained from random data. Because five points are located above this line, results of parallel analysis also suggested extracting five factors.

Table 7 presents the results of the exploratory factor analysis of the MASm scores. The five-factor model accounted for approximately 56% of the variance in scores. Factor 1 accounted for 14.5% of the total variance, with Factors 2 through 5 accounting for 14.3%, 10.4%, 10%, and 6.6% of the total variance, respectively. Several of the factors were correlated (see Table 8), indicating that the use of oblique rotation was warranted. Scores for the five factors were calculated for each of the participants. These scores ranged from -4.4 to 3.9, with lower scores indicating more positive attitudes and higher scores indicating more negative attitudes.

These factor scores were used in the multiple regression modeling analyses discussed later in this paper. To improve the ease of interpretation for these regression analyses, it is necessary to examine the structure of each factor in greater detail. Although there is considerable variation in the research literature, Hair, Anderson, Tatham, and Black (1998) suggest that while 0.3 is often considered to be the "minimum" factor loading, loadings above 0.4 are more meaningful. For this reason, 0.4 will be considered the cut-off level for an item to be considered to load onto a given factor. Using this criterion, seven items loaded onto Factor 1, five items loaded onto Factor 2, three items loaded onto Factors 3 and 4, and two items loaded onto Factor 5. No items cross-loaded to multiple factors using a criterion of 0.4. However, using a lower criterion of 0.3, three items cross-loaded onto two factors.

Analysis of the items that loaded strongly onto each of the five factors suggests a slight departure from the results for the original MAS. The factors of "Positive Cognition" and "Calm Affect" described by Vilchinsky et al. (2010) are equivalent to Factors 2 and 3 in the current analysis. Therefore, these same terms will be used to describe these factors. Vilchinsky et al.'s "Negative Affect" factor is very similar to Factor 1. However, Vhilchinsky et al.'s model contained an additional factor termed "Inter-personal Stress." In the current analysis, some of these inter-personal stress items loaded onto Factor 1, while others did not load strongly onto any factor. As a result, the term “Negative Affect” will be used to describe Factor 1, with the caveat that it is not directly comparable to this factor in the former model. Finally, Vilchinsky et al.’s “Distancing Behavior” factor corresponds to a combination of Factors 4 and 5. Three of the behavior items (“Get out,” “Move away,” and “Move to another table”) load strongly onto Factor 4, while the other two (“Find an excuse to leave” and “Dwell on reading the newspaper or using a cell phone”) load onto Factor 5. These latter two items appear to be more “polite” forms of distancing behavior that may reflect a more covert attempt to avoid social interaction. For the purpose of this analysis, Factor 4 will be termed “Overt Avoidance Behavior” and Factor 5 will be termed “Covert Avoidance Behavior.”

Statistical analysis overview. A number of statistical analyses were conducted to test each of the primary research aims, using the statistical program R (R Core Team, 2013). First, individual items on both the CM-TBIm and MASm were analyzed. To compare performance between groups for each item, a series of chi-square analyses and independent samples t-tests were conducted for the CM-TBIm and MASm, respectively.

Next, a number of linear regression models were conducted to identify predictors of knowledge and attitude scores. For the knowledge regressions, total score on the CM-TBIm served as the dependent variable. Independent variables for all linear regressions included group (control vs. experimental) and the demographic variables: years of education, age, gender (male vs. female; two cases of non-specified gender were coded as missing), and residence (urban, suburban, rural). Four dichotomous brain injury experience variables were also included in the model: personal history of brain injury, immediate family member history of brain injury, extended family or close friend with history of brain injury, and professional experience with brain injury (positive history vs. no history for each variable). The "personal history" variable included individuals who reported having had either a concussion, a more severe brain injury, or both. Because very few participants in our sample reported having a personal history of severe brain injury, it was necessary to create this aggregated variable for all statistical analyses. In addition, history of learning disability (positive history vs. no history) and neurological impairment (positive history vs. no history) were also included for statistical control. Finally, the interaction of group with all the demographic and brain injury experience variables with group were considered if their inclusion resulted in a significant improvement in the model's overall fit.

For the attitude regressions, factor score was used as the dependent variable, and separate models were run for each of the five factors. All of the independent variables described in the preceding paragraph were also used in the attitude regression models. However, to assess whether knowledge about TBI was associated with attitudes, CM-TBIm score was also entered as an additional predictor.

Finally, two logistic regression models were run to determine whether attitudes or any other variables predict intended information-seeking behaviors. In these models, the dependent variable was participants' responses on each of the two information-seeking intended behavior questions, coded as "0" for "yes" responses and "1" for "no" responses. Because the primary research question was to determine the relationship between knowledge, attitudes, and intended information-seeking behavior, the primary independent variables of interest included group assignment, total score on the CM-TBIm and scores for each of the five factors on the MASm. However, to control for effects of demographics and brain injury experience, these variables were also included in the model. Interactions of these variables with group were not included.

Results

Knowledge about Traumatic Brain Injury

Performance on the CM-TBIm. The percent correct, incorrect, and uncertain for each of the 20 items on the CM-TBIm are shown in Table 9. Scores are displayed separately for the control group and for the experimental group. The control group's scores are more likely to be reflective of the general population because they did not view the educational video, so their scores will be reported first. Averaging across all items on the CM-TBIm, the control group's accuracy was 68%. Certain items were answered correctly by a majority of participants in the control group; five items were answered correctly by over 90% of the control group participants and an additional seven items were answered correctly by at least 70% of participants. Conversely, other items had substantially lower accuracy. For example, less than 10% of control group participants answered Item 10 correctly ("People who have survived a brain injury can forget who they are and not recognize others, but be normal in every other way.") and less than 40% recognized that a complete recovery from a severe brain injury is not possible (Item 16). The two items relating to coma (Items 6 and 7) were also difficult for participants in the control group, with only 34 and 46 percent accuracy, respectively. In addition, although approximately half of the control group participants correctly indicated that Item 9 ("A person with brain injury may have trouble remembering events that happened before the injury, but usually does not have trouble learning new things.") was false, over a third of the sample did not realize that new learning is a challenge for individuals with brain injury.

Because the experimental group viewed the educational video prior to completing the CM-TBIm, differences in scores between the two groups reflect the contribution of the video to knowledge about TBI. Comparisons between the two groups can be seen numerically in Table 9 and graphically in Figure 5. A series of chi-square analyses were conducted to compare the proportion of participants in each group who answered each item accurately (i.e., had a score of "4" or "5" on the item). The experimental group's accuracy on twelve items was significantly different than that of the control group. For nine items, the experimental group demonstrated a greater proportion correct than the control group. However, for three additional items the control group actually outperformed the experimental group. These items will be discussed in greater detail in the discussion section.

Predictors of CM-TBI score: Following the analysis of individual items on the CM-TBIm, a multiple regression analysis was conducted to determine whether group assignment and/or any of the demographic and experience variables were associated with higher TBI knowledge. Participant scores on the CM-TBIm were entered as the dependent variable into the model. Independent variables included group, the demographic variables (education, age, gender, and residence), control variables (history of learning disability and neurological impairment), and brain injury experience variables (personal, immediate family, extended family/friend, or professional experience). Initially, the model also included the interaction of all the categorical variables with group. However, a comparison of the models with and without these interaction terms suggested that inclusion of the interaction terms did not significantly improve the fit of the model ($F(9,302) = 1.044$, $p = 0.405$). Therefore, only the results of the simpler model will be presented. Figure 6 contains to diagnostic plots for this simpler model to assess whether the model meets the statistical assumptions for a multiple regression model. More specifically, the first plot displays the model's residuals plotted against the fitted values. This plot is useful to assess whether the assumption of constant variance of the residuals is met. Because the trend line is flat and the points are evenly distributed, the model meets this assumption. The Q-Q plot in the second pane evaluates the requirement that residuals are normally distributed. Although there is some evidence of slight inconsistency with the normal distribution at the tails of the distribution, the overall pattern suggests that the model meets the assumption.

Results of the multiple regression analysis are displayed in Table 10. Three variables emerged as significant predictors of CM-TBIm score: group assignment ($F(1,336) = 52.41$, $p < 0.0001$), years of education ($F(1,336) = 13.76$, $p = 0.0002$), and professional experience ($F(1,336) = 6.92$, $p = 0.009$). For this sample, the mean score on the CM-TBIm was 77.05 for participants in the control group and 82.44 for participants in the experimental group (see Figure 7). Controlling for all the other demographic and background experience variables included in the regression model, participants who view the educational video can be expected to score of approximately 5.7 points higher on the

CM-TBIm than the participants who do not view the video. A higher number of years of education was also associated with higher CM-TBIm scores. Interpretation of the education coefficient in the model suggests that for each one year increase in education, individuals can be expected to have a score increase of approximately 0.6 points.

Raw data illustrating the relationship between education level and CM-TBIm score are presented in Figure 8. As can be seen in this figure, the point corresponding to the participant with the highest education level appears to be a potential outlier. To determine whether the results of the regression model were overly influenced by this data point, the regression model was rerun without the data for this participant. Results were nearly identical to the original model, suggesting that the outlier did not substantially influence the relationship between knowledge and education level.

Finally, controlling for group assignment and the other demographic and experience variables, individuals with professional experience can be expected to score nearly 2.5 points higher on the CM-TBI than individuals without professional experience. Because the inclusion of group interaction terms did not improve the model, viewing the educational video was associated with higher CM-TBI scores, even for participants with professional experience with TBI. Nevertheless, in the regression model containing interaction terms, there was a tendency that assignment to the experimental group was associated with a smaller increase in expected score for participants with professional experience than for individuals without professional experience. This tendency is shown in Figure 9. In this sample, experimental group participants with professional experience scored an average of 3 points higher than control group participants with professional experience. However, assignment to the experimental group was associated with a 6.4 point increase in scores for participants without professional experience.

Attitudes towards Individuals with Traumatic Brain Injury

Performance on the MASm. Average scores on the MASm, expressed as a mean proportion of the VAS line, are shown in Table 11. Because all items phrased positively were reverse scored, higher scores indicate a greater likelihood that participants expected the hypothetical person in the vignette to experience negative emotions, cognitions, and behaviors. Overall, participants in both groups expressed largely positive emotions, with only four items rated at above 0.5 (i.e., the midpoint of the VAS line). These emotions included pity, relaxation, calmness, and serenity. Similarly, participants in both groups rated the five cognition items positively, with only a single item (“We may get along really well.”) with a mean score above 0.5 for the control group only. No behavioral items had a mean score above 0.5, indicating that participants believed the hypothetical person in the vignette would be relatively unlikely to engage in avoidant behaviors towards a person with TBI. Because this measure purports to indirectly measure the participants’ own attitudes, it appears that participants in this sample demonstrate relatively positive attitudes about individuals with TBI, on the whole. A series of independent sample t-tests were conducted to compare performance on each item between groups. Only a single item (rejection) differed between groups (t = -2.654, df = 340.644, p = 0.008). Mean scores for both groups indicated participants expected that the hypothetical person in the vignette would be unlikely to experience an emotion of rejection. However, the mean score was slightly higher for participants in the experimental group, indicating a mildly less positive attitude.

Predictors of MASm factor scores. A series of linear regression models were run for each of the five factors that emerged from the factor analysis of the MASm. Initially, a Multivariate Analysis of Variance (MANOVA) was planned to analyze all five factors in a single model. Because promax rotation, which was used in the factor analysis, allows factors to be correlated, a MANOVA would be able to account for any correlation among the factors. However, preliminary analyses of the actual factor scores for each participant revealed Pearson correlation coefficients that were relatively small. Figure 10 present the correlation matrix of the factor scores. Generally, MANOVA is recommended when the dependent variables are moderately correlated between 0.3 and 0.7 (Tybout et al., 2001). Only three correlations were at 0.3 or higher (Factors 1 and 5 at -0.34, Factors 2 and 3 at -0.33, and Factors 3 and 5 at -0.30), with the remainder ranging between absolute value 0.027 and 0.145. Because most of these correlations were negligible, five separate regression analyses were conducted instead of a MANOVA to increase the ease of interpretation.

For each factor, two separate models were run: a simple model and a full model with interaction terms. In the simple models, participants' factor scores were entered as the dependent variable. Independent variables included group, CM-TBIm score, the demographic variables (education, age, gender, and residence), control variables (history of learning disability and neurological impairment), and brain injury experience variables (personal, immediate family, extended family/friend, or professional experience). For the full models, the interactions of all demographic and brain injury experience variables with group were also included. Analyses of variance were then conducted to compare the simple models with the full models. For each of the five factors, these analyses indicated that the full model did not significantly improve the fit of the model ($p = 0.335$, $p = 0.412$, $p = 0 .473$, $p = 0.353$, $p = 0.065$ for Factors 1-5, respectively). For this reason, results of only the simple models will be presented in the following sections.

Factor 1: Negative Affect. Table 12 presents the results of the linear regression model for Factor 1 and Figure 11 displays diagnostic plots for the model. Inspection of these plots reveals that both the assumptions of constant variance and normal distribution of the residuals are met. The model was significant ($p = 0.008$), but only accounted for approximately 4.8% of the variance in Factor 1 scores (*multiple* $R^2 = 0.086$, *adjusted* $R^2 = 0.048$). Three variables significantly predicted Factor 1 scores: group ($p = 0.028$), age ($p = 0.026$), and professional experience ($p = 0.013$). The significant coefficient for group suggests that controlling for all other variables, participants in the control group can be expected to score 0.287 points lower than participants in the experimental group. Because lower factor scores indicate more positive attitudes, this suggests that participants in the control group are expected to have more positive attitudes than participants who viewed the educational video. This effect is shown graphically in Figure 12. Results for the effect of age are shown in Figure 13. As can be seen in the plot, the positive coefficient indicates that as age increases, so too do expected scores for Factor 1. This suggests that older adults may be more likely to express negative affective responses in response to the social scenario contained in the MASm. It should also be noted, however, that the variability in expected scores was also greater at both ends of the age distribution. Finally, the significant effect of professional experience is shown in Figure 14. Controlling for all other variables, Factor 1 scores for participants without professional experience with brain injury can be expected to be 0.358 points lower than those of participants without such experience, indicating more favorable attitudes. It should be noted, however, that although each of these effects is statistically significant, the effect sizes are small. Because factor scores ranged from 3.09 to 3.87, the expected score differences between groups, professional experience, and across age are relatively slight. Furthermore, because the entire model only accounted for a small amount of the variance in Factor 1 scores, there are likely other factors that predict scores but were not captured by the model.

Factor 2: Calm Affect. The results of the linear regression model and diagnostic plots for Factor 2 are shown in Table 13 and Figure 15, respectively. The diagnostic plots reveal that there is no major evidence against the assumptions of constant variance and normal distribution of the residuals. Overall, the model was not significant (*multiple* $R^2 = 0.045$, *adjusted* $R^2 = 0.0056$, $p = 0.325$) and none of the variables were significant predictors of Factor 2 scores. Because less than 1% of the variance in scores was accounted for, it appears that responses of calm affect in response to the hypothetical situation in the vignette must be related to factors other than the demographic, brain injury experience, and brain injury knowledge variables used in this study.

***Factor 3: Positive Cognition*.** Full details of this model are shown in Table 14.

Overall, the model accounted for only a small, non-significant proportion of the total variance (*multiple* $R^2 = 0.055$; *adjusted* $R^2 = 0.016$, $p = 0.157$), and none of the independent variables emerged as significant predictors of factor scores. However, inspection of the diagnostic plots for this model suggests that this model does not meet the standard assumptions for a linear regression model. Pane a. of Figure 16 of displays a plot of the model residuals against the fitted values. Because the trend line of the data is relatively flat, it is reasonable to assume that this assumption is met. However, inspection of the Q-Q Plot in pane b. reveals that there the model fails to meet the requirement that residuals be normally distributed. This graph displays the standardized residuals plotted against the theoretical quantiles that would be achieved from a perfectly normal distribution. Because the tail ends of the distribution fall below the diagonal, the residuals are not normally distributed, and the confidence intervals for the variables in the model are likely too conservative.

To determine whether overly conservative confidence intervals were contributing to the lack of significant findings in the original model, a box cox transformation was conducted. This type of transformation involves raising the value of the dependent variable to a given exponential power to increase the likelihood that the model will meet the assumption of normality of the residuals (Box & Cox, 1964). Results of the box cox analysis suggested that a transformation of the dependent variable to the second power was reasonable in this case. Therefore, the regression model was re-run, using the square of the Factor 3 scores as the dependent variable. Inspection of the diagnostic plots for the transformed regression (see Figure 16, panes c. and d.) suggests that this model meets the assumption of constant variance of the residuals. Although the Q-Q plot in pane d. suggests some deviation of the residuals from the normal distribution, it represents a considerable improvement over the original model. Nevertheless, the model still only accounted for a negligible proportion of the variance (*multiple* $R^2 = 0\ .063$, *adjusted* $R^2 = 0.025$), and none of the independent variables emerges as significant predictors of the transformed Factor 3 scores. Therefore, it appears other variables not accounted for in this model must be important for predicting attitudes relating to positive cognitions.

Factor 4: Overt Avoidance Behavior. The regression model predicting Factor 4 scores was significant and accounted for approximately 4% of the variance in scores (*multiple* $R^2 = 0.078$, *adjusted* $R^2 = 0.040$, $p = 0.018$). Further details are presented in Table 15. The only variable that significantly predicted Factor 4 scores was gender. As can be seen in Figure 17, the expected score for male participants is 0.415 points higher than that of female participants. This suggests that males may have more negative attitudes related to overt avoidance behaviors. Due to the low proportion of variance accounted for, there are likely other variables that were not included in this model that are also important for predicting attitudes related to overt avoidance behaviors.

Inspection of the diagnostics plots (see Figure 18, panes a. and b.) suggests there is some evidence that the residuals are not normally distributed. Because the tails of the distribution fall above the diagonal, this may result in the model producing confidence intervals that are too liberal, thus increasing the possibility for Type 1 error. For this reason, a box cox analysis was conducted to determine if a transformation would improve the fit of the model. This analysis suggested a logarithmic transform (i.e., y^0) was appropriate, and the model was rerun using the log of the Factor 4 scores as the dependent variable. Diagnostic plots for the transformed model (see panes c. and d. of Figure 18) indicate that the transformation resulted in residuals that better approximate a normal distribution. However, the results of this model were nearly identical to the non-transformed model, both in terms of variance accounted for (*multiple* $R^2 = 0.077$, *adjusted* $R^2 = 0.039$, $p = 0.02$) and the significant effect of gender. Therefore, it is not the case the violation of the assumptions resulted in Type 1 error.

***Factor 5: Covert Avoidance Behavior*.** Results of the final linear regression model for the MASm are reported in Table 16. The model was significant and accounted for 6.78% of the variance in Factor 5 scores (*multiple* $R^2 = 0.105$, *adjusted* $R^2 = 0.068$, $p < 0.001$). Model diagnostic plots, shown in Figure 19, indicate both the assumptions of constant variance and normal distribution of residuals are met. Although there is some deviation from the normal distribution in the lower tail of the distribution, it is a close enough approximation for the purposes of this model.

Two variables emerged as significant predictors of Factor 5 scores: age ($p < 0.001$) and total score on the CM-TBIm ($p = 0.041$). The negative coefficient for age indicates that for every one year increase in age, the expected Factor 5 score decreases by 0.016 points (see Figure 20). In other words, we can expect older participants to be less likely to endorse covert avoidance behaviors in response to the social scenario on the MAS than younger participants. In contrast, the slope for the effect of CM-TBIm score was positive, indicating that expected scores on Factor 5 increase as TBI knowledge increases (see Figure 21). This finding was contrary to expectations and indicates that participants with greater knowledge about TBI also are expected to be more likely to report covert avoidance behaviors.

Information-Seeking Behaviors

Overall, the percent of participants who responded "yes" to the questions related to intended information-seeking behaviors was low. Results will be reported separately for Question 1 ("Would you like more information about brain injury to take with you") and Question 2 ("Would you like to sign up to receive free newsletters from the MN Brain Injury Alliance?"). Only 28% of participants in the control group and 29% of participants in the experimental group answered "yes" to Question 1. Even fewer participants indicated that they wanted to sign up to receive free newsletters from the Minnesota Brain Injury Alliance; only 15% of participants in both groups answered "yes" to this question.

To determine the relationship between knowledge, attitudes, and intended information-seeking behaviors, a logistic regression analysis was run for each question. Results of these analyses are displayed in Tables 17 and 18. The model for Question 1 had significantly better fit than the empty model ($\chi^2 = 39.588$, $df = 18$, $p = 0.002$). Three variables emerged as significant predictors of participants' responses: Factor 3 score, Factor 5 score, and age. The odds ratio corresponding to Factor 3 score is 1.363 (*95% CI*: 1.027, 1.809), which indicates that increasing Factor 3 score by 1 point increases the odds of answering "no" by 0.36, if all other variables are held constant. In other words, as scores increase on the Calm Affect factor (i.e., indicating participants would report a lower likelihood of experiencing calmness, serenity, and relaxation while interacting with someone with TBI), they can be expected to become less likely to desire additional information about TBI. The odds ratio for Factor 5 is 1.381 (*95% CI*: 1.003, 1.910), indicating that a one point increase in Factor 5 score increases the odds of answering "no" by 0.38. Therefore, as participants indicate a greater likelihood of engaging in covert avoidance behaviors, they also become less open to receiving education about TBI. Although the primary aim was not to predict responses based on the demographic variables, the odds ratio for age is 0.978 (*95% CI:* 0.962, 0.995), suggesting that for every one year increase in age (with all other variables held constant), the odds of answering "no" decrease by approximately 0.022. Among these participants, only 17% of adults younger than 30 wanted additional educational materials, whereas 49% of adults aged 60 and older requested these materials. Figures detailing the effects of Factor 3, Factor 5, and age are shown in Figures 22, 23, and 24.

The model for Question 2 had significantly better fit than the empty model (χ^2 = 31.668, *df* = 18, *p* = 0.024). Two variables significantly predicted responses: Factor 3 and Factor 5 scores. The odds ratio for Factor 3 was 1.549 (95% CI: 1.109, 2.165) and the odds ratio for Factor 5 was 1.659 (*95% CI*: 1.091, 2.524). These findings indicate that for every 1 point increase in Factor 3 and 5, the odds of a "no" response increased by approximately 0.55 and 0.66, respectively (controlling for the other variables). Therefore, we can expect more negative attitudes on the Calm Affect and Covert Avoidance

Behavior factors to be associated with a smaller likelihood that individuals would want to receive educational newsletters. See Figures 25 and 26 for plots of these effects.

Because each of these logistic regression models contained a large number of factors, it is possible that some of the significant findings may actually reflect Type I error due to the large number of statistical tests that were performed. To evaluate whether this occurred in these data, backward selection logistic regression models were performed for each question, using the Akaike Information Criterion (AIC). This method begins with the full model with all the independent variables and sequentially removes variables to determine the most parsimonious model. The AIC allows comparisons between the models based on their fit, while also penalizing models based on the number of variables included. By using the AIC (rather than statistical tests) to compare the models, the concern regarding Type 1 error from multiple statistical tests is avoided. For Question 1, the model that resulted from using backward selection resulted in the same significant predictors (Factor 3, Factor 5, and age) as the full model. Furthermore, the estimates were quite close. For Question 2, the model resulting from backward selection had three significant variables: Factor 3, Factor 5, and history of neurological impairment. Again, the estimates for Factors 3 and 5 were similar. Therefore, it appears unlikely that the significant results in the full models reflect Type I error.

Discussion

This study aimed to answer four sets of research questions related to public knowledge about TBI, public attitudes towards individuals with TBI, the relationship between attitudes and intended information-seeking behavior, and the impact of providing the public with education about TBI. The overall pattern of results indicates that although the general public continues to demonstrate a number of misconceptions about TBI, attitudes towards individuals with TBI may be generally favorable, at least in certain contexts. The links between public knowledge, attitudes, and information-seeking behaviors were not as strong as hypothesized, but providing the public with education about TBI was an effective means of improving knowledge. Each of these aims will be discussed in further detail in the following sections.

Research Aim 1a: Determine the level of public knowledge about TBI and interpret it in relation to previous research

Previous research suggests that the general public holds a great deal of misconception and inadequate knowledge about TBI, especially with regard to terminology, the scope and timeline of recovery, the nature of “hidden” impairments, and unconsciousness (Ralph & Derbyshire, 2013). However, much of this research was conducted more than a decade ago, thus necessitating an updated description of TBI knowledge. The current study hypothesized that participants would endorse misconceptions about brain injury at a relatively high rate. However, in recent years, the issue of TBI has received considerable attention from mainstream and social media sources, particularly in relation to concussions resulting from sports injuries and combat-related blasts in veterans. As a result of this increase in media coverage and public awareness, it was also predicted that participants would demonstrate better knowledge about certain items, especially those related to mild traumatic brain injury.

In general, these hypotheses were supported. Participants in the control group responded to the items on the CM-TBIm with an average accuracy of only 68%. Furthermore, eight items were answered correctly by less than 70% of the participants in the control group. This suggests that the general public continues to endorse a number of TBI misconceptions, despite the recent increase in public awareness of TBI.

It should also be noted, however, that accuracy of individual items varied considerably; while the lowest item had only 8% accuracy, five items were answered correctly by over 90% of participants in the control group. One of these five items related to mild TBI ("A head injury can cause brain damage even if the person is not knocked unconscious"). Interestingly, three of these items related to hidden impairments. Participants in the control group displayed good knowledge that individuals with TBI can experience changes in personality or may feel depressed, sad or hopeless. The vast majority of participants also recognized that it is not obvious that someone has had a TBI from their physical appearance. This suggests that participants in this sample were knowledgeable about at least some of the hidden consequences of TBI. However this knowledge appears incomplete; the item with the lowest accuracy also related to hidden impairments, albeit indirectly. Approximately 92% he participants incorrectly reported that people with TBI could have complete amnesia, but be completely normal in every other way. This indicates poor awareness of the type of memory deficits that typically occur after TBI (i.e., greater impairment in memory of new information versus remote information). Furthermore, if someone with TBI exhibited so profound a deficit in memory that he or she could not remember basic biographical information, he or she would most almost certainly experience deficits in other cognitive domains, such as attention, reasoning, and information-processing.

In addition to determining the overall level of TBI knowledge in this sample, a related aim of this study was to compare results from this study to those reported in previous research to identify any changes in TBI knowledge over time and across different geographic locations. The most useful comparisons include the Gouvier et al. (1988) survey which reflects the earliest description of TBI knowledge among the American general public, the Hux et al. (2006) study which provides the most recent description of the American public's knowledge (using the CM-TBI), and the Chapman et al. (2010) survey which is the most recent English-language replication of the CM-TBI (conducted in Great Britain).

Unfortunately, however, there are several challenges to comparing results across studies. First, not all of the comparison studies included all of the CM-TBIm items that were used in the current study. Another challenge is that several modifications were used in this study. One modification involved the response method. In each of the comparison studies, participants indicated whether statements were true (or probably true) versus false (or probably false). The percentage of participants who answered the item incorrectly was termed the "misconception rate." In the current study, an option for "don't know" was also given to differentially measure misconception versus uncertainty. Therefore, each item has both a "misconception rate" and an "uncertainty rate." As a result, many of the items in the currently study have misconception rates that are lower than those of the comparison samples. However, if the misconception and uncertainty rates are considered together, the results look similar.

Another modification involved changes to the wording for certain items to reflect more updated terminology. For example, Item 2 was originally phrased “Most people with brain damage look and act retarded” by Gouvier et al., and was rephrased as “… look and act disabled” by Hux et al. (2006) and Chapman et al. (2010). In the current study, it was phrased as “It is obvious that someone has brain damage because they look and act different from people who don't have brain damage" in accordance with the wording proposed by Springer et al. (1997). A final modification that limits comparisons across studies is that participants were instructed to consider only a moderate or severe TBI when responding to the last six items on the CM-TBIm. The purpose of this modification was to reduce ambiguity of items that may have different answers depending on the severity of the injury. Therefore, direct comparisons across studies must be interpreted with caution.

Despite these caveats, several conclusions can be drawn by comparing the current study to the results of these prior studies. First, results for several items suggest that knowledge among this sample is better than that of participants in previous samples. To illustrate, Item 12 (“People who have had one brain injury are more likely to have a second one.”) had a misconception rate of approximately 33% for participants in the control group, with an additional 19% indicating they did not know the answer (i.e., the uncertainty rate). This misconception rate is considerably lower than that reported in previous studies, which ranged from 68% (Hux et al., 2006) to 89% for members of the public in Great Britain (Chapman & Hudson, 2010). Even when the uncertainty rate is added to the misconception rate, participants in the current study still demonstrated better knowledge on this item. Therefore, it appears that the public may becoming more knowledgeable that have one TBI is a risk factor for having a subsequent one. One potential explanation for this finding is that a number of cases of chronic traumatic encephalopathy (CTE) were reported in the national media in the months prior to data collection (e.g., coverage of CTE among former National Football League players). This coverage may have increased awareness about the incidence and severity of subsequent TBI after an initial injury.

Similarly, results for Item 14 (“How quickly a person recovers depends mainly on how hard they work at recovering.”) revealed promising improvement compared to results from previous research. Approximately 70% of participants in the control group answered this item correctly, with misconception and uncertainty rates of roughly 19% and 11%, respectively. In comparison, misconception rates for the Hux et al. (2006) and Gouvier et al. (1988) samples were 52% and 70%, respectively. Therefore, it appears that the public may be gradually becoming more aware that hard work is not the primary determinant of recovery. Although hard work is certainly important, research suggests that variables related to severity of initial injury tend to be some of the strongest predictors of outcomes (e.g., Catroppa, Anderson, Morse, Haritou, & Rosenfeld, 2008; Cifu et al., 1997; Sigurdardottir, Andelic, Cecilie, & Schanke, 2009; Steyerberg et al., 2008). In addition, factors such as baseline level of function, severity of resulting impairments, degree of social support, and access to services also greatly impact the recovery process. This finding has important potential implications for supporting recovery of individuals with TBI. If the public believes that effort is the largest predictor of recovery, they may falsely attribute residual deficits to a lack of effort or "laziness" (Hux et al., 2006), rather than an unavoidable consequence of the injury. In turn, this misattribution could lead to negative attitudes towards individuals with TBI and/or reduced opportunities (e.g., social, vocational, academic opportunities, etc.).

Improvement was also observed for Item 2 ("It is obvious that someone has brain damage because they look different from people who don't have brain damage"). As mentioned earlier, participants in the control group answered this item with very high accuracy (98%), with misconception and uncertainty rates of only 1%. Previous studies revealed considerably higher misconception rates: 6% for the sample in Hux et al. (2006), 8% for the members of the general public in Great Britain (Chapman & Hudson, 2010), and 31% for participants in the original Gouvier et al. (1998) sample. Thus, it appears that the public has become increasingly aware that TBI is frequently a "hidden" disability.

Despite this evidence of improvement over time, there were also items for which there was no substantial change across studies or for which knowledge actually decreased compared to previous research. In general, items with the lowest accuracy were similar to those that were also most challenging for participants in previous studies. For example, two items related to memory deficits had low accuracy in the current study. Item 10 ("People who have survived a brain injury can forget who they are and not recognize others, but be normal in every other way.") had a misconception rate of 73% and an uncertainty rate of 19%. Considering these two rates together, 92% of participants in the control group did not know that this item is false. This figure is similar to the misconception rates reported in the most recent comparison studies (93% and 91% for Hux et al. (1996), and Chapman and Hudson (2010), respectively). Interestingly, this misconception rate is higher than the 82% rate reported in Gouvier et al. (1988).

A similar pattern was observed for Item 9 ("A person with brain injury may have trouble remembering events that happened before the injury, but usually does not have trouble learning new things."). Roughly 35% of control group participants answered incorrectly, with an additional 14% indicating uncertainty about the correct answer. The combined figure of 49% is similar to the misconception rate for Hux et al. (48%). Conversely, it is higher than that of Gouvier et al. (43%), but lower than the figure reported in Chapman and Hudson (69%). Therefore, while this U.S. sample may have greater knowledge than the public in Britain, it does not appear that knowledge has improved substantially in recent years. However, it should be noted that different wording was used in the current study. While the gist of the item was the same, it is possible that the change in wording may have influenced accuracy.

In considering these results for Items 9 and 10, it appears that misconceptions relating to memory loss after TBI are particularly persistent, despite public education and awareness campaigns. One possible explanation is that amnesia is commonly used as a plot device in films and television shows. In a review of films containing characters with amnesia, Baxendale (2004) concluded:

> In the real world, post-traumatic amnesia is common after a head injury, and deficits in the learning and retention of new information are often seen the early stages of recovery. In the movies, however, head injuries often result in a profound retrograde amnesia with the capacity for new learning left completely intact (p. 1483).

Baxendale (2004) further reported that these inaccurate depictions began as early as 1915 and continue to frequently appear in entertainment media. Of the films reviewed, only three depicted realistic images of amnesia. Research from other fields suggests that these inaccurate media portrayals have the power to influence both public knowledge and attitudes. For example, there is evidence to suggest that inaccurate scientific information contained in entertainment media results in inaccurate knowledge about scientific phenomena (Barnett et al., 2006) and that inaccurate portrayals of individuals with mental illness may lead to more negative public perceptions of mental illness (Wahl, 1992). As a result, it seems reasonable to expect that as long as entertainment media continues to misrepresent the nature of memory deficits after TBI, public misconceptions will continue to abound.

In addition to the items on amnesia, two questions related to coma have also been relatively impervious to change over time. Item 6 ("People in a coma are usually not aware of what is happening around them.") had a combined misconception and uncertainty rate of 65.5% in the current study, which is similar to the 60% misconception rate in Hux et al. (2006) and 58% rate in Chapman and Hudson (2010), but higher than the 32% rate reported by Gouvier et al. (1988). Likewise, Item 7 ("Even after several weeks in a coma, when people wake up, most recognize and speak to others right away.") had a combined misconception and uncertainty rate of 54%, which is higher than that reported in each of the comparison studies (41% in Gouvier et al.; 24% in Hux et al.; and 47% in Chapman & Hudson).

Item 6 relates directly to the definition of “coma.” The high misconception rate suggests poor understanding among the public that by definition, individuals in a coma are in a prolonged state of unconsciousness in which they lack any response to external stimuli. Moreover, the public appears to lack awareness that emergence from coma after a TBI is typically a gradual process, rather than a discrete event. As this process progresses, individuals become increasingly responsive and able to meaningfully interact with people and objects in the environment. Public awareness and education campaigns typically do not include education about coma, so it is not surprising that knowledge about coma has not improved. However, it is not clear why knowledge on this item appears to have decreased since the original public knowledge survey.

One possible explanation for the apparent decline in knowledge relates to how scientific research is translated for the general public. With recent advances in brain imaging and research into disorders of consciousness, there has also been an increase in efforts to convey this information to the general public by mainstream media. However, in a review of such attempts, Samuel and Kitzinger (2013) argue that research is often misrepresented and the terminology used to describe various disorders of consciousness (e.g., coma, persistent vegetative state, minimally-conscious state, etc.) is frequently confused. To illustrate, they cite several news articles that framed recent fMRI research as a “medical miracle” that allowed researchers to “read” the minds of individuals in comatose states to allow them to “speak.” Samuel and Kitzinger further argue that while the purpose of such misleading articles might be to inspire hope, they also “evoke unrealistic visions of recovery” (p. 1) and ignore the limitations of scientific research.

Finally, the accuracy of one additional item relating to recovery does not appear to have changed substantially compared to previous research. Item 16 (“Complete recovery from a severe brain injury is not possible, no matter how badly a person wants to recover.”) had a misconception rate of 39% and an uncertainty rate of 25% among the control group in the current study. The combined misconception and uncertainty rate falls between the 58% misconception rate reported in Gouvier et al. (1988) and the 70% and 73% rates of Hux et al. (2006) and Chapman and Hudson (2010). Nevertheless, the misconception rate on its own is notably lower. Unfortunately, because previous research didn’t assess certainty, it is difficult to determine whether any change has occurred over time.

The low accuracy on this item likely reflects a combination of factors. First, hope for full recovery may serve an adaptive purpose for individuals with severe TBI and their families. The *possibility* for a full recovery may help motivate individuals as they work through the recovery process and reduce feelings of loss or depression. Secondly, it is possible that agreement or disagreement with this statement may be associated not only with knowledge about TBI, but also with religious, cultural, or personal beliefs and attitudes. For example, individuals with strong religious convictions might disagree with this item due to faith in the idea that anything is possible with the aid of a higher power. This possibility is supported by the findings of Pappadis et al. (2011) that TBI misconception rates were higher among participants who were actively practicing a particular religion (predominantly Christianity in their study). Thirdly, a final possibility is that the “black and white” nature of the wording of this item introduces ambiguity. Individuals may recognize that complete recovery from a severe TBI is highly improbable, but they may not want to rule it out as a rare exception.

Therefore, although the answer to this item is technically “true,” (Gouvier et al., 1988), it may be more beneficial to consider participants’ responses to this item as an indication of their attitudes, rather than a metric of their lack of knowledge. Regardless, public views toward this item have important ramifications for individuals with TBI. As mentioned earlier, this view may lead the public to believe that someone with residual deficits after a TBI simply did not want to recover badly enough. Similarly, it may result in unrealistic expectations about recovery that may prove maladaptive in the long term.

Research Aim 1b: Identify predictors of TBI knowledge

Based on the results of previous research, it was hypothesized that the demographic variables of age, education level, gender, and place of residence would not predict knowledge about TBI. Conversely, it was expected that experience with TBI, including personal history of TBI, having an immediate family member with TBI, or professional experience with TBI would be associated with better knowledge. These hypotheses were partly supported. As anticipated, most of the demographic variables did not predict CM-TBIm scores. However, results suggested that a higher level of education was associated with better scores. Intuitively, this finding makes sense. More highly-educated participants might be more likely to have received some kind of education about brain injury during the course of their academic careers. They may also be more likely to seek out information about the topic on their own. As mentioned earlier, the previous literature was divided on this topic, with some studies showing that education level predicted knowledge and others demonstrating no relationship. One potential reason for the significant finding in the current study relates to the way that education level was measured. While previous studies treated education level as a categorical variable (e.g., high school versus college education), it was treated as a continuous variable in the current study. Rather than arbitrarily dividing participants into groups of “low” versus “high” education, our analyses used the raw number of years of education. Therefore, it is possible that the current study was able to detect more subtle education-related differences in knowledge.

Contrary to expectations, neither personal history nor family/friend history of TBI predicted CM-TBIm scores. Many of the prior studies also failed to establish a link between this kind of personal experience and TBI knowledge. However, because they only measured TBI experience very broadly (i.e., by aggregating any type of personal, family, or friend history of TBI into a single dichotomous variable), it was hypothesized that the variable was not sensitive enough to detect meaningful differences in knowledge. For this reason, the current study measured experience with TBI more specifically, using three separate variables to indicate whether a participant had personally sustained a TBI, knew a friend or extended family member with TBI, or had an immediate family member with TBI. However, none of these variables predicted knowledge. As a result, these findings indicate one of two possibilities: 1) that personal experience with TBI truly does not result in any better knowledge about TBI, or 2) the CM-TBIm does not adequately measure the type of knowledge that is gained as a result of having personal experience with TBI. Of these two alternatives, the latter appears much more probable. The CM-TBIm only provides a very coarse-grained picture of knowledge. It does not reveal knowledge about more nuanced aspects of TBI consequences and recovery that could be gained through experience. Therefore, it is realistic to predict that a more detailed instrument of TBI knowledge might reveal a significant relationship between personal experience and knowledge. Nevertheless, the first option should not be ignored. If individuals with experience with TBI truly do not demonstrate adequate knowledge, this might indicate that health care providers and other related professionals are not doing an adequate job of educating patients and their families after TBI.

As anticipated, professional experience working with individuals with TBI did emerge as a significant predictor of knowledge. However, although this effect was statistically significant, its magnitude was relatively small. Controlling for all other variables, the regression model predicted that participants with professional experience would score 2.5 points higher than those without professional experience. This small effect is not particularly surprising, given that professional experience was measured broadly. The degree, type, and context of the professional experience likely varied widely among participants. Previous research suggests that the amount of professional experience matters. For example, Farmer and Johnson-Gerard (1997) observed that health-care providers with extensive TBI experience demonstrated better knowledge than educators who had only incidental interaction with students with TBI. Similarly, educators with some experience teaching students with TBI outperformed those who had never taught a student with TBI (Linden et al., 2013). Therefore it seems likely that the benefit of professional experience exists on a continuum. If the background questionnaire had measured the *amount* and *nature* of professional experience in a more detailed manner, a stronger effect might have resulted.

Research Aim 2a: Describe public attitudes towards individuals with TBI by reporting and interpreting descriptive statistics for the control group's performance on the MASm

Based on the small amount of previous research on public attitudes towards individuals with TBI, it was hypothesized that participants in the control group would endorse some degree of unfavorable attitudes. Contrary to expectations, however, attitudes expressed using the MASm were largely positive. Overall, participants were unlikely to expect that a hypothetical person engaged in a social situation with a stranger with TBI would experience a range of negative emotions. Results also indicated that they expected the hypothetical person would be unlikely to engage in avoidance behaviors, but would be somewhat likely to think a number of positive thoughts about the person.

On the other hand, scores for several items indicated less favorable attitudes. As discussed earlier, raw scores on the MASm range from 0 to 1. A score of 0.5 indicates neither positive nor negative attitude on a given item, while scores below 0.5 indicate more favorable attitudes and scores above 0.5 reflect more negative attitudes. Each of the three items on the Calm Affect factor had mean scores above 0.8, suggesting that participants did not expect this type of social situation to result in feelings of relaxation, calmness, or serenity. This finding is difficult to interpret. The items of "stress" and “tension” did not load onto the Calm Affect factor, and both had mean raw scores slightly below 0.5. In other words, participants were somewhat unlikely to think the person in the vignette would experience stress or tension. Therefore, it is possible that participants might expect the person to experience an neutral emotional state, in which he or she is engaged or potentially experiences some degree of unease, but is neither relaxed nor stressed by the situation. The low score on the “Alertness” item (i.e., indicating the person would be likely to feel alert) supports this possibility.

Another item with a mean score above 0.5 was the emotional experience of “pity.” The concept of pity is a complicated emotional experience. On one hand, pity is sometimes considered a positive emotional reaction. In the mental illness literature, pity has been linked with more supportive responses and greater willingness to interact with individuals with mental illness (Corrigan, Markowitz, Watson, Rowan, & Kubiak, 2003). In this sense, it is contrasted with feelings of anger and fear, which result in less willingness to help people with mental illness.

However, other scholars argue that pity is a negative emotion, because it places the person feeling pity in a position of superiority over the person who is pitied. Smith (2000) classifies pity as a “downward” emotion, because it is directed toward someone less fortunate. Empathy, on the other hand, is characterized as a lateral emotion because it emphasizes the kinship or similarity between two people. Similarly, Fiske, Cuddy, Glick, and Xu (2002) conceptualize pity as a form of “paternalistic prejudice.” They argue that pity is typically directed at a person (or group) that is viewed as warm, but incompetent. Furthermore, people or groups that are pitied often have low-status and are seen as noncompetitive. Common examples include the elderly and people with disabilities (Fiske et al., 2002).

Therefore, while pity may not be the most-damaging negative attitude that the public could endorse, high levels of pity may contribute to prejudice and stigma in more subtle ways. On the other hand, a complete lack of pity could result in poor support for individuals with TBI. In the current study, the mean score for pity was only slightly above the mid-point (0.553). However, scores varied considerably across participants along the entire range of the scale, so it is not surprising that the average score would be near the midpoint. It is possible that scores might have differed depending on participants' interpretations of "pity." To illustrate, 27 participants had quite low scores on this item (i.e., below 0.2, indicating that they would not expect someone to feel pity towards the person with TBI in the vignette). Some of these participants might not have endorsed feelings of pity, because they view individuals with TBI as equals, rather than as incompetent and inferior. Conversely, other participants could have equated pity with empathy. In that case, low ratings could be due to a lack of compassion. The fact that pity did not load strongly onto any of the five factors on the MASm supports this explanation. In this sense, the MASm does not explain the *reason* for low versus high scores. To fully explore these possibilities, a qualitative study approaching the issue using a phenomenological approach would be more illuminating.

Despite these few exceptions, it was surprising that attitudes were so favorable on the whole. This finding conflicts with the previous research that suggests the public holds negative attitudes towards individuals with TBI (e.g., Ralph & Derbyshire, 2013) and that

TBI is associated with stigma and shame (Simpson et al., 2000). However, given that the vast majority of research on public attitudes was conducted overseas, it may be the case that those findings do not generalize to the American public. It is also possible that attitudes have improved over time. Nevertheless, these findings do conflict with research that Americans with TBI often report that others do not understand their problems (Kennedy, Krause, & O'Brien, 2014). Anecdotally, many Americans with TBI report that this lack of understanding leads to negative attitudes and poor social support.

One possible explanation is that the MASm is not an ideal indicator of attitudes. Because no measures have been developed specifically for use in TBI, the MASm was modified from an instrument designed to assess attitudes towards individuals with physical disabilities. As a result, it has never been validated for the current purpose. The MASm only measures attitudes in the context of a relatively simplistic social situation. Consequently, it may not be sensitive to more subtle forms of negative attitudes that affect integration and acceptance in more complex situations. It could also be the case that the public demonstrates positive attitudes in low-stakes, short-term social situations like the one described in the MASm vignette. However, unfavorable affective, cognitive, and behavioral responses might be more prevalent during interactions with individuals with TBI in long-term, high-stakes contexts (e.g., the workplace).

A second possibility relates to the fact that the MASm is an indirect measure of attitudes. This means that participants were not asked to directly report their own attitudes. Instead, they were asked to imagine a scenario in which a hypothetical person was engaged in a social situation with someone with TBI. Participants were asked to rate the likelihood that this hypothetical person would experience each of the affective, cognitive, and behavioral responses. The intention behind using this approach was that indirect measures are thought to be less susceptible to bias from normative pressures. However, one drawback is that this method may have conflated two different types of responses. Some participants likely responded as the measure intends: by imagining themselves into the social situation and projecting their own attitudes onto this hypothetical person. In contrast, other participants could have rated the items based on how they thought *other* members of the public might respond. In this case, the responses would be less an indicator of public attitudes and more an indicator of *perceptions* of public attitudes. There is evidence that individuals express more positive views towards people with brain injury when asked to describe the perceptions of *others* in society compared to when they are asked to describe their own perceptions. For example, Linden & Boylan (2010) asked participants to explain how they would describe individuals with brain injury and how they thought other members of society would describe individuals with brain injury. Participants only used negative words (e.g., “sad” and “handicap”) in their own descriptions, but used both positive (e.g., “brave” and “strong”) and negative words to explain how others might describe people with TBI.

A final possibility is that one of two types of biases influenced participants’ ratings. First, although an anonymous, indirect method was used, it is still possible that response bias from normative pressure influenced ratings. If participants were concerned about the social desirability of their responses, scores could be overly low. Secondly, the current study was almost certainly affected by sample bias. The study was conducted in a research building at the fair in which at least six other studies were also recruiting participants. The participants who chose to participate in this particular study (as opposed to others in the building) may have had a disproportionately high interest in the topic of TBI and/or more favorable attitudes towards TBI than the general public.

Research Aim 2b: Identify predictors of attitudes about individuals with TBI

TBI knowledge. It was anticipated that higher knowledge would be associated with more favorable attitudes. However, CM-TBIm scores did not predict scores for the Negative Affect, Calm Affect, Positive Cognition, or Overt Avoidance Behavior factors. CM-TBIm score did significantly predict scores on the Covert Avoidance Behavior factor, but the effect was in opposite direction as expected. Higher knowledge was associated with higher expected factor scores. It is not clear why participants with better knowledge would indicate a greater likelihood of engaging in covert avoidance behaviors. However, it should be noted that the size of the effect was quite small. The estimate of the effect for CM-TBIm indicated that for every one point increase in CM-TBIm score, the Covert Avoidance Behavior factor score increased by 0.016. Given that scores on the factor had a spread of over 5 points, 0.016 reflects only a small percentage of this range. Therefore, although the effect is statistically significant, it is less clear if it is conceptually meaningful.

Experience with TBI. Another hypothesis was that having experience with TBI would be predictive of more positive attitudes. However, personal, friend, or family member history of TBI failed to predict any of the five factors. Only professional experience significantly predicted a single factor. Controlling for all other variables, participants with professional experience had expected Negative Affect scores that indicated more negative attitudes than participants without professional experience. Intuitively, this result is surprising. One might expect that professionals working in careers that involve interactions with individuals with TBI would have more positive attitudes. However, Redpath et al. (2010) reported the similar result that more experienced doctors and nurses endorsed more prejudicial attitudes towards individuals with TBI than less experienced doctors and nurses. As mentioned in the results section, the size of the effect for professional experience was small. Controlling for all other variables, individuals with professional experience only scored about 0.358 points higher than those without professional experience. Negative Affect scores had a range of nearly 7 points, so 0.358 is not a substantial difference on the whole.

One possible explanation for this finding is that a single item might be driving the results. To evaluate this possibility, post-hoc analyses of raw scores for each of the items that loaded highly onto the Negative Affect factor were conducted. Comparisons of mean raw scores between professional experience groups revealed a consistent pattern. Descriptively, the mean score for participants with professional experience was higher than the mean score for participants without professional experience for every item. Furthermore, this difference reached statistical significance (at $\alpha < 0.05$) for three of the seven items: Upset, Tension, and Stress. Therefore, it appears that participants with professional experience working with individuals with TBI demonstrate a subtle, but consistent pattern of negative affective attitudes. Continued research is needed to further investigate the reason for these attitudes among professionals. One possibility is that providing rehabilitation, education, and other services can be very challenging due to the complex and variable impairments that often result from TBI. These professional challenges could result in negative feelings (such as stress), that in turn affect attitudes related to social interactions with individuals with TBI.

Demographic variables. Based on previous research, it was not anticipated that demographic variables would be strong predictors of attitudes. This hypothesis was supported. Only three significant effects emerged. Age predicted Negative Affect and Covert Avoidance Behavior scores. *Older* age was associated with higher (i.e., more negative) expected Negative Affect scores, while *younger* age was associated with higher expected Covert Avoidance Behavior scores. Finally, being male predicted higher Overt Avoidance scores (i.e., greater likelihood of engaging in overt avoidance behaviors).

As with the other significant predictors, effect sizes were relatively small. Therefore, the real-world importance of these results is unclear. Furthermore, the MASm did not include a control vignette that described a social interaction with a stranger who did *not* have TBI. As a result, it is impossible to determine whether the results reflect attitudes directed towards interacting with a stranger *with TBI* or towards interacting with *any* stranger. If the results indicate the latter, it is not surprising that younger adults would be more likely to engage in covert avoidance behaviors, such as dwelling on using a cellular phone. Considering the high use personal electronic devices among younger adults, it is entirely possible that these types of behaviors are much more socially appropriate among younger generations that among older generations. Therefore, the results might be more indicative of changing social customs and attitudes than attitudes about TBI. Similarly, it is also possible that males are more likely than women to engage in overt avoidance behaviors, regardless of whether a stranger has a TBI.

A final caveat to these results is that each of the regression models designed to identify predictors of attitudes accounted for only a very small proportion of the variance in scores. This means attitudes may be better predicted by other variables that were not accounted for in the current study. Because the MASm assessed attitudes in relation to a social scenario, various personality variables could be acting as latent variables. For example, traits such as extraversion, openness, optimism, anxiousness, etc. could all presumably have strong effects on attitudes towards social interaction in general and towards interaction with individuals with TBI, specifically. There could also be a variety of other experiential variables (e.g., experience with other types of disabilities) that predict attitudes.

Research Aim 3: To identify the relationship between attitudes and intended information-seeking behavior

The intended information-seeking behavior questions prompted participants to indicate if they would like to receive more information about brain injury to take with them (Question 1) or if they would like to sign up for free educational newsletters (Question 2). Scores on two factors, Calm Affect and Covert Avoidance Behavior, predicted participants' responses on both questions. Results were in the expected direction; participants with less favorable attitudes were also less likely to desire additional education. Less favorable attitudes with regard to these two factors suggest a feeling of some degree of social unease during an interaction with someone with TBI.

This finding is potentially worrisome for two reasons. As discussed earlier, two of the most effective methods to change attitudes are contact and education (Allport, 1954; Corrigan & Penn, 1999; Dalky, 2012). Individuals experiencing greater social unease and increased likelihood of socially avoidant behavior might be less apt to seek out or participate in opportunities for contact with individuals with TBI, thereby reducing the potential for attitude change. Secondly, if they are also less interested in seeking out information about TBI, the potential for attitude change through education may also be low.

On the other hand, there is a possible alternate explanation for these results. The survey prompted participants to talk to a research assistant after completing the study if they answered “yes” to either question. The research assistant would then provide the educational materials and/or obtain the participants’ contact information for the newsletters. More introverted participants who indicated less calm affect and socially avoidant behaviors on the MASm might also feel less comfortable approaching a research assistant. However, this does not necessarily mean that they would not independently seek out more information about TBI. Similarly, it might be the case that these participants’ scores are more indicative of negative attitudes towards social interaction with strangers in general, rather than anything to do with TBI.

Surprisingly, none of the other factors predicted intended information-seeking behaviors. Overall, relatively few participants wanted to take information with them or to sign up for newsletters. Because the study was conducted at the state fair, it is very likely that participants did not want to carry around additional items with them all day. In addition, participants might not have felt comfortable giving out contact information in this setting. A number of participants also remarked that they already received too many e-mails. As a result, these questions may not be particularly reflective of participants' general interest in learning more about TBI.

It is also the case that the relationship between attitudes and behavior is notoriously complex. Ajzen and Cote (2008) suggest that despite the theoretical link between attitudes and behavior, a large number of empirical studies failed to demonstrate the predictive power of attitudes on behavior. In explaining this issue, they argue that there must be a degree of similarity between the attitude object and the behavior being measured. For example, they observe that there is very little empirical support that attitudes about conceptual attitude objects (e.g., a specific entity, construct, person, etc.) predict discrete behaviors. However, attitudes about a specific behavior are good predictors of whether someone will actually do that particular behavior. Therefore, as the similarity between the attitude object and the measured behavior increases, so too should the predictive power of the attitude.

The MASm does measure attitudes in relation to behaviors, at least in an indirect sense. Items loading onto Factors 2, 4, and 5 were behavioral in that they prompted participants to rate the likelihood of *doing* or *thinking* something. Although the items loading onto Factors 1 and 3 were affective, they still related to how someone might feel while doing something (i.e., interacting with someone with TBI). However, these attitude objects are quite different from the behaviors measured by the intended information-seeking behavior questions. Therefore, it is not surprising that results failed to show a strong attitude-behavior link. Based on Ajzen and Cote's (2008) framework, attitudes about signing up for email newsletters and carrying around materials at a fair would be more predictive of these behaviors. In contrast, results on the MASm should be a better predictor of behaviors had we actually set up a mock social situation similar to the one described in the MASm vignette.

Alternatively, Ajzen and Cote (2008) suggest that a stronger relationship between attitudes and behavior would have emerged had the current study used a "behavioral aggregate" measure, instead of two discrete behavior questions. A behavioral aggregate measure is defined as a "multiple-act index obtained by aggregating across a variety of behaviors involves many different actions directed at the target of interest, performed in different contexts and at different points in time" (Ajzen & Cote, p. 299). Because an aggregated measure would indicate a more general pattern of behavior towards individuals with TBI, it might correlate much more strongly with the attitudes measured using the MASm.

Research Aim 4: To determine whether exposing participants with a brief educational video will result in improved knowledge about brain injury, more favorable attitudes towards individuals with TBI, or differing intended information-seeking behavior

This study used a between groups design in which participants in the experimental group viewed an educational video about TBI and participants in the control group viewed a video unrelated to TBI. As a result, the effect of group in each of our analyses reflects the impact of viewing the educational video. The impact of group assignment on TBI knowledge, attitudes, and information seeking behavior will be discussed separately in the next three sections.

Knowledge about TBI. Participants in the experimental group scored over 5 points higher than control group participants on the CM-TBIm, indicating that the educational video was effective in improving public knowledge. This difference remained significant even after controlling for all other variables, including the demographic and TBI experience variables. Inspection of individual items reveals that the experimental group was significantly more accurate on 9 of the 20 items. Of these nine items for which the experimental group had better accuracy, four items were directly answered in the educational video. The remaining items were addressed indirectly in that the interviewees' comments more-or-less hinted at the correct responses, but did not specifically state the answer. Therefore, although it was important that the video's content relate to the CM-TBIm items, the group difference was not simply due to the fact that the video gave away the answers. Participants still had to infer the correct answers for some items based on details in the personal narratives of the interviewees with TBI.

The three items with the most striking group differences included two about coma ("People in a coma are usually not aware of what is happening around them." and "Even after several weeks in a coma, when people wake up, most recognize and speak to others right away.") and one about recovery ("Complete recovery from a severe brain injury is not possible, no matter how badly a person wants to recover."). Only 36% of participants in the control group answered the latter item correctly, while 90% of participants in the experimental group recognized that this item is true. This item was directly addressed in the video, so it is not surprising that accuracy differed between groups. Nevertheless, it is one of the most common misconceptions from previous research. As a result, it was quite promising that accuracy was so high for the experimental group. One explanation for the high accuracy relates to how this information was presented in the video. During the interviews, each of the individuals with TBI was asked to give their opinion on this item. All of them strongly agreed with the statement and were able to clearly and passionately articulate the reason for their agreement. Clips of their responses were then incorporated into the video. It is possible that this information was more powerful because it came from individuals with TBI rather than the TBI experts. This highlights the importance of including individuals with TBI in future educational efforts.

Although total scores on the CM-TBIm were higher for participants in the experimental group, it should be noted that accuracy on eight items did not differ between groups. Of the items for which there was no group difference, one was directly addressed in the video, four were addressed indirectly, and three were not addressed. In addition, the control group actually outscored the experimental group on three items. None of these items were addressed in the video.

There are two likely explanations for the poorer performance of the experimental group on these three items. One of the items ("People who have had one brain injury are more likely to have a second one.") is a relatively straight-forward fact. Because the video contained other facts about prevalence and prevention, participants may have incorrectly considered the *absence* of this information in the video as an indication of its falsehood. The other two items both deal with the level of awareness someone has about his or her injury and recovery ("Most people with brain damage are not fully aware of its effect on their behavior." and "Asking someone who has had a brain injury about their progress is the most accurate, informative way to find out how he/she has progressed."). None of the individuals with TBI shown in the video were in the acute stages of recovery. They all had considerable experience dealing with the implications of their injuries and had worked on finding strategies to compensate for the effects of the TBI. They were also very articulate and able to describe their recovery process and how the TBI impacted their lives. Indeed, these individuals were chosen specifically because of their insight into TBI. Unfortunately, an unintended consequence appears to be that it presented the incorrect notion that all individuals with TBI and/or at all stages of recovery have similarly high levels of insight into the consequences of their injuries.

Attitudes. Results failed to provide support for the hypothesis that the viewing the educational video would be associated with more favorable attitudes towards individuals with TBI. Group assignment did not predict scores for the Calm Affect, Positive Cognition, Overt Avoidance Behavior, or Covert Avoidance Behavior factors. Group assignment did predict Negative Affect factor scores, but in the opposite direction. Assignment to the experimental group was associated with higher factor scores (i.e. less favorable attitudes). However, this effect size was quite small. Controlling for all other variables, participants who viewed the video could be expected to score 0.288 points higher on this factor, which reflects a difference of only about 4% of the total range of factor scores.

Unfortunately, it is difficult to interpret the meaning of this difference in relation to the original visual analog scale on the MASm. However, inspection of raw scores suggests a similarly small difference. Participants in the control group had an average raw score of 0.29 for the items that loaded highly (i.e., above 0.4) onto this factor, while participants in the experimental group had an average raw score of 0.32. Furthermore, the only item with for which raw scores differed significantly between groups was "rejection." Again, the difference was small. Both groups had largely favorable attitudes, with average scores of 0.205 and 0.139 for the experimental and control groups, respectively. Whether this slight difference has real-world implications is unclear.

It should also be mentioned that the initial plan for analysis was to include the interaction of group with the demographic and experience variables into the regression models. Significant interactions would have provided information on whether the effect of viewing the video differed among particular subsets of participants. However, because inclusion of these interaction terms did not improve the fit of any of the models, they were dropped from the models. Although some of these interaction terms may have been statistically significant (e.g., the interaction between group and professional experience on CM-TBIm scores), the effect sizes would be so small that any differences would not be meaningful.

One possible reason why the video did not have a substantial impact on attitudes is that attitudes were generally quite favorable overall. It was hypothesized that the video might improve negative attitudes towards individuals with TBI. However, it is less certain whether such a video could make favorable attitudes even *more* favorable. Another plausible explanation is that the video was did not contain enough contact to result in any meaningful attitude change. Although previous research suggests that indirect contact (via filmed presentations) with individuals with mental illness was effective in improving attitudes (Corrigan et al., 2007; Reinke et al., 2004), each of these studies used 10 minute videos of a single person telling his or her story. The video in the current study was only approximately 6 minutes, and contained a mixture of education and contact. Furthermore, clips from 4 different individuals with TBI were included. As a result, participants only had a small amount of indirect content with each individual. It is possible that a format containing more indirect contact would have been more effective. Additionally, according to the initial formulation of the Contact Hypothesis, Allport (1954) suggested that contact should include a cooperative activity in which both participants have equal status and a shared goal. Certainly, none of these conditions were met in the indirect contact contained in the educational video used in this study.

Intended information-seeking behaviors. Group assignment did not predict responses for either of the information-seeking behavior questions. Given the lack of previous research on this topic, we had no a priori hypotheses on this research question. Given that so few participants requested additional information about TBI, it appears likely that variable(s) unrelated to TBI influenced responses. These variables likely include characteristics of both the participants and the research setting of the state fair.

Limitations

There are a number of features of the present study that limit the conclusions that can be drawn. Several of these limitations relate to the measures used. First, as mentioned earlier, the CM-TBI only provides a coarse grained picture of knowledge about TBI. Specifically, it lacks sensitivity about knowledge related to the cognitive impairments after TBI and only evaluates knowledge about recovery in a relatively simplistic way. The validity of the measure has also yet to be determined. Although it has good face validity, less is known about its content and concurrent validity. Therefore, it may be the case that it provides information about these particular facts about TBI, but is not necessarily an adequate index of TBI knowledge in a more general sense.

The MASm also poses important limitations. The most pressing of these limitations is the lack of a control vignette, which makes it difficult to determine whether the results reflect attitudes towards an interaction with a stranger with TBI versus any stranger. Information on the validity of the MASm is also lacking. Although Vilchinsky et al. (2010) examined the validity of the original version, the modified version was used in an exploratory sense in the current study. As a result, it is unknown whether the results can be generalized to other contexts besides the simplistic social scenario described in the vignette or if they correlate with other attitude measures used in the field. There also may be other affective, cognitive, and behavioral responses which would be more appropriate to measure with regard to attitudes about TBI. Finally, there was a disproportionately high proportion of missing data on the MASm. This is most likely due to the way that the electronic survey was designed. Although an algorithm was created to classify missing data points as true missing data versus ratings of “not at all”, it is possible that some responses were incorrectly classified.

The intended information-seeking behavior questions were also exploratory in nature. Behaviors related to information-seeking were selected because of their practicality in the context of the state fair. However, they are not particularly informative in determining the relationship between attitudes and real-world behaviors directed towards individuals with TBI. Unfortunately, this is a limitation of all previous research on attitudes in TBI; no studies exist that link attitudes with actual behavior.

Other limitations relate to the methods employed in this study. Because the study was conducted at the state fair, it was necessary to minimize the time it took participants to complete the study. As a result, a number of questions from the original CM-TBI were eliminated, and it was not possible to include a control vignette for the MASm. Likewise, the length of the educational video was limited to six minutes for this reason. A between-groups design was also used to shorten the completion time. In the absence of a time constraint, participants could have completed measures both before and after viewing the educational video. This type of within-groups comparison might have yielded stronger results. Furthermore, although our sample was relatively diverse, the average educational attainment was quite high and likely included individuals with a greater-than-average level of interest in the topic of TBI. Finally, the current study did not include any long-term follow-up with participants. It is not clear whether any changes in knowledge or attitudes will persist over longer periods of time.

Future Directions

Continued research on the topic of public perceptions of TBI is needed. Future research should focus on refinement of existing measures of public knowledge and attitudes and the development of new tools that are more sensitive and appropriate for use with TBI. For example, new measures should evaluate knowledge about a wider range of hidden disabilities and on their potential impact on daily functioning (e.g., academically, socially, vocationally, etc.). Furthermore, continuing research should also focus on establishing methods to measure meaningful behaviors towards individuals with TBI in naturalistic contexts. Systematic examination of the reliability, internal validity, and external validity of any new or adapted instruments should also be conducted.

Based on the results of the current study, it is also clear that continued examination of the impact of public education campaigns is warranted. Such research should address the most effective content, formats, and presentation modes of these educational materials, both in terms of improving knowledge and attitudes. Further research on the dosage and long-term effects of these campaigns is also indicated.

Finally, the finding that personal and family history of TBI did not predict knowledge or attitudes was surprising and potentially worrisome. Presumably, these individuals should have received extensive education about TBI from health-care and other service providers immediately after the injury and throughout the recovery process. The next logical step would be to explore the reason for this finding. Future studies should evaluate whether this finding stems from: 1) flawed or incomplete instruments used in the current study and in many previous studies to measure knowledge and attitudes, or 2) a breakdown in the process of patient/family education after a new TBI. If the latter alternative proves true, researchers should examine the reason for this communication breakdown to determine whether individuals with TBI and their families received insufficient education, inaccurate education, or poor recall of educational materials. Such research could inform health care providers and other professionals about how to more effectively educate these individuals.

Conclusions and Implications

One of the primary conclusions of the current research is that considerable misconceptions about TBI persist among the general public. It appears that information about TBI from a variety of sources can have important effects on public knowledge. When information comes in the form of carefully constructed public education campaigns it can result in improved knowledge. However, when information comes in certain other forms, such inaccurate portrayals of TBI in entertainment media, it may foster continued public misconception. The results of the current study support continued efforts to educate the public, especially with regard to recovery and consequences TBI.

However, all educational materials should be created with great care and pilot-tested to ensure there are no unintended effects. Findings also support the inclusion of individuals with TBI throughout the stages of planning, creating, and implementing these education campaigns.

Overall, attitudes about individuals with TBI were largely positive in the current study. Nevertheless, attitude research is inherently complex, and it would be premature to make over-arching generalizations about the nature of public attitudes based solely on these findings. This study sets the stage for continued research in this area and serves as a jumping-off point for further investigation of public attitudes, the relationship between knowledge, attitudes, and behavior, and the broader implications of attitudes about TBI.

Finally, the current study has important implications for those professionals who work with individuals with TBI, including medical professionals, rehabilitation providers, social workers, educators, etc. It is of paramount importance that these professionals provide accurate and effective education not only to individuals with TBI and their families, but also to the public at large. Such education about TBI can rectify misconceptions, foster the development of realistic expectations and assumptions about recovery, and describe concrete ways to help support recovery with the ultimate goal of improving outcomes and quality of life for individuals living with TBI.

Tables

Table 1. Summary of Previous Research on Knowledge about Brain Injury among the General Public

Study	Approach	Location	Survey, Questionnaire, or Task	General Conclusions
Gouvier, Prestholdt, & Warner (1988)	Survey	U.S.	25-item survey on brain damage, amnesia, unconsciousness, recovery, seatbelt use, and exposure to information about brain injury	• Considerable misconception about brain injury recovery, unconsciousness, and memory.
Aubrey, Dobbs, & Rule (1989)	Experiment	Canada	Likelihood judgments of physical, cognitive, and affective symptoms after TBI	• Better knowledge about physical effects of brain injury compared to cognitive effects.
Willer, Johnson, Rempel, & Linn (1993)	Survey	U.S., Canada	Selected items from the Gouvier et al. survey	• Results replicated Gouvier, et al.'s (1988) findings of considerable misconception about brain injury.
Vaughn, Frank, Leach, O'Neal, & Sylvester (1994)	Survey	U.S.	Telephone survey consisting of 108 questions on knowledge and attitudes about brain injury	• Participants (especially those who knew someone with a brain injury) overwhelmingly reported that head injury is a serious public health problem.
Guilmette & Paglia (2004)	Survey	U.S.	Selected items from the Gouvier et al. survey and 8 new items related to litigation	• Considerable misconception, especially on items relating to moderate and severe brain injury. • Age, gender, and education level were not associated with brain injury knowledge.
Hux, Deuel-Schram, & Goeken (2006)	Survey	U.S.	Selected items from the Gouvier et al. survey	• Considerable misconception about recovery, memory, and unconsciousness, but improvement compared to the sample in Gouvier et al. (1988).
Chapman & Hudson (2010).	Survey	U.K.	Selected items from the Gouvier et al. survey	• Considerable misconception about brain injury. • Higher misconceptions rates than for the American sample in Hux, et al. (2006).
McKinlay, Bishop, & McLellan (2011)	Survey	New Zealand	Questionnaire related to concussion knowledge and attitudes about brain injury	• Participants expressed uncertainty about what a concussion is and how it should be managed.
Maviş & Akyıldız (2013)	Survey	Turkey	Selected items from the Gouvier et al. survey (translated)	• Considerable misconceptions, especially on items related to recovery
Pretorius & Broodryk (2013)	Survey	South Africa	Common Misperceptions about Traumatic Brain Injury Questionnaire (Fisher et al., 1997)	• Considerable misconceptions, especially on items related to memory and unconsciousness.

Table 2. Summary of Previous Research on Knowledge about Brain Injury among Special Populations

Study	Approach	Participants	Country	Survey, Questionnaire, or Task	General Conclusions
Springer, Farmer, & Bouman (1997)	Survey	Relatives or friends of individuals with acute brain injury	U.S.	Common Misperceptions about Traumatic Brain Injury Questionnaire (CM-TBI): A 40-item survey consisting of 24 items from the Gouvier et al. (1988) survey and 16 new items	• Participants had relatively good knowledge about brain injury in general (including its significance and impact). • More misconception on certain items related to unconsciousness, memory, and recovery.
Farmer & Johnson-Gerard (1997)	Survey	Education professionals and hospital-based brain injury rehabilitation specialists	U.S.	CM-TBI	• Rehabilitation specialists demonstrated relatively good knowledge. • Education professionals demonstrated more misconceptions than rehabilitation specialists and a similar amount of misconception compared to the sample of family members in Springer, et al. (1997).
O'Jile et al. (1997)	Survey	College students with and without head injury	U.S.	Gouvier et al. survey	• Participants demonstrated fewer misconceptions compared to previous studies involving the general public. • Personal or family history of head injury was not associated with knowledge.
Simpson, Mohr, & Redman (2000)	Qualitative	Ethnicity minorities (Italian, Vietnamese, and Lebanese) with brain injury and their family members	Australia	Semi-structured interviews about knowledge of brain injury, perceptions of treatment, and cultural issues	• Wide range of knowledge about brain injury rehabilitation among participants. • Participants reported experiencing social stigma and shame as a result of brain injury.
Swift & Wilson (2001)	Qualitative	Individuals with brain injury, family members, non-medical rehabilitation professionals	U.K.	Semi-structured interviews about perceptions of brain injury knowledge and misconception among the general public and health care providers	• Four themes emerged: 1) misconceptions about timeline/extent of recovery; 2) lack of awareness of the diversity of brain injury consequences (especially cognitive and behavioral consequences); 3) misconceptions about how brain injury is distinct from other disorders such as mental illness; 4) misconceptions regarding hidden disability and physical disability.
Mackenzie & McMillan (2005)	Survey	Medical doctors, general public, individuals with mild TBI	U.K.	Symptom identification tasks in relation to a vignette detailing mild TBI	• Participants expected very few post-concussion symptoms to occur one month after a mild TBI. • Better knowledge of real post-concussion syndrome symptoms than "foil" symptoms.

Guilmette, Malia, & McQuiggan (2007)	Survey	High school football coaches	U.S.	Selected items from the Gouvier et al. survey and 6 new items related to concussion management	• Coaches demonstrated good knowledge on items related to mild TBI.
Ernst, Trice, Gilbert, & Potts (2009)	Survey	Nursing students	U.S.	Selected items from the Gouvier et al. survey and 4 new items related to pediatric brain injury	• Both new and advanced level nursing students demonstrated considerable misconception, especially on items related to memory, recovery, and unconsciousness.
Evans, Hux, Chleboun, Goeken, & Deuel-Schram (2009)	Survey	Speech-language pathology graduate students and new graduates	U.S.	Selected items from the Gouvier et al. survey and one new item related to clinical management of pediatric TBI	• Beginning students demonstrated fewer misconceptions than the general public in Hux, et al. (2006), but more misconceptions than students who had completed the graduate program.
Hooper (2010)	Survey	School psychologists	U.S.	Selected items from the Gouvier et al. survey	• Participants endorsed fewer misconceptions than the general public (Guilmette & Paglia, 2004), but still had high misconception rates for certain items, especially those related to recovery and memory.
Pappadis, Sander, Struchen, Leung, Smith (2011)	Survey	Ethnic minorities with brain injury	U.S.	CM-TBI (and a Spanish translation)	• Participants with brain injury demonstrated misconceptions, primarily related to memory and recovery. • Spanish-speakers had higher levels of misconception than ethnic minorities who were native English-speakers.
Linden,Braiden, & Miller, (2013)	Survey	Educators	U.K.	Modified version of the CM-TBI	• Considerable misconception about brain injury. • Educators with personal or professional experience with TBI had slightly lower levels of misconception.
Yuhasz (2013)	Survey	Health care professionals working in correctional facilities	U.S.	Selected items from the Gouvier et al. survey	• Fewer misconceptions than members of the general public. • Most misconception on items related to LOC, memory, and recovery.
Block et al.(2014)	Survey	Veterans and family/friends of veterans	U.S.	Survey containing selected items from the Gouvier et al. survey and the Neurobehavioral Symptom Inventory	• Poor knowledge about symptoms that are *not* typically associated with mild TBI. • Personal history of TBI and receipt of TBI education did not influence knowledge.

Table 3. Participants Excluded from Analysis

Rationale for exclusion	Number excluded
• Suspected developmental disability resulting in reduced ability to complete the survey and/or extensive missing data	2
• Self-reported or suspected alcohol intoxication	2
• Questionable English language proficiency AND self-reported residence outside the United States	1
• Underage participant who misled research team regarding age during consent process	1
• Participants requiring extensive assistance from family members to complete the survey, such that it was unclear the degree to which responses reflected the participant or the assistant's answers.	2
• Participants who completed only the demographic questions, but none of the experimental tasks	2

Table 4. Age and Education Level Characteristics of the Sample

	Mean	Min	Max	Standard Deviation
Age	43.38	18	87	17.067
Education	16.3	10	33	2.636

Note. Age and education measured in years. For reference, a high school education = 12.

Table 5. Demographic Characteristics of the Sample

	Control Group (proportion)		Experimental Group (proportion)		Entire Sample (proportion)	
Total	195	(.497)	197	(.503)	392	(1.000)
Age						
18-29	61	(0.313)	59	(0.299)	120	(0.306)
30-39	19	(0.097)	29	(0.147)	48	(0.122)
40-49	35	(0.179)	31	(0.157)	66	(0.168)
50-59	45	(0.231)	33	(0.168)	78	(0.199)
60-69	25	(0.128)	32	(0.162)	57	(0.145)
70-79	10	(0.051)	10	(0.051)	20	(0.051)
80-89	0	(0.000)	2	(0.010)	2	(0.005)
Missing data	0	(0.000)	1	(0.005)	1	(0.003)
Gender						
Male	61	(0.313)	71	(0.360)	132	(0.337)
Female	132	(0.677)	126	(0.640)	258	(0.658)
Unspecified	2	(0.010)	0	(0.000)	2	(0.005)
Missing data	0	(0.000)	0	(0.000)	0	(0.000)
Education						
< 12	1	(0.005)	2	(0.010)	3	(0.008)
12-16	54	(0.277)	50	(0.254)	104	(0.265)
16-17	69	(0.354)	76	(0.386)	145	(0.370)
18+	57	(0.292)	57	(0.289)	114	(0.291)
Missing data	14	(0.072)	12	(0.061)	26	(0.066)
Residence						
Urban	75	(0.385)	68	(0.345)	143	(0.365)
Suburban	99	(0.508)	108	(0.548)	207	(0.528)
Rural	21	(0.108)	21	(0.107)	42	(0.107)
Missing data	0	(0.000)	0	(0.000)	0	(0.000)
English as a Primary Language						
Yes	190	(0.974)	191	(0.970)	381	(0.972)
No	5	(0.026)	5	(0.025)	10	(0.026)
Missing data		(0.000)		(0.000)	1	(0.003)
Alcohol Consumption						
Yes	31	(0.159)	35	(0.178)	66	(0.168)
No	164	(0.841)	161	(0.817)	325	(0.829)
Missing data	0	(0.000)	1	(0.005)	1	(0.003)

Table 6. Learning Disability, Neurological Disorder, and Brain Injury Experience

	Control Group (proportion)		Experimental Group (proportion)		Entire Sample (proportion)	
Personal History of Learning Disability						
Yes	19	(0.097)	16	(0.081)	35	(0.089)
No	176	(0.903)	180	(0.914)	356	(0.908)
Missing data	0	(0.000)	1	(0.005)	1	(0.003)
Personal History of Neurological Disorder						
Yes	14	(0.072)	10	(0.051)	24	(0.061)
No	181	(0.928)	187	(0.949)	368	(0.939)
Missing data	0	(0.000)	0	(0.000)	0	(0.000)
Personal History of Concussion						
Yes	53	(.727)	43	(.218)	96	(.245)
With complications[1]	37	(.190)	29	(.147)	66	(.168)
Without complications[1]	16	(.082)	14	(.071)	30	(.077)
No	111	(.569)	130	(.660)	241	(.615)
Not Sure	31	(.159)	24	(.122)	55	(.140)
Missing data					0	(0.000)
Personal History of Brain Injury More Severe than Concussion						
Yes	7	(.036)	7	(.036)	14	(.036)
Requiring hospitalization	5	(.026)	6	(.030)	11	(.028)
Not requiring hospitalization	2	(.010)	1	(.005)	3	(.008)
No	188	(.964)	190	(.964)	378	(.964)
Missing data	0	(0.000)	0	(0.000)	0	(0.000)
Member of Immediate Family with Brain Injury						
Yes	76	(.390)	58	(.294)	134	(.342)
No	119	(.610)	139	(.706)	258	(.658)
Missing data	0	(0.000)	0	(0.000)	0	(0.000)
Member of Extended Family or Close Friend with Brain Injury						
Yes	91	(.467)	93	(.472)	184	(.469)
No	103	(.528)	104	(.528)	207	(.528)
Missing data	1	(.005)	0	(0.000)	1	(.003)
Professional Experience with Brain Injury						
Yes	53	(.727)	46	(.234)	99	(.253)
No	142	(.728)	151	(.766)	293	(.747)
Missing data	0	(0.000)	0	(0.000)	0	(0.000)

[1] self-reported complications such as headaches, fatigue, difficulty with concentration or memory, difficulty with balance, etc.

Table 7. Factor Analysis for MASm

	Item	Loadings				
		Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
Emotions	Depression	**.567**		-.119	.132	-.210
	Guilt	**.601**				
	Rejection	**.517**			.246	-.153
	Upset	**.774**				-.157
	Tension	**.726**		.111		.156
	Stress	**.786**				
	Shyness	**.446**			-.108	.219
	Pity	.358				.366
	Alertness	.376		-.263		
	Relaxation	.139		**.818**		
	Serenity			**.832**		
	Calmness			**.902**		
Cognitions	S/he seems to be an interesting person.		**.742**			
	S/he looks like an OK person.		**.689**			-.179
	I enjoy meeting new people.		**.790**			.197
	We may get along really well.		**.843**			.159
	S/he looks friendly.		**.856**			
Behaviors	Get out.				**.715**	.173
	Move away.				**.897**	.134
	Move to another table.				**.745**	.105
	Find an excuse to leave.		.116		.372	**.693**
	Dwell on reading the newspaper or using a cell phone.				.176	**.709**
	(Cumulative Variance)	(.145)	(.288)	(.392)	(.492)	(.557)

Note: Items in bold indicate loadings higher than 0.4.

Table 8. MASm Factor Correlations

Factor Correlations	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	1.0	.014	-.118	-.484	-.348
Factor 2		1.0	.385	.139	-.062
Factor 3			1.0	.137	-.258
Factor 4				1.0	.458
Factor 5					1.0

Table 9. CM-TBIm Item Accuracy by Group

		Percent Correct		Percent Uncertain		Percent Incorrect	
	Item	Control	Exp.	Control	Exp.	Control	Exp.
1.	A head injury can cause brain damage even if the person is not knocked unconscious. (T)	97.44	98.48	1.03	1.52	1.54	0.00
2.	It is obvious that someone has brain damage because they look different from people who don't have brain damage. (F)	97.95	97.97	1.03	1.52	1.03	0.51
3.	It is possible that a person's personality will change after a brain injury. (T)	**92.82**	**97.97***	3.08	1.02	4.10	1.02
4.	Problems with irritability and difficulties controlling anger are common in people who have had a brain injury. (T)	**76.96**	**89.85****	14.66	8.12	8.38	2.03
5.	Brain injuries may cause one to feel depressed, sad, and hopeless. (T)	92.27	94.39	6.19	5.10	1.55	0.51
6.	People in a coma are usually not aware of what is happening around them. (T)	**34.36**	**84.18*****	21.54	6.63	44.10	9.18
7.	Even after several weeks in a coma, when people wake up, most recognize and speak to others right away. (F)	**46.15**	**65.48** ***	30.77	15.23	23.08	19.29
8.	Sometimes a second blow to the head can help a person remember things that were forgotten. (F)	74.87	78.68	16.41	15.74	8.72	5.58
9.	A person with brain injury may have trouble remembering events that happened before the injury, but usually does not have trouble learning new things. (F)	50.77	57.14	13.85	12.76	35.38	30.10
10.	People who have survived a brain injury can forget who they are and not recognize others, but be normal in every other way. (F)	**8.21**	**28.21*****	18.97	13.85	72.82	57.95
11.	Once a person is able to walk again, his or her brain is almost fully recovered. (F)	88.21	92.35	9.23	5.61	2.56	2.04
12.	People who have had one brain injury are more likely to have a second one. (T)	**47.40**	**29.74*****	19.27	29.23	33.33	41.03
13.	Once a person recovering from brain injury feels "back to normal," the recovery process is complete. (F)	92.31	93.33	4.62	4.62	3.08	2.05
14.	How quickly a person recovers depends mainly on how hard they work at recovering. (F)	70.26	76.53	10.77	6.12	18.97	17.35
15.	Most people with brain damage are not fully aware of its effect on their behavior. (T)	**75.90**	**65.48***	8.72	8.12	15.38	26.40
16.	Complete recovery from a severe brain injury is not possible, no matter how badly a person wants to recover. (T)	**35.90**	**90.31*****	25.13	2.55	38.97	7.14

17.	It is common for people with brain injuries to be easily angered. (T)	**59.28**	**71.57***	28.35	21.32	12.37	7.11
18.	Asking someone who has had a brain injury about their progress is the most accurate, informative way to find out how he/she has progressed. (F)	**68.72**	**56.85***	13.33	15.23	17.95	27.92
19.	It is common for people to experience changes in behavior after a brain injury. (T)	**88.21**	**96.94****	8.72	2.04	3.08	1.02
20.	Recovery from a brain injury is usually complete in 5 months. (F)	**75.90**	**89.34*****	20.51	8.12	3.59	2.54

Note:
Control = Control Group, Exp.= Experimental Group
Comparison of the percent of correct responses between the control group and experimental groups: *= p<.05, **=p<.01. ***=p<.001.
Significant comparisons are listed in bold. Statistical comparisons for percent uncertain and percent incorrect were not conducted.

Table 10. Results of the Multiple Linear Regression Model predicting TBI Knowledge (CM-TBIm Score)

	Estimate	Std. Error	t value	Sum Sq.	Df	F	p
(Intercept)	68.8903	3.1232	22.06				
Education	0.6023	0.1624	3.71	736.43	1	13.76	0.0002
Age	0.0129	0.0256	0.51	13.68	1	0.26	0.6135
Group				2805.20	1	52.41	<.0001
Experimental	5.7322	0.7918	7.24				
Gender				88.51	2	0.83	0.438
Male	1.1089	0.8650	1.28				
Learning Disability				70.22	1	1.31	0.253
Positive history	-1.6457	1.4368	-1.15				
Neurological Impairment				32.84	1	0.61	0.434
Positive history	-1.3715	1.7509	-0.78				
Residence				45.73	2	0.43	0.653
Suburban	0.0549	0.8685	0.06				
Rural	1.1987	1.3722	0.87				
Brain Injury Experience (personal)				0.62	1	0.01	0.914
Negative history	-0.1005	0.9304	-0.11				
Brain Injury Experience (immed. family)				55.37	1	1.03	0.310
Negative history	-0.8758	0.8611	-1.02				
Brain Injury Experience (extended)				22.01	1	0.41	0.522
Negative history	-0.5307	0.8276	-0.64				
Brain Injury Experience (professional)				370.43	1	6.92	0.009
Negative history	-0.5307	0.8276	-0.64				
Residuals				17984.57	336		

Multiple R-squared: 0.1957, Adjusted R-squared: 0.1646 , F-statistic: 6.288 on 13 and 336 DF, p-value: <.0001
Residual standard error: 7.316 on 336 degrees of freedom
Note: Reference Categories are not shown.

Table 11. Mean MASm scores by item and group

Item	Control	Experimental
Depression	0.117	0.160
Guilt	0.272	0.267
Pity	0.553	0.556
Rejection	0.139	*0.205
Upset	0.197	0.251
Tension	0.470	0.476
Stress	0.418	0.440
Shyness	0.421	0.466
Alertness	0.385	0.361
+Relaxation	0.857	0.856
+Serenity	0.873	0.872
+Calmness	0.828	0.852
+S/he seems to be an interesting person.	0.486	0.446
+S/he looks like an OK person.	0.392	0.355
+ I enjoy meeting new people.	0.486	0.453
+We may get along really well.	0.525	0.471
+S/he looks friendly.	0.390	0.378
Get out.	0.256	0.273
Move away.	0.244	0.248
Move to another table.	0.170	0.180
Find an excuse to leave.	0.424	0.454
Dwell on reading the newspaper or using a cell phone.	0.442	0.441

Notes:
* indicates group comparison is significant at p<.01.
+ indicates items that have been reverse scored for consistency, such that higher scores on all items reflect more negative emotions, thoughts, and behaviors.

Table 12. Results of the Multiple Linear Regression Model predicting MASm Factor 1 Scores

MAS FACTOR 1	Estimate	Std. Error	t value	Sum Sq.	Df	F	p
(Intercept)	0.962	0.755	1.275				
CM-TBIm	-0.015	0.009	-1.729	3.461	1	2.989	0.085
Education	0.0181	0.025	0.726	0.611	1	0.528	0.468
Age	0.009	0.004	2.232	5.768	1	4.981	0.026
Group				5.655	1	4.884	0.028
Experimental	0.288	0.130	2.210				
Gender				1.274	1	1.100	0.295
Male	-0.138	0.132	-1.049				
Learning Disability				0.898	1	0.775	0.380
Positive history	-0.193	0.219	-0.880				
Neurological Impairment				0.419	1	0.361	0.548
Positive history	-0.159	0.264	-0.601				
Residence				2.831	2	1.222	0.296
Suburban	-0.176	0.132	-1.326				
Rural	-0.266	0.208	-1.281				
Brain Injury Experience (personal)				0.207	1	0.178	0.673
Negative history	0.0593	0.141	0.422				
Brain Injury Experience (immed. family)				3.458	1	2.986	0.085
Negative history	-0.225	0.130	-1.728				
Brain Injury Experience (extended)				.001	1	0.001	0.977
Negative history	0.004	0.126	0.029				
Brain Injury Experience (professional)				7.213	1	6.228	0.013
Negative history	-0.358	0.144	-2.496				
Residuals				362.471	313		

Multiple R-squared: 0.08565 , Adjusted R-squared: 0.04768 , F-statistic: 2.255 on 13 and 313 DF, p-value: <.008
Residual standard error: 1.076 on 313 degrees of freedom
(41 observations deleted due to missingness)
Note: Reference Categories are not shown.

Table 13. Results of the Multiple Linear Regression Model predicting MASm Factor 2 Scores

MAS FACTOR 2	Estimate	Std. Error	t value	Sum Sq.	Df	F	p
(Intercept)	1.061	0.720	1.474				
CM-TBIm	-0.008	0.008	-0.935	0.922	1	0.875	0.350
Education	-0.012	0.024	-0.500	0.263	1	0.250	0.618
Age	0.000	0.004	0.133	0.019	1	0.018	0.894
Group				0.423	1	0.402	0.527
Experimental	-0.079	0.124	-0.634				
Gender				2.736	1	2.597	0.108
Male	0.202	0.126	1.611				
Learning Disability				0.019	1	0.018	0.893
Positive history	-0.028	0.209	-0.134				
Neurological Impairment				0.020	1	0.019	0.890
Positive history	-0.035	0.252	-0.139				
Residence				2.579	2	1.224	0.295
Suburban	-0.195	0.126	-1.541				
Rural	-0.070	0.198	-0.355				
Brain Injury Experience (personal)				3.842	1	3.647	0.057
Negative history	-0.256	0.134	-1.910				
Brain Injury Experience (immed. family)				0.000	1	0.000	1.000
Negative history	0.000	0.124	0.000				
Brain Injury Experience (extended)				2.872	1	2.727	0.100
Negative history	0.198	0.120	1.651				
Brain Injury Experience (professional)				0.781	1	0.742	0.390
Negative history	-0.118	0.137	-0.861				
Residuals				329.755	313.000		

Multiple R-squared: 0.0452, Adjusted R-squared: 0.005541, 1.14 on 13 and 313 DF, p-value: 0.3246
Residual standard error: 1.026 on 313 degrees of freedom
(41 observations deleted due to missingness)
Note: Reference Categories are not shown.

Table 14. Results of the Multiple Linear Regression Model predicting MASm Factor 3 Scores

MAS FACTOR 3	Estimate	Std. Error	t value	Sum Sq.	Df	F	p
(Intercept)	-1.620	0.710	-2.281				
CM-TBIm	0.013	0.008	1.591	2.597	1	2.532	0.113
Education	0.039	0.023	1.656	2.811	1	2.741	0.099
Age	-0.002	0.004	-0.556	0.317	1	0.309	0.579
Group				0.115	1	0.112	0.738
Experimental	0.041	0.122	0.334				
Gender				3.947	1	3.848	0.051
Male	-0.243	0.124	-1.962				
Learning Disability				0.370	1	0.360	0.549
Positive history	0.124	0.206	0.600				
Neurological Impairment				2.246	1	2.190	0.140
Positive history	-0.368	0.248	-1.480				
Residence				4.399	2	2.144	0.119
Suburban	0.143	0.125	1.144				
Rural	-0.223	0.196	-1.141				
Brain Injury Experience (personal)				0.077	1	0.075	0.784
Negative history	-0.036	0.132	-0.275				
Brain Injury Experience (immed. family)				0.007	1	0.007	0.934
Negative history	0.010	0.123	0.083				
Brain Injury Experience (extended)				0.020	1	0.019	0.890
Negative history	-0.016	0.118	-0.139				
Brain Injury Experience (professional)				1.228	1	1.197	0.275
Negative history	0.148	0.135	1.094				
Residuals				321.064	313		

Multiple R-squared: 0.055, Adjusted R-squared: 0.01574, F-statistic: 1.401 on 13 and 313 DF, p-value: 0.157
Residual standard error: 1.013 on 313 degrees of freedom
(41 observations deleted due to missingness)
Note: Reference Categories are not shown.

Table 15. Results of the Multiple Linear Regression Model predicting MASm Factor 4 Scores

MAS FACTOR 4	Estimate	Std. Error	t value	Sum Sq.	Df	F	p
(Intercept)	-0.551	0.728	-0.756				
CM-TBIm	-0.001	0.008	-0.068	0.005	1	0.005	0.945
Education	-0.008	0.024	-0.324	0.113	1	0.105	0.746
Age	0.003	0.004	0.788	0.669	1	0.621	0.431
Group				0.224	1	0.208	0.649
Experimental	-0.057	0.125	-0.456				
Gender				11.544	1	10.721	0.001
Male	0.416	0.127	3.274				
Learning Disability				3.456	1	3.210	0.074
Positive history	0.378	0.211	1.792				
Neurological Impairment				0.534	1	0.496	0.482
Positive history	-0.179	0.254	-0.704				
Residence				1.739	2	0.808	0.447
Suburban	0.151	0.128	1.183				
Rural	0.007	0.200	0.034				
Brain Injury Experience (personal)				0.202	1	0.187	0.665
Negative history	0.059	0.136	0.433				
Brain Injury Experience (immed. family)				3.575	1	3.320	0.069
Negative history	0.229	0.126	1.822				
Brain Injury Experience (extended)				0.998	1	0.927	0.336
Negative history	0.117	0.121	0.963				
Brain Injury Experience (professional)				0.704	1	0.654	0.419
Negative history	0.112	0.138	0.809				
Residuals				337.037	313		

Multiple R-squared: 0.0778, Adjusted R-squared: 0.03951, F-statistic: 2.032 on 13 and 313 DF, p-value: 0.018
Residual standard error: 1.038 on 313 degrees of freedom
(41 observations deleted due to missingness)
Note: Reference Categories are not shown.

Table 16. Results of the Multiple Linear Regression Model predicting MASm Factor 5 Scores

MAS FACTOR 5	Estimate	Std. Error	t value	Sum Sq.	Df	F	p
(Intercept)	-0.673	0.686	-0.982				
CM-TBIm	0.016	0.008	2.056	4.042	1	4.229	0.041
Education	0.016	0.023	0.706	0.477	1	0.499	0.481
Age	-0.016	0.003	-4.646	20.629	1	21.582	0.000
Group				2.188	1	2.289	0.131
Experimental	-0.179	0.118	-1.513				
Gender				0.319	1	0.334	0.564
Male	-0.069	0.120	-0.578				
Learning Disability				0.900	1	0.941	0.333
Positive history	0.193	0.199	0.970				
Neurological Impairment				0.085	1	0.089	0.766
Positive history	0.071	0.240	0.298				
Residence				2.193	2	1.147	0.319
Suburban	0.180	0.120	1.498				
Rural	0.072	0.189	0.382				
Brain Injury Experience (personal)				0.181	1	0.189	0.664
Negative history	-0.056	0.128	-0.435				
Brain Injury Experience (immed. family)				0.029	1	0.031	0.861
Negative history	0.021	0.118	0.175				
Brain Injury Experience (extended)				0.647	1	0.677	0.411
Negative history	-0.094	0.114	-0.823				
Brain Injury Experience (professional)				0.722	1	0.756	0.385
Negative history	-0.113	0.130	-0.869				
Residuals				299.174	313		

Multiple R-squared: 0.1049, Adjusted R-squared: 0.06777, F-statistic: 2.823 on 13 and 313 DF, p-value: 0.00076
Residual standard error: .9777 on 313 degrees of freedom
(41 observations deleted due to missingness)
Note: Reference Categories are not shown.

Table 17. Results of the Logistic Regression Model predicting Responses on Intended Information-Seeking Behavior Question 1

	Odds Ratio	95% Confidence Interval	
(Intercept)	1.748	0.068	45.177
Factor1	0.965	0.722	1.291
Factor2	0.957	0.724	1.264
Factor3	1.357*	1.022	1.802
Factor4	1.213	0.897	1.640
Factor5	1.376*	1.000	1.895
CM-TBIm	1.026	0.988	1.065
Age	0.978*	0.961	0.995
Education	0.935	0.840	1.041
Group			
Experimental	0.890	0.504	1.573
Gender			
Male	1.054	0.571	1.947
Learning Disability			
Positive History	1.184	0.414	3.386
Neurological Impairment			
Positive History	0.400	0.128	1.245
Residence			
Suburban	0.948	0.527	1.705
Rural	0.786	0.325	1.903
Brain Injury Experience (personal)			
Negative history	1.119	0.601	2.081
Brain Injury Experience (immed. family)			
Negative history	1.108	0.630	1.950
Brain Injury Experience (extended)			
Negative history	1.304	0.750	2.267
Brain Injury Experience (professional)			
Negative history	1.727	0.933	3.198

Null deviance: 381.58 on 324 degrees of freedom; Residual deviance: 341.99 on 306 degrees of freedom; AIC: 379.99 (43 observations deleted due to missingness)

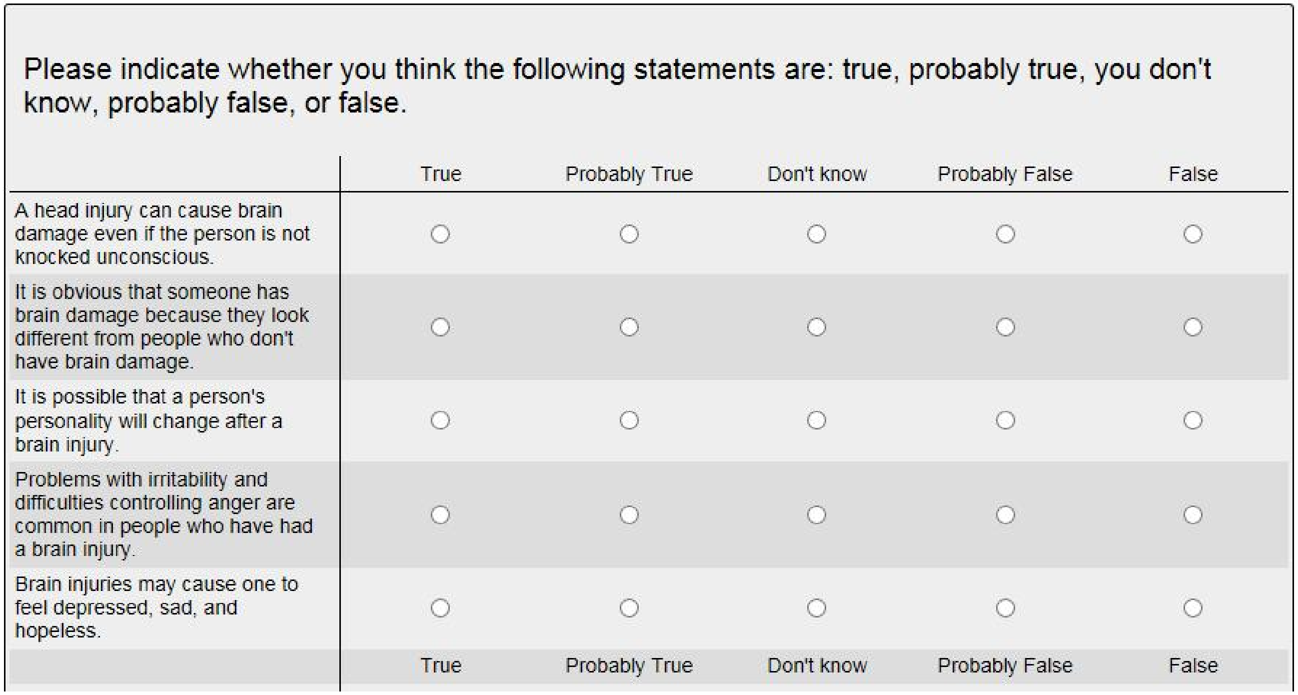
Note: *indicates p<.05. Reference Categories are not shown.

Table 18. Results of the Logistic Regression Model predicting Responses on Intended Information-Seeking Behavior Question 2

	Odds Ratio	95% Confidence Interval	
(Intercept)	5.526	0.096	319.582
Factor1	1.021	0.713	1.462
Factor2	1.131	0.795	1.610
Factor3	1.549*	1.109	2.165
Factor4	0.935	0.640	1.365
Factor5	1.659*	1.091	2.524
CM-TBIm	0.994	0.948	2.524
Age	0.990	0.968	1.012
Education	0.976	0.858	1.111
Group			
Experimental	1.227	0.592	2.542
Gender			
Male	1.854	0.803	4.281
Learning Disability			
Positive History	2.018	0.408	9.977
Neurological Impairment			
Positive History	0.333	0.101	1.093
Residence			
Suburban	1.370	0.660	2.844
Rural	2.219	0.580	8.485
Brain Injury Experience (personal)			
Negative history	1.497	0.691	3.243
Brain Injury Experience (immed. family)			
Negative history	1.569	0.778	3.166
Brain Injury Experience (extended family)			
Negative history	1.238	0.612	2.503
Brain Injury Experience (professional)			
Negative history	1.858	0.877	3.936

Null deviance: 265.04 on 324 degrees of freedom; Residual deviance: 233.37 on 306 degrees of freedom; AIC: 271.37 (43 observations deleted due to missingness)
Note: *indicates p<.05. Reference Categories not shown.

Figures



Please indicate whether you think the following statements are: true, probably true, you don't know, probably false, or false.

	True	Probably True	Don't know	Probably False	False
A head injury can cause brain damage even if the person is not knocked unconscious.	○	○	○	○	○
It is obvious that someone has brain damage because they look different from people who don't have brain damage.	○	○	○	○	○
It is possible that a person's personality will change after a brain injury.	○	○	○	○	○
Problems with irritability and difficulties controlling anger are common in people who have had a brain injury.	○	○	○	○	○
Brain injuries may cause one to feel depressed, sad, and hopeless.	○	○	○	○	○
	True	Probably True	Don't know	Probably False	False

Figure 1. Screenshot of Selected Items on the CM-TBIm

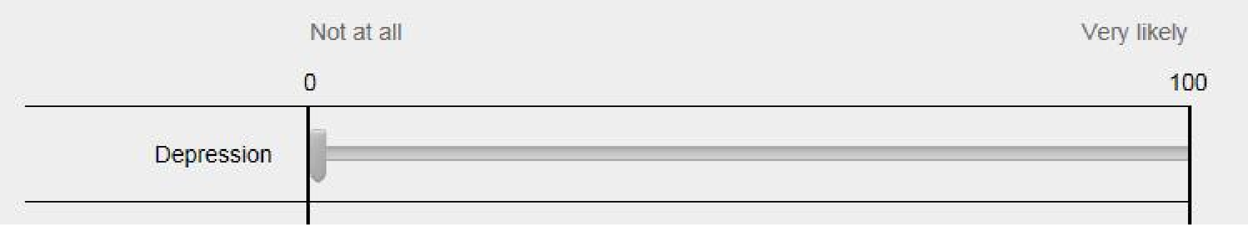


Figure 2. Screenshot of the VAS used for the MASm

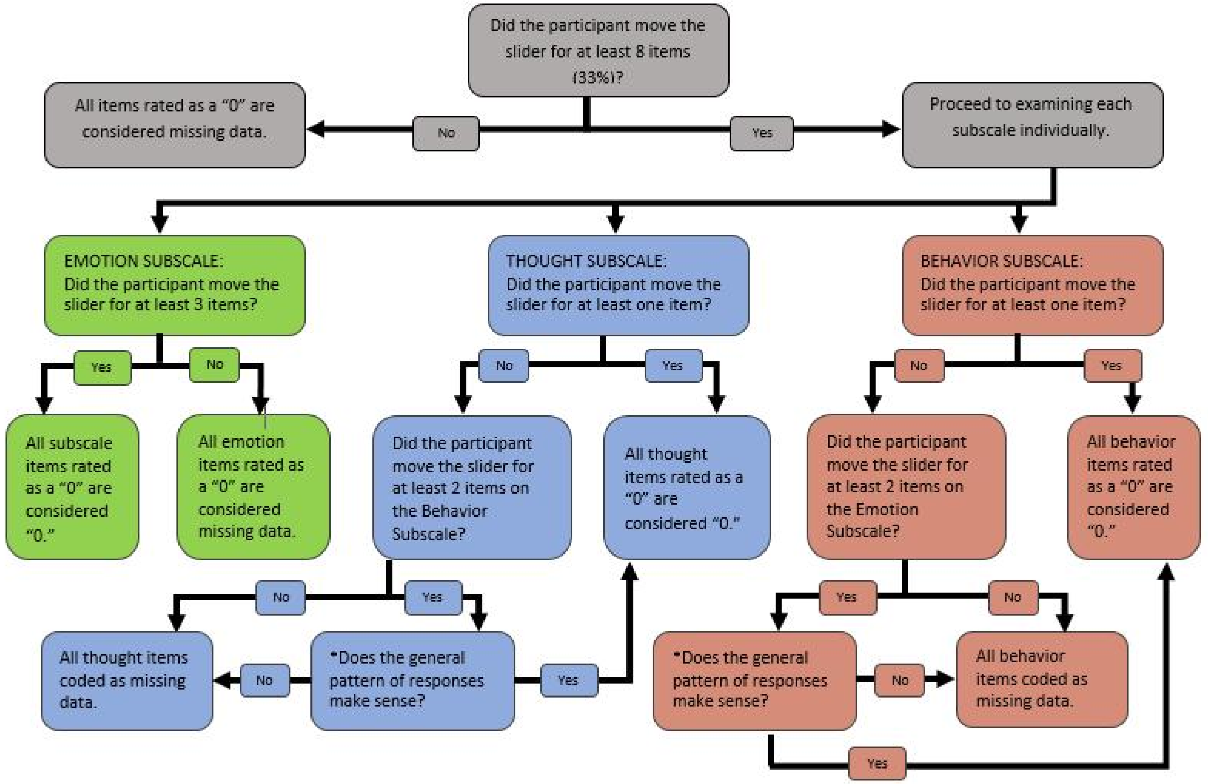


Figure 3. Decision-Making Tree to deal with Missing Data on the MASm

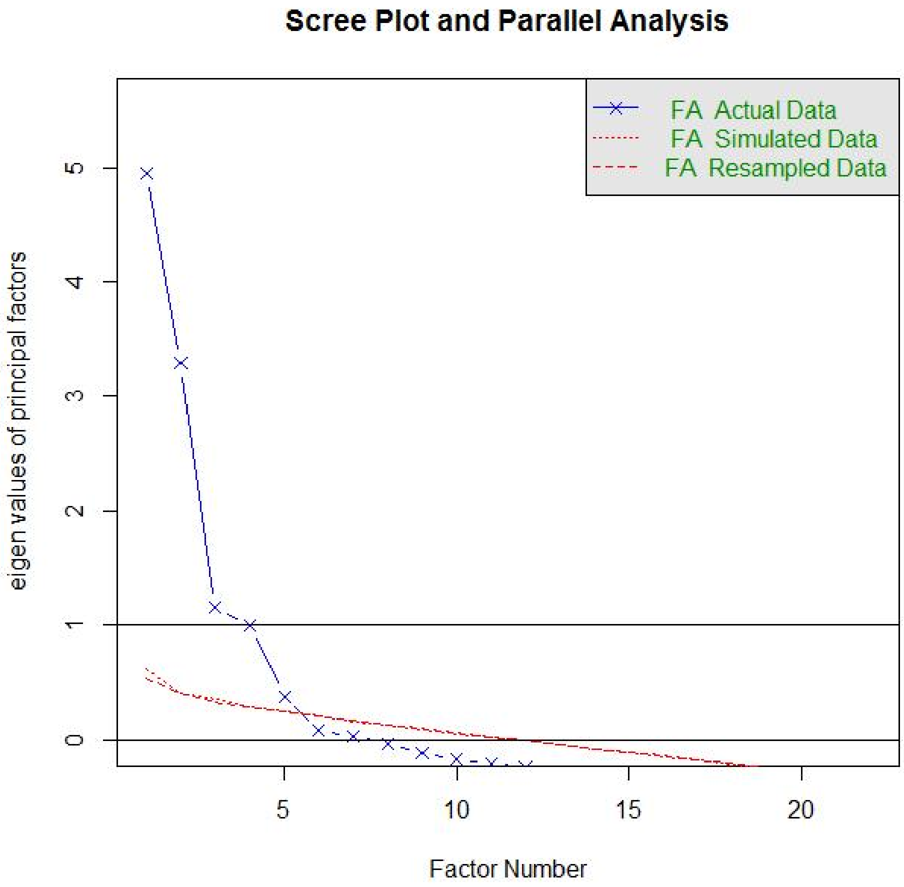


Figure 4. Scree Plot with Parallel Analysis for the MASm Factor Analysis

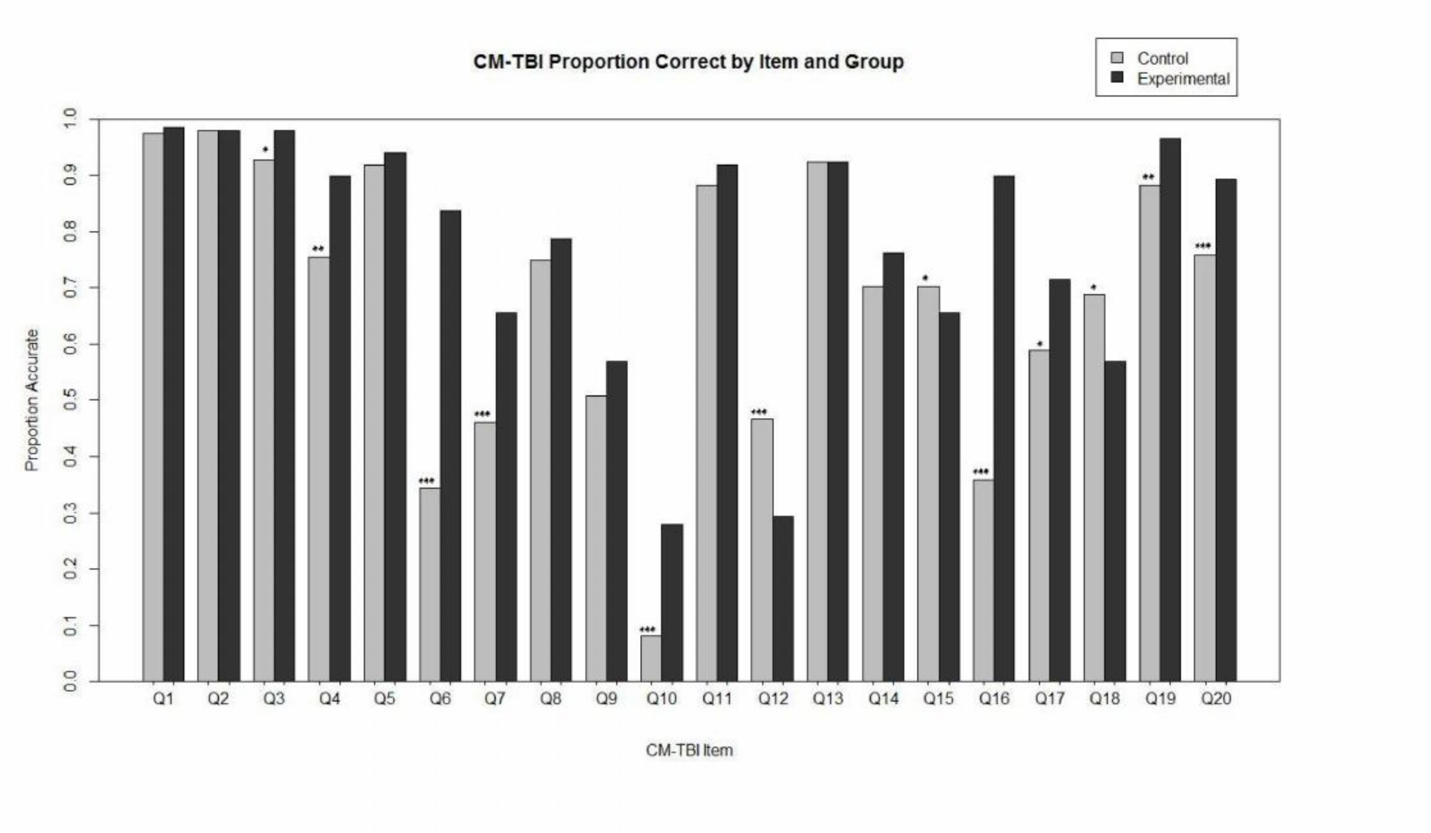


Figure 5. CM-TBIm Percent Accuracy by Item and Group. Note: *** indicates a group difference at p<.001; ** indicates a group difference at p<.01; * indicates a group difference at p<.05.

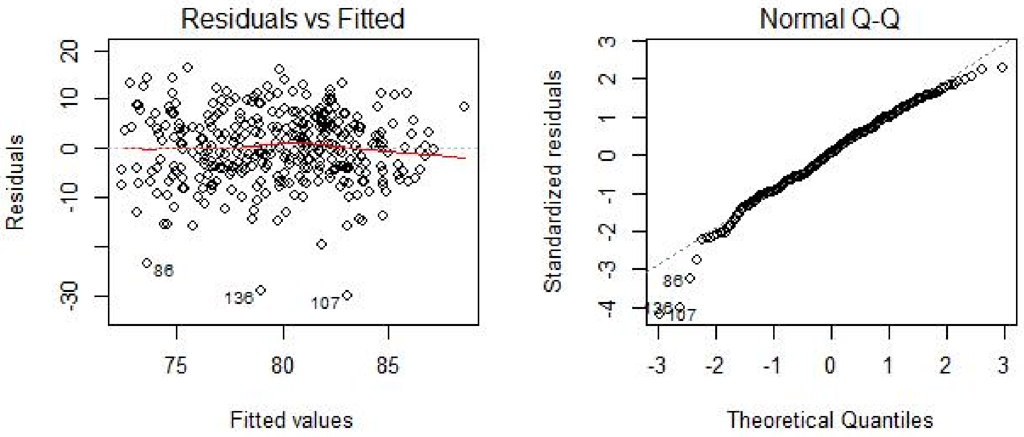


Figure 6. Diagnostic Plots for the Multiple Regression Model Predicting TBI Knowledge (CM-TBIm Scores)

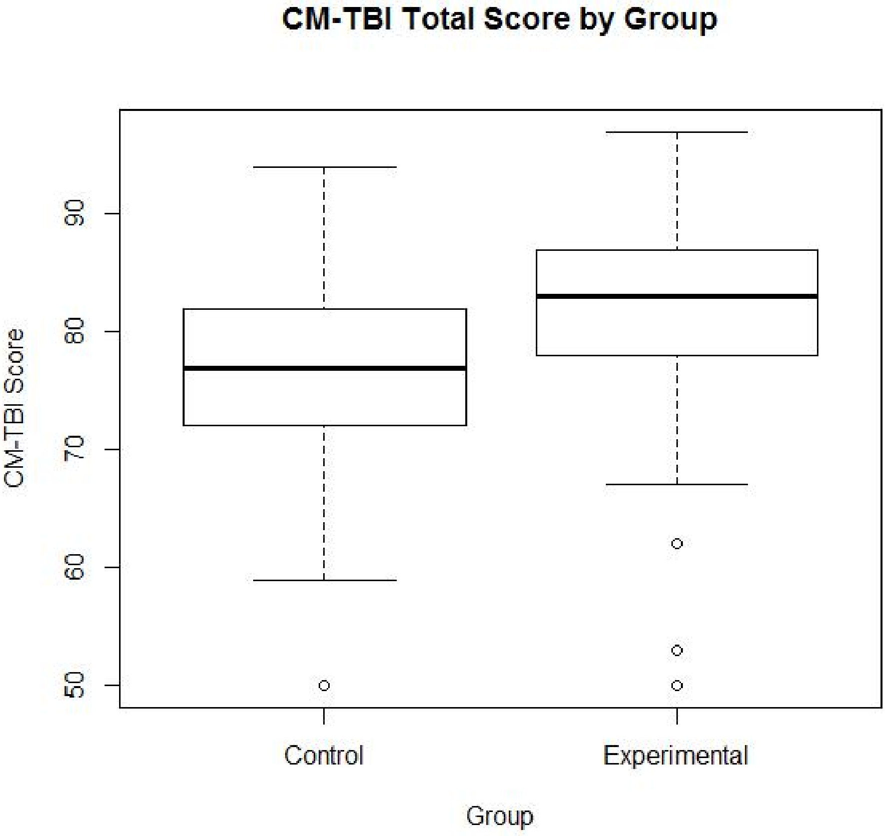


Figure 7. CM-TBIm Score by Group Assignment

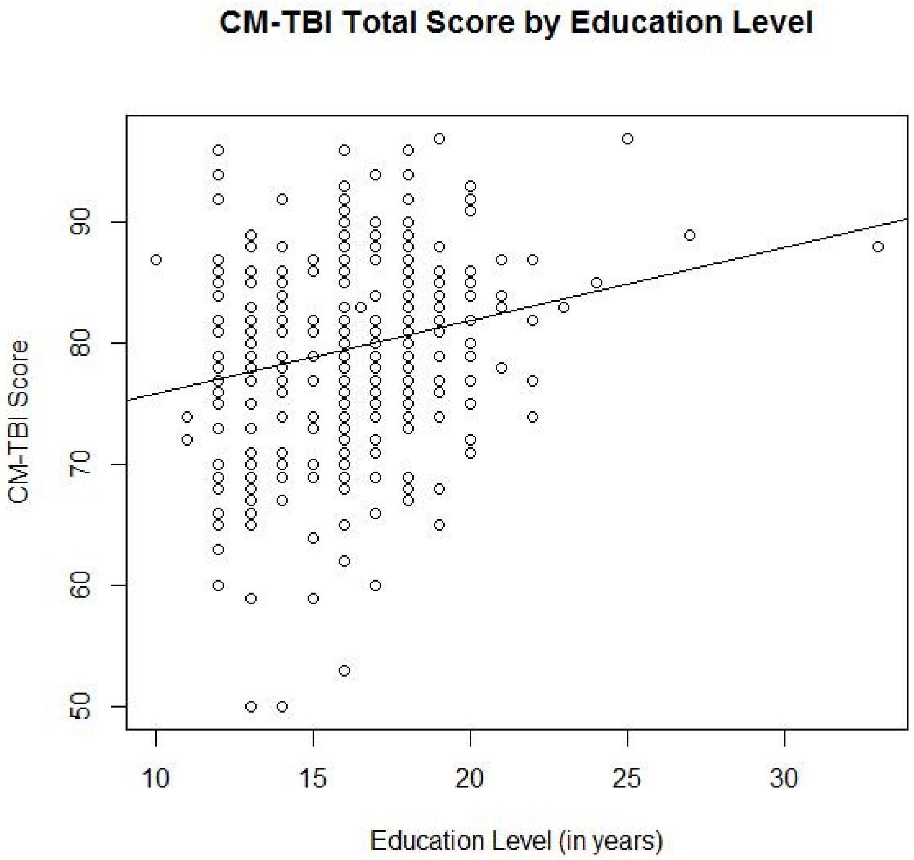


Figure 8. CM-TBIm Score by Education Level. Note: the line shown reflects the correlation between education and CM-TBI score in this sample, not the slope predicted by the regression model.

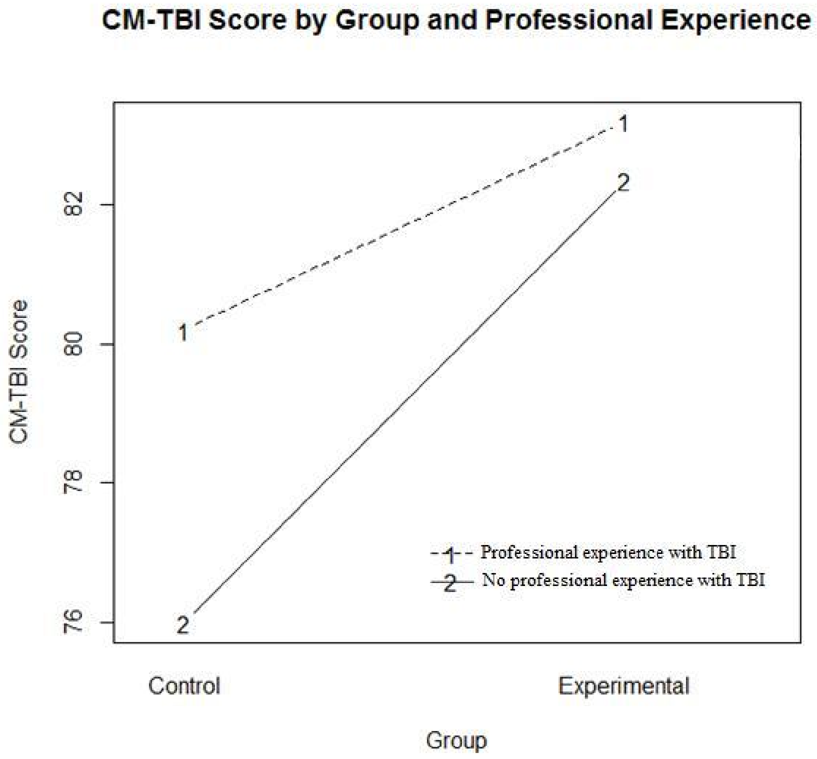


Figure 9. CM-TBIm Score by Group and Professional Experience.

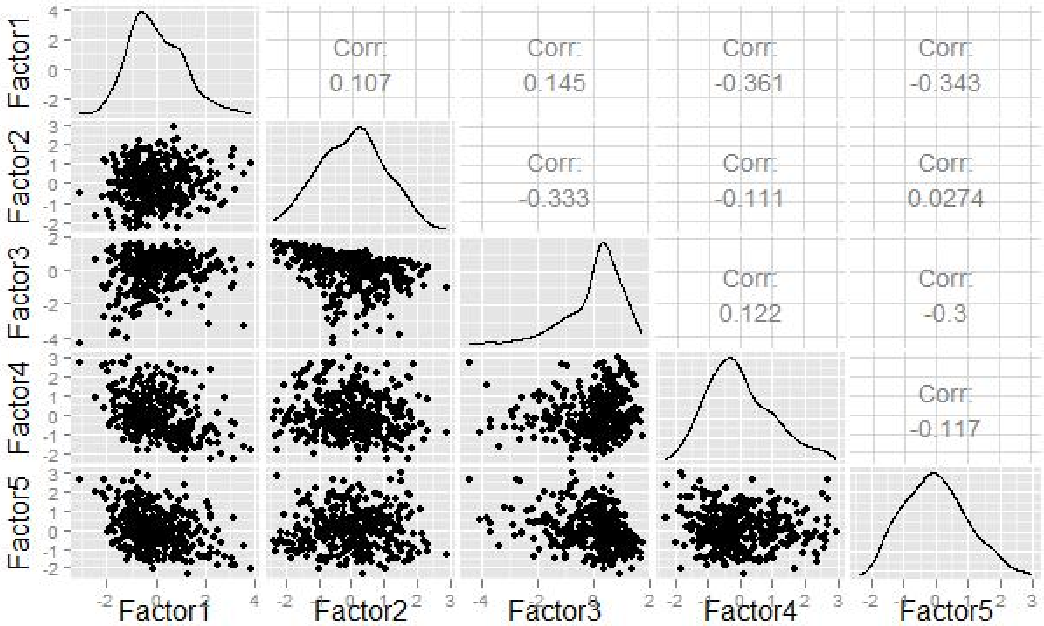


Figure 10. Correlations of Factor Scores

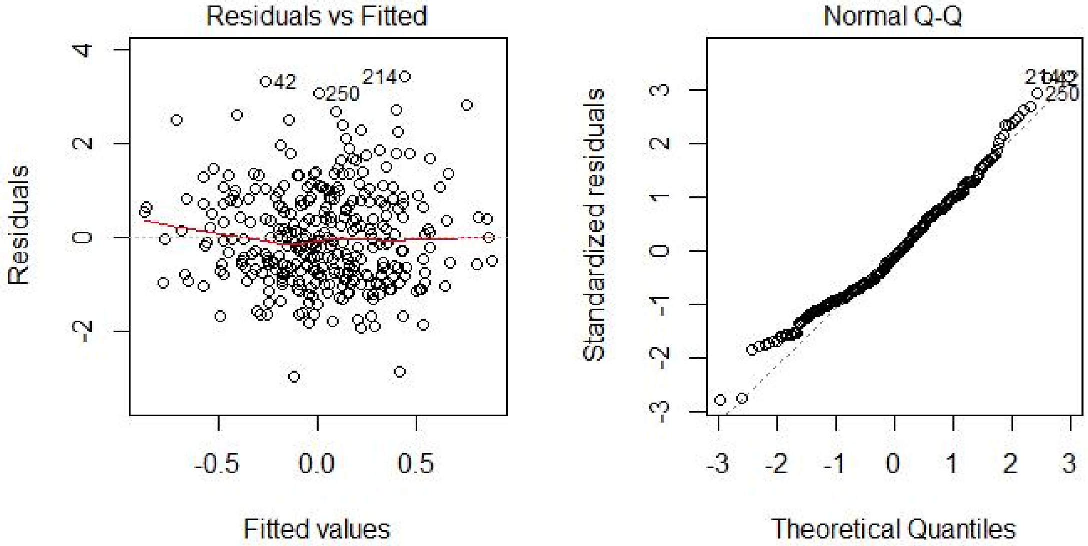


Figure 11. Diagnostic Plots for the Multiple Regression Model Predicting MASm Factor 1 Scores

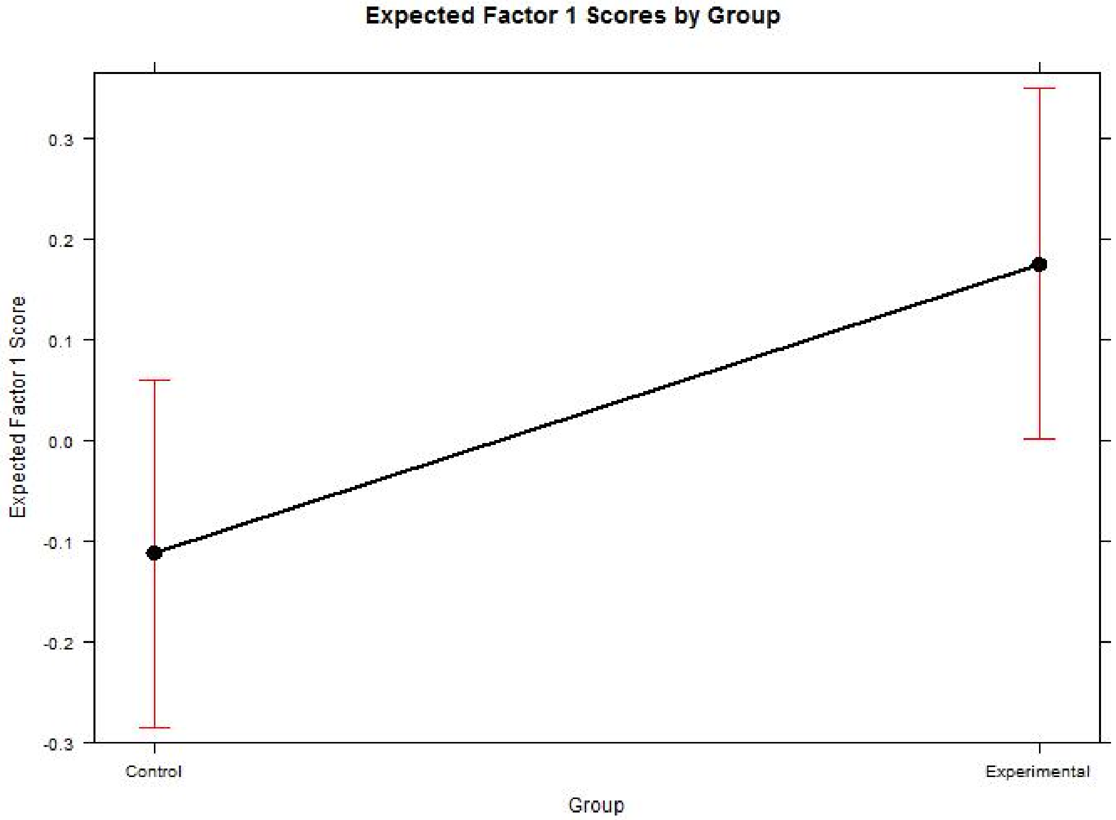


Figure 12. Results of the Linear Regression Model for MASm Factor 1: Expected Scores by Group.

Figure 13. Results of the Linear Regression Model for MASm Factor 1: Expected Scores by Age

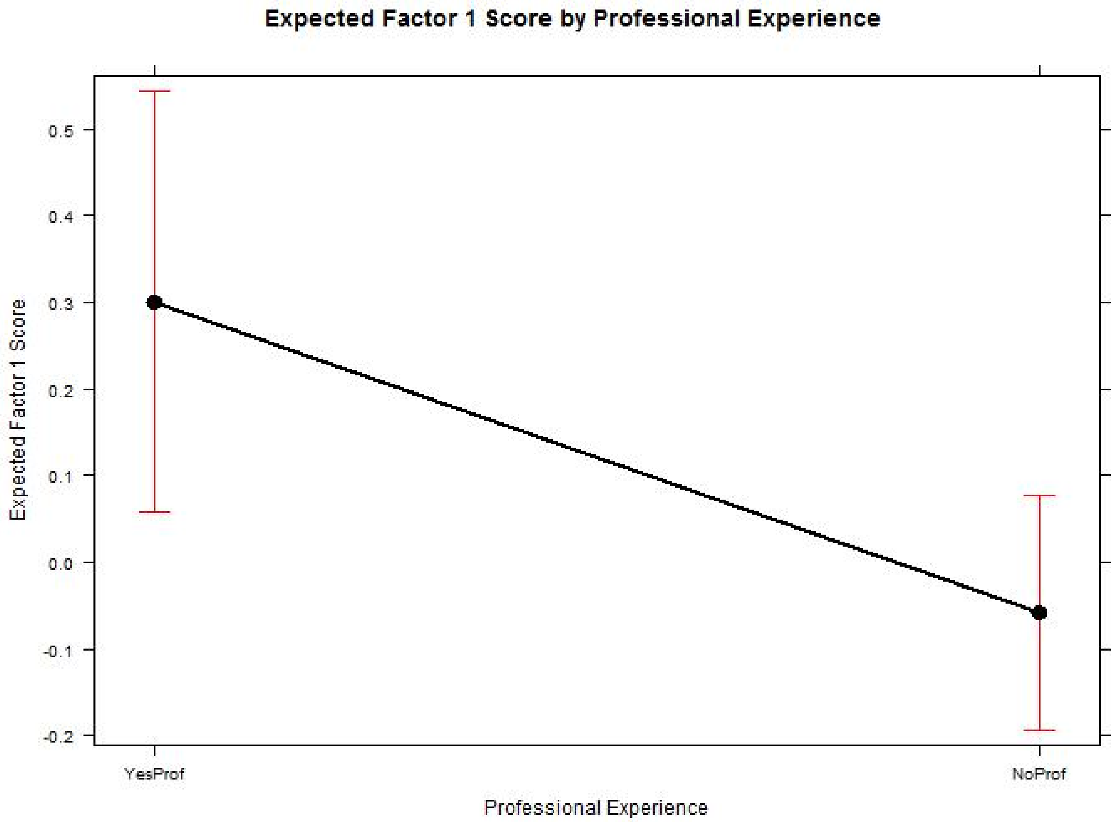


Figure 14. Results of the Linear Regression Model for MASm Factor 1: Expected Scores by Professional Experience

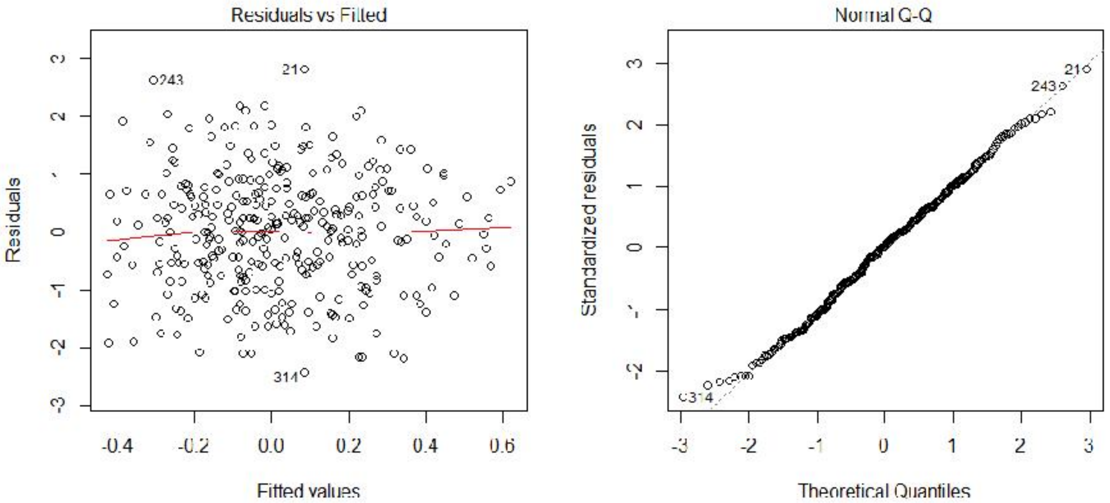


Figure 15. Diagnostic Plots for the Multiple Regression Model Predicting MASm Factor 2 Scores

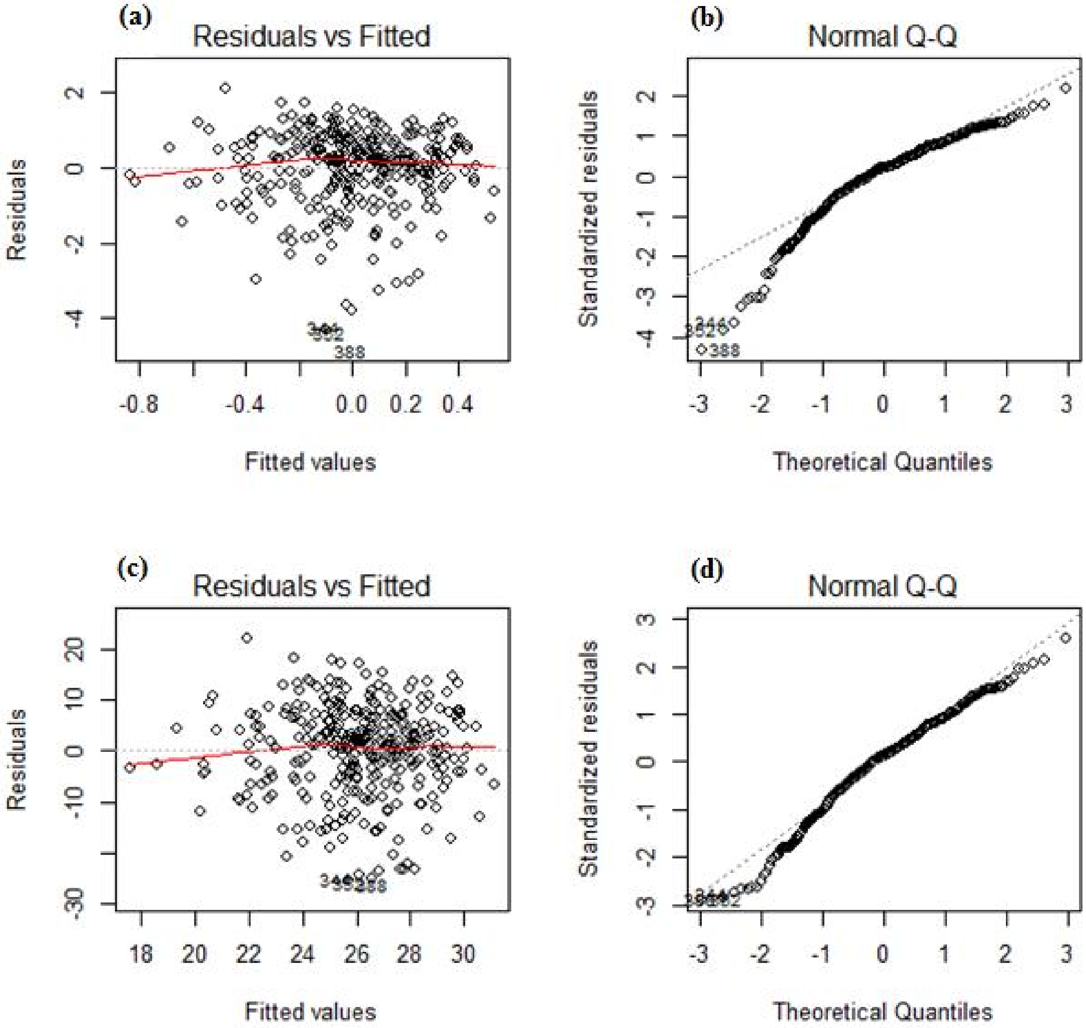


Figure 16. Diagnostic Plots for the Multiple Regression Model Predicting non-transformed MASm Factor 3 scores (panes a. and b.) and transformed MASm Factor 3 scores (panes c. and d.)

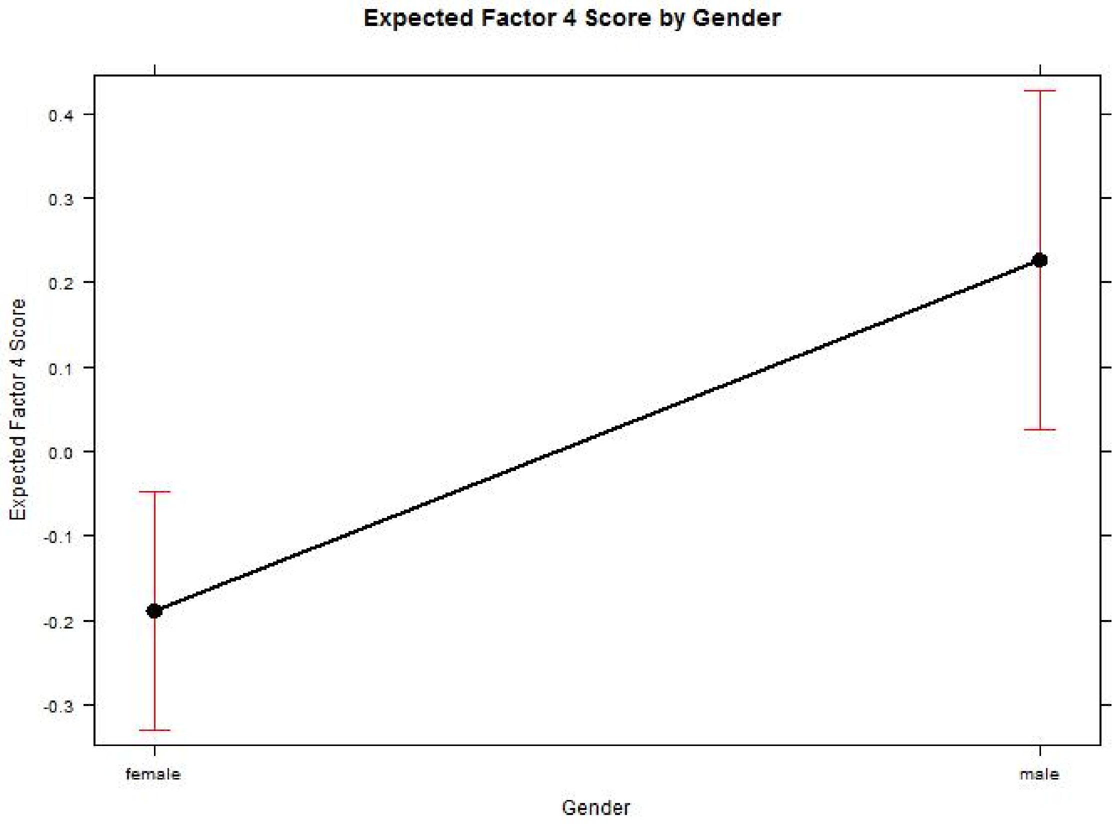


Figure 17. Results of the Linear Regression Model for MASm Factor 4: Expected Scores by Gender

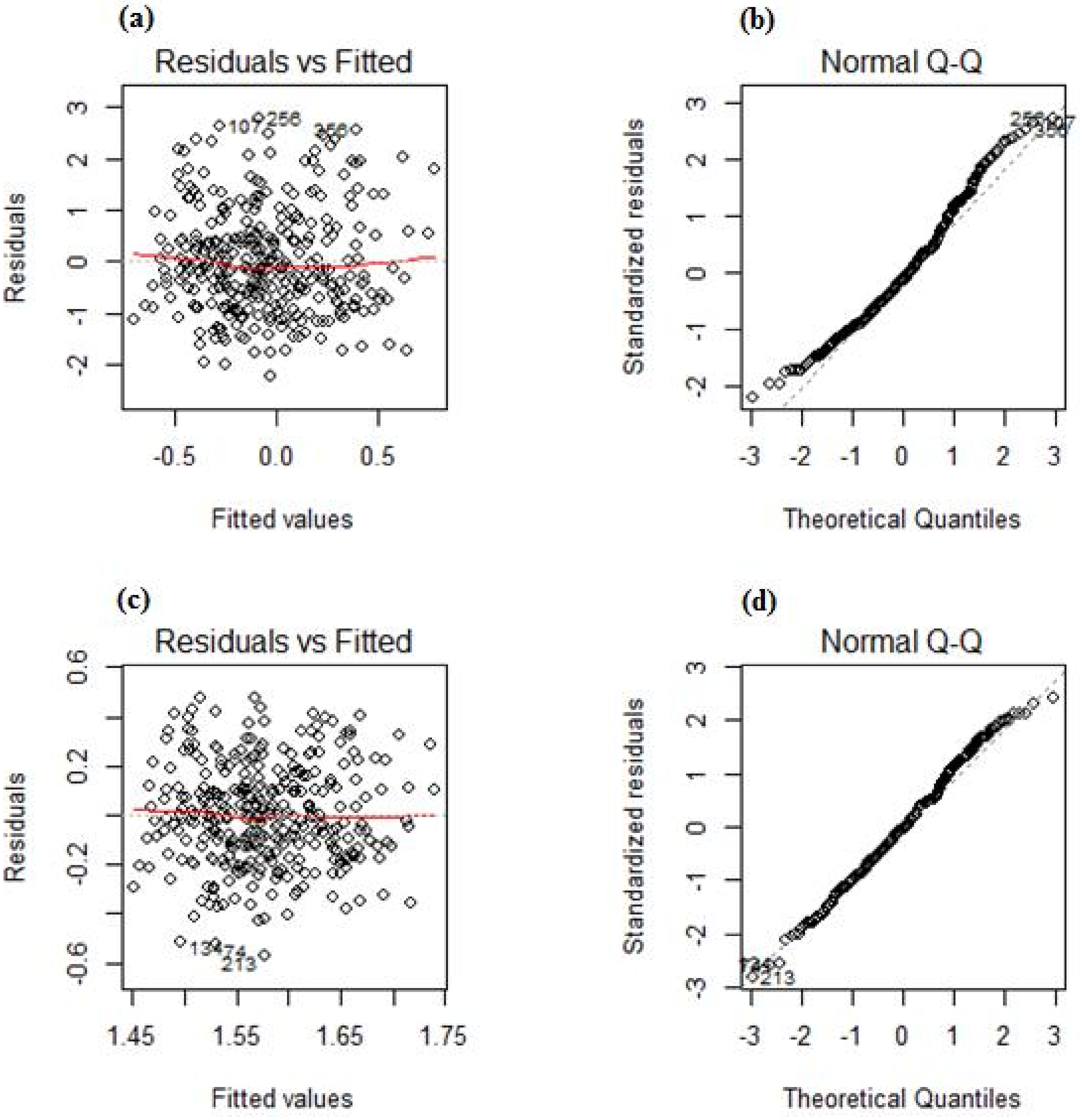


Figure 18. Diagnostic Plots for the Multiple Regression Model Predicting non-transformed MASm Factor 4 scores (panes a. and b.) and transformed MASm Factor 4 scores (panes c. and d.)

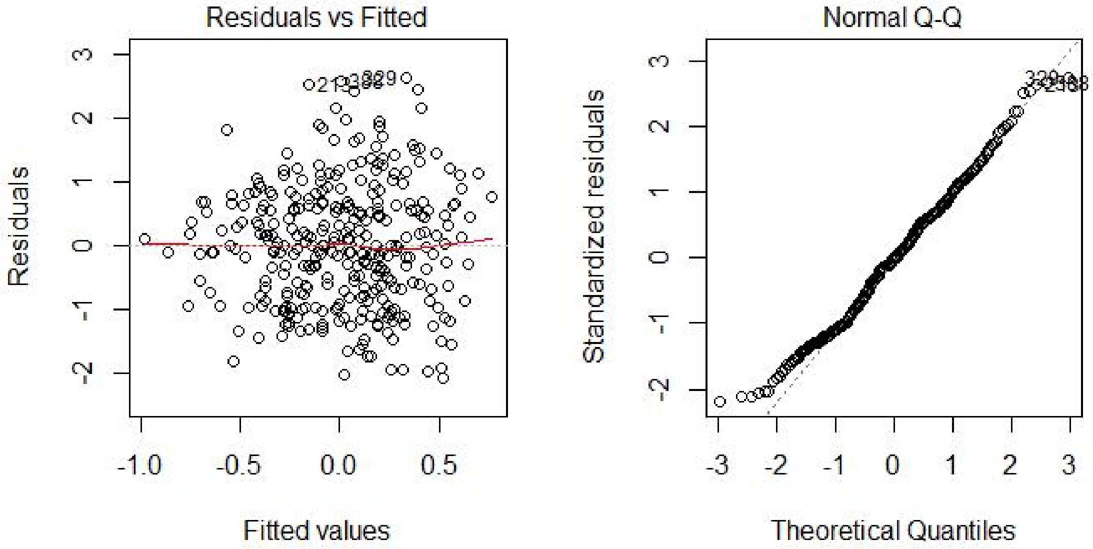


Figure 19. Diagnostic Plots for the Multiple Regression Model Predicting MASm Factor 5 Scores

Figure 20. Results of the Linear Regression Model for MASm Factor 5: Expected Scores by Age

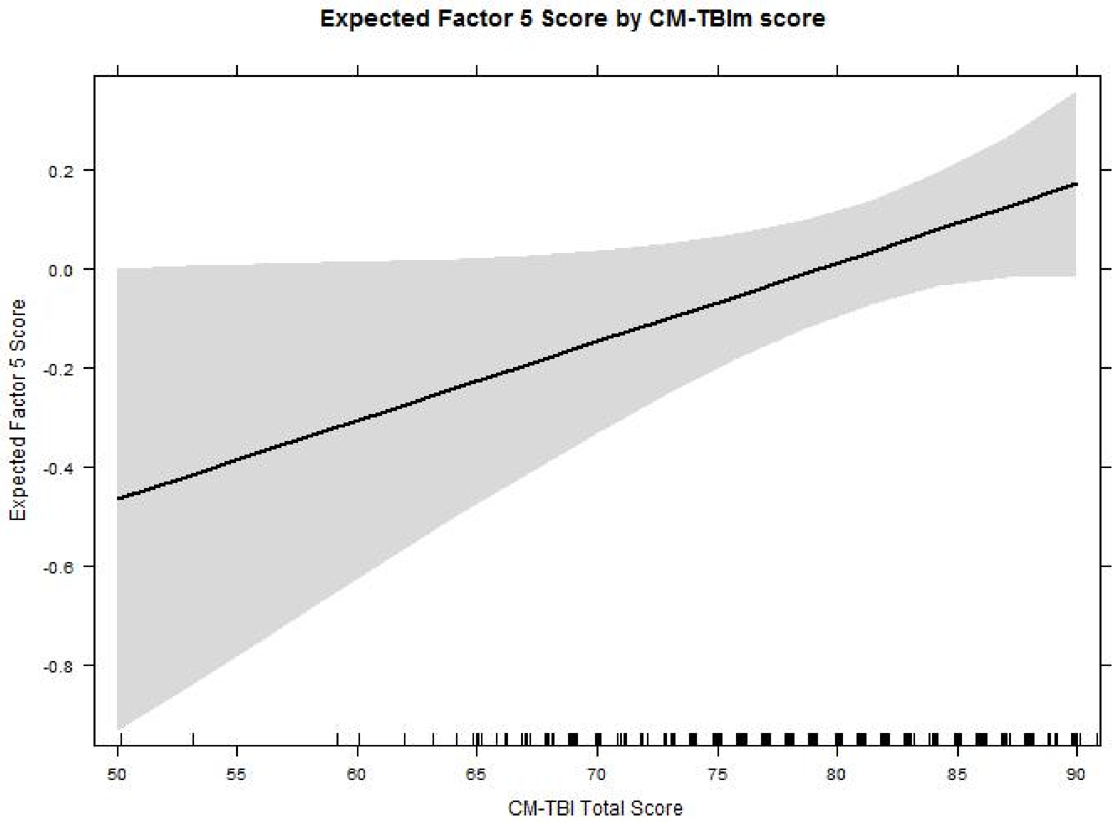


Figure 21. Results of the Linear Regression Model for MASm Factor 5: Expected Scores by CM-TBIm total score

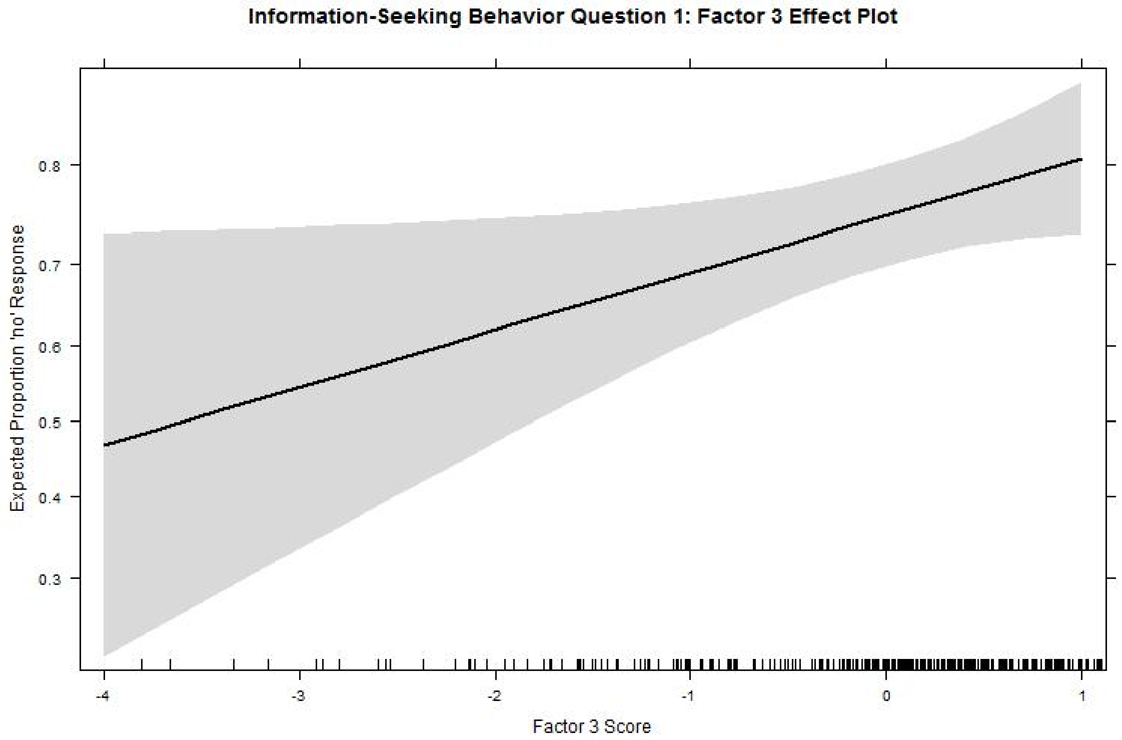


Figure 22. Results of the Logistic Regression predicting Intended Information-Seeking Behavior Question 1: Effect of Factor 3

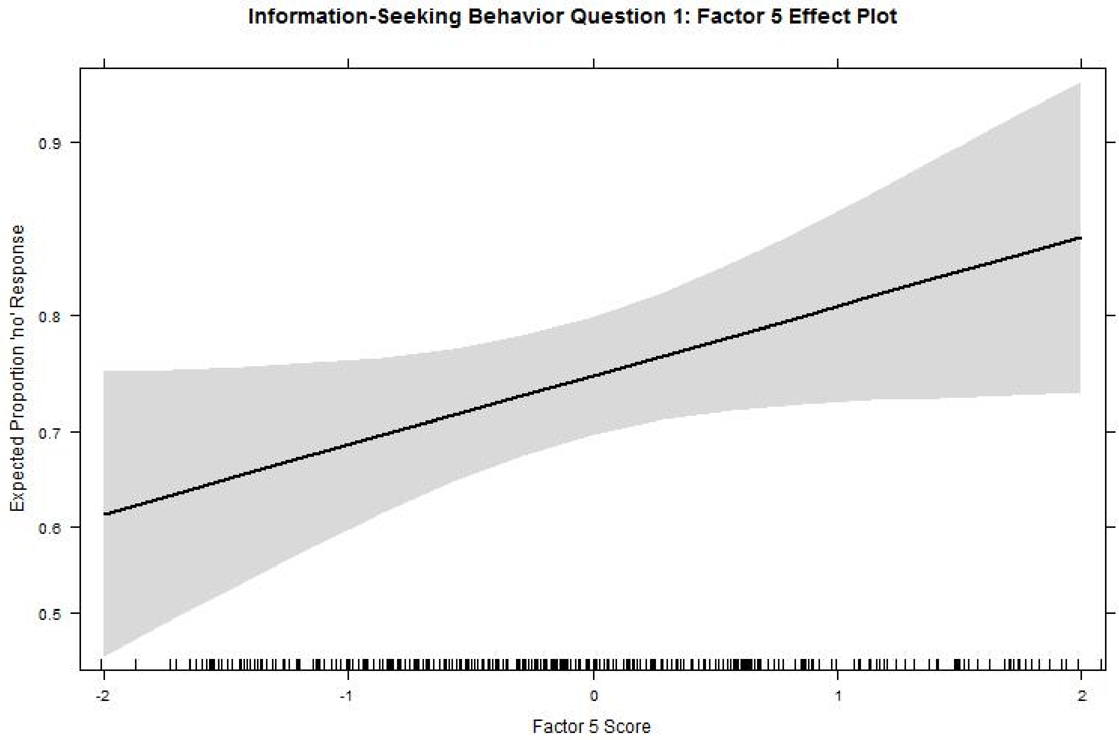


Figure 23. Results of the Logistic Regression predicting Intended Information-Seeking Behavior Question 1: Effect of Factor 5

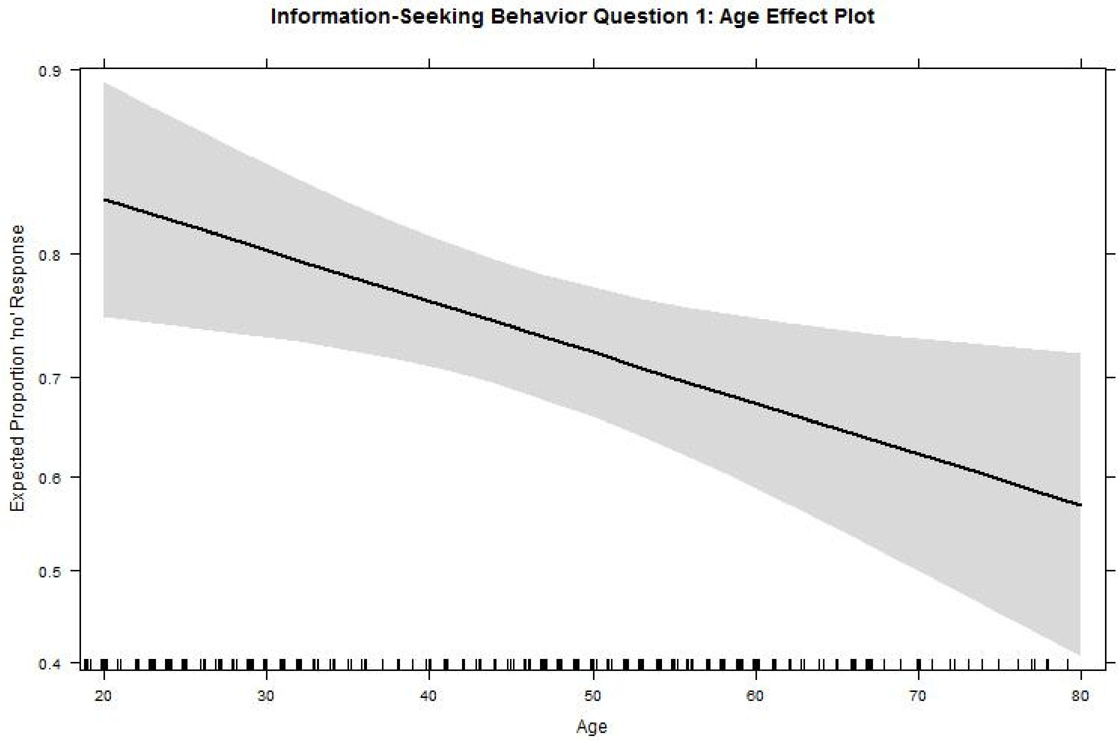


Figure 24. Results of the Logistic Regression predicting Intended Information-Seeking Behavior Question 1: Effect of Age

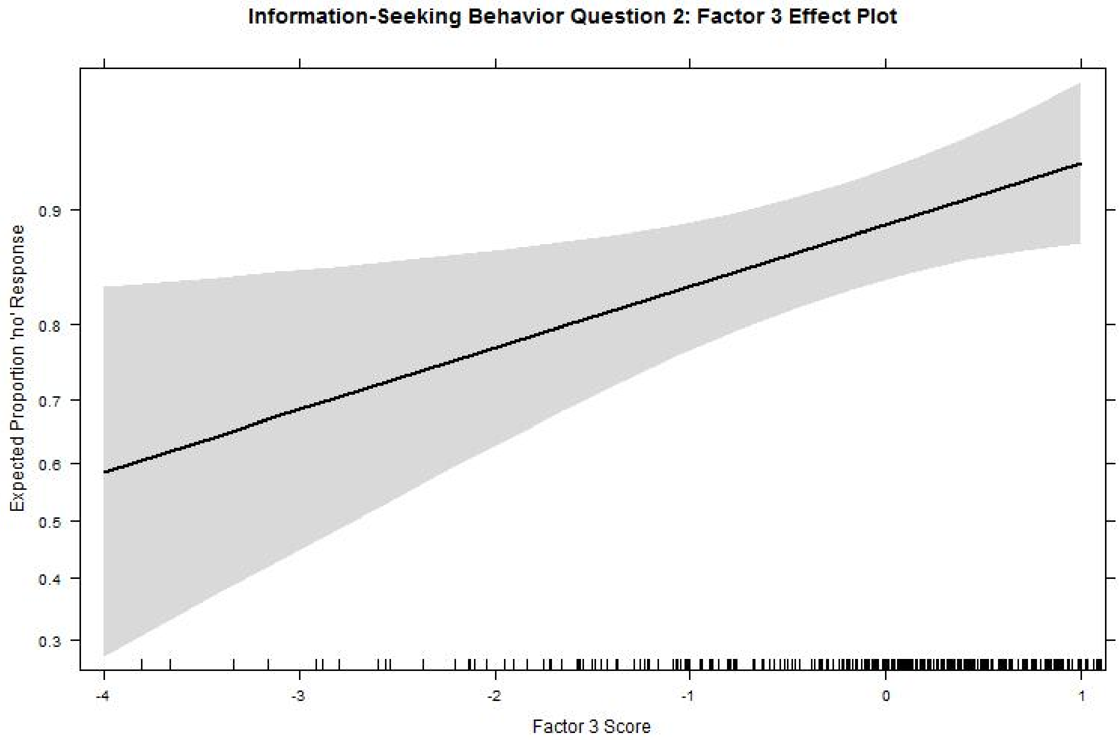


Figure 25. Results of the Logistic Regression predicting Intended Information-Seeking Behavior Question 2: Effect of Factor 3

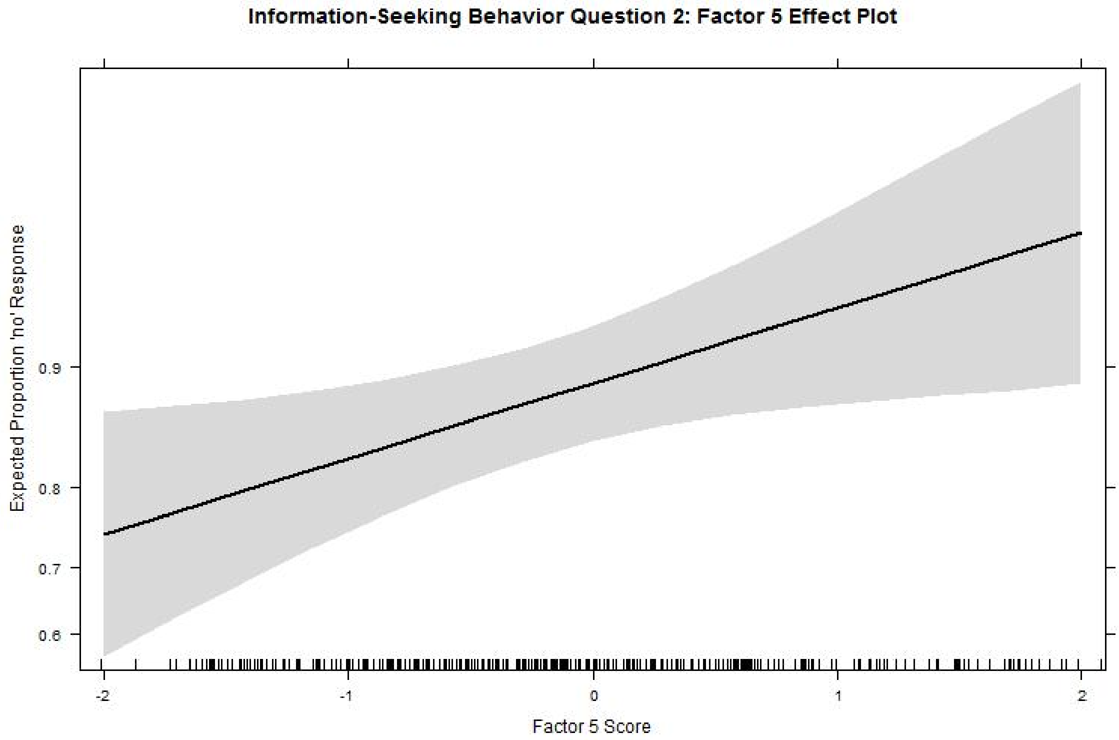


Figure 26. Results of the Logistic Regression predicting Intended Information-Seeking Behavior Question 2: Effect of Factor 5

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Appendices

Appendix 1. Consent Form Text

Introduction:

You are invited to be in a research study investigating public perceptions about traumatic brain injury (TBI). This study is being conducted by Sarah Schellinger, M.S., Mary Kennedy, Ph.D., and Dr. Benjamin Munson, Ph.D. in the Department of Speech-Language-Hearing Sciences at the University of Minnesota. Please read this page and ask any questions before agreeing to be in the study.

Study Purpose:

A TBI is caused by a bump, blow or jolt to the head that damages how the brain works. Each year, 10,000 Minnesotans sustain a new TBI, and this rate appears to be increasing. A major goal in health care is to make brain injuries less common and to help people recover from these injuries. One step in reaching this goal is to determine what the public knows about TBI. The purpose of this study is to examine the public's knowledge and views about TBI. The information gained from this project will help us learn about public understanding of TBI.

Study Procedures:

If you agree to be in this study, you will answer questions related to your knowledge and attitudes about TBI. You will also answer questions about yourself and watch a short video. This video will either be about TBI or another topic that is not related to TBI.

Benefits of Study Participation:

The only benefit to you is that you may learn more about TBI.

Risks of Study Participation:

In this study, we will ask you to provide some basic information about yourself, such as your age and education level. The only risk is that this someone who isn't involved in this study will get this information. However, this isn't very likely, since we will protect the information very closely.

Survey Costs/Compensation:

There is no cost to participate in this study. You will receive a drawstring backpack as a token of thanks for participating.

Confidentiality:

The records of this study will be kept private. You will not need to provide your name, but the researchers may review your answers. We will keep data from this study on file for five years.

Voluntary Nature of the Study:
Participation is completely voluntary. If you decide to participate, you may stop at any time.

Contacts and Questions:
The primary researcher is Sarah Schellinger, M.S. CCC-SLP. If you have any questions, please contact her. You can reach her at schel204@umn.edu.
If you have any questions about this study and would like to talk to someone other than the researcher(s), you may contact:

Research Subjects’ Advocate Line
D528 Mayo
420 Delaware St. Southeast, Minneapolis, MN 55455
(612) 625-1650

Appendix 2. Demographic and Background Experience Questionnaire

Question		**Response**
1.	What is your age?	
2.	What is your gender?	☐Male ☐Female ☐Other
3.	What is your zip code?	Free response
4.	Is English your primary language?	☐Yes ☐No
5.	What is the highest grade of education you completed? Note: A high school degree would be 12. Please add 1 year for each year of college or technical school completed after high school.	Free response
6a.	Have you consumed any alcohol today?	☐Yes ☐No
6b.	If yes, please indicate the approximate number of alcoholic beverages you have consumed.	Free response
7.	Have you ever been diagnosed with a disability that impeded your ability to learn (for example: a learning disability, dyslexia, attention deficit disorder, autism, language delay/disorder)?	☐Yes ☐No
8.	Have you even been diagnosed with any of the following: stroke, multiple sclerosis, Parkinson's disease, dementia, psychological difficulty requiring hospitalization, or other neurological impairment?	☐Yes ☐No
9.	Please indicate which of the following matches your current place of residence.	☐Urban ☐Suburban ☐Rural
10a.	Have you ever had a concussion?	☐Yes ☐No ☐I'm not sure
10b.	If yes, did you experience any complications from the concussion, such as headaches, fatigue, difficulty with concentration or memory, difficulty with balance or other symptoms?	☐Yes ☐No
11a.	Have you ever had a brain injury that was more severe than a concussion?	☐Yes ☐No
11b.	If yes, were you hospitalized for the injury?	☐Yes ☐No
12.	To the best of your knowledge, has a member of your immediate family (mother, father, sibling, significant other, child) had a brain injury (including a concussion)?	☐Yes ☐No
13.	To the best of your knowledge, has a member of your extended family or a close friend had a brain injury (including a concussion)?	☐Yes ☐No
14.	Do you have any professional experience working with individuals with brain injury (for example: providing education, health care, or other services)?	☐Yes ☐No

Appendix 3. Common Misperceptions about TBI Questionnaire - Modified

Please indicate whether you think the following statements are: true, probably true, you don't know, probably false, or false.

1. A head injury can cause brain damage even if the person is not knocked unconscious. (T)
2. It is obvious that someone has brain damage because they look different from people who don't have brain damage. (F)
3. It is possible that a person's personality will change after a brain injury. (T)
4. Problems with irritability and difficulties controlling anger are common in people who have had a brain injury. (T)
5. Brain injuries may cause one to feel depressed, sad, and hopeless. (T)
6. People in a coma are usually not aware of what is happening around them. (T)
7. Even after several weeks in a coma, when people wake up, most recognize and speak to others right away. (F)
8. Sometimes a second blow to the head can help a person remember things that were forgotten. (F)
9. A person with brain injury may have trouble remembering events that happened before the injury, but usually does not have trouble learning new things. (F)
10. People who have survived a brain injury can forget who they are and not recognize others, but be normal in every other way. (F)
11. Once a person is able to walk again, his or her brain is almost fully recovered. (F)
12. People who have had one brain injury are more likely to have a second one. (T)
13. Once a person recovering from brain injury feels "back to normal," the recovery process is complete. (F)
14. How quickly a person recovers depends mainly on how hard they work at recovering. (F)

For the following questions, please consider people who have had a more severe brain injury <u>(not a concussion).</u>

15. Most people with brain damage are not fully aware of its effect on their behavior. (T)
16. Complete recovery from a severe brain injury is not possible, no matter how badly a person wants to recover. (T)
17. It is common for people with brain injuries to be easily angered. (T)
18. Asking someone who has had a brain injury about their progress is the most accurate, informative way to find out how he/she has progressed. (F)
19. It is common for people to experience changes in behavior after a brain injury. (T)
20. Recovery from a brain injury is usually complete in 5 months. (F)

Appendix 4: Multidimensional Attitude Scale - Modified (Version for Female Participants)

Scenario: Michelle went out for lunch with some friends to a coffee shop. A woman, with whom Michelle is not acquainted, enters the coffee shop and joins the group. Michelle is introduced to this person, and discovers she has had a traumatic brain injury. Shortly thereafter, everyone else leaves, with only Michelle and the woman with brain injury alone together at the table. Michelle has 15 minutes to wait for her ride. Try to imagine this situation.

Part 1. People experience a variety of emotions when they are involved in such a situation. Below is a list of possible emotions, which may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that this emotion might arise in Michelle.

1. Depression
2. Guilt
3. Pity
4. Rejection
5. Upset
6. Tension
7. Stress
8. Shyness
9. Alertness
10. Relaxation
11. Serenity
12. Calmness

Part 2. People experience a variety of thoughts when they are involved in such a situation. Below is a list of possible thoughts that may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that this thought might arise in Pat.

13. She seems to be an interesting person.
14. She looks like an OK person.
15. I enjoy meeting new people.
16. We may get along really well.
17. She looks friendly.

Part 3. People experience a variety of behaviors when they are involved in such a situation. Below is a list of possible behaviors that may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that Michelle might behave in this manner.

18. Get out.
19. Move away.
20. Move to another table.
21. Find an excuse to leave.
22. Dwell on reading the newspaper or using a cell phone.

Appendix 5: Multidimensional Attitude Scale - Modified (Version for Male Participants)

Scenario: Joe went out for lunch with some friends to a coffee shop. A man, with whom Joe is not acquainted, enters the coffee shop and joins the group. Joe is introduced to this person, and discovers he has had a traumatic brain injury. Shortly thereafter, everyone else leaves, with only Joe and the man with brain injury alone together at the table. Joe has 15 minutes to wait for his ride. Try to imagine this situation.

Part 1. People experience a variety of emotions when they are involved in such a situation. Below is a list of possible emotions, which may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that this emotion might arise in Joe.

1. Depression
2. Guilt
3. Pity
4. Rejection
5. Upset
6. Tension
7. Stress
8. Shyness
9. Alertness
10. Relaxation
11. Serenity
12. Calmness

Part 2. People experience a variety of thoughts when they are involved in such a situation. Below is a list of possible thoughts that may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that this thought might arise in Joe.

13. He seems to be an interesting person.
14. He looks like an OK person.
15. I enjoy meeting new people.
16. We may get along really well.
17. He looks friendly.

Part 3. People experience a variety of behaviors when they are involved in such a situation. Below is a list of possible behaviors that may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that Joe might behave in this manner.

18. Get out.
19. Move away.
20. Move to another table.
21. Find an excuse to leave.
22. Dwell on reading the newspaper or using a cell phone.

Appendix 6. Appendix 3: Multidimensional Attitude Scale - Revised (Version for Participants Who Choose not to Specify Gender)

Scenario: Pat went out for lunch with some friends to a coffee shop. A person, with whom Pat is not acquainted, enters the coffee shop and joins the group. Pat is introduced to this person, and discovers they have had a traumatic brain injury. Shortly thereafter, everyone else leaves, with only Pat and the person with brain injury alone together at the table. Pat has 15 minutes to wait for a ride. Try to imagine this situation.

Part 1. People experience a variety of emotions when they are involved in such a situation. Below is a list of possible emotions, which may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that this emotion might arise in Pat.

1. Depression
2. Guilt
3. Pity
4. Rejection
5. Upset
6. Tension
7. Stress
8. Shyness
9. Alertness
10. Relaxation
11. Serenity
12. Calmness

Part 2. People experience a variety of thoughts when they are involved in such a situation. Below is a list of possible thoughts that may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that this thought might arise in Pat.

13. They seem to be an interesting person.
14. They look like an OK person.
15. I enjoy meeting new people.
16. We may get along really well.
17. They look friendly.

Part 3. People experience a variety of behaviors when they are involved in such a situation. Below is a list of possible behaviors that may arise before, during, and/or after such a situation. Please draw a mark somewhere along the line to rate the likelihood that Pat might behave in this manner.

18. Get out.
19. Move away.
20. Move to another table.
21. Find an excuse to leave.
22. Dwell on reading the newspaper or using a cell phone.

Appendix 7. Interview Questions for Individuals with TBI

1. Can you tell us your name and a little about yourself? (i.e., Introduce yourself to the viewer.)
2. Can you walk us through how and when you got your injury/injuries?
3. Did you lose consciousness when you had your injury?
    a. If so, how long were you unconscious and what do you remember about the time immediately before and after the injury?
4. Were you in a coma? How long?
    a. If so, can you tell us a little about the process of coming out of the coma and what you remember about being in the coma?
5. What kind of problems have you experienced as a result of your injury?
    a. Cognitive?
    b. Emotional regulation?
    c. Physical?
    d. Others?
6. What factors do you think impacted your recovery?
    a. Research suggests that the public believes effort is the most important thing that determines how fast or how much a person recovers. However, this belief may result in negative attitude towards people who recover slowly or incompletely, because they "must not be working hard enough." Do you agree? What other factors do you think influence the recovery process?
    b. Research also suggests that the public thinks that it is possible for people with very severe brain injuries to recovery completely and be just like they were before the injury, provided they work hard enough. Do you agree?
7. What advice would you give to help prevent future TBIs?
8. What advice would you give someone with a new TBI to help them recover?
9. Are there any other thoughts you would like to share with the public about TBI?

Appendix 8. Electronic Links to the Control and Experimental Videos

Control Video: https://www.youtube.com/watch?v=bljIeUg9EMg

Experimental (TBI) Video: https://www.youtube.com/watch?v=svGpVf6P1oM