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Perspective-Taking And Relationship Quality In Traumatic Brain Injury And Support Person Dyads

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PERSPECTIVE-TAKING AND RELATIONSHIP QUALITY IN TRAUMATIC BRAIN INJURY AND SUPPORT PERSON DYADS

by

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DEDICATION

I dedicate this project to the many important support people in my life. To my parents, Mark and Debbie De Iorio, and my sister, Regina Hughes, thank you for believing in me from the very beginning. I cannot imagine doing this without your encouragement, advice, and listening ears.

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CHAPTER 1: INTRODUCTION

Traumatic brain injury (TBI) is a significant public health concern. More than 5 million people in the United States are living with residual deficits associated with TBI (Faul, Xu, Wald, Coronado, & Dellinger, 2010). One area adversely affected by moderate-to-severe TBI is social functioning. Six months after injury, adults with TBI frequently have problems with social communication, as well as reduced contact with friends, and less satisfying social relationships than adults without history of TBI (Temkin, 2009). Additionally, people with moderate-to-severe TBI have been found to have substantial difficulty with perspective-taking on performance-based tasks (Bivona et al., 2014). Impaired abilities in perspective-taking may underlie problems in social integration and relationships following injury. Poor perspective-taking ability could also adversely affect rehabilitative interventions via impaired interpersonal and communication skills that have a negative impact on family functioning, therapeutic engagement, and occupational outcomes (Saxton, Younan, & Lah, 2013).

The well-being of family members is also often affected after moderate-to-severe TBI. Family members of people who sustain a TBI have increased incidence of anxiety disorders, mood disorders, and social adjustment difficulty (Carlozzi et al., 2015; Ergh, Hanks, Rapport, & Coleman, 2003; Ergh, Rapport, Coleman, & Hanks, 2002; Kratz, Sander, Brickell, Lange, & Carlozzi, 2017; Marsh, 1998). The well-being of family systems, caregivers, and support people have reciprocal effects on people with moderate-to-severe TBI. Caregiver distress and life satisfaction predicts functional outcome of people with TBI (Vangel, Rapport, & Hanks, 2011). However, research on well-being after TBI has largely focused on either the person with TBI or their family members and support people. Few studies have examined the role of dynamic processes within supportive relationships after TBI. This study will focus on how people with TBI

and support people in their life understand each other's perspectives, and how perspective-taking ability is related to relationship quality.

Section 1.1 Personality and Emotional Changes Following Traumatic Brain Injury

After experiencing a moderate-to-severe TBI, people learn to adjust to life after injury. Commonly, sequelae of TBI include changes in personality and emotionality that can be distressing to the individual and their family members. Previous studies have found that 60-70% of informants report perceiving personality change in relatives with TBI (Brooks & McKinlay, 1983; Weddell & Leggett, 2006; Weddell & Wood, 2018). Weddell and Wood (2016) found that a comparable percentage of individuals with TBI self-reported substantial personality change. The types of personality changes experienced can take many forms; however, common changes include increases in neuroticism and decreases in extraversion and conscientiousness (Norup & Mortensen, 2015). The experience of personality change is not unique to TBI, but rather, it is a common outcome after orthopedic injuries as well, likely due to psychosocial factors (Beadle, Ownsworth, Fleming, & Shum, 2016). Regardless of the factors contributing to personality change, it is important to note that people with TBI who experience personality changes report poorer general health and quality of life (Diaz et al., 2012).

In addition to personality change, emotional changes are common after moderate-to-severe TBI. People with TBI are at risk for developing chronic problems with depression, anxiety, affective lability, irritability, disinhibition, and apathy (Arciniegas & Wortzel, 2014; Diaz et al., 2012). Emotional distress after injury can be affected by preinjury psychological status, severity of injury, and social support. Sigurdardottir, Andelic, Roe, and Schanke (2014) identified four typical trajectories of distress following mild-to-severe TBI. Individuals in the chronic trajectory

who developed emotional distress that did not decline over 5 years post injury were more likely to have maladaptive coping styles and premorbid psychiatric symptoms.

Changes in personality and emotionality can contribute to an altered overall sense of self. People recovering from TBI may feel as if they need to rediscover who they are as a person. Bryson-Campbell, Shaw, O'brien, Holmes, and Magalhaes (2013) reviewed qualitative studies of self-identity after TBI and loss of identity was one of the themes that emerged. As people experience cognitive, physical, and emotional sequelae of TBI, they may have differential ability to engage in self-care, leisure activities, or occupational tasks compared to their pre-injury status leading to poorer self-concept. Thus, one goal of rehabilitation efforts is helping participants reconnect with their values and develop a sense of self that integrates who they were before their injury and the changes that occurred after injury (Ownsworth & Haslam, 2016).

Section 1.2 Social Cognition Following Traumatic Brain Injury

An important aspect of personality change following TBI is social cognition. The ability to take another's perspective is a form of cognitive empathy, which falls within the domain of social cognition. Social cognition is an umbrella term that encompasses emotional perception, interpretation of emotion and social cues, and emotional regulation. Social cognition and social neuroscience are growing areas of research, but there is still much to be learned about the impact of TBI in this domain (S. McDonald, 2013). It is well documented that, compared to healthy adults, people with moderate-to-severe TBI are more socially isolated with fewer friends and less social participation (Govereover, Genova, Smith, Chiaravalloti, & Lengenfelder, 2017; Hawthorne, Gruen, & Kaye, 2009; Kozloff, 1987). As social cognition aids in communication and positive interpersonal interactions, it is an important domain to attend to after injury.

There is substantial evidence that emotion recognition and perception decline after TBI. Compared to healthy adults and orthopedic comparison groups, individuals with moderate-to-severe TBI tend to have more difficulty identifying emotions through facial and vocal cues (Ietswaart, Milders, Crawford, Currie, & Scott, 2008; Milders, Fuchs, & Crawford, 2003; Milders, Ietswaart, Crawford, & Currie, 2008). Babbage et al. (2011) estimated that people with moderate-to-severe TBI fall, on average, about one standard deviation below healthy adults on facial affect recognition, and approximately 13-39% of people with moderate-to-severe TBI have difficulties in this area. Some studies have shown a valence effect in which recognition of negative emotions, like sadness and anger, are particularly impaired (Spikman et al., 2013). However, more recent studies have shown that some emotions, like happiness and surprise, are easier to recognize for healthy adults as well (Rosenberg, McDonald, Dethier, Kessels, & Westbrook, 2014). Examination of a broader range of emotions suggests that people with TBI experience poorer overall emotion recognition across ranges of emotional valence than healthy adults (Rosenberg, McDonald, Rosenberg, & Frederick Westbrook, 2018). These deficits may be particularly pronounced in men, who show more difficulty with vocal emotion recognition and emotional inferencing compared to women (Zupan, Babbage, Neumann, & Willer, 2016).

Impairment in emotion recognition is hypothesized to underlie complex social communication difficulties. For example, McDonald, Fisher, and Flanagan (2015) showed that ability to infer speaker meaning was not facilitated by emotional hints in adults with TBI. People with TBI who demonstrate impairments in emotion recognition are also more likely to exhibit behavioral problems, apathy, and have poorer social integration (Knox & Douglas, 2009; May et al., 2017; Rosenberg et al., 2018; Spikman et al., 2013).

Further, there has been a recent increase in research examining empathic abilities following TBI. *Empathy* is a broad term that has been discussed as an essential ability for functioning with society. Empathy is defined as the ability to comprehend and experience how another person thinks and feels while maintaining an understanding of the boundaries between self and other (Decety & Lamm, 2006). The construct is often divided into two domains, *cognitive empathy* and *affective empathy*. Research has supported this division with behavioral and neurological evidence. Additionally, both cognitive and affective empathy seem to be important for healthy social functioning.

Affective empathy has also been referred to as emotional empathy, the mirror system or hot social cognition. It involves the ability to understand other's feelings through simulating some portion of that emotional experience within the self. The amygdala and insula, regions involved in the mediation of emotional experiences, are important for affective empathy (Dvash & Shamay-Tsoory, 2014). Some evidence suggests that prefrontal regions may also be important for affective empathy (Shamay-Tsoory, Tomer, Goldsher, Berger, & Aharon-Peretz, 2004). Wood and Williams (2008b) found that approximately 60% of their sample of people with TBI showed low affective empathy on a self-report measure compared with about 30% of the healthy adult sample. According to de Sousa et al. (2010), people with TBI have lower autonomic arousal to emotional pictures, demonstrating impairment in affective empathy compared to a healthy comparison group. In contrast, healthy adults tend to automatically mimic emotional facial expressions and show stronger skin conductance in response to angry faces compared to people with TBI (de Sousa et al., 2011).

Affective empathy is not accounted for by injury severity, neuropsychological impairment, or symptoms of anxiety or depression (Wood & Williams, 2008b). However, incidence of

alexithymia does seem to be related to problems with affective empathy after injury. Alexithymia involves difficulty identifying feelings, describing emotions, and a tendency to avoid thinking about emotions. Williams and Wood (2010a) found that 60.9% of their TBI sample had alexithymia compared to 10.9% of the healthy adult sample. Additionally, they found a negative relationship between alexithymia and affective empathy. Alexithymia is also related to cognitive empathy. Specifically, externally oriented thinking, or emotional avoidance, has been found to account for the majority of variance in cognitive empathy in people with TBI (Neumann, Zupan, Malec, & Hammond, 2014).

Cognitive empathy is also referred to as cold social cognition and the mentalizing system. This type of empathy involves theory of mind and mentalizing ability. In other words, cognitive empathy is the ability to take another person's perspective and consider how the other person thinks and feels. The medial prefrontal cortex, superior temporal sulcus, and ventromedial prefrontal cortex are involved in cognitive empathy ability (Dvash & Shamay-Tsoory, 2014; Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharon-Peretz, 2005).

Cognitive empathy has been dissociated from general cognitive ability. Spikman, Timmerman, Milders, Veenstra, and van der Naalt (2012) found that people with TBI had poorer performance on a theory of mind task compared to healthy adults, but theory of mind performance was not related to processing speed, attention, memory or executive functioning. However, some evidence has linked theory of mind impairments to deficits in working memory (Honan, McDonald, Gowland, Fisher, & Randall, 2015). Other aspects of cognitive empathy that may be affected by moderate-to-severe TBI include use of thought and feeling words in conversation, and ability to infer speaker beliefs and mental states of others (Byom & Turkstra, 2012; de Sousa et al., 2010; McDonald & Flanagan, 2004).

Perspective-taking is encompassed within the construct of cognitive empathy, and it may be referred to as cognitive affective empathy or affective theory of mind if the perspective-taking involves inference of the emotional state of another person (Dvash & Shamay-Tsoory, 2014). In healthy adults, having people imagine taking the perspective of a person experiencing pain produces more empathetic concern than having people imagine themselves in the same situation, which elicits more personal distress than empathy (Decety & Lamm, 2006; Lamm, Batson, & Decety, 2007). Indeed, perspective taking generally has been proposed as a critical component to social connection (Galinsky, Ku, & Wang, 2005). Following TBI, difficulty making inferences about the mental states of others is likely one of several factors that impact people's social integration (Bibby & McDonald, 2005; Saxton et al., 2013). Further, interpersonal functioning is ingrained in daily life such that difficulty in social communication is likely to interfere when interacting with family, coworkers, and treating providers.

Section 1.3 Support Person, Caregiver, and Family Member Impact

Traumatic brain injury also adversely affects the lives of family members and people who may provide support following injury. Family members of people who sustain a TBI have increased incidence of anxiety disorders, mood disorders, and social adjustment difficulty (Carlozzi et al., 2015; Ergh et al., 2003; Ergh et al., 2002; Kratz et al., 2017; Marsh, 1998; Semlyen, Summers, & Barnes, 1998). Qualitative research has identified that caregivers of people with moderate-to-severe TBI struggle with role demands and adjustments to the changes in the person with TBI. Caregivers of people with TBI at least 1 year post injury describe feeling overburdened with responsibilities and lacking time to care for themselves (Kratz et al., 2017). Additionally, some caregivers report experiencing grief for the loss of the pre-injury personality of the person with TBI, and increased anger, guilt, anxiety, and sadness. Carlozzi et al. (2015) found that

caregivers were most concerned about their social health, including feeling socially isolated and desiring companionship and support. Powell et al. (2017) also found that family members and friends with care responsibilities were struggling to meet the needs of the person with TBI while simultaneously attending to their own emotional and physical health.

Depression, anxiety, and somatic concerns are commonly experienced in support people in the lives of people with moderate-to-severe TBI. The emotional distress experienced by family and friends can persist for years after injury and be significant enough to warrant professional intervention (Verhaeghe, Defloor, & Grypdonck, 2005). Caregiver distress is related to poor functional status and substance use of the person with TBI, high supervision needs, and low caregiver life satisfaction (Kreutzer et al., 2009). It is clear that the experience of support people is important to understand so that clinical intervention can target appropriate needs of both members of the dyad.

Section 1.4 Importance of the Caring Relationship

Most research on well-being after TBI has focused on either the person with TBI or their caregivers and family members. However, there does seem to be a reciprocal relationship between family functioning and TBI outcomes. Schönberger, Ponsford, Olver, and Ponsford (2010) found that changes in mood and behavior after TBI predicted poor family functioning and increased anxiety and depression symptoms in family members, and they also found that family functioning effects recovery from TBI. Vangel et al. (2011) and several other studies (Sander, Maestas, Sherer, Malec, & Nakase-Richardson, 2012; Smith & Schwirian, 1998; Temple, Struchen, & Pappadis, 2016) similarly found evidence for reciprocal effects between support person psychosocial well-being and well-being of people with TBI.

The relationship between people with TBI and their support people is important for supporting positive outcomes for both members of the relationship. Open communication and emotional connection are related to coping in both support people and people with TBI (Verhaeghe et al., 2005). However, despite general agreement that family and support people experience important changes after a family member experiences TBI, there is a dearth of research regarding possible interventions addressing family systems or caregiver-care receiver dyads. Boschen, Gargaro, Gan, Gerber, and Brandys (2007) found that the existing research on family interventions for brain injury is lacking methodologically and there is a need for more rigorous studies regarding how to intervene at the family systems level after TBI. Nevertheless, studies of existing family interventions, like the Brain Injury Family Intervention, have supported that addressing familial needs leads to improvement in both caregivers and people with TBI (Kreutzer, Marwitz, Sima, & Godwin, 2015; Kreutzer, Stejskal, Godwin, Powell, & Arango-Lasprilla, 2010).

Section 1.5 Perspective Taking and Empathy of Support People

Little is known about how support people in the lives of people with TBI understand and interpret the experiences of people with TBI. Qualitative research indicates that adjusting to and making sense of the changes people experience after TBI is an important concern of caregivers (Kratz et al., 2017; Powell et al., 2017). However, it is not clear how support person empathy affects outcomes for either the person with TBI or the support people themselves.

Commonly, researchers and clinicians utilize proxy reports in which support people are asked to report on the abilities of people with TBI. Proxy reports are employed because deficits in self-awareness are common after brain injury, although patients generally do not need a proxy when reporting on quality of life (Machamer, Temkin, & Dikmen, 2013). Proxy report may provide insight into how support people understand the impact of brain injury on functional

abilities, but reporting on perceptions of change in the person with TBI does not require caregivers to "step into the care receiver's shoes." Rather, perspective-taking involves imagining how the other person in the relationship feels and experiences their world. Unfortunately, there is a lack of research examining perspective-taking ability, or empathy more broadly, in support people in the lives of people with TBI.

Some research has begun to examine perspective-taking and empathy in caregivers for chronic conditions other than TBI. Initial results suggest that caregiver perspective-taking ability is important for quality of life. Martini, Grusec, and Bernardini (2001) found that accurate perception of partner feelings was a strong predictor of partner satisfaction in dyads of older mothers and adult daughters. It is hypothesized that perspective-taking promotes communication competence, perceptual accuracy and enhanced ability to meet patient needs, but more research is needed to understand how these abilities may be related (Lobchuk, 2006).

Section 1.6 Rationale for the Present Study

Moderate-to-severe TBI commonly leads to substantial changes in the lives of the people who sustain injury and the support people in their lives. Social cognition is one domain of functioning that has been shown to be affected in some people with TBI. It is well documented that individuals with TBI tend to have deficits in emotion recognition. Complex social cognition skills, like affective and cognitive empathy, also decline after injury. Impairment in social cognition may underlie relationship difficulties experienced following injury. However, social cognitive ability is typically measured using lab tasks that require applying social cognitive ability to artificial scenarios, or it may be measured through self-report.

This study examined perspective-taking ability, a cognitive empathy skill, within a specific and meaningful relationship in the life of a person with TBI. No previous studies have examined

how people with TBI understand the experience of specific support people in their lives and what impact this understanding may have on relationship quality. Similarly, studies have not elucidated how support people understand the experience of people with TBI. Thus, the present study was a detailed investigation of the perspective-taking abilities in both individuals with TBI and support people, including examination of correlates of accurate understanding of the relationship partner's experiences. Research targeting the complexities of specific meaningful relationships in the lives of people with TBI can aid in guiding development of interventions to optimize adjustment to life after injury.

Section 1.7 Aims of the Present Study

The current study sought to expand the literature on perspective-taking ability after TBI by examining perspective-taking within relationships with support people. A unique aspect of this study is that perspective-taking ability was examined in both members of the dyad: people with TBI and support people. Including both members of the relationship in the study is an acknowledgment of the dynamic processes that take place between support people and people with TBI. The main objective of the proposed study was to examine patterns of perspective-taking accuracy of both members of the dyad across various domains of functioning. A secondary objective was to examine the role of perspective-taking accuracy on relationship quality. The utility of self-reported empathy was also examined by comparing empathy on a self-report measure to performance on a perspective-taking task.

Objective 1: To examine perspective-taking accuracy of adults with moderate-to-severe TBI and support people, and to determine tendencies to over- or under-estimate symptom experience of the other member of the dyad.

Hypothesis 1a. Adults with TBI will have less accurate perspective-taking ability across domains compared with support people.

Hypothesis 1b. Individuals with TBI and their support people will underestimate symptoms in their loved one.

Objective 2: To learn about the relationship between perspective-taking ability and relationship quality in both persons with moderate-to-severe TBI and support people.

Hypothesis 2a. Perspective-taking accuracy will be positively related to perceived relationship quality in both support people and individuals with TBI.

Hypothesis 2b. Perspective-taking accuracy will be more important to relationship quality for support people than for people with TBI.

Hypothesis 2c. Accurate perspective-taking of psychological symptoms will be most related to relationship quality, because psychological symptoms are less stable than personality factors and may be more difficult to perceive accurately.

Objective 3: To examine the relationship between self-reported empathy and perspective-taking accuracy.

Hypothesis 3. Self-reported empathy will be positively related to perspective-taking accuracy, with self-reported perspective-taking and empathic concern as stronger predictors than fantasy and personal distress.

CHAPTER 2: METHOD

Section 2.1 – Participants

All participants were between the ages of 20-78. Participants with a history of mild complicated or moderate-to-severe TBI were recruited primarily from the South Eastern Michigan Traumatic Brain Injury Model System (SEMTBIS) and Traumatic Brain Injury Research Registry. TBI severity was indicated by post-traumatic amnesia ≥ 24 hours, loss of consciousness ≥ 30 minutes, and Glasgow Coma Scale (GCS) < 13 at emergency department admission or abnormal neuroimaging. Participants were also recruited from local brain injury support groups. All participants sustained their TBI after the age of 16, and the injuries sustained were severe enough to warrant inpatient rehabilitation. At the time of participation in the study, participants were at least 1 year post injury. In the context of the current study, a support person was identified by each participant with TBI. To participate, support people had to have no history of significant neurological impairment, and they must regularly spend time with the person with TBI. Participants in either group were excluded if they (1) did not speak English; (2) had injuries too severe to engage in assessment; (3) had progressive neurological disease, psychotic disorder, or medical conditions, other than TBI, that were likely to affect cognition or social communication; (4) individuals with a legally authorized representative were excluded from the study.

The total sample collected included 121 participants. Four support people were excluded due to history of neurological impairment. Three support people never attended their portion of the study. Four TBI participants were excluded because they had medical or psychiatric conditions other than TBI that could affect their cognition or social communication ability. Due to the dyadic nature of the study, the study partner of each excluded participant was also excluded from analyses, resulting in 102 participants total (n = 51 per group). An additional three dyads were excluded

because one or both members of the dyad contributed multiple significant outliers across measures. The final sample consisted of 96 participants, 48 in each group.

Section 2.2 Measures

Instructional Conditions. Participants provided information regarding characteristics of the caregiving relationship and completed the Wechsler Test of Adult Reading, FAS and Animals, Interpersonal Reactivity Index, and Mutuality Scale with standard instructions (i.e. self-report). The Depression Anxiety Stress Scales (DASS-21), and Big Five Inventory-2-Short Form (BFI-2-SF) were completed in two instructional conditions: ***self-report instruction*** in which the person reported on how they themselves think and feel, and ***imagine-other perspective-taking*** in which the person was asked to take the other person's perspective and respond as the other person would. Participants with TBI completed the Acceptance and Action Questionnaire – Acquired Brain Injury (AAQ-ABI) in a self-report condition and completed a perspective-taking version of the Acceptance and Action Questionnaire-2 (AAQ-II). The support people completed the AAQ-II in a self-report condition and the AAQ-ABI with perspective-taking instructions. Support people also completed the PCRS Relative Form and Zarit Burden Interview – 12 using standard instructions.

Characteristics of the Caregiving Relationship. Several characteristics of the caregiving relationship were measured to gain an understanding of the type of relationship within each dyad. Characteristics of interest included duration of caregiving measured in months, degree of perceived knowing thoughts and feelings of the other person in the dyad (rated on a 5-point scale ranging from *not at all* to *very well*), and degree of contact (rated on a 5-point scale ranging from <*weekly, we live separately* to *daily, we live together*). Characteristics of the caregiving relationship questions were modeled after Lobchuk and Vorauer (2003). Support people were also asked to estimate the amount of time in hours spent with the person with TBI each week.

Wechsler Test of Adult Reading (WTAR; The Psychological Corporation, 2001). The WTAR is a reading recognition test commonly used as an estimate of premorbid intellectual functioning. This task requires participants to pronounce 50 phonetically irregular words. The manual indicates that the WTAR has good internal consistency (α = .87-.97), test-retest reliability (> .90), and external validity (e.g., AMNART r = .90; The Psychological Corporation, 2001). Word reading has been found to be strongly related to intellectual functioning and is typically preserved following brain injury (Green et al., 2008).

Phonemic and Semantic Verbal Fluency (FAS and Animals;Tombaugh, Kozak, & Reese, 1999). These tasks are word-list generation tasks that have been widely used as measures of language and executive functioning, including cognitive initiation and flexibility. Phonemic verbal fluency (FAS) involves generating as many words as possible beginning with a particular letter of the alphabet within one minute. Three trials are completed with a different letter provided each time. The semantic fluency task (Animals) involves generating as many different types of animals as possible within a one-minute interval. Scores on both tasks consist of the number of unique words provided consistent with the criteria as defined by standardized protocol. Internal consistency across phonemic fluency trials has been found to be high (r = .83; Tombaugh et al., 1999).

Interpersonal Reactivity Index (IRI; Davis, 1980). A 28-item self-report measure of empathy, the IRI, uses a multidimensional approach to empathy in which four subscales tap an aspect of overarching empathy. All subscales are related in that they concern responsivity to others. The four subscales include Perspective-Taking (tendency to spontaneously adopt the point of view of others), Fantasy (tendency to imaginatively experience the feelings and actions of fictitious characters), Empathic Concern ("other-oriented" feelings of sympathy), and Personal Distress

("self-oriented" feelings of personal unease in tense interpersonal settings). Each subscale is composed of 7 items. Participants rate items using a 5-point scale ranging from A (*does not describe me well*) to E (*describes me very well*). Example items include "I often have tender, concerned feelings for people less fortunate than me," "I sometimes try to understand my friends better by imagining how things look from their perspective," and "I am usually pretty effective in dealing with emergencies." Higher scores suggest higher levels of empathy; however, eight of the items (two in each scale) are reverse keyed. This measure has been used successfully in several studies investigating empathy in TBI populations (Bivona et al., 2014; de Sousa et al., 2010; Neumann et al., 2012; Zupan, Neumann, Babbage, & Willer, 2018). Flesch-Kincaid Grade Level for the 28-item scale is 7.8. Flesch-Kincaid Grade Levels for the subscales are: Perspective Taking = 8.0; Fantasy = 8.4; Empathic Concern = 7.4; Personal Distress = 8.0; however, reading level of individual items varies widely, from grades 2.6 to 14.0.

Mutuality Scale (Archbold, Stewart, Greenlick, & Harvath, 1990). The Mutuality scale was developed for use among caregivers in reference to their caregiving relationship. It is a 15-item measure of the ability to find gratification, meaning, and reciprocity in the relationship. Mutuality includes domains of love (3 items), shared pleasurable activities (4 items), shared values (2 items), and reciprocity (6 items). Example items include "How much love do you feel for him or her," "How often do you confide in him or her," and "To what extent do you enjoy the time the two of you spend together?" Participants rate the extent to which items apply to their relationship using a 5-point scale from 0 (*not at all*) to 4 (*a great deal*). The measure is scored by averaging ratings across items. Thus, scores range from 0 to 4. In this study, the Mutuality Scale was used as a measure of relationship quality with high scores representing high relationship quality. The scale has a Flesch-Kincaid reading level of Grade 3.4, with items ranging from < 1st- to 7th-grade

reading level. This scale has been found to be reliable among both caregiver and care receiver populations with cognitive impairments, with strong internal consistency ($\alpha > .90$; Karlstedt, Fereshtehnejad, Aarsland, & Lökk, 2019; Pucciarelli et al., 2016).

Depression Anxiety Stress Scales (DASS-21; Lovibond, 1995). The DASS-21 is a 21-item self-report measure of depression, anxiety, and stress. In this short-form version of the scale (Henry & Crawford, 2005), each subscale has seven items. Participants use a 4-point scale, from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*), indicating the extent to which each item applied to them over the past week. Example items include "I found it hard to wind down," "I felt downhearted and blue," and "I was worried about situations in which I might panic and make a fool of myself." Subscale scores range from 0 to 21, with higher scores representing greater distress. Average reading level required for the 21 items is Grade 5.4, with individual items varying widely, ranging from < 1st- to >16th-grade reading level. The DASS-21 has been found to have good internal consistency in general and clinical populations ($\alpha = .87$ to .94), including adults with severe TBI (Ownsworth, Little, Turner, Hawkes, & Shum, 2008; Randall, Thomas, Whiting, & McGrath, 2017).

Big Five Inventory – 2 – Short Form (BFI-2-SF; Soto & John, 2017). The BFI-2-SF is a 30-item measure of personality designed to assess traits defined by the five-factor theory of personality (extraversion, agreeableness, conscientiousness, negative emotionality, and openness), each subscale has six items, three of which are reverse scored. Participants rate the extent to which items apply to them (i.e., "I am someone who… tends to be quiet) on a 5-point scale, from 1 (*disagree strongly*) to 5 (*agree strongly*). Subscale scores range from 0 to 30, with higher scores representing stronger applicability of the trait. This short-form measure has shown adequate internal consistency ($\alpha = .73$ to .83) and test-retest reliability, among healthy adults (.69 to .83;

Soto & John, 2017). Although this short-form version of the BFI-2 has not been used previously in moderate to severe TBI, the original, longer predecessor of the scale (BFI) has been used successfully (Mendez, Owens, Jimenez, Peppers, & Licht, 2013). The BFI-2-SF was designed to be easily understood and it has a Flesch-Kincaid reading level of 5.8, although items range from < 1st to > 12-grade level.

Acceptance and Action Questionnaire-II (AAQ-2; Bond et al., 2011). The AAQ-II is a 7-item measure of psychological flexibility and experiential avoidance. Psychological flexibility is a construct that consists of accepting challenging thoughts and feelings that occur while maintaining the ability to engage in valued behavior. This measure was completed by support people in this study to examine both psychological distress and coping. Example items include "I'm afraid of my feelings," "My painful memories prevent me from having a fulfilling life," and "Worries get in the way of my success." Higher scores represent more psychological inflexibility (i.e., more distress and poorer coping). Participants rate how true each statement is of them, using a 7-point scale (1 = *never true* to 7 = *always true*). Scores range from 7 to 49. Previously, this measure has been found to have a strong positive correlation with the reactive avoidance factor on the AAQ-ABI (Whiting, Deane, Ciarrochi, McLeod, & Simpson, 2015). This measure has demonstrated good internal consistency (α = .78 to .88) and test-retest reliability after 3 (.81) and 12 (.79) months among healthy adults (Bond et al., 2011). The items read at a 5th-grade level (range, 2 to 8).

Acceptance and Action Questionnaire-Acquired Brain Injury (AAQ-ABI; Sylvester, 2011). The AAQ-ABI was created as a measure of psychological flexibility within the context of functional disability following ABI. Persons with ABI rate the extent to which the items are true of them, using a 4-point scale (0 = *not at all true* to 4 = *very true*). Example items include "I hate

how my brain injury makes me feel about myself," "I stop doing things when I feel scared about my brain injury," and "Most people are doing better than me." Of note, one item is reverse keyed ("I am moving forward with my life").

Factor analysis of the AAQ-ABI has shown that the scale consists of three factors, including reactive avoidance of emotions, denial of ABI, and active acceptance of the ABI (Whiting et al., 2015). The factor representing reactive avoidance of emotions has been found to have good internal consistency ($\alpha = .89$) and strong test-retest reliability after 7-14 days (ICC = .92), among people with ABI (Whiting et al., 2015). The current study used only the reactive avoidance factor, a 9-item measure. The factors representing denial of ABI and active acceptance were not included because they have been found to have low internal consistency ($\alpha = .38$ & .46, respectively) and they each consist of only two items. Thus, scores for the reactive avoidance subset range from 0-36, with higher scores suggesting higher experiential avoidance, and lower psychological flexibility, related to brain injury (Sylvester, 2011). The Flesch-Kincaid reading level for the scale is Grade 4.4 (item range, grades 2.3 to 6.5).

Patient Competency Rating Scale (PCRS; Prigatano & Fordyce, 1986). Originally developed to measure self-awareness, the PCRS is a 30-item measure with patient, relative, and clinician rating forms. Each rating form asks the reporter to rate degree of difficulty with activities of daily living, and components of behavioral, emotional, cognitive, and physical functioning. Example items include "How much of a problem do they have in taking care of their finances," "How much of a problem do they have in remembering their daily schedule" and "How much of a problem do they have in handling arguments with people they know well?" Ratings are made on a 5-point scale (1 = *can't do* to 5 = *can do with ease*), yielding scores ranging from 30 to 150 with higher scores representing better functional ability. Kolakowsky-Hayner, Wright, and Bellon

(2012) reviewed the psychometric properties of the PCRS and found it has good test-retest reliability (intraclass correlation = .85-.97) and internal consistency (α = .91-.93) when measuring self-awareness after TBI. Good internal consistency (α = .93) has also been found for the PCRS patient report and relative report used to measure functional ability after TBI (Ergh et al., 2002). The Flesch-Kincaid reading level for the scale is Grade 6.3 (item range, grades 2.8 to 11.7).

Zarit Burden Interview-12 (ZBI-12; Bedard et al., 2001). The ZBI-12 is a short-form version of the 22-item Zarit Burden Interview (Zarit, Orr, & Zarit, 1985). The instrument was developed to measure subjective caregiver burden. Example items include "Do you feel… stressed between caring for your relative and trying to meet other responsibilities (work/family)," "that your social life has suffered because of your involvement with your relative," and "You should be doing more for your relative?" Ratings are made on a 5-point scale (0 = *never* to 4 = *nearly always*). Scores range from 0 to 48, with higher scores suggesting higher burden. It has been found to have good internal consistency among caregivers of people with cognitive impairment (α = 0.88). The short form has been found to correlate well with the full 22-item total in samples of caregivers for people with dementia (r = 0.92-0.97; Bedard et al., 2001). The ZBI-12 has also been examined within a sample of caregivers of people with ABI, and it was found to have good internal consistency (α = 0.89) and strong correlation with the 22-item total (rho = 0.97; Higginson, Gao, Jackson, Murray, & Harding, 2010). The Flesch-Kincaid reading level for the scale is Grade 6.8 (item range, grades 2.2 to 12).

Section 2.3 Procedure

Participants in the TBI group were recruited from the SEMTBIS and TBI Research Registry and from local community support groups. Prior to their testing session, participants were screened for inclusion and exclusion criteria, and they were asked to identify a significant person

in their life who serves as a caregiver or support person. In order to participate, both the person with TBI and a support person needed to agree to take part in the study. The SEMTBIS and TBI Research Registry databases provided demographic information including age, gender, years of education, time since injury, and injury severity as assessed by the Glasgow Coma Scale at the time of admission to the Emergency Department. Each member of the dyad was scheduled for a 60- to 90-minute testing session. Each participant was seen for their testing session within 2 weeks of their dyadic partner with the majority of participant dyads seen on the same day. To minimize selection bias due to mobility or transportation limitations, participants were offered the options of being tested either at the Rehabilitation Institute of Michigan or in their homes. Participant pairs that were tested on the same day completed testing in separate rooms to ensure privacy of responding. Each participant received $20 for their time and participation.

During their respective testing sessions, each member of the dyad completed informed consent procedures in accordance with Institutional Review Board and hospital policy guidelines. Participants also provided information regarding relationship characteristics and completed the WTAR, as well as phonemic and semantic word generation measures to estimate general intelligence and cognitive ability. Each participant completed a collection of measures using the standard self-report instructions, and a second set of measures was completed using perspective-taking, imagine-other instructions. These two instructional sets were counterbalanced as were the order of measures within each set. The ZBI and PCRS-relative form were completed only by the support person group. All questionnaires were read aloud to participants as they read along.

Prior to completing several measures under the perspective-taking condition, participants completed a priming task in which they were asked two open ended questions about how their study partner was affected by their injury. The questions were as follows; *"What were [___]'s*

biggest concerns following the brain injury," and *"How did the brain injury affect [____]'s life?"* Each participant was prompted once at the end of their answer with either "Anything else," or "Tell me more." This priming task was included to place each participant in the mindset of thinking about the effects of brain injury specifically.

The perspective-taking imagine-other instructions have been adapted for use in this study from Urbanik and Lobchuk (2009) and Batson, Early, and Salvarani (1997). Participants were read the perspective-taking prompt prior to completing the measures in the perspective-taking condition (See Appendix A). They were able to ask clarifying questions and the examiner ensured that they understood that they were to be completing the questionnaires from their study partner's point-of-view. The prompt *"How would [ ] respond?"* was used as needed throughout the perspective-taking measures to remind the participants that they were to be responding from the other person's perspective.

CHAPTER 3: RESULTS

Descriptive statistics for demographic characteristics of the TBI and SP groups are presented in Table 1. The majority of the dyads consisted of people who saw each other daily, with all but 2.1% seeing each other at least weekly. The most common relationship among the dyads was spouse or significant other (41.7%). The TBI participants self-reported their race as follows: 62.5% African American, 27.1% White, 2.1% Asian, 2.1% Hispanic/Latinx, 4.2% unidentified. The distribution was generally similar within support persons (60.4% African American; 35.4% White; 2.1% Mixed; 2.1% Unidentified). Paired-samples *t* tests revealed there was no significant difference between groups in age, or performance on the WTAR or on semantic or phonemic fluency (p = .12 - .78). The SP group completed more years of education compared to the TBI group, $t(46) = -3.50$, $p = .001$, $d = 0.49$. Consistent with population- based demographics, the SP group had a larger percentage of women than the TBI group, $X^2 = 26.05$, $p < .001$. Injury characteristics for the TBI group are also presented in Table 1. Mean score on the GCS at time of hospital admission was in the severe range (M = 8.5, range 3 – 14). The mean duration of post-traumatic confusion was also consistent with a severe TBI (M = 26.7, range 3 – 170 days).

Descriptive characteristics and reliability of the main outcome measures are presented in Table 2. Of note, the Empathic Concern, Fantasy, and Personal Distress subscales of the IRI had particularly poor internal consistency in both groups (α = .46 - .53). Thus, these scales were excluded from analyses. A prorated Perspective Taking subscale was used which had internal consistency of α = .77 and .63 for the TBI and SP groups, respectively. The scale was prorated such that the score for Item 15 was replaced by the mean response across the remaining items, because the original scale had poor internal consistency with the inclusion of Item 15 (*If I'm sure I'm right about something, I don't waste much time listening to other people's arguments*; Grade

level 9.0, reverse coded). The prorated Perspective-Taking subscale of the IRI was used in subsequent analyses.

Cutoffs for clinical interpretation of the DASS-21 (Henry & Crawford, 2005; Lovibond, 1995) indicate that the TBI group, on average, reported mild depression (75 – 81st percentile), anxiety (86 – 89th percentile), and stress (77 – 81st percentile). Among the TBI group, 54% scored above the cutoff for "mild" depressive symptoms: 18.8% mild (*n* = 9,), 12.5% moderate (*n* = 6), 14.6% severe (*n* = 7). For DASS-21 Anxiety, 50% (*n* = 24) scored as mild or higher: 12.5% were in the mild range (*n* = 6); 16.7% moderate (*n* = 8); and 20.8% severe (*n* = 10). For DASS-21 stress, 43.8% (*n* = 21) scored mild or higher: 20.8% were in the mild range (*n* = 7); 16.7% moderate (*n* = 8); and 12.5% severe (*n* = 6).

In contrast, the average DASS-21 scores for the SP group corresponded with normal levels of depression, anxiety, and stress. Among the SP group, frequencies indicated that 12.5% scored above the cutoff for "mild" depressive symptoms: 10.4% mild (*n* = 5), 4.2% moderate (*n* = 2), 6.3% severe (*n* = 3). For DASS-21 Anxiety, 39.5% (*n* = 19) scored mild or higher: 27.1% were in the mild range (*n* = 19); 8.3% moderate (*n* = 4); and 4.2% severe (*n* = 2). For DASS-21 stress, 27% (*n* = 13) scored mild or higher: 12.5% were in the mild range (*n* = 6,); 8.3% moderate (*n* = 4); and 6.3% severe (*n* = 3).

The TBI group reported significantly higher levels of symptoms than the SP group on DASS-21 Depression, $t(47) = -2.90$, $p = .006$, $d = 0.51$; Anxiety, $t(47) = -2.88$, $p = .006$, $d = 0.53$; and Stress, $t(47) = -2.14$, $p = .037$, $d = 0.44$.

Cutoff scores for clinically relevant distress were also examined for scores on the AAQ-II and AAQ-ABI. An AAQ-II scores above a range of 24-28 indicate clinically relevant distress (Bond et al., 2011). The average AAQ-II score in the SP group (*M* = 15.4) was well below the

clinical cut point. Among the SP group, 18.8% of people scored above 24, indicating clinically relevant distress (n = 9). There has not been normative data published for the AAQ-ABI, nor recommended clinical cutoff scores. The TBI group scores on the AAQ-ABI ranged from 0 to 28 out of a possible 36, and the TBI group had an average AAQ-ABI score of 10.9. The mean score is equivalent to an average-item endorsement of 1.2, which corresponds to "a little true of me" on the 0 – 4 response alternatives scale. However, 18 (37.5%) of the TBI group indicated meaningful problems on the AAQ-ABI, having endorsed average-item AAQ-ABI > 1.5 (pretty true of me), with 4 of those participants (8.3%) endorsing average item > 2.5 (true of me).

Raw score differences between the TBI and SP groups on the BFI-2-SF were examined instead of examining levels of raw scores within groups, because normative data have not been published for this measure. Compared with the TBI group, the SP group endorsed higher agreeableness, $t(47) = 2.21$, $p = .032$, $d = 0.45$, and conscientiousness, $t(47) = 2.68$, $p = .010$, $d = 0.61$. There were no significant differences between groups on extraversion, negative emotionality, or openness, and effect sizes were small, $p = .22$-$.94$, $d = 0.02$-0.26.

Levels of burden were examined within the SP group. Higginson and colleagues (2010) found that the scale had optimal sensitivity and specificity using a cut score of 12 for high burden (Sensitivity = 92%, Specificity = 94%). The mean ZBI-12 score for the SP group (M = 10.5) was below the cut score for high burden. The scores for 39.6% of the SP group were within the high burden range.

3.1 *Perspective-Taking Accuracy Group Comparisons*

To examine the perspective-taking accuracy of adults with TBI and support people, perspective-taking accuracy was calculated by subtracting the *self-reported* score of the participant's study partner from the *perspective-taking*, imagine-other, score of the participant. Thus, scores of 0 represent perfect perspective-taking, scores above 0 represent an overestimation

of the score, and scores below 0 represent an underestimation of the score. Difference scores (referred to as perspective-taking accuracy) were calculated for the DASS-21, AAQ-II, AAQ-ABI, and BFI-2-SF. Table 3 presents the means, standard deviations, and ranges for each difference score. The DASS-21 and BFI-2-SF are each made up of several subscales, and participants' perspective taking accuracy could vary across these subscales. Thus, a composite perspective-taking variable was computed for both the DASS-21 and the BFI-2-SF by averaging perspective-taking accuracy across subscales to be used in analyses.

Single-sample *t* tests were conducted to test statistical differences between perspective-taking accuracy scores and zero (which would represent perfect accuracy). As shown in Table 3, within the TBI group, participants significantly *overestimated* the self-report scores of their support people on the DASS-21, effect sizes were positive and medium for the average score and all subscales of the DASS-21 ($p < .000$ to .01; $d = 0.42$ to 0.66). Similarly, the effect size on the AAQ-II was positive and medium ($p = .03$; $d = 0.32$), indicating overestimation of psychological inflexibility relative to their support person's self-report. For The BFI-2-SF personality total and subscale indexes, accuracy scores did not differ significantly from zero and effect sizes were generally small ($p = .09$ to .95; $d = -0.01$ to -0.25). In contrast, among the SP group, there was no significant difference between perspective-taking accuracy and zero on the DASS-21, AAQ-ABI, and BFI-2-SF, and effect sizes were small ($p = .08$ to .84; $d = -0.02$ to -0.26), indicating generally accurate estimation of the person with TBI's experience, with the exception of a medium effect indicating *underestimation of* BFI-2-SF Openness relative to the person with TBI's self-report ($p = .01$; $d = -0.40$).

Notably, similar patterns were found when examining perspective-taking accuracy within subgroups of men and women. Within the SP group, perspective-taking accuracy scores were not

significantly different from zero on the DASS-21, AAQ-ABI, or BFI-2-SF (composite and subscale scores examined) in a subgroup of men (n = 10, p = .07 - .92). The subgroup of SP women significantly underestimated openness of their study partners (n = 36, p = .04), but otherwise perspective-taking accuracy scores were not significantly different from zero across composites scores and subscales (n = 36, p = .23 - .94). Within the TBI group, both men (n = 35, p < .001) and women (n = 11, p = .01) significantly overestimated their study partners' DASS-21 composite scores. Specifically, men in the TBI group significantly overestimated partner scores on the DASS-21 Anxiety and Stress subscales (n = 35, p < .001 & p = .001, respectively). Men in the TBI group also significantly *underestimated* partner scores on the BFI-2-SF Agreeableness subscale (n = 35, p = .02). Women in the TBI group significantly overestimated partner scores on the DASS-21 Depression and Stress subscales (n = 11, p = .02 & .02, respectively).Women with TBI also significantly overestimated study partner AAQ-II scores (p = .05).

A multivariate analysis of variance (MANOVA) was conducted to examine perspective-taking accuracy between groups (TBI and Support Person) within the domains of psychological distress (DASS-21), psychological flexibility (AAQ-II or AAQ-ABI), and personality (BFI-2-SF). There was a significant effect of group on perspective-taking accuracy, V = 0.09, F(3,92) = 2.97, p = .036. Follow-up paired-samples t tests show that this effect is driven by differences on perspective-taking accuracy on the DASS-21, t(47) = 2.73, p = .004, d = 0.59. Support people had more accurate perspective-taking on the DASS-21 (M = 0.16) compared to people with TBI (M = 2.31), who tended to overestimate partner distress (See Table 4). Differences between perspective-taking accuracy on the BFI-2-SF or AAQ-II/AAQ-ABI were not significant (p = .14 and .27, respectively).

An additional MANOVA was conducted to examine perspective-taking accuracy between groups across the subscales of the DASS-21. The assumption of equality of covariance matrices was violated; thus, nonparametric Mann-Whitney tests were used to conduct group comparisons. The pattern of results was consistent with that seen in parametric analyses; thus, MANOVA and follow-up paired-samples *t* tests are reported. Paired-samples *t* tests were used to account for non-independence within dyads. Notably, the pattern of results was commensurate with the more conservative independent-samples *t* tests. The overall model was significant, $V = 0.09$, $F(3,92) = 2.97$, $p = .039$. As shown in Table 4, follow-up paired-samples *t* tests indicate significant differences in perspective-taking accuracy between groups on the stress and anxiety subscales, with both showing medium effect size ($d = 0.5$). In each instance, the TBI group tended to overestimate partner distress more than the support person group. The difference in perspective-taking accuracy on the depression subscale also was significant ($p = .048$), with slightly smaller but similar effect size ($d = 0.37$).

One possible explanation for why the TBI group overestimated distress in their support people is that they may have had a more difficult time disconnecting from their own emotional experience. Pearson correlations between self-report and perspective-taking scores within the same person show multiple medium-sized positive relationships within both the TBI and the support person groups (See Table 5). These correlations highlight the difficulty of the perspective-taking task and suggest that how neurologically-healthy adults and adults with TBI understand experiences of others are often affected by their own emotional state.

To further examine the relationship between a participant's self-reported score and the score they expected their study partner to produce, difference scores were calculated for scores within a single participant. Participant self-report scores were subtracted from that same

participant's perspective-taking score on a single measure. A resulting score of zero would indicate that the participant expected that their study partner would have the same score as they self-reported. Scores above zero represent that they expected their study partner to have a higher score compared to their own self-report, and scores below zero represent that participants expected their study partner to have a lower score than their own self-report. As shown in Table 6, the TBI group yielded difference scores across the DASS-21 subscales that were not significantly different from zero and had small effect sizes (d = -0.13 – 0.20). Conversely, the SP group reported *less* depression, anxiety, and stress in *themselves* compared to what they reportedly expected their study partner to report, as indicated by their positive difference scores which significantly differed from zero and had medium effect sizes (d = 0.41 – 0.43).

Correlates of Perspective-Taking Accuracy. The absolute value of perspective-taking accuracy scores were used to explore correlates of perspective-taking accuracy in both the TBI and SP groups. Nonparametric correlations were used because taking the absolute value of difference scores produced positively-skewed distributions. Associations varied depending on the domain in which the perspective-taking took place. Below, scales that showed particular relationships are indicated in parentheses.

As shown in Table 7, among the TBI group, perspective-taking accuracy *increased* with TBI group education (DASS-21 Anxiety and BFI-2-SF Conscientiousness), and WTAR (AAQ-II and BFI-2-SF Conscientiousness and Openness). The TBI group was also more likely to have accurate perspective-taking if they had lower severity of injury, as indicated by GCS (DASS-21 Stress and BFI-2-SF Conscientiousness), and if they had better functional ability, measured by informant-report PCRS (DASS-21 Stress). Additionally, TBI group perspective-taking *increased* with lower support person burden, as measured by ZBI-12 (BFI-2-SF Conscientiousness).

Table 8 shows that perspective-taking accuracy among support persons i*ncreased* with SP group education (DASS-21 Anxiety, Stress, and BFI-2-SF Agreeableness), WTAR (BFI-2-SF Openness), months of caregiving (DASS-21 Anxiety), and low experience of caregiving burden (DASS-21 Depression). Additionally, SP participants were most accurate for TBI participants with lower severity of injury (BFI-2-SF Extraversion) and higher functional ability (DASS-21 Depression, Stress, and BFI-2-SF Openness). Perspective-taking accuracy in the SP group *decreased* with months of caregiving (BFI-2-SF Negative Emotionality), and it also decreased for TBI participants with more months post injury (BFI-2-SF Extraversion).

3.2 Predicting Relationship Quality from Perspective-Taking Accuracy

Examination of scatterplots revealed differential relationships among subgroups of people who either overestimated or underestimated scores in their study partner. As perfect perspective-taking accuracy was represented by a score of zero, theory would predict positive correlations for underestimators (mutuality improves as perspective-taking accuracy increases toward zero) and negative correlations for overestimators (mutuality improves as perspective-taking accuracy scores move toward zero). Therefore, analyses were conducted to investigate the relationship between mutuality scores and perspective taking accuracy within subgroups of people who under- or over- estimated their study partner's scores. Subgroups of under- and over- estimators were created for these analyses. On each perspective-taking accuracy measure, participants with scores of zero or below were in the underestimator group and participants with scores above zero were in the overestimator group.

Moderation analysis, as described by Baron and Kenny (1986), was considered as the first method of choice to understand the differential relationships within groups of under- and over-estimators. Classic moderation analysis entails conducting hierarchical multiple regression to

assess statistical significance of an interaction term. In the current study, the interaction between perspective-taking accuracy and under- or over-estimator status was tested across the various domains. Unfortunately, this method was determined to be inappropriate for these data. This study was powered to a medium effect for two-group comparisons, but the moderation models require dividing these groups into smaller subsets. Once divided into these subsets, the group sizes did not support the needed power for the analyses.

Alternatively, a series of correlations between perspective-taking accuracy and mutuality were conducted to explore the relationships between perspective-taking ability and relationship quality within these subgroups. Tables 9-12 show Spearman's rho correlations exploring relationships between mutuality and perspective-taking within the subgroups of under- and over-estimators. Spearman's rho correlations were used because the creation of subgroups yielded variables with non-normal distributions, and these robust analyses allow for conservative investigation of relationships.

Correlates of Support Person Group Mutuality. Table 9 shows correlations between *SP group mutuality* and *SP group perspective-taking accuracy*. In the SP group, perspective-taking accuracy on the BFI-2-SF Agreeableness was positively correlated to SP group mutuality among underestimators (rho =.46). However, among overestimators, there was no significant relationship between perspective-taking accuracy on BFI-2-SF Agreeableness and SP mutuality. No other correlations between SP perspective-taking accuracy and SP mutuality were significant among underestimators. Among overestimators, SP mutuality had a negative relationship to perspective-taking accuracy on the BFI-2-SF Conscientiousness subscale with a medium effect size (rho = -.29), although power was too low for significance due to small sample size. It is notable that overestimators also showed a significant positive relationship between SP mutuality and SP

perspective-taking accuracy on BFI-2-SF with a large effect size (rho = .57). This relationship is in the opposite direction as expected; SP mutuality was predicted by their overestimation of extraversion in people with TBI.

Table 10 shows correlations between *SP group mutuality* and *TBI group perspective-taking accuracy*. Among the TBI group, within underestimators, there was a positive relationship between their perspective-taking accuracy on BFI-2-SF Openness and SP mutuality (rho = .41). This correlation denotes that when people with TBI more accurately predict support person openness, their support people tend to report more mutuality. Otherwise, correlations in the underestimator group were non-significant and had small effect sizes. Within overestimators, there was a negative relationship between TBI perspective-taking accuracy on the AAQ-II and SP mutuality (rho = -.49). Thus, when people with TBI overestimate their support person's psychological inflexibility (AAQ-II), their support person is more likely to report lower mutuality. Overestimators also had positive relationships of medium size, although non-significant, between SP mutuality and TBI perspective-taking accuracy on BFI-2-SF Openness and DASS-21 Anxiety (both rho = .29).

Correlates of TBI Group Mutuality. Table 11 shows the correlations between *TBI group mutuality* and *TBI group perspective-taking accuracy*. Among underestimators, TBI perspective-taking accuracy on BFI-2-SF subscales of Agreeableness (rho = .43) and Openness (rho = .50) are positively related to TBI mutuality. Additionally, there was a non-significant but medium-sized relationship between TBI perspective-taking accuracy on BFI-2-SF Conscientiousness and TBI mutuality (rho = .28). Among overestimators, there was a significant negative relationship between TBI perspective-taking accuracy on the AAQ-II and TBI mutuality (rho = -.48) such that when people with TBI were more accurate in predicting support person psychological flexibility, they also tended to report better mutuality. Also among overestimators, there was a negative

relationship with medium effect size between DASS-21 Depression perspective-taking accuracy and TBI mutuality (rho = -.29), but the relationship was non-significant due to small sample size. There was an additional non-significant relationship of medium effect size worth noting in the opposite direction of what was predicted within overestimators. There was a positive relationship between TBI mutuality and BFI-2-SF Extraversion perspective-taking accuracy (rho = .28).

Table 12 shows the correlations between *TBI group mutuality* and *SP group perspective-taking accuracy* in under- and over- estimators. There was a positive relationship of large effect size between SP perspective-taking accuracy on the DASS-21 Depression subscale and TBI mutuality (rho = .63). Thus, having a support person who underestimates depression is related to lower mutuality in people with TBI. Among overestimators, there were no significant correlations between SP perspective-taking accuracy and TBI mutuality.

3.3 Self-Reported Empathy and Perspective-Taking Accuracy Scores

Spearman rho correlations were calculated to examine the relationship between self-reported empathy as measured by the IRI Perspective-Taking subscale and perspective-taking accuracy across outcome measures. Subgroups of under- and over- estimators were used to allow for clearer interpretation of relationships. Nonparametric rho correlations were again used because of non-normality within subgroups.

TBI Group. As shown in Table 13, in the TBI group, there were no significant relationships between IRI Perspective Taking and perspective-taking accuracy within the underestimators. However, there was a correlation of medium effect size between perspective-taking accuracy on BFI-2-SF Openness and IRI Perspective Taking in the predicted, positive direction (rho = .29). There were also two meaningful, but nonsignificant, negative correlations between IRI Perspective Taking and perspective-taking accuracy on the BFI-2-SF subscales of

Agreeableness and Conscientiousness (rho = -.26 and -.29, respectively). In other words, the more that people with TBI underestimated how their support person would report on their agreeableness and conscientiousness, the more likely they were to report frequently engaging in perspective-taking behavior.

Table 13 also shows that there was one significant positive correlation between TBI perspective-taking accuracy on the DASS-21 Stress scale and IRI Perspective Taking score (rho = .33). This is in the direction opposite of prediction, such that self-reported perspective taking was higher in people who expected their study partner to report more stress than was actually reported. Although non-significant, there were also meaningful positive correlations between IRI Perspective Taking and Perspective-taking accuracy on the BFI-2-SF subscales of Extraversion and Negative Emotionality (rho .27 and .29).

Support Person Group. In the SP group (Table 14), there were two significant correlations in the expected direction within the underestimator subgroup. Specifically, there were medium to large positive relationships between SP group IRI Perspective Taking score and DASS-21 Anxiety perspective-taking accuracy and BFI-2-SF Agreeableness perspective-taking accuracy (rho = .51 & .37, respectively). There was also a medium-sized positive relationship between DASS-21 Depression perspective-taking accuracy and IRI Perspective Taking in the SP group (rho = .32), although the correlation was not significant, likely due to the small group size and low power.

Among overestimators, there was one medium-to-large, but non-significant negative relationship between SP group perspective-taking accuracy on BFI-2-SF Conscientiousness and IRI Perspective Taking (rho = -.47). Thus, support people who overestimated TBI group

conscientiousness were more likely to report lower tendency to take the perspective of others. No other relationships were significant among SP group overestimators.

Self-Reported Perspective-Taking and Mutuality. Because self-reported perspective taking did not show an overarching relationship with perspective-taking accuracy, additional analyses were conducted to understand the effect of self-reported perspective taking on relationship quality. As shown in Table 15, within the TBI group there was no significant relationship between IRI perspective-taking and mutuality either in people with TBI or support people. However, within the SP group, self-reported perspective-taking was positively correlated with support person (rho = .46) and TBI (rho = .34) mutuality and both relationships had a medium effect size. Thus, support people believing that they are empathic is an important predictor of relationship quality for both members of the dyad, regardless of empathic accuracy.

CHAPTER 4: DISCUSSION

Empathy for partners in close relationships is a critical element of relationship quality, and it appears to be especially important in the context of TBI. The current study supports prior research that documents impairment in social cognition following brain injury. In this study, people with TBI showed impairment in perspective-taking, even within relationships with close significant others. Contrary to expectation, the perspective-taking errors observed in people with TBI were such that they tended to overestimate distress experienced by their support people. It is notable that the people with TBI acknowledged experiencing relatively high levels of distress (depression, anxiety, and stress) themselves, so it is possible that they projected their own experience onto their loved ones. Therefore, one potential target for intervention after injury could be helping individuals to separate their own experience from the experience of others. In contrast to people with TBI, support people were generally accurate in their understanding of how people with TBI think and feel about themselves and their place in the world. This finding lends support to the common practice of clinicians obtaining reports from support people in assessments with people with TBI.

The ability to understand the experience of a relationship partner was associated with relationship quality for both people with TBI and their support people under certain circumstances. Relationships between perspective-taking accuracy and relationship quality differed for dyads in which the person tended to overestimate versus underestimate partner report, and relationships differed depending on the domain in which the person was asked to perspective-take. Particularly notable was that when people with TBI overestimated psychological inflexibility in their support people, both members of the dyad tended to experience poorer relationship quality. Also, there was an especially strong relationship indicating that when support people underestimate depression

in their loved ones with TBI, the person with TBI tends to experience poorer relationship quality. These associations highlight the importance of attending to perspective-taking accuracy, and identifying perspective-taking accuracy as a possible target of interventions supporting relationship quality after injury.

The hypotheses regarding self-rated empathy and its relation to objective empathy in perspective-taking accuracy could not be fully addressed due to problems with reliably assessing self-view. One of the most common ways of measuring empathy is through self-report. Although the measure selected for the present study (Interpersonal Reactivity Scale) has been used successfully and widely, it was not appropriate in this context, showing very low reliability. With this caveat in mind, some complex and unexpected relationships were observed between self-reported empathy and perspective-taking accuracy across domains in both people with TBI and support people. Again, associations varied according to whether relationship partners tended to over- or under- estimate responses. However, the associations observed were not consistently as expected by theory, in which self-reported empathy was positively associated with accuracy in understanding partner experience.

4.1 Perspective-Taking Accuracy in People with TBI and Support People

This is the first study to examine perspective-taking ability of support people within a specific relationship with someone with brain injury. Previous research suggests that people with TBI often feel misunderstood by others, noting that because their injury is invisible their difficulties can be downplayed or attributed to a personality flaw (Swift & Wilson, 2001). This study shows that support people who have an intimate knowledge of the behavior of the person with TBI generally have accurate understanding of their loved one's emotional well-being. This finding contrasts with the hypothesis that support people would underestimate symptoms, but it is

consistent with previous research that shows that familiarity with brain injury minimizes misattribution of neurobehavioral symptoms (Foster, McClure, McDowall, & Crawford, 2013).

The accurate perspective-taking of support people lends support for the common practice of treatment providers obtaining collateral information about a person with TBI from family members and other informal caregivers. Clinicians often seek to obtain information from family members and other support people regarding the functional abilities of people with TBI because self-awareness and insight can be affected by brain injury. However, support people may also be asked to report on the emotional functioning of people with TBI. The findings from this study suggest that many support people can accurately comment upon how people with TBI views themselves and their emotional world. In this regard, the likelihood of obtaining accurate collateral report on emotional and personality functioning of a person with TBI increases as education level of the support person increases and as functional ability of the person with TBI increases. Additionally, the likelihood of obtaining accurate collateral report on depression in a person with TBI increases as level of caregiver burden decreases.

Consistent with expectation, adults with TBI had less accurate perspective-taking abilities compared with support people. However, this difference was apparent only within the domain of psychological distress, and people with TBI tended to *overestimate* the distress of their support person. The pattern of overestimated distress contrasts with previous research that has found that people with TBI tend to underestimate emotional intensity and have poorer performance, compared to healthy comparisons, on tasks in which they are required to identify social faux pas (Bibby & McDonald, 2005; Bivona et al., 2014; S McDonald, 2013; Wearne et al., 2020). However, it is important to highlight that the current study is the first to examine perspective-taking regarding emotional experiences within a close relationship and allowed for differentiating

between over- and under- estimation of distress rather than noting generalized problems with tasks of empathy.

There are multiple possible explanations for why people with TBI may overestimate distress in their support people. One possibility is that the overestimated depression, anxiety, and stress in support people is due to an experience of guilt within people with TBI. There is a dearth of research examining how people with TBI think about the experiences of support people and caregivers in their lives. However, some qualitative studies have noted that people with TBI report feeling like a burden to their support people (Ashworth, Clarke, Jones, Jennings, & Longworth, 2015; Freeman, Adams, & Ashworth, 2015). People with TBI struggling with self-criticism after brain injury may expect that support people in their lives would be particularly upset by the need to provide additional support after the injury, leading to the overestimation of distress compared to that which support people actually report.

Another possible explanation is that people with TBI have difficulty differentiating their own experience from the experience of others. The participants with TBI endorsed experiencing meaningful levels of depression, anxiety and stress, and substantially greater distress than their support person. Thus, people with TBI may be prone to endorsing that support people would report levels of distress similar to their own experience. This explanation is supported by the finding that there was no difference between levels of anxiety, depression, or stress self-reported in people with TBI and the levels that people with TBI expected their support people would report. In actuality, the support people endorsed experiencing substantially less distress than did their partners with TBI. Indeed, research on the development of theory of mind has found that inhibitory control is essential to be able to differentiate between the self and others (Carlson & Moses, 2001; Xie, Pei, & Su, 2019). Further, research has found that the representation of the self is what needs to be

inhibited before a person is able to "step in to the other person's shoes" (Gilovich, Medvec, & Savitsky, 2000; Nickerson, 1999; Riva, Triscoli, Lamm, Carnaghi, & Silani, 2016; Surtees & Apperly, 2012). Research suggests that the right inferior parietal lobe, frontopolar cortex, and somatosensory cortex are important for making self/other distinctions (Ruby & Decety, 2003). Future research should examine the role of inhibitory brain regions and executive functioning abilities in perspective-taking accuracy after brain injury.

Although it is a complex and abstract task to take another person's perspective, there are indications that the TBI group was able to understand the nature of the task and its instructions. When administering the perspective-taking instructions, the researcher took care to ensure understanding, and clarification was provided as necessary. Further, reminders were provided intermittently as people with TBI completed the perspective-taking measures (e.g., "What would your mom say about herself?"). If people with TBI were struggling to consistently consider their support person's point of view, it would be expected that their consistency of responding on similar items would be low. However, reliability coefficients were generally acceptable across measures completed in the perspective-taking condition.

4.2 Perspective-Taking Accuracy and Relationship Quality

It was expected that inaccurate perspective-taking for both people with TBI and support people would be associated with poorer relationship quality. This hypothesis was partially supported, and importantly, there were several different associations among subgroups of overestimators and underestimators. This pattern indicates that in addition to understanding when relationship partners may have an inaccurate understanding of their partner's experience, it is meaningful to characterize *how* they are inaccurate. Also, due to the complex pattern of relationships found, there was not clear support for the hypothesis that perspective-taking accuracy

would be more important to relationship quality for support people than for people with TBI. Rather, the relative importance of perspective-taking for relationship quality between groups varied depending on the domain in which the perspective-taking was conducted. The strongest association indicated that people with TBI have stronger relationships when their support person has an accurate understanding of their depression. This finding provides partial support to the hypothesis that accurate perspective-taking of psychological symptoms would be most related to relationship quality. Alternatively, the majority of strong associations between perspective-taking accuracy and relationship quality were within personality domains.

For people with TBI, perspective-taking accuracy within the domain of psychological flexibility was important for their own relationship quality, and the relationship quality reported by their support person. This pattern was present in people who overestimated partner psychological inflexibility, but not among underestimators. In other words, for a person with brain injury, underestimating psychological inflexibility in their support person was not related to relationship quality. However, overestimating psychological inflexibility in their support person was related to poorer relationship quality in both the person with TBI and the support person. Future research should explore what mediates the relationship between overestimating psychological inflexibility and poorer relationship quality among people with TBI and their support people. One possibility is that when people with TBI overestimate inflexibility in support people, they may not feel confident that their support person can handle the stress associated with life changes after brain injury.

Support person relationship quality was also related to the accuracy of people with TBI perspective-taking in the domain of openness. The pattern of findings was not as predicted, yet a powerful common theme emerged. Overall, among people with TBI who underestimated and

overestimated their partner's openness, attributing a greater amount of openness to the support person was associated with better relationship quality. Similarly, relationship quality for both support people and people with TBI was positively associated with *overestimating* extraversion in their study partner, not with accurate assessments of it. Additionally, people with TBI who expected their support person to report less openness, agreeableness, and conscientiousness than the support person (i.e., underestimation of these positive qualities), experienced poorer relationship quality. Taken together, the findings suggest that perceiving the relationship partner in a prosocial manner (e.g., expecting openness and extraversion) enhances personal experience of relationship quality, regardless of accuracy, whereas expecting low sociability (e.g., underestimating openness and agreeableness) detracts from good feeling in the relationship. Further research is needed to understand this relationship, but it is speculated that overestimation of certain prosocial qualities may be linked to feeling that the study partner is sociable within the caregiving relationship, thus improving relationship satisfaction.

People with TBI who expected their support person to report more depression than the support person actually did, reported poorer relationship quality. This relationship is particularly worth noting considering people with TBI on average overestimated depression in their support person. Future research should examine whether intervention to help people with TBI have more accurate perceptions of the emotionality of their support people might lead to improved relationship quality.

People with TBI's experience of their relationship quality was associated with how accurately support people understood their experience of depression. In particular, when support people underestimated how much depression the person with TBI experienced, the person with TBI had poorer relationship quality. This was a strong relationship and suggests that

psychoeducation about depression after brain injury may be in important clinical tool for support people in the lives of people with TBI.

Overall, the complex and varied relationships between perspective-taking accuracy and relationship quality is consistent with a *social function approach on emotion* (Keltner & Haidt, 1999; Van Kleef, 2016). The social function approach on emotions emphasizes how different emotions serve to communicate about beliefs and intentions, and as such, accurate ability to perceive various emotions in a relationship partner leads to different outcomes. Le, Cote, Stellar, and Impett (2020) applied the social function approach on emotions to perspective-taking ability within romantic relationships. The authors found that accurate perspective-taking of emotions, such as guilt, embarrassment and shame, was positively associated with relationship quality, but this relationship was not observed for accuracy in perspective-taking of anger and contempt. Future research should continue to explore patterns of relationships between perspective-taking accuracy for various emotional experiences and relationship quality to aid in development of interventions that can best support development and maintenance of strong positive caregiving relationships after TBI.

4.3 Self-Reported Empathy and Perspective-Taking Accuracy

The hypotheses regarding self-perceptions of empathy were not well addressed in the current study, because it was not assessed reliably. The Interpersonal Reactivity Index is a well-established measure of empathy; however, it was not an appropriate measure for this sample. In this context it is unsurprising that self-reported empathy did not have a clear, direct relationship with perspective-taking accuracy within specific relationships of people with TBI and their support people.

For people with TBI, relationships between self-reported empathy and perspective-taking accuracy varied depending on domain and whether people were overestimating or underestimating the response of their study partner. The strongest relationship indicated that people with TBI who overestimated the amount of stress in their support person tended to report having more empathy than people with TBI who had an accurate understanding of partner stress. This relationship is in the opposite direction than was hypothesized, in terms of objectively accurate empathy; however, it is consistent with the notion that people who see themselves as highly empathic might overinterpret or magnify signs that someone they love is in distress. Only two relationships were observed that supported the expected relationship between self-perception of empathy and objectively accurate empathy among the TBI group. People with TBI who overestimated agreeableness or underestimated negative emotionality in their support person tended to self-report low empathy. However, all other relationships between perspective-taking accuracy and self-reported empathy were either in an unexpected direction or too small in size to be meaningfully interpreted.

The pattern of relationships between self-reported empathy and perspective-taking accuracy among support people were similarly variable. However, support people had fewer relationships that were in the unexpected direction between self-reported and observed perspective-taking. Generally, when support people self-reported more empathy, they were more likely to take the perspective of their study partner with TBI accurately. Support people who were underestimators were able to accurately self-report when they had low empathy for partner anxiety, depression, and agreeableness. Support people who were overestimators were able to accurately self-report when they had low empathy for partner experience of conscientiousness. However, there was one meaningful relationship in the unexpected direction among support people.

Specifically, in support people who were overestimators, self-reported empathy did not correspond with more accurate understanding of partner depression.

The variability in relationships between self-perceived empathy and observed perspective-taking accuracy across domains is consistent with previous research that has cautioned against generalization of self-perceived empathy. Previous research using self-perceived empathy has yielded variable results as to whether or not people with TBI report lower empathy than adults without neurological impairment (Bivona et al., 2014; de Sousa et al., 2010; Williams & Wood, 2010b; Wood & Williams, 2008a). Due to variable findings and problems with low self-awareness among people with TBI, Bivona et al. (2014) recommended against using self-reported questionnaires as sole measures of perspective-taking ability. Self-report measures of empathy can still be useful. Indeed, support person self-reported empathy had important relationships with their own and their study partner's relationship quality. However, it is important to keep in mind that self-reported empathy does not necessarily mean that the person has more *accurate* empathy, particularly among people with TBI. Measuring empathy and perspective-taking ability is challenging due to the ambiguous and interpersonal nature of the construct. As the field of social cognition and social neuroscience continues to grow, it will be important to continue to explore meaningful ways to measure these constructs.

4.4 Limitations and Future Directions

An important limitation of this study was that several of the measures had reliability coefficients that were lower than expected. Interpersonal Reactivity Index subscales, Fantasy, Empathic Concern, and Personal Distress were not included in analyses because of their low reliabilities. Exploration of self-reported empathy was restricted to the Perspective Taking subscale of the IRI. It could be that perspective-taking accuracy is more related to components of

self-reported empathy that could not be explored in the current study. One possible explanation for the low reliability on these scales is the low number of items (7 items per scale). However, previous studies have found acceptable reliabilities, particularly for the Perspective Taking and Empathic Concern subscales (Davis, 1980; Issner, Cano, Leonard, & Williams, 2012). High reading level on some of the items, and variable reading level across items is likely a better explanation for why participants in this study yielded low reliability coefficients. The average reading ability for both people with TBI and support people in this study was in the average to low average range. However, there was wide variability in reading level, which ranged from exceptionally low to above average. The reading level required by the IRI subscales is generally at the eighth-grade level; however, reading level for individual items varied widely. Additionally, it seems very noteworthy that this scale among the set of questionnaires uniquely includes numerous reverse-coded items. Thus, although the reading levels of each individual item of the IRI may be reasonable for this sample, the requirement to recognize the different directionality of these unique items and shift cognitive set for the responses introduced considerable added complexity. Although all measures were read aloud to participants while they read along, it may be that comprehension interfered with responding reliably across items on the IRI subscales.

In interpreting results of this study, it is also important to consider that the sample size was modest. When investigating relationships with perspective-taking accuracy, the TBI and support person groups were broken down into subgroups of over- and under-estimators, which yielded small subgroups. Although subgroup analysis allowed for clearer understanding of how relationships with perspective-taking accuracy depend upon direction of inaccuracy not only magnitude of inaccuracy, small group size within subgroups contributed to low power to detect relationships. Effect sizes were examined in this study to allow for an appreciation of the presence

of relationships despite low power for statistical significance. One-tailed significance tests were also used to maximize power to detect effects in hypothesized directions. However, multiple tests with liberal criterion for significance greatly increases the likelihood of Type I error. Therefore, study results should be interpreted with caution until replicated in an independent sample.

It is also important to recognize that the sample in this study was heterogeneous regarding type of caregiving relationship, severity of injury, and time since injury. Future research should examine if perspective-taking ability of people with TBI varies according to severity of injury and if it changes across time. TBI participants in this study were all in the post-acute stage of recovery with wide variability of time since injury. It may be particularly important to examine perspective-taking ability of people with TBI and support people in the early stages of recovery. Early in recovery, support people are likely both adjusting to the needs of the person with TBI and learning new ways of interacting with this person.

Additionally, there was an important difference in the gender proportions of the groups. Reflecting a natural demographic of disproportionate incidence of TBI in men versus women, the support person group had significantly more women than the TBI group. Previous research conducted with healthy adults has shown that women tend to report stronger empathy skills compared to men, although findings on various empathy tasks have yielded mixed results regarding gender effects (Baez et al., 2017; Christov-Moore et al., 2014; Frank, Baron-Cohen, & Ganzel, 2015). Research on gender differences in empathy following brain injury has also been mixed, with some research suggesting that women and men with severe TBI have similar empathic ability (Turkstra et al., 2020; Zupan et al., 2018). However, in western cultures, there is typically a societal expectation for women to be particularly warm and empathic, and low empathy within women after TBI may have a differential effect on relationships compared to low empathy in men.

The differences in perspective-taking accuracy observed in this study may be at least partially explained by gender differences between the groups rather than related to brain injury specifically. Examination of gender differences was somewhat limited in this study due to the unequal distribution of gender across groups. However, similar patterns of perspective-taking accuracy were found within subgroups of men and women in this sample, indicating that differences between groups cannot be solely explained by gender differences. Future studies should aim to recruit larger groups with equivalent gender compositions to allow for gender comparisons. Current findings are informative of general perspective-taking expectations between these groups, particularly considering that the gender composition of groups in this study is reflective of typical gender compositions of TBI and support person populations.

Given that this study found relationships between perspective-taking accuracy and relationship quality for both people with TBI and support people, future research should examine whether improvement in perspective-taking ability leads to improvement in relationship quality. This study was correlational in nature. Thus, within the domains that showed a relationship in the expected direction between perspective-taking ability and relationship quality, it is not clear whether perspective-taking ability led to better relationships or if better relationships led to improved perspective-taking ability. Additionally, it is possible that a third variable, such as duration of the relationship, improved both perspective-taking ability and relationship quality. Future studies may also benefit from using the dyadic interaction paradigm to allow measurement of perspective-taking empathy in relation to a video recorded conversation (Ickes, Bissonnette, & Garcia, 1990). This paradigm would allow for exploration of perspective-taking in an ecologically valid context while also being amenable to exploration of complex relationships with perspective-taking across type of emotions.

4.5 Conclusion and Applications

People with TBI and support people in their lives have expressed important ongoing relationship and social needs years after injury that should be addressed by researchers and clinicians (Brickell et al., 2019; Gan, 2010; Rotondi, Sinkule, Balzer, Harris, & Moldovan, 2007). This study demonstrated that impairments in cognitive empathy observed in people with TBI generalize to specific close relationships. This is the first study that has examined specific characterization of perspective-taking difficulties among people with TBI. People with TBI overestimated distress in their support people, possibly due to problems separating their own experience from the other person's. Conversely, this study provides evidence that support people are able to accurately take the perspective of a person with TBI. This information may be beneficial to share with people with TBI and family members or other caregivers when recovering from injury.

Further, although the patterns of relationships between relationship quality and perspective-taking were complex, results from this study may be used to inform interventions. Support people may benefit from interventions that help them appreciate depressive symptoms in their loved ones with TBI. Support people also seem to benefit from believing that they are empathic, regardless of their empathic accuracy. It is worth exploring whether promoting feelings of compassion might mediate the relationship between self-perceived empathy and relationship quality among support people. Similarly, drawing upon the strongest relationships with relationship quality, people with TBI may benefit from interventions that help them appreciate the resilience and psychological flexibility within the support people in their lives. Related to these phenomena was a constellation of findings indicating that expectations of prosocial personality

and behavior in a loved one is associated with feeling close in a good relationship, regardless of the accuracy of those evaluations of the loved one.

Social cognition is a growing area of research with important implications for people with TBI and their families. This study showed that there are meaningful and complex relationships between perspective-taking ability and relationship quality. The findings of this study highlight the importance of examining cognitive empathy within specific and important relationships and including both members of the relationship in the investigation.

APPENDIX A

While you respond to the following, please try to imagine how [_____] feels about how the traumatic brain injury has affected his or her life. In your mind's eye, put yourself in [_____'s] shoes. Forget yourself. Try to picture how [_____] experiences life. Answer the questions as you believe [_____] would so that if I were to compare your responses to [his/hers] later they would match.

Prompt: How would [____] respond?

APPENDIX B

Table 1. *Descriptive Statistics for Traumatic Brain Injury (TBI) and Support Persons (SP)*

	TBI (n = 48)		SP (n = 48)		Total (n = 96)		
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*
Age (years)	46.5	11.9	48.8	13.9	47.7	12.9	20-78
Education (years)	12.4	2.5	13.5	2.3	12.9	2.4	7-20
WTAR Standard Score	90.2	16.9	91.3	16.2	90.7	16.5	54-122
FAS T Score	44.8	9.8	44.3	10.1	44.6	9.9	23-71
Animals T Score	45.2	9.3	48.0	11.9	46.6	10.7	8-76
Glasgow Coma Scale[1]	8.5	3.5	-	-	-	-	3-14
Days Post-traumatic confusion[2]	26.7	32.7	-	-	-	-	3-170
Length in Rehab in days[3]	24.4	23.0	-	-	-	-	5-150
Month since injury	169.5	107.3					11-342
Month as Support Person			112.4	91.5			11-312
Sex							
Men (Percent)	75.0		22.9		49.0		
Women (Percent)	25.0		77.1		51.0		
Reported Race (Percent)							
African American	62.5		60.4		61.5		
White	27.1		35.4		31.3		
Asian	2.1		0.0		1.0		
Hispanic/Latinx	2.1		0.0		1.0		
Mixed	0.0		2.1		1.0		
Unidentified	4.2		2.1		3.1		
Amount of contact (Percent)							
Daily, live together			64.6				
Daily, live separately			10.4				
> Weekly			16.7				
Weekly			6.3				
< Weekly			2.1				
Relationship (Percent)							
Spouse			27.1				
Significant Other			14.6				
Parent			20.8				
Child			12.5				
Sibling			10.4				
Friend			10.4				
Other			6.3				

Note. WTAR = Wechsler Test of Adult Reading

[1] n = 37. [2] n = 26. [3] n = 40.

Table 2. *Descriptive Statistics for Outcomes: Traumatic Brain Injury (TBI) and Support Persons (SP)*

	TBI (n = 48)				SP (n = 48)			
Variable	*M*	*(SD)*	*Range*	*α*	*M*	*(SD)*	*Range*	*α*
IRI Perspective Taking[1]	26.1	6.3	12.8-35	.77	27.6	4.7	14-35	.63
IRI Empathic Concern	27.1	4.5	17-35	.46	28.8	4.0	21-35	.53
IRI Fantasy	20.4	5.0	9-31	.47	21.8	5.2	11-35	.50
IRI Personal Distress	17.8	5.1	10-30	.51	17.8	5.1	9-30	.60
Mutuality Scale	3.3	0.6	1.7-4.0	.92	3.3	0.8	.6-4.0	.95
Self-Report DASS-21 Depression	4.8	4.8	0-17	.88	2.7	3.3	0-13	.83
Self-Report DASS-21 Anxiety	4.6	3.8	0-15	.71	2.8	2.6	0-11	.49
Self-Report DASS-21 Stress	7.1	4.4	0-17	.80	5.3	3.8	0-14	.75
Self-Report AAQ-II Flexibility	-	-	-	-	15.4	9.0	7-40	.91
Self-Report AAQ-ABI	10.9	8.3	0-28	.85	-	-	-	-
Self-Report BFI Extraversion	21.5	4.0	14-30	.52	21.0	5.1	11-30	.67
Self-Report BFI Agreeableness	23.6	5.0	12-30	.75	25.5	3.3	16-30	.47
Self-Report BFI Conscientiousness	22.0	5.4	9-30	.77	24.9	4.2	14-30	.74
Self-Report BFI Negative Emotionality	15.8	5.3	6-28	.74	14.4	5.5	6-28	.81
Self-Report BFI Openness	23.8	4.5	8-30	.73	23.8	3.6	16-30	.55
Perspective-Taking DASS-21 Depression	4.1	3.8	0-17	.79	4.7	4.7	0-19	.87
Perspective-Taking DASS-21 Anxiety	5.5	4.7	0-21	.82	4.8	4.8	0-19	.84
Perspective-Taking DASS-21 Stress	8.1	3.9	0-19	.69	7.5	4.2	1-17	.77
Perspective-Taking AAQ	18.5	8.7	7-40	.88	-	-	-	-
Perspective-Taking AAQ-ABI	-	-	-	-	12.7	8.9	0-35	.87
Perspective-Taking BFI Extraversion	22.1	4.8	10-29	.63	21.3	4.7	10-30	.57
Perspective-Taking BFI Agreeableness	24.3	4.2	15-30	.68	22.9	4.4	13-30	.65
Perspective-Taking BFI Conscientiousness	24.3	5.0	12-30	.78	20.8	4.9	9-30	.64
Perspective-Taking BFI Negative Emotionality	15.3	4.1	7-25	.65	16.5	5.0	6-27	.65
Perspective-Taking Openness	23.7	3.8	15-30	.58	22.0	4.8	11-30	.69
Relative Report PCRS	-	-	-	-	114.8	21.1	57-147	.95
Zarit Burden Interview-12	-	-	-	-	10.5	8.6	0-34	.87

Note. IRI = Interpersonal Reactivity Index; DASS-21 = Depression Anxiety and Stress Scale – 21; AAQ-II = Acceptance and Action Questionnaire – II; AAQ-ABI = Acceptance and Action Questionnaire – Acquired Brain Injury; BFI = Big Five Inventory – 2 – Short Form; PCRS = Patient Competency Rating Scale. Perspective-Taking scores represent responses on measures under perspective-taking, imagine-other condition.

[1]IRI Perspective Taking subscale was prorated such that the score for item 15 was replaced by the mean response across the remaining items.

Table 3. *Descriptive Statistics for Perspective-Taking Accuracy Scores for Traumatic Brain Injury (TBI) and Support Person (SP) Groups*

	TBI (n = 48)				SP (n = 48)			
Perspective-Taking Accuracy Score	*M*	*(SD)*	*Range*	*Cohen's d*	*M*	*(SD)*	*Range*	*Cohen's d*
DASS-21 Average	2.3	3.1	-5.7 – 11.7	0.74**	0.2	4.1	-8.3 – 8	0.05
DASS-21 Depression	1.4	3.3	-10 – 10	0.42**	-0.1	5.0	-17 – 10	-0.02
DASS-21 Anxiety	2.7	4.1	-5 – 16	0.66**	0.2	5.3	-12 – 13	0.04
DASS-21 Stress	2.9	4.4	-10 – 11	0.66**	0.4	5.0	-9 – 11	0.08
AAQ-II/AAQ-ABI	3.1	9.7	-18 – 27	0.32*	1.8	9.5	-17 – 28	0.19
BFI Average	-0.02	2.5	-4.6 – 5.4	-0.01	-0.6	2.3	-5.6 – 3.4	-0.26
BFI Extraversion	1.1	4.9	-10 – 12	0.22	-0.2	4.5	-10 – 10	-0.04
BFI Agreeableness	-1.3	5.1	-13 – 9	-0.25	-0.6	5.3	-12 – 10	-0.11
BFI Conscientiousness	-0.6	4.6	-12 – 8	-0.13	-1.2	5.5	-16 – 12	-0.22
BFI Negative Emotionality	0.8	5.3	-12 – 11	0.15	0.7	5.8	-14 – 14	0.12
BFI Openness	-0.2	3.9	-8 – 9	-0.05	-1.7	4.3	-14 – 9	-0.40**

Note. DASS-21 = Depression Anxiety Stress Scales; AAQ-II = Acceptance and Action Questionnaire-II; AAQ-ABI = Acceptance and Action Questionnaire - Acquired Brain Injury; BFI = Big Five Inventory-2-Short Form. Perspective-Taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
Single-sample *t* test, $t(47)$; *$p < .05$, **$p < .01$, *two-tailed*.

Table 4. *Group Comparisons of Perspective-Taking Accuracy for Traumatic Brain Injury (TBI) and Support Person (SP) Groups.*

	TBI (*n* = 48)		*SP* (*n* = 48)				
Perspective-Taking Accuracy Score	*M*	*SD*	*M*	*SD*	*t*(47)	*p*	*d*
DASS-21 Average Distress	2.3	(3.1)	0.2	(4.1)	2.73	.005	0.59
AAQ-II/AAQ-ABI Flexibility	3.1	(9.7)	1.8	(9.5)	0.61	.272	0.14
BFI-2-SF Average	-0.02	(2.5)	-0.6	(2.3)	1.10	.140	0.25
DASS-21 Depression	1.4	(3.3)	-0.1	(5.0)	1.70	.048	0.37
DASS-21 Anxiety	2.7	(4.1)	0.2	(5.3)	2.43	.010	0.53
DASS-21 Stress	2.9	(4.4)	0.4	(5.0)	2.22	.016	0.51

Note. DASS-21 = Depression Anxiety and Stress Scale – 21; AAQ-II = Acceptance and Action Questionnaire 2; AAQ-ABI = Acceptance and Action Questionnaire - Acquired Brain Injury; BFI-2-SF = Big Five Inventory 2 Short Form; *p* value; *d* = Cohen's d. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
Single-sample *t* test.

Table 5. *Correlations between Self-Report and Perspective-Taking Scores on Equivalent Measures within the Same Person.*

	TBI (n = 48)	SP (n = 48)
DASS-21 Depression	.25*	.33*
DASS-21 Anxiety	.33*	.40**
DASS-21 Stress	.23	.06
AAQ-II/AAQ-ABI	.37**	.18
BFI-2-SF Extraversion	.10	.19
BFI-2-SF Agreeableness	.04	.35**
BFI-2-SF Conscientiousness	-.17	-.21
BFI-2-SF Negative Emotionality	.14	.18
BFI-2-SF Openness	.34**	.27*

Note. DASS-21 = Depression Anxiety and Stress Scale 21; AAQ-II = Acceptance and Action Questionnaire 2; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI-2-SF = Big Five Inventory 2 Short Form. *$p < .05$, **$p < .01$, *one-tailed test.*

Table 6. *Descriptive Statistics for Differences Scores Exploring Differences between Self-Report and Perspective-Taking Responses within the Same Person*

Variable	*M*	*(SD)*	*Range*	*Cohen's d*
TBI Group				
DASS-21 Depression Difference	-0.73	(5.33)	-15 – 9	-0.13
DASS-21 Anxiety Difference	0.96	(4.98)	-8 – 12	0.19
DASS-21 Stress Difference	1.04	(5.17)	-11 - 14	0.20
SP Group				
DASS-21 Depression Difference	1.98	(4.79)	-7 – 17	0.41**
DASS-21 Anxiety Difference	1.92	(4.44)	-11 – 16	0.43**
DASS-21 Stress Difference	2.25	(5.53)	-12 – 13	0.41**

Note. TBI = Traumatic Brain Injury; SP = Support Person; DASS-21 = Depression Anxiety and Stress Scale – 21. Difference scores were calculated as: Imagine-other (participant) – self-report (participant); scores of zero indicate that the participant imagined their study partner's response would yield the same score as their own self-report.
Single-sample *t* test, $t(47)$; $*p < .05$, $**p < .01$, *two-tailed*.

Table 7. *Spearman's Rho Correlations with Absolute Value of Perspective-Taking Accuracy and Descriptives for the Traumatic Brain Injury Group (n = 48).*

Variable	Depression[2]	Anxiety[2]	Stress[2]	AAQ-II	Extraversion[3]	Agreeableness[3]	Conscientiousness[3]	Negative Emotionality[3]	Openness[3]
Age	-.05	-.14	.06	.08	-.18	-.14	-.02	.07	-.03
Education (years)	-.07	-.29*	-.04	-.16	.01	-.17	-.32*	-.20	-.03
WTAR SS	-.22	-.21	.10	-.27*	-.24	-.02	-.32*	-.08	-.37**
FAS T	-.20	-.10	-.22	-.12	-.02	.13	-.01	-.01	-.05
Animals T	-.07	-.06	-.23	.12	.09	-.04	-.23	.13	-.08
Glasgow Coma Scale[1]	-.06	.10	.31*	-.04	-.12	-.06	.31*	.09	-.14
Months since injury	.10	.23	-.003	-.23	-.07	.13	.18	.03	.18
Months with support person	.13	-.04	-.10	-.13	-.07	-.10	-.03	-.06	.11
Partner ZBI-12	.05	-.08	-.13	.21	-.04	-.15	-.34*	-.08	.13
PCRS Relative	.09	.06	.26*	-.11	-.14	.05	.21	.11	-.10

Note. WTAR = Wechsler Test of Adult Reading; SS = Standard Score; T = T score; ZBI-12 = Zarit Burden Interview-12; PCRS = Patient Competency Rating Scale – Relative. Absolute value of perspective-taking accuracy scores used such that deviation from zero represents poorer perspective-taking accuracy.

[1] $n = 37$; [2] Depression Anxiety and Stress Scale-21; [3] Big Five Inventory-2-Short Form.

*$p < .05$, **$p < .01$, one-tailed test.

Table 8. *Spearman's Rho Correlations for Absolute Value of Perspective-Taking Accuracy and Descriptives for the Support Person Group (n = 48).*

Variable	Depression[2]	Anxiety[2]	Stress[2]	AAQ-II	Extraversion[3]	Agreeableness[3]	Conscientiousness[3]	Negative Emotionality[3]	Openness[3]
Age	.19	-.10	.16	.03	-.08	.11	-.13	.23	.22
Education (years)	.01	-.31*	-.27*	-.02	.13	-.28*	-.01	-.05	-.21
WTAR SS	-.19	-.21	-.06	-.16	-.12	-.24	-.05	-.05	-.32*
FAS T	-.15	.21	.06	-.07	.19	.02	.08	.07	-.13
Animals T	-.15	.16	-.03	-.12	.10	.07	-.09	.08	-.01
Partner GCS[1]	-.24	.14	.24	-.15	-.37*	-.02	-.04	.11	.01
Months since injury	-.05	-.09	.08	.06	.29*	.07	.08	.16	.16
Months as support person	.09	-.26*	-.05	.10	.21	.09	-.10	.28*	.02
ZBI-12	.36**	.14	.05	.05	.01	.04	-.003	.19	.16
PCRS Relative	-.34**	-.27*	.01	-.07	.04	-.07	.15	-.12	-.32*

Note. WTAR = Wechsler Test of Adult Reading; SS = Standard Score; T = T score; ZBI-12 = Zarit Burden Interview-12; PCRS = Patient Competency Rating Scale – Relative. Absolute value of perspective-taking accuracy scores used such that deviation from zero represents poorer perspective-taking accuracy.

[1] $n = 37$; [2] Depression Anxiety and Stress Scale-21; [3] Big Five Inventory-2-Short Form.

*$p < .05$, **$p < .01$, one-tailed test.

Table 9. *Spearman's Rho Correlations between Support Person Mutuality and Support Person Perspective-Taking Accuracy for Subgroups of Participants who Under- or Over-Estimate Study Partner Responses*

	Underestimators		Overestimators	
	n	*rho*	*n*	*rho*
DASS21 Depression Perspective-Taking Accuracy	25	.07	23	-.14
DASS21 Anxiety Perspective-Taking Accuracy	28	-.10	20	.06
DASS21 Stress Perspective-Taking Accuracy	23	-.20	25	-.09
AAQ-ABI Perspective-Taking Accuracy	23	.08	25	.23
BFI Extraversion Perspective-Taking Accuracy	28	.12	20	.57**
BFI Agreeableness Perspective-Taking Accuracy	28	.46*	20	.07
BFI Conscientiousness Perspective-Taking Accuracy	35	.04	13	-.29
BFI Negative Emotionality Perspective-Taking Accuracy	25	.15	23	-.23
BFI Openness Perspective-Taking Accuracy	32	.04	16	.05

Note. DASS21 = Depression Anxiety and Stress Scale 21; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI = Big Five Inventory-2 Short Form. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
*$p < .05$, **$p < .01$, *one-tailed test.*

Table 10. *Spearman's Rho Correlations between Support Person Mutuality and Traumatic Brain Injury Group Perspective-Taking Accuracy for Subgroups of Participants who Under- or Over-Estimated Study Partner Responses*

	Underestimators		Overestimators	
	n	*rho*	*n*	*rho*
DASS21 Depression Perspective-Taking Accuracy	21	.03	27	-.03
DASS21 Anxiety Perspective-Taking Accuracy	16	-.08	32	.29
DASS21 Stress Perspective-Taking Accuracy	14	-.04	34	.17
AAQ-II Perspective-Taking Accuracy	21	-.07	27	-.49**
BFI Extraversion Perspective-Taking Accuracy	23	.08	25	.17
BFI Agreeableness Perspective-Taking Accuracy	30	.17	18	.07
BFI Conscientiousness Perspective-Taking Accuracy	29	-.06	18	-.15
BFI Negative Emotionality Perspective-Taking Accuracy	23	.15	25	-.16
BFI Openness Perspective-Taking Accuracy	28	.41*	20	.29

Note. DASS21 = Depression Anxiety and Stress Scale 21; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI = Big Five Inventory-2 Short Form. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
*$p < .05$, **$p < .01$, *one-tailed test*.

Table 11. *Spearman's Rho Correlations between Traumatic Brain Injury Group Mutuality and Traumatic Brain Injury Group Perspective-Taking Accuracy for Subgroups of Participants who Under- or Over-Estimated Study Partner Responses*

	Underestimators		Overestimators	
	n	*rho*	*n*	*rho*
DASS21 Depression Perspective-Taking Accuracy	21	-.07	27	-.29
DASS21 Anxiety Perspective-Taking Accuracy	16	-.04	32	.08
DASS21 Stress Perspective-Taking Accuracy	14	.23	34	.07
AAQ-II Perspective-Taking Accuracy	21	-.01	27	-.48**
BFI Extraversion Perspective-Taking Accuracy	23	.22	25	.28
BFI Agreeableness Perspective-Taking Accuracy	30	.43**	18	-.11
BFI Conscientiousness Perspective-Taking Accuracy	29	.28	18	.01
BFI Negative Emotionality Perspective-Taking Accuracy	23	.15	25	-.11
BFI Openness Perspective-Taking Accuracy	28	.50**	20	.09

Note. DASS21 = Depression Anxiety and Stress Scale 21; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI = Big Five Inventory-2 Short Form. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
*$p < .05$, **$p < .01$, *one-tailed test*.

Table 12. *Spearman's Rho Correlations between Traumatic Brain Injury Mutuality and Support Person Perspective-Taking Accuracy for Subgroups of Participants who Under- or Over-Estimated Study Partner Responses*

	Underestimators		Overestimators	
	n	*rho*	*n*	*rho*
DASS21 Depression Perspective-Taking Accuracy	25	.63**	23	.09
DASS21 Anxiety Perspective-Taking Accuracy	28	-.16	20	-.13
DASS21 Stress Perspective-Taking Accuracy	23	-.10	25	-.16
AAQ-ABI Perspective-Taking Accuracy	23	.27	25	.08
BFI Extraversion Perspective-Taking Accuracy	28	-.09	20	.04
BFI Agreeableness Perspective-Taking Accuracy	28	.16	20	-.12
BFI Conscientiousness Perspective-Taking Accuracy	35	-.13	13	-.20
BFI Negative Emotionality Perspective-Taking Accuracy	25	-.06	23	-.02
BFI Openness Perspective-Taking Accuracy	32	.00	16	.21

Note. DASS21 = Depression Anxiety and Stress Scale - 21; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI = Big Five Inventory-2 Short Form. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
*$p < .05$, **$p < .01$, *one-tailed test.*

Table 13. *Spearman's Rho Correlations between Self-Reported Perspective Taking (IRI) and Perspective-Taking Accuracy in Subgroups of the Traumatic Brain Injury Group who Under- or Over-Estimated Study Partner Responses*

	Underestimators		Overestimators	
	n	*Rho*	*n*	*Rho*
DASS21 Depression Perspective-Taking Accuracy	21	-.05	27	-.18
DASS21 Anxiety Perspective-Taking Accuracy	16	-.08	32	-.04
DASS21 Stress Perspective-Taking Accuracy	14	.20	34	.33*
AAQ-ABI Perspective-Taking Accuracy	21	-.06	27	.11
BFI Extraversion Perspective-Taking Accuracy	23	.14	25	.27
BFI Agreeableness Perspective-Taking Accuracy	30	-.26	18	-.30
BFI Conscientiousness Perspective-Taking Accuracy	29	-.29	18	-.01
BFI Negative Emotionality Perspective-Taking Accuracy	23	.29	25	.29
BFI Openness Perspective-Taking Accuracy	28	.22	20	.20

Note. IRI = Interpersonal Reactivity Index – Perspective Taking subscale; DASS21 = Depression Anxiety and Stress Scale 21; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI = Big Five Inventory-2 Short Form. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.
*$p < .05$, **$p < .01$, *one-tailed test.*

Table 14. *Spearman's Rho Correlations between Self-Reported Perspective Taking (IRI) and Perspective-Taking Accuracy Scores in Subgroups of the Support Person Group who Under- or Over-Estimated Study Partner Responses*

	Underestimators		Overestimators	
	n	*Rho*	*n*	*Rho*
DASS21 Depression Perspective-Taking Accuracy	25	.32	23	.27
DASS21 Anxiety Perspective-Taking Accuracy	28	.51**	20	-.05
DASS21 Stress Perspective-Taking Accuracy	23	.24	25	·20
AAQ-ABI Perspective-Taking Accuracy	23	-.21	25	-.03
BFI Extraversion Perspective-Taking Accuracy	28	-.09	20	.14
BFI Agreeableness Perspective-Taking Accuracy	28	.37*	20	-.02
BFI Conscientiousness Perspective-Taking Accuracy	35	-.06	13	-.47
BFI Negative Emotionality Perspective-Taking Accuracy	25	.21	23	.15
BFI Openness Perspective-Taking Accuracy	32	.22	16	-.23

Note. IRI = Interpersonal Reactivity Index – Perspective Taking Subscale; DASS21 = Depression Anxiety and Stress Scale 21; AAQ-ABI = Acceptance and Action Questionnaire Acquired Brain Injury; BFI = Big Five Inventory-2 Short Form. Perspective-taking accuracy scores calculated as: Imagine-other (participant) – self-report (partner); positive scores reflect overestimation of the study partner, whereas negative scores reflect underestimation of the study partner.

*$p < .05$, **$p < .01$, *one-tailed test.*

Table 15. *Pearson Correlations between Mutuality and Self-Reported Perspective Taking (IRI)*

	TBI Mutuality	*SP Mutuality*
TBI Group		
IRI Perspective Taking	.22	.02
SP Group		
IRI Perspective Taking	.34**	.46**

Note. IRI = Interpersonal Reactivity Index – Perspective Taking subscale; TBI = Traumatic Brain Injury; SP = Support Person.
** < .001, *one-tailed test.*

REFERENCES

Archbold, P. G., Stewart, B. J., Greenlick, M. R., & Harvath, T. (1990). Mutuality and preparedness as predictors of cargiver role strain. *Research in Nursing & Health, 13*, 375-384.

Arciniegas, D. B., & Wortzel, H. S. (2014). Emotional and behavioral dyscontrol after traumatic brain injury. *Psychiatr Clin North Am, 37*(1), 31-53. doi:10.1016/j.psc.2013.12.001

Ashworth, F., Clarke, A., Jones, L., Jennings, C., & Longworth, C. (2015). An exploration of compassion focused therapy following acquired brain injury. *Psychology and Psychotherapy: Theory, Research and Practice, 88*, 143-162. doi:10.1111/papt.12037

Babbage, D. R., Yim, J., Zupan, B., Neumann, D., Tomita, M. R., & Willer, B. (2011). Meta-analysis of facial affect recognition difficulties after traumatic brain injury. *Neuropsychology, 25*(3), 277-285. doi:10.1037/a0021908

Baez, S., Flichtentrei, D., Prats, M., Mastandueno, R., Garcia, A. M., Cetkovich, M., & Ibanez, A. (2017). Men, women...who cares? A population-based study on sex differences and gender roles in empathy and moral cognition. *PloS one, 12*(6). doi:10.1371/journal.pone.0179336

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Batson, C. D., Early, S., & Salvarani, G. (1997). Perspective taking: Imagining how another feels versus imagining how you would feel. . *Personality & Social Psychology Bulletin, 23*(7), 751-758.

Beadle, E. J., Ownsworth, T., Fleming, J., & Shum, D. (2016). The Impact of Traumatic Brain Injury on Self-Identity: A Systematic Review of the Evidence for Self-Concept Changes. *J Head Trauma Rehabil, 31*(2), E12-25. doi:10.1097/HTR.0000000000000158

Bedard, M., Molloy, D. W., Squire, L., Dubois, S., Lever, J. A., & O'Donnell, M. (2001). The Zarit burden interview: A new short version and screening version. *The Gerontologist, 41*(5), 652-657.

Bibby, H., & McDonald, S. (2005). Theory of mind after traumatic brain injury. *Neuropsychologia, 43*(1), 99-114. doi:10.1016/j.neuropsychologia.2004.04.027

Bivona, U., Riccio, A., Ciurli, P., Carlesimo, G. A., Delle Donne, V., Pizzonia, E., . . . Costa, A. (2014). Low self-awareness of individuals with severe traumatic brain injury can lead to reduced ability to take another person's perspective. *Journal of Head Trauma Rehabilitation, 29*(2), 157-171. doi:10.1097/HTR.0b013e3182864f0b

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., . . . Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire-II: a revised measure of psychological inflexibility and experiential avoidance. *Behavior Therapy, 42*(4), 676-688. doi:10.1016/j.beth.2011.03.007

Boschen, K., Gargaro, J., Gan, C., Gerber, G., & Brandys, C. (2007). Family interventions after acquired brain injury and other chronic conditions: A critical appraisal of the quality of the evidence. *NeuroRehabilitation, 22*, 19-41.

Brickell, T. A., Lippa, S. M., French, L. M., Gartner, R. L., Driscoll, A. E., Megan, M., & Lange, R. T. (2019). Service needs and health outcomes among caregivers of service members and veteran following TBI. *Rehabilitation Psychology, 64*(1), 72-86. doi:10.1037/rep0000249

Brooks, D. N., & McKinlay, W. (1983). Personality and behavioural change after severe blunt head injury - A relative's view. *Journal of Neurology, Neurosurgery, and Psychiatry, 46*, 336-344.

Bryson-Campbell, M., Shaw, L., O'brien, J., Holmes, J., & Magalhaes, L. (2013). A scoping review on occupational and self identity after a brain injury. *Work, 44*, 57-67. doi:10.3233/WOR-2012-1561

Byom, L. J., & Turkstra, L. (2012). Effects of social cognitive demand on Theory of Mind in conversations of adults with traumatic brain injury. *Int J Lang Commun Disord, 47*(3), 310-321. doi:10.1111/j.1460-6984.2011.00102.x

Carlozzi, N. E., Kratz, A. L., Sander, A. M., Chiaravalloti, N. D., Brickell, T. A., Lange, R. T., . . . Tulsky, D. S. (2015). Health-related quality of life in caregivers of individuals with traumatic brain injury: Development of a conceptual model. *Archives of Physical Medicine and Rehabilitation, 96*(1), 105-113. doi:10.1016/j.apmr.2014.08.021

Carlson, S., & Moses, L. J. (2001). Individual differences in inhibitory control and childen's theory of mind. *Child Development, 72*(4), 1032-1053.

Christov-Moore, L., Simpson, E. A., Coude, G., Grigaityte, K., Iacoboni, M., & Ferrari, P. F. (2014). Empathy: Gender effects in brain and behavior. *Neuroscience & Biobehavioral Reviews, 46*(4), 604-627. doi:10.1016/j.neubiorev.2014.09.001

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology, 10*(85).

de Sousa, A., McDonald, S., Rushby, J., Li, S., Dimoska, A., & James, C. (2010). Why don't you feel how I feel? Insight into the absence of empathy after severe traumatic brain injury. *Neuropsychologia, 48*(12), 3585-3595. doi:10.1016/j.neuropsychologia.2010.08.008

de Sousa, A., McDonald, S., Rushby, J., Li, S., Dimoska, A., & James, C. (2011). Understanding deficits in empathy after traumatic brain injury: The role of affective responsivity. *Cortex, 47*(5), 526-535. doi:10.1016/j.cortex.2010.02.004

Decety, J., & Lamm, C. (2006). Human empathy through the lens of social neuroscience. *ScientificWorldJournal, 6*, 1146-1163. doi:10.1100/tsw.2006.221

Diaz, A. P., Schwarzbold, M. L., Thais, M. E., Hohl, A., Bertotti, M. M., Schmoeller, R., . . . Walz, R. (2012). Psychiatric disorders and health-related quality of life after severe traumatic brain injury: a prospective study. *J Neurotrauma, 29*(6), 1029-1037. doi:10.1089/neu.2011.2089

Dvash, J., & Shamay-Tsoory, S. G. (2014). Theory of Mind and Empathy as Multidimensional Constructs. *Topics in Language Disorders, 34*(4), 282-295. doi:10.1097/tld.0000000000000040

Ergh, T. C., Hanks, R. A., Rapport, L. J., & Coleman, R. D. (2003). Social support moderates caregiver life satisfaction following traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology, 25*(8), 1090-1101. doi:10.1076/jcen.25.8.1090.16735

Ergh, T. C., Rapport, L. J., Coleman, R. D., & Hanks, R. A. (2002). Predictors of caregiver and family functioning following traumatic brain injury: Social support moderates caregiver distress. *Journal of Head Trauma Rehabilitation, 17*(2), 155-174. doi:10.1097/00001199-200204000-00006

Faul, M., Xu, L., Wald, M. M., Coronado, V., & Dellinger, A. M. (2010). Traumatic Brain Injury in the United States: National Estimates of Prevalence and Incidence, 2002-2006. *Injury Prevention, 16*, A268-A268. doi:DOI 10.1136/ip.2010.029951

Foster, L., McClure, J., McDowall, J., & Crawford, M. T. (2013). Attributions about persons with brain injury: The effects of knowledge and familiarity about brain injury. *Brain Injury, 27*(4), 485-491. doi:10.3109/02699052.2012.750747

Frank, C. K., Baron-Cohen, S., & Ganzel, B. L. (2015). Sex differences in the neural basis of false-belief and pragmatic language comprehension. *NeuroImage, 105*, 300-311. doi:10.1016/j.neuroimage.2014.09.041

Freeman, A., Adams, M., & Ashworth, F. (2015). An exploration of the experience of self in the social world for men following traumatic brain injury. *Neuropsychological Rehabilitation, 25*(2), 189-215. doi:10.1080/09602011.2014.917686

Galinsky, A. D., Ku, G., & Wang, C. S. (2005). Perspective-taking and self-other overalp: Fostering social bonds and facilitating social coordination. *Group Process and Intergroup Relations, 8*(2), 109-124. doi:10.1177/1368430205051060

Gan, C. (2010). Family caregivers' support needs after brain injury: A synthesis of perspectives from caregivers, programs, and researchers. *NeuroRehabilitation, 27*(1), 1053-8135. doi:10.3233/NRE-2010-0577

Gilovich, T., Medvec, V. H., & Savitsky, K. (2000). The spotlight effect in social judgement: An egocentric bias in estimates of the salience of one's own actions and appearance. *Journal of Personality and Social Psychology, 78*(2), 211-222. doi:10.1037/0022-3514.78.2.211

Govereover, Y., Genova, H., Smith, A., Chiaravalloti, N., & Lengenfelder, J. (2017). Changes in activity participation following traumatic brain injury. *Neuropsychological Rehabilitation, 27*(4). doi:10.1080/09602011.2016.1168746

Green, R. E., Melo, B., Christensen, B., Ngo, L. A., Monette, G., & Bradbury, C. (2008). Measuring premorbid IQ in traumatic brain injury: an examination of the validity of the

Wechsler Test of Adult Reading (WTAR). *J Clin Exp Neuropsychol, 30*(2), 163-172. doi:10.1080/13803390701300524

Hawthorne, G., Gruen, R. L., & Kaye, A. H. (2009). Traumatic brain injury and long-term quality of life: Findings from an Australian study. *Journal of Neurotrama, 26*. doi:10.1089/neu.2008.0735

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 44*(Pt 2), 227-239. doi:10.1348/014466505x29657

Higginson, I. J., Gao, W., Jackson, D., Murray, J., & Harding, R. (2010). Short-form Zarit caregiver burden interviews were valid in advanced conditions. *Journal of Clinical Epidemiology, 63*, 535-542. doi:10.1016/j.jclinepi.2009.06.014

Honan, C. A., McDonald, S., Gowland, A., Fisher, A., & Randall, R. K. (2015). Deficits in comprehension of speech acts after TBI: The role of theory of mind and executive function. *Brain Lang, 150*, 69-79. doi:10.1016/j.bandl.2015.08.007

Ickes, W., Bissonnette, V., & Garcia, S. (1990). Naturalistic social cognition: Empathic accuracy in mixed-sex dyads. *Journal of Personality and Social Psychology, 59*, 730-742. doi:10.1037/0022-3514.59.4.730

Ietswaart, M., Milders, M., Crawford, J. R., Currie, D., & Scott, C. L. (2008). Longitudinal aspects of emotion recognition in patients with traumatic brain injury. *Neuropsychologia, 46*(1), 148-159. doi:10.1016/j.neuropsychologia.2007.08.002

Issner, J. B., Cano, A., Leonard, M. T., & Williams, A. M. (2012). How do I empathize with you? Let me count the ways: Relations between facets of pain-related empathy. *The Journal of Pain, 13*(2), 167-175. doi:10.1016/j.jpain.2011.10.009

Karlstedt, M., Fereshtehnejad, S. M., Aarsland, D., & Lökk, J. (2019). Mediating effect of mutuality on caregiver burden in Parkinson's disease partners. *Aging Ment Health*, 1-8. doi:10.1080/13607863.2019.1619165

Keltner, D., & Haidt, J. (1999). Socail functions of emotions at four levels of analysis. *Cognition & Emotion, 13*, 505-522. doi:10.1080/026999399379168

Knox, L., & Douglas, J. (2009). Long-term ability to interpret facial expression after traumatic brain injury and its relation to social integration. *Brain Cogn, 69*(2), 442-449. doi:10.1016/j.bandc.2008.09.009

Kolakowsky-Hayner, S. A., Wright, J., & Bellon, K. (2012). A brief overview of the Patient Competency Rating Scale: updates and additions to the COMBI. *J Head Trauma Rehabil, 27*(1), 83-85. doi:10.1097/HTR.0b013e31823645db

Kozloff, R. (1987). Networks of social support and the outcome from severe head injury. *Journal of Head Trauma Rehabilitation, 2*, 14-23.

Kratz, A. L., Sander, A. M., Brickell, T. A., Lange, R. T., & Carlozzi, N. E. (2017). Traumatic brain injury caregivers: A qualitative analysis of spouse and parent perspectives on quality of life. *Neuropsychological Rehabilitation, 27*(1), 16-37. doi:10.1080/09602011.2015.1051056

Kreutzer, J. S., Marwitz, J. H., Sima, A. P., & Godwin, E. E. (2015). Efficacy of the Brain Injury Family Intervention: Impact on Family Members. *J Head Trauma Rehabil, 30*(4), 249-260. doi:10.1097/HTR.0000000000000144

Kreutzer, J. S., Rapport, L. J., Marwitz, J. H., Harrison-Felix, C., Hart, T., Glenn, M., & Hammond, F. (2009). Caregivers' well-being after traumatic brain injury: a multicenter prospective investigation. *Arch Phys Med Rehabil, 90*(6), 939-946. doi:10.1016/j.apmr.2009.01.010

Kreutzer, J. S., Stejskal, T. M., Godwin, E. E., Powell, V. D., & Arango-Lasprilla, J. C. (2010). A mixed methods evaluation of the Brain Injury Family Intervention. *NeuroRehabilitation, 27*(1), 19-29. doi:10.3233/Nre-2010-0578

Lamm, C., Batson, C. D., & Decety, J. (2007). The neural substrate of human empathy: Effcts of perspective-taking and cognitive appraisal. *Journal of Cognitve Neuroscience, 19*(1), 42-58.

Le, B. M., Cote, S., Stellar, J., & Impett, E. A. (2020). The distinct effects of empathic accuracy for a romantic partner's appeasement and dominance emotions. *Psychological Science*. doi:10.1177/0956797620904975

Lobchuk, M. M. (2006). Concept analysis of perspective-taking: Meeting informal caregiver needs for communication competence and acurate perception. *Journal of Advanced Nursing, 54*(3), 330-341. doi:10.111/j.1365-2648.2006.03815.x

Lobchuk, M. M., & Vorauer, J. D. (2003). Family caregiver perspective-taking and accuracy in estimating cancer patient symptom experiences. *Social Science & Medicine, 57*(12), 2379-2384. doi:10.1016/s0277-9536(03)00132-1

Lovibond, P. F., & Lovibond, S.H. (1995). The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behavior Research and Therapy, 33*(3), 335-343.

Machamer, J., Temkin, N., & Dikmen, S. (2013). Health-related quality of life in traumatic brain injury: is a proxy report necessary? *J Neurotrauma, 30*(22), 1845-1851. doi:10.1089/neu.2013.2920

Marsh, N. V., Kersel, Denyse A., Havill, Jack H., & Sleigh, Jamie W. (1998). Caregiver burden at 1 year following severe traumatic brain injury. *Brain Injury, 12*(12), 1045-1059.

Martini, T. S., Grusec, J. E., & Bernardini, S. C. (2001). Effects of interpersonal control, perspective taking, and attributions on older mothers' and adult daughters' satisfaction with their helping relationships. *Journal of Family Psychology, 15*(4), 688-705. doi:10.1037/0893-3200.15.4.688

May, M., Milders, M., Downey, B., Whyte, M., Higgins, V., Wojcik, Z., . . . O'Rourke, S. (2017). Social Behavior and Impairments in Social Cognition Following Traumatic Brain Injury. *J Int Neuropsychol Soc, 23*(5), 400-411. doi:10.1017/S1355617717000182

McDonald, S. (2013). Impairments in social cognition following severe traumatic brain injury. *Journal of the International Neuropsychological Society, 19*, 231-246. doi:10.1017/S1355617712001506

McDonald, S. (2013). Impairments in social cognition following severe traumatic brain injury. *J Int Neuropsychol Soc, 19*(3), 231-246. doi:10.1017/S1355617712001506

McDonald, S., Fisher, A., & Flanagan, S. (2015). When diplomacy fails: difficulty understanding hints following severe traumatic brain injury. *Aphasiology, 30*(7), 801-814. doi:10.1080/02687038.2015.1070948

McDonald, S., & Flanagan, S. (2004). Social perception deficits after traumatic brain injury: interaction between emotion recognition, mentalizing ability, and social communication. *Neuropsychology, 18*(3), 572-579. doi:10.1037/0894-4105.18.3.572

Mendez, M. F., Owens, E. M., Jimenez, E. E., Peppers, D., & Licht, E. A. (2013). Changes in personality after mild traumatic brain injury from primary blast vs. blunt forces. *Brain Inj, 27*(1), 10-18. doi:10.3109/02699052.2012.722252

Milders, M., Fuchs, S., & Crawford, J. R. (2003). Neuropsychological impairments and changes in emotional and social behaviour following severe traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology, 25*(2), 157-172. doi:10.1076/jcen.25.2.157.13642

Milders, M., Ietswaart, M., Crawford, J. R., & Currie, D. (2008). Social behavior following traumatic brain injury and its association with emotion recognition, understanding of intentions, and cognitive flexibility. *Journal of the International Neuropsychological Society, 14*(02), 318-326.

Neumann, D., Zupan, B., Babbage, D. R., Radnovich, A., Tomita, M. R., Hammond, F., & Willer, B. (2012). Affect recognition, empathy, and dysosmia after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation, 93*(8), 1414-1420.

Neumann, D., Zupan, B., Malec, J. F., & Hammond, F. (2014). Relationships between alexithymia, affect recognition, and empathy after traumatic brain injury. *J Head Trauma Rehabil, 29*(1), E18-27. doi:10.1097/HTR.0b013e31827fb0b5

Nickerson, R. S. (1999). How we know-and sometimes misjudge-what others know: Imputing one's own knowledge to others. *Psychological Bulletin, 125*(6), 737-759.

Norup, A., & Mortensen, E. L. (2015). Prevalence and predictors of personality change after severe brain injury. *Arch Phys Med Rehabil, 96*(1), 56-62. doi:10.1016/j.apmr.2014.08.009

Ownsworth, T., & Haslam, C. (2016). Impact of rehabilitation on self-concept following traumatic brain injury: An exploratory systematic review of intervention methodology and efficacy. *Neuropsychol Rehabil, 26*(1), 1-35. doi:10.1080/09602011.2014.977924

Ownsworth, T., Little, T., Turner, B., Hawkes, A., & Shum, D. (2008). Assessing emotional status following acquired brain injury: the clinical potential of the depression, anxiety and stress scales. *Brain Inj, 22*(11), 858-869. doi:10.1080/02699050802446697

Powell, J. M., Wise, E. K., Brockway, J. A., Fraser, R., Temkin, N., & Bell, K. R. (2017). Characteristics and Concerns of Caregivers of Adults With Traumatic Brain Injury. *J Head Trauma Rehabil, 32*(1), E33-E41. doi:10.1097/HTR.0000000000000219

Prigatano, G. P., & Fordyce, D. J. (1986). Cognitive dysfunction and psychological adjustment after brain injury. In G. P. Prigatano, H. K. Fordyce, J. R. Zeiner, M. P. Roueche, & B. C. Wood (Eds.), *Neuropsychological rehabillitation after brain injury* (pp. 96-118). Baltimore, MD: Johns Hopkins University Press.

Pucciarelli, G., Buck, H. G., Barbaranelli, C., Savini, S., Simeone, S., Juarez-Vela, R., . . . Vellone, E. (2016). Psychometric Characteristics of the Mutuality Scale in Stroke Patients and Caregivers. *Gerontologist, 56*(5), e89-98. doi:10.1093/geront/gnw083

Randall, D., Thomas, M., Whiting, D., & McGrath, A. (2017). Depression Anxiety Stress Scales (DASS-21): Factor Structure in Traumatic Brain Injury Rehabilitation. *Journal of Head Trauma Rehabilitation, 32*(2), 134-144. doi:10.1097/HTR.0000000000000250

Riva, F., Triscoli, C., Lamm, C., Carnaghi, A., & Silani, G. (2016). Emotional egocentricity bias across the life-span. *Frontiers in Aging Neuroscience, 8*(74). doi:10.3389/fnagi.2016.00074

Rosenberg, H., McDonald, S., Dethier, M., Kessels, R. P., & Westbrook, R. F. (2014). Facial emotion recognition deficits following moderate-severe Traumatic Brain Injury (TBI): re-examining the valence effect and the role of emotion intensity. *J Int Neuropsychol Soc, 20*(10), 994-1003. doi:10.1017/S1355617714000940

Rosenberg, H., McDonald, S., Rosenberg, J., & Frederick Westbrook, R. (2018). Amused, flirting or simply baffled? Is recognition of all emotions affected by traumatic brain injury? *J Neuropsychol, 12*(2), 145-164. doi:10.1111/jnp.12109

Rotondi, A. J., Sinkule, J., Balzer, K., Harris, J., & Moldovan, R. (2007). A qualitative needs assessment of persons who have experienced traumatic brain injury and their primary family caregivers. *Journal of Head Trauma Rehabilitation, 22*(1), 14-25.

Ruby, P., & Decety, J. (2003). What you believe versus what you think they believe: A neuroimaging study of conceptual perspective-taking. *European Journal of Neuroscience, 17*, 2475-2480. doi:10.1046/j.1460-9568.2003.02673.x

Sander, A. M., Maestas, K. L., Sherer, M., Malec, J. F., & Nakase-Richardson, R. (2012). Relationship of caregiver and family functioning to participation outcomes after postacute rehabilitation for traumatic brain injury: A multicenter investigation. *Archives of Physical Medicine and Rehabilitation, 93*(5), 842-848. doi:10.1016/j.apmr.2011.11.031

Saxton, M. E., Younan, S. S., & Lah, S. (2013). Social behaviour following severe traumatic brain injury: contribution of emotion perception deficits. *NeuroRehabilitation, 33*(2), 263-271. doi:10.3233/NRE-130954

Schönberger, M., Ponsford, J., Olver, J., & Ponsford, M. (2010). A longitudinal study of family functioning after TBI and relatives' emotional status. *Neuropsychological Rehabilitation, 20*(6), 813-829. doi:10.1080/09602011003620077

Semlyen, J. K., Summers, S. J., & Barnes, M. P. (1998). Aspects of Caregiver Distress After Severe Head Injury. *Neurorehabilitation and Neural Repair, 12*(2), 53-59. doi:10.1177/154596839801200202

Shamay-Tsoory, S. G., Tomer, R., Berger, B. D., Goldsher, D., & Aharon-Peretz, J. (2005). Impaired "affective theory of mind" is associated with right ventromedial prefrontal damage. *Cognitive Behavioral Neurology, 18*(1), 55-67.

Shamay-Tsoory, S. G., Tomer, R., Goldsher, D., Berger, B. D., & Aharon-Peretz, J. (2004). Impairment in cognitive and affective empathy in patients with brain lesions: anatomical and cognitive correlates. *J Clin Exp Neuropsychol, 26*(8), 1113-1127. doi:10.1080/13803390490515531

Sigurdardottir, S., Andelic, N., Roe, C., & Schanke, A. K. (2014). Identifying longitudinal trajectories of emotional distress symptoms 5 years after traumatic brain injury. *Brain Inj, 28*(12), 1542-1550. doi:10.3109/02699052.2014.934285

Smith, A. M., & Schwirian, P. M. (1998). The relationship between caregiver burden and TBI survivors' cognition and functional ability after discharge. *Rehabilitation Nursing: The Official Journal of the Association of Rehabilitation Nurses., 23*(5), 252-257. Retrieved from <Go to ISI>://MEDLINE:10067640

Soto, C. J., & John, O. P. (2017). Short and extra-short forms of the Big Five Inventory–2: The BFI-2-S and BFI-2-XS. *Journal of Research in Personality, 68*, 69-81. doi:10.1016/j.jrp.2017.02.004

Spikman, J. M., Milders, M., Visser-Keizer, A. C., Westerhof-Evers, H. J., Herben-Dekker, M., & van der Naalt, J. (2013). Deficits in facial emotion recognition indicate behavioral changes and impaired self-awareness after moderate to severe traumatic brain injury. *PloS one, 8*(6), e65581.

Spikman, J. M., Timmerman, M. E., Milders, M. V., Veenstra, W. S., & van der Naalt, J. (2012). Social cognition impairments in relation to general cognitive deficits, injury severity, and prefrontal lesions in traumatic brain injury patients. *J Neurotrauma, 29*(1), 101-111. doi:10.1089/neu.2011.2084

Surtees, A. D. R., & Apperly, I. A. (2012). Egocentrism and automatic perspective taking in children and adults. *Child Development, 83*(2), 452-460. doi:10.1111/j.1467-8624.2011.01730.x

Swift, T. L., & Wilson, S. L. (2001). Misconceptions about brain injury among the general public and non-expert health professionals: An exploratory study. *Brain Injury, 15*(2), 149-165.

Sylvester, M. (2011). *Acceptance and commitment therapy for improving adaptive functioning in persons with a history of pediatric acquired brain injury*. University of Nevada, Reno,

Temkin, N. R., Corrigan, J.D., Dikmen, S.S., & Machamer, J. (2009). Social functioning after traumatic brain injury. *Journal of Head Trauma Rehabilitation, 24*(6), 460-467.

Temple, J. L., Struchen, M. A., & Pappadis, M. R. (2016). Impact of pre-injury family functioning and resources on self-reported post-concussive symptoms and functional outcomes in persons with mild TBI. *Brain Injury, 30*(13-14), 1672-1682. doi:10.3109/02699052.2015.1113561

The Psychological Corporation. (2001). *Wechsler Test of Adult Reading*. San Antonio, TX: Harcourt Brace & Company.

Tombaugh, T. N., Kozak, J., & Reese, L. (1999). Normative data stratified by age and education for two measures of verbal fluency: FAS and animal naming. *Archives of Clinical Neuropsychology, 14*(2), 167-177.

Turkstra, L. S., Mutlu, B., Ryan, C. W., Despins Stafslien, E. H., Richmond, E. K., Hosokawa, E., & Duff, M. C. (2020). Sex and gender difference in emotion recognition and theory of mind after TBI: A narrative review and directions for future research. *Frontiers in Neurology, 11*(59). doi:10.3389/fneur.2020.00059

Urbanik, C. M., & Lobchuk, M. M. (2009). Encouraging family caregivers to "step inside the patient's shoes". *Home Healthcare Nurse, 27*(4), 213-218.

Van Kleef, G. A. (Ed.) (2016). *Socail effects of emotions in close relationships*. Cambridge, England: Cambridge University Press.

Vangel, S. J., Rapport, L. J., & Hanks, R. A. (2011). Effects of family and caregiver psychosocial functioning on outcomes in persons with traumatic brain injury. *Journal of Head Trauma Rehabilitation, 26*(1), 20-29. doi:10.1097/HTR.0b013e318204a70d

Verhaeghe, S., Defloor, T., & Grypdonck, M. (2005). Stress and coping among families of patients with traumatic brain injury: A review of the literature. *Journal of Clinical Nursing, 14*, 1004-1012.

Wearne, T. A., Osborne-Crowley, K., Logan, J. A., Wilson, E., Rushby, J., & McDonald, S. (2020). Understanding how others feel: Evaluating the relationship between empathy and various aspects of emotion recognition following severe traumatic brain injury. *Neuropsychology, 34*(3), 288-297. doi:10.1037/neu0000609

Weddell, R. A., & Leggett, J. A. (2006). Factors triggering relatives' judgements of personality change after traumatic brain injury. *Brain Inj, 20*(12), 1221-1234. doi:10.1080/02699050601049783

Weddell, R. A., & Wood, R. L. (2016). Exploration of correlates of self-reported personality change after moderate-severe traumatic brain injury. *Brain Inj, 30*(11), 1362-1371. doi:10.1080/02699052.2016.1195921

Weddell, R. A., & Wood, R. L. (2018). Perceived personality change after traumatic brain injury II: comparing participant and informant perspectives. *Brain Inj, 32*(4), 442-452. doi:10.1080/02699052.2018.1429657

Whiting, D. L., Deane, F. P., Ciarrochi, J., McLeod, H. J., & Simpson, G. K. (2015). Validating measures of psychological flexibility in a population with acquired brain injury. *Psychological Assessment, 27*(2), 415-423. doi:10.1037/pas0000050

Williams, C., & Wood, R. L. (2010a). Alexithymia and emotional empathy following traumatic brain injury. *J Clin Exp Neuropsychol, 32*(3), 259-267. doi:10.1080/13803390902976940

Williams, C., & Wood, R. L. (2010b). Alexithymia and emotional empathy following traumatic brain injury. *Journal of Clinical and Experiemental Neuropsychology, 32*(3), 259-267. doi:10.1080/13803390902976940

Wood, R. L., & Williams, C. (2008a). Inability to empathize following traumatic brain injury. *Journal of the International Neuropsychological Society, 14*, 289-296. doi:10.10170S1355617708080326

Wood, R. L., & Williams, C. (2008b). Inability to empathize following traumatic brain injury. *J Int Neuropsychol Soc, 14*(2), 289-296. doi:10.1017/S1355617708080326

Xie, D., Pei, M., & Su, Y. (2019). "Favoring my playmate seems fair": Inhibitory control and theory of mind in preschoolers' self-disadvantaging behaviors. *Journal of Experimental Child Psychology, 184*, 158-173. doi:10.1016/j.jecp.2019.03.004

Zarit, S. H., Orr, N. K., & Zarit, J. M. (1985). *The hidden victims of Alzheimer's disease: Families under stress*. New York: New York University Press.

Zupan, B., Babbage, D., Neumann, D., & Willer, B. (2016). Sex Differences in Emotion Recognition and Emotional Inferencing Following Severe Traumatic Brain Injury. *Brain Impairment, 18*(01), 36-48. doi:10.1017/BrImp.2016.22

Zupan, B., Neumann, D., Babbage, D., & Willer, B. (2018). Sex-based differences in affective and cognitive empathy following severe traumatic brain injury. *Neuropsychology, 32*(5), 554-563. doi:10.1037/neu0000462

ABSTRACT

PERSPECTIVE-TAKING AND RELATIONSHIP QUALITY IN TRAUMATIC BRAIN INJURY AND SUPPORT PERSON DYADS

by

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August 2020

Advisor: Dr. Lisa J. Rapport

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Introduction: People with moderate-to-severe traumatic brain injury (TBI) often have problems with social communication, reduced contact with friends, and less satisfying social relationships than adults without history of TBI. Impaired abilities in perspective-taking may underlie problems in social integration and relationships following injury. This study sought to examine the perspective-taking ability of adults with moderate-to-severe TBI and support people, and examined the relationship between perspective-taking accuracy and relationship quality.

Methods: 48 dyads of adults with moderate-to-severe TBI and support people were included in the study. Both members of each dyad completed scales of distress, personality, and psychological flexibility. Measures were completed as traditional self-report, and in a perspective-taking imagine-other condition in which participants predicted the response of their study partner. Study partner self-report scores were subtracted from participant perspective-taking scores. Difference scores were used to examine perspective-taking accuracy for each scale. Self-report measures of empathy, caregiver burden, and functional ability were also included.

Results: TBI participants tended to overestimate distress in their support people. Additional analyses indicated that people with TBI experienced significantly more distress than

their dyad partners, and the pattern of their responses to self- and imagine-other tasks suggests that they had difficulty separating their personal experience from their partner's. In contrast, support people tended to have accurate perspective-taking accuracy of partner distress and personality. Further, accurate perspective-taking among support people was positively associated with their education and reading ability, inversely associated with their experience of caregiver burden, and positively associated with functional ability in the person with TBI. The ability to understand the experience of a relationship partner was related to relationship quality for both people with TBI and support people under certain conditions, although associations varied depending on whether participants overestimated or underestimated partner report. There was an especially strong correlation showing that when support people underestimate depression in people with TBI, those people with TBI tend to report poorer relationship quality. There were also varied correlations between perspective-taking accuracy and self-reported empathy depending on whether relationship partners tended to over- or under- estimate their partner's responses. Alternatively, support person self-reported empathy had a correlation of medium effect size with both support person and TBI relationship quality.

Conclusions: This study demonstrated that impairments in cognitive empathy observed in people with TBI generalize to specific close relationships. Findings from the current study may be used to educate families after injury and to inform assessment and intervention to support improved relationship quality after brain injury.

AUTOBIOGRAPHICAL STATEMENT

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