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Self-Efficacy, Health Promotion, And Rehabilitation In Acquired Brain Injury

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SELF-EFFICACY, HEALTH PROMOTION, AND REHABILITATION IN ACQUIRED BRAIN INJURY

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DEDICATION

To my late grandmother, Marian Butler Grimm, whose love of learning, industriousness, and compassion have always inspired me.

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CHAPTER 1 INTRODUCTION

Acquired Brain Injury (ABI)

Acquired brain injury (ABI) encompasses a wide array of injuries that occur after birth that disrupt brain function and are not a result of congenital, developmental, or degenerative conditions (Brain Injury Association of America, 2014a). ABI includes traumatic brain injury (TBI), which occurs due to external force, and non-traumatic brain injury, which occurs due to disease processes (Greenwald, Burnett, & Miller, 2003). Common causes of non-traumatic brain injury include stroke, tumor, aneurysm, viral encephalitis, and anoxic or hypoxic brain injury (McKinney, 2004; Mohr et al., 1997; Morgan & Ricker, 2008). Clinical and epidemiological studies often focus on specific ABI conditions that share a common etiology, such as TBI or stroke.

Acquired brain injury (ABI) represents a significant public health concern in the United States with the annual incidence of ABIs of all causes estimated at 2.6 to nearly 5 million (Brain Injury Association of America, 2014b; Coronado et al., 2012; Faul, Xu, Wald, & Coronado, 2010; Go et al., 2014). TBI is the leading cause of ABI with an annual incidence of 1.7 to 3.5 million, and stroke and tumor are the next most common causes of ABI with annual incidences of 795,000 and 66,240, respectively (Brain Injury Association of America, 2014b; Central Brain Tumor Registry of the United States, 2013; Coronado et al., 2012; Go et al., 2014). These estimates likely underrepresent the scope of ABI given that neurological symptoms are often unrecognized or unreported, ABIs that are secondary to other conditions often are uncounted (e.g., metastatic versus primary brain tumors), and civilian surveillance systems may exclude injuries that are treated within the military healthcare system (Corrigan, Selassie, & Orman, 2010; Go et al., 2014; National Cancer Institute at the National Institutes of Health, 2014).

Trends in ABI incidence data indicate that more people survive after brain injuries now than in the past. In particular, the overall mortality rates of stroke and TBI have decreased in the past several years (Faul et al., 2010; Go et al., 2014). Although incidence data for brain tumors in the U.S. do not capture the full scope of both primary and metastatic tumors, the 5-year relative survival rate for malignant primary brain or central nervous system (CNS) tumors is 33.8%. Prevalence estimates indicate that there are more than 688,096 individuals living with malignant and non-malignant primary brain and CNS tumors (National Cancer Institute at the National Institutes of Health, 2014).

The prevalence of individuals in the U.S. with lasting impairments due to ABI is strikingly high. Approximately 43% of individuals hospitalized annually for TBI develop long-term impairments by 1 year after injury (Selassie et al., 2008), and at least 3.2 million individuals live with lasting impairments associated with TBI (Zaloshnja, Miller, Langlois, & Selassie, 2008). Additionally, about 6.8 million individuals have had a stroke in their lifetimes and many develop long-term disabilities as a result (Go et al., 2014). With first-ever stroke, among individuals who survive to 30 days after injury, about half of them survive to 5 years post injury and about one third of these individuals have lasting disabilities due to the stroke (Hankey, Jamrozik, Broadhurst, Forbes, & Anderson, 2002). Some estimates of stroke outcomes suggest that about 10% of individuals experience a near complete recovery of functioning, about 25% recover with lasting mild impairments, and about 40% recover with lasting moderate to severe impairments requiring ongoing, specialized care (The Stroke Center at University Hospital, 2014). Among individuals with brain tumors, many factors contribute to prognosis (e.g., type and location of the tumor and adverse treatment-related effects), many people live with significant cognitive and functional disabilities from both the tumors and treatments, and many individuals require inpatient rehabilitation to address functional declines (Marciniak, Sliwa, Heinemann, & Semik, 2001; National Cancer Institute at the National Institutes of Health, 2014).

Furthermore, the economic costs associated with ABI in the U.S. are immense. Annual direct and indirect costs are estimated to be $48.3 to $78.1 billion for TBI and $34.3 to $36.6 billion for stroke (Finkelstein, Corso, & Miller, 2006; Ma, Chan, & Carruthers, 2014). Direct annual expenses for brain and other nervous system cancer are about $4.47 billion (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011), and indirect costs due to lost productivity are estimated to be approximately $5.8 billion (Bradley et al., 2008). The total economic burden of combined causes of ABI in the U.S. is likely underrepresented by these estimates because these studies focus on patient-related expenses and may miss costs incurred by members of the patients' support network (e.g., missed work by family members).

Impairments associated with ABI. Acquired brain injury (ABI) often is associated with long-term impairments in cognitive and physical functioning that disrupt independence in activities of daily living (ADLs), psychosocial functioning, and mental health (Andelic et al., 2010; Corrigan et al., 2010; Dehcordi, Mariano, Mazza, & Galzio, 2013; Hankey et al., 2002; Patel et al., 2006; Selassie et al., 2008; Zucchella, Bartolo, Di Lorenzo, Villani, & Pace, 2013). Impairments to ADLs may include difficulty bathing, dressing, toileting, transferring, or walking. Psychosocial impairments may include difficulty with social integration, autonomy, maintaining relationships or having injury-related symptoms that preclude individuals from completing desired activities and problems with physical functioning may relate directly to the effects of the injury, such as hemiparesis, necessary treatments, such as chemotherapy or radiation, or to poor physical health broadly (Andelic et al., 2010; Giovagnoli, 2012; Patel et al., 2006; Selassie et al., 2008).

At 6 months and 1 year after moderate or worse TBI, a substantial subset of individuals experience cognitive impairment, which may present as difficulties in attention, working memory, processing speed, memory, executive functioning, language abilities, and visuospatial abilities (Andelic et al., 2010; Dikmen et al., 2009; Kelly-Hayes et al., 2003). Cognitive and physical functioning are key factors predicting 1-year outcomes of TBI, including degree of overall disability, community integration and employment status (Bush et al., 2003). Similarly, cognitive impairment associated with stroke predicts long-term functional outcomes, and high levels of disability often necessitate transition to a nursing home post injury (Kelly-Hayes et al., 2003; Patel, Coshall, Rudd, & Wolfe, 2002).

Acquired brain injury (ABI) as a chronic health condition. Although the initial injury may be a single event, the long-term sequelae of ABI evolve over time. The evolution of ABI can be linked to both degenerative progression of traumatic encephalopathy, such as increasing number and density of neurofibrillary plaques and tangles (Johnson, Stewart, & Smith, 2012), and the consequences of cognitive and behavioral impairments caused by the initial injury, which may relate to declines in the ability of the brain to orchestrate coping responses to manage daily tasks and stressors. There has been an accumulation of evidence that even a single brain injury can correspond with significant and chronic impairments with delayed onset and degeneration across multiple areas of functioning, including physical, cognitive, psychiatric, and psycho-social (Corrigan & Hammond, 2013). The concept of chronic brain injury refers to the progression of impairments that originate with a brain injury and progress into a lifelong health condition and runs counter to longstanding views that brain injury leads to stable long-term outcomes (Corrigan & Hammond, 2013).

In shifting toward a disease management approach, it is important to identify "common and preventable complications" of brain injury, which include deleterious health behaviors, and to identify methods to improve outcomes and reduce cost burden (Corrigan & Hammond, 2013). Thus, like other chronic health conditions, clinical management of ABI should include validated approaches for making early diagnosis, identifying risk and protective factors, and providing prevention and intervention efforts, such as training in self-management (Corrigan & Hammond, 2013).

Self-Efficacy

Self-efficacy is an essential component of self-management, which involves individuals making ongoing decisions related to their chronic conditions. Self-management can support overall wellness and positive outcomes for health conditions generally and for rehabilitation of acquired brain injury specifically. Self-efficacy reflects individuals' beliefs or confidence in their capacity to achieve specific goals; as described by Bandura (1977), "an efficacy expectation is the conviction that one can successfully execute the behavior required to produce outcomes" (p. 193).

Bandura's work on self-efficacy, which arose out of the cognitive psychology movement, emphasized how perceived self-efficacy affects the regulation of behavior, motivation, and affective arousal (Bandura, 1977, 1989). He described ample support of reciprocal causation between self-efficacy and related performance, each serving to reinforce the other. Self-efficacy directly affects goal setting, goal-directed activity, and persistence, and although not the sole determinant of behavior, he emphasized how "given appropriate skills and adequate incentives… efficacy expectations are a major determinant of people's choice of activities, how much effort they will expend, and of how long they will sustain effort in dealing with stressful situations" (Bandura, 1977, p. 194). Beliefs about personal capacity (self-efficacy) are positively associated with goal setting, determination, effort to reach goals, and perseverance in response to challenge or setbacks (Bandura, 1989). Rooted in social learning theory, Bandura identified the sources of self-efficacy beliefs as performance accomplishments, vicarious experiences, verbal persuasion, and physiological states (Bandura, 1977).

With assessment of self-efficacy, it is important to assess *specific tasks or domains* of functioning, to assess *specific levels of difficulty or demand* of tasks, and to assess *variable degrees of self-efficacy* for these task demand levels (Bandura, 2006). Such measures can be used to examine the variability in a performance domain that can be accounted for by self-efficacy. Self-efficacy measures linked to specific domains or tasks yield better explanatory and predictive ability of related performance than do measures of general efficacy (Bandura, 2006). However, general self-efficacy may predict multiple specific domains of performance if there is a shared subset of skills and abilities, or if the social structure for the development of different sets of beliefs and abilities co-occur. Also, self-efficacy measures are more useful when linked to proximal beliefs, which regulate behavior, versus remote beliefs about the self (Bandura, 1989).

Disparities between self-efficacy and actual ability can be damaging if extremely divergent. However, most people tend to overestimate their abilities, and moderate overestimation of abilities can actually lead to higher performance than potentially limiting (but more realistic) self-efficacy beliefs (Bandura, 1989). In addition, *mood affects self-efficacy*, such that positive mood enhances, and negative mood diminishes, self-efficacy; therefore, mood-inducing events influence self-efficacy, and this influence affects broad domains of self-efficacy (Bandura, 1989). Furthermore, knowledge of a skill or function can be independent of self-efficacy for such function (e.g., memory), and performance requires knowledge and skills as well as strong self-efficacy to use skills (Bandura, 1989). For example, acquiring memory skills is a necessary step toward successful completion of memory tasks, but completion of these tasks also requires belief in the utility of the skills to aid memory and in one's ability to learn and utilize the memory skills. As described in the memory example, expectations for the outcome of a behavior also is independent of self-efficacy to complete a given behavior and must be assessed separately (Bandura, 1977).

In a review of resilience among persons with physical illness, Stewart and Yuen (2011) identified several constructs related to resilience, including self-efficacy, self-esteem, internal locus of control, mastery, hardiness, and optimism. These researchers found that resilience directly related to physical functioning across multiple domains, including self-care, adherence to treatment, health related quality of life, illness perception, pain perception, and physical outcomes specific to diseases. They also concluded that self-efficacy effects on physical functioning might vary in response to type of disease, severity of disease, and/or degree of certainty about outcomes.

Self-efficacy as related to rehabilitation. In rehabilitation settings, self-efficacy is positively associated with health outcomes, such as engagement in self-care activities, physical functioning, and tolerance for physical symptoms (Barlow, 2010). In particular, self-efficacy has been identified as a meaningful predictor of health, well-being, and/or functional outcomes in a rehabilitation context for persons with spinal cord injury (SCI; Hampton, 2001; Middleton, Tran, & Craig, 2007), TBI (Cicerone & Azulay, 2007), stroke (Jones & Riazi, 2011), and orthopedic injury (Chen, Neufeld, Feely, & Skinner, 1999; Waldrop, Lightsey, Ethington, Woemmel, & Coke, 2001). For example, Middleton et al. (2007) established that high self-efficacy among people with SCI corresponded positively to physical and mental health at 12 months or longer after injury and that self-efficacy was unrelated to demographic and injury characteristics.

Overall, this study provided support for the role of self-efficacy beliefs on health quality across a range of physical and mental health outcomes and underscored the need for further research on the role of self-efficacy on health and rehabilitation outcomes. Additionally, a review of evidence on the relation between self-efficacy and stroke rehabilitation concluded that self-efficacy is an important factor to consider with regard to rehabilitation outcomes, such as quality of life or perceived health status, depression, ADLs, and to some extent physical functioning (Jones & Riazi, 2011).

Specific types of self-efficacy also have been shown to correspond with important rehabilitation outcomes. Self-care self-efficacy has been shown to predict long-term quality of life and depression in persons with stroke (Robinson-Smith, Johnston, & Allen, 2000). Self-efficacy for the management of TBI-related physical, cognitive, and emotional problems predicts global life satisfaction (Cicerone & Azulay, 2007). Fall-related self-efficacy has been linked to a range of rehabilitation outcomes after stroke. Although prior falls and physical functioning are typically the strongest predictors of future falls, fall-related self-efficacy is independently associated with fall risk (Belgen, Beninato, Sullivan, & Narielwalla, 2006; Pang & Eng, 2008), as well as rehabilitation health outcomes, such as mobility and physical activity (Vahlberg, Cederholm, Lindmark, Zetterberg, & Hellstrom, 2013) and gains in ADL independence (Hellstrom, Lindmark, Wahlberg, & Fugl-Meyer, 2003).

Internal health locus of control and self-efficacy relating to health beliefs specifically relate to rehabilitation outcomes, such as compliance with home exercise regimens for individuals with upper-extremity impairment (Chen et al., 1999). Self-efficacy relating to health beliefs and to rehabilitation-specific tasks, as with orthopedic rehabilitation, also have been shown to be positively associated with rehabilitation outcomes and to a greater extent than optimism, a broad trait characteristic, and health value, which captures how much individuals value their health (Waldrop et al., 2001).

Self-efficacy has been qualitatively examined with neurologically disabled adults (i.e., stroke, TBI, and other monophasic neurological impairment) participating in inpatient rehabilitation (Dixon, Thornton, & Young, 2007). Three general themes for self-efficacy among the rehabilitation population with ABI emerged as related to self, other, and process. The self-themes included concepts such as self-reliance, recognizing improvements, and pushing limits. The other-themes included concepts such as external reassurance and vicarious experience. The process-themes included concepts such as setting goals and information needs (Dixon et al., 2007).

Overall, empirical work on self-efficacy within the rehabilitation context for ABI has been quite limited in scope. Two meta-analyses examining self-efficacy in stroke rehabilitation concluded that there is a limited amount of research on this topic though the research conducted supports a relationship between self-efficacy and stroke outcomes (Jones & Riazi, 2011; Korpershoek, van der Bijl, & Hafsteinsdottir, 2011). Also, within these studies, self-efficacy has been limited most often to physical abilities, such as balance or falls, and to a very limited extent, memory and self-care (Jones & Riazi, 2011; Korpershoek et al., 2011). Of note, the authors specially called for research to determine whether self-efficacy has independent predictive value, beyond that accounted for by objective characteristics related to the stroke impairment.

Self-efficacy as related to cognitive functioning. In rehabilitation settings, self-efficacy has been shown to have direct effects on outcomes as well as indirect effects on outcomes through its relationship with cognitive functioning. Of note, Andersson et al. (2008) observed significantly greater cognitive impairment among individuals with low versus high fall-related self-efficacy for individuals with a history of falls; however, cognitive impairment was not significantly different across levels of self-efficacy for those without a fall history. Their assessment of cognitive functioning was gross (MMSE), but these findings suggest a moderating effect, such that cognitive impairment may moderate the role of self-efficacy in fall risk. It may be that there is a threshold effect and restricted range of cognitive function (e.g., nonfallers have few cognitive deficits), which in turn attenuates the relationship between cognition and self-efficacy among nonfallers. Alternatively, the pattern could be produced by a nonlinear effect, such that nonfallers *also* include persons with deficits so profound that they are experiencing behavioral inertia, which lowers risk of fall.

Research in our laboratory has observed this moderating effect involving the influences of cognitive impairment and self-assessment of abilities on risk for accident in a variety of contexts (Rapport, Bryer, & Hanks, 2008; Rapport et al., 1993; Ryan et al., 2009). Essentially, self-assessment (e.g., awareness of deficit) is a key component in risk for accident because it influences whether an individual is prone to act in ways that will place him or her in jeopardy.

Similarly, some research supports the concept that self-efficacy can mediate the effects of cognition on rehabilitation outcomes (Cicerone & Azulay, 2007; Kendall & Terry, 1996; Wood & Rutterford, 2006). Cognitive impairment shows direct effects on rehabilitation outcomes but also has indirect (mediating) effects via influence on appraisal of the situation, self- appraisal of abilities to address the situation (e.g., awareness of deficit and self-efficacy) and coping.

Self-efficacy as related to general health. Self-efficacy has been identified as an important factor in a broad range of health and functional outcomes, such as among persons with coronary heart disease (Sullivan, LaCroix, Russo, & Katon, 1998), myocardial infarction (Brink, Alsen, Herlitz, Kjellgren, & Cliffordson, 2012), Type 1 diabetes (Johnston-Brooks, Lewis, &

Garg, 2002), arthritis (Wright, Zautra, & Going, 2008), multiple sclerosis (Amtmann et al., 2012), spinal cord injury (Amtmann et al., 2012), and management of chronic conditions generally (Bodenheimer, Lorig, Holman, & Grumbach, 2002). For example, high self-efficacy among multiple sclerosis and SCI patients was associated with a range of positive physical and mental health outcomes related to fatigue, stress, pain interference, sleep problems, and depression (Amtmann et al., 2012). In another example, cross-sectional studies with young adults with Type 1 diabetes, self-efficacy better predicts self-care behaviors and diabetes outcome at 3 and 6 months follow-up than self-esteem, with the influence of self-efficacy on diabetes outcome partially mediated by self-care behaviors (Johnston-Brooks et al., 2002).

Self-efficacy specific to one area of beliefs can predict outcomes to a range of physical and psychosocial functioning. For example, self-efficacy related to broad levels of health and lifestyle characteristics has been shown to predict specific health outcomes, such as with Type 1 diabetes (Johnston-Brooks et al., 2002), and self-efficacy for coping with a specific condition, such as heart disease (Sullivan et al., 1998), has been shown to have broad implications for health and well-being outcomes. Also, general self-efficacy has been shown to predict long-term physical and mental health outcomes, as shown among individuals with myocardial infarction (Brink et al., 2012).

Self-efficacy has been shown to mediate the effects of psychological characteristics on health outcomes. For example, self-efficacy mediated the effect of resilience, which included extraversion, positive affectivity, and vitality, on physical outcomes among persons with early knee osteoarthritis, underscoring the importance of high self-efficacy for low pain and high physical functioning (Wright et al., 2008). Also, self-efficacy related to managing rheumatoid-arthritis was found to mediate the influence of perceived control on disability outcomes

(Schiaffino & Revenson, 1992). Furthermore, among persons with multiple sclerosis, self-efficacy, in conjunction with health-promoting behaviors, resources, barriers, and acceptance, was found to partially mediate the effects of severity of illness on quality of life outcomes (Stuifbergen, Seraphine, & Roberts, 2000).

Self-management is an increasingly important aspect of primary care medicine and disease management, which emphasizes the role of the patient-professional partnership and the role of patients as active, problem-solving collaborators in the management of their chronic illnesses. Self-management relies heavily on self-efficacy, and multiple interventions designed to increase self-management have led to improved self-efficacy and health outcomes (Bodenheimer et al., 2002). For example, self-management interventions emphasizing problem-solving skills and self-efficacy overall are associated with better clinical outcomes and reduced costs for some chronic conditions, such as arthritis and adult asthma, compared with usual-care or only giving information (Bodenheimer et al., 2002).

Research on cognitively normal adults with disabilities supports a special role for *health-related* self-efficacy apart from general (global) self-perceptions of efficacy (Stuifbergen & Becker, 1994). Findings indicating a unique role of *health-related* self-efficacy to health outcomes are consistent with classic theory, which proffers that the belief system comprising self-efficacy is not a global trait, but rather, is a distinct collection of self-beliefs related to specific spheres of functioning (Bandura, 2006). For instance, in a study comparing models of compliance with home exercise regimens for individuals with upper-extremity impairments, self-efficacy specifically for health beliefs related directly to rehabilitation outcomes, whereas internal locus of control related inversely to these compliance outcomes (Chen et al., 1999).

Health Promotion

Self-efficacy is a key predictor of engagement in health-promoting behaviors, which in turn affect wellness and functional ability. Within the broad context of the healthcare system, the traditional medical model has dealt with supply and demand problems by limiting supply by delaying or restricting availability of services. However, this model is unsustainable, especially because we have an aging population with an increasing imbalance of chronic versus acute conditions, which creates heavy demand for healthcare services. An alternative approach to managing this issue is to focus on demand by increasing individuals' ability to manage chronic health conditions and therefore reduce the demand burden on the healthcare system (Bandura, 2004).

Health promotion involves activities that are motivated by goals to increase well-being and reach one's potential. Health-promoting behaviors have been conceptualized as central to enhancing adaptation to current disabilities and reducing risk for the development of further disabilities (Marge, 1988). Health-promoting behaviors also have been defined as ongoing behavioral, cognitive and emotional efforts to improve or maintain health and wellness (Pender, 1987).

A review of the literature on *health behavior change* and relation to rehabilitation (Nieuwenhuijsen, Zemper, Miner, & Epstein, 2006) concluded that research on health behavior change interventions is mixed and that definitions for health behavior change vary. Nieuwenhuijsen et al. (2006) provided a general definition of health behavior change as "the shift from risky behaviors to the initiation and maintenance of healthy behaviors and functional activities, and the self-management of chronic health conditions" (p. 245). Health behavior change requires planning, initiation and maintenance of health-promoting behaviors, including managing health conditions, and positive health behaviors are highly dependent on environmental factors. Studies on health behavior change suggest that intention to engage and self-efficacy for health behavior change are significantly related to health behavior change. Within the health behavior change literature, there are multiple theoretical models and a few are well suited with consideration of rehabilitation research.

Models of health-behavior change. Rehabilitation and health promotion efforts aim to improve physical and psychosocial functioning, which often necessitates individuals making positive changes in their health practices. Several theoretical models of health-behavior change exist and a few models are well-suited for consideration in rehabilitation for individuals with physical and cognitive impairments (Nieuwenhuijsen et al., 2006). For example, the Health Belief Model, Health Promotion Model, Social Cognitive Theory, and Transtheoretical Model of Behavior Change address important psychological factors, such as motivation, perceived benefits and barriers, and self-efficacy. These models also address environmental and social factors relevant to rehabilitation progress. These models of health-behavior change provide theoretical context for examining past research on self-efficacy and health-promotion among rehabilitation populations and for identifying important issues to consider in developing future research.

Health Belief Model. The health belief model indicates that a combination of barriers, resources, cues to action, and health-related self-efficacy contribute to individuals' abilities to participate in health behaviors (Nieuwenhuijsen et al., 2006; Rosenstock, 1974). This model originated in the 1950s with the work of social psychologists Hochbaum, Kegles, Leventhal, and Rosenstock, who were addressing concerns of the U.S. Public Health Service regarding need for increased health prevention efforts and compliance to medical recommendations (Rosenstock, 1974). This model focuses on four key constructs influencing the likelihood of an individual taking recommended health action, which are *perceived susceptibility or vulnerability to the* *condition*, *perceived severity of the condition*, *perceived benefit of treatment*, and *perceived barriers to treatment*, as well as two additional constructs that have been included in the model, *self-efficacy* and *cues for action* (Nieuwenhuijsen et al., 2006; Rosenstock, 1974). Self-efficacy is conceptualized as a necessary component to holding beliefs that one can overcome barriers to treatment (Nieuwenhuijsen et al., 2006). A review of the health belief model in relation to long-term health behaviors found that perceived severity, benefits and barriers related positively toward health behaviors, whereas susceptibility had essentially no relationship with health behaviors, and perceived benefits and barriers were the best predictors of health behaviors that were examined (Carpenter, 2010). This meta-analysis was unable to examine the relationship of self-efficacy to health behaviors due to the scope of the studies included, but researchers emphasized the need for future research on the role of self-efficacy within the model and with health behaviors (Carpenter, 2010). Overall, the health belief model is best conceptualized as a disease avoidance or protective model (Galloway, 2003; Rosenstock, 1974).

Social-cognitive theory. This model explains human functioning based on triadic reciprocal determinism among internal personal characteristics, behaviors, and environmental factors and includes key constructs, such as behavioral capability, expectations, observations, and self-efficacy (Bandura, 1986, 2001). This model was developed in the 1970s as an extension of social learning theory by Albert Bandura (1986), who argued that health behavior resulted from the reciprocal interactions among person, behavior, social environment (Nieuwenhuijsen et al., 2006). In social cognitive theory, health-related self-efficacy in particular is considered fundamental to health-behavior changes, such as smoking cessation or adherence to exercise regimens, and is comprised of performance accomplishments, vicarious experiences, social persuasion, and emotional arousal (Nieuwenhuijsen et al., 2006). In this model, self-efficacy should be considered in relationship to functional outcomes, it relates to specific behaviors and not personality traits, and it can be strong for some behaviors and weak for others (Nieuwenhuijsen et al., 2006).

Health Promotion Model. The constructs in the health promotion model are similar to those found in the health belief model, but the emphasis in the present model is on achieving higher levels of well-being and self-actualization rather than health protection (Nieuwenhuijsen et al., 2006; Pender, 1987). The modifying factors of behavior in this model include behavioral, situational, interpersonal, biological, and demographic factors. This model also incorporates principles from social learning theory in explaining how individuals learn behaviors and respond to cues for action (Galloway, 2003). The utility of Pender's (1987) health promotion model is supported by research demonstrating that engagement in health-promoting behaviors among people with disabilities is positively associated with self-efficacy specific to health behaviors and also with general self-efficacy (Stuifbergen & Becker, 1994).

Transtheoretical model of behavior change. The emphasis in this model is on one's readiness to change toward health behaviors and includes an emphasis on self-efficacy in conjunction with other change processes, such as decisional-balance (Prochaska & Velicer, 1997). This model was developed in the late 1970s by James Prochaska and is based on the theory that people go through stages of change before capable of engaging in positive health behaviors, that behavior change corresponds with increased readiness for change, and that people often cycle through the stages, such that they may move fluidly among the levels of readiness (Prochaska & Velicer, 1997). These stages include precontemplation, contemplation, preparation, action, and maintenance and research on this model generally supports that health interventions work best when matched to one's readiness level for a particular health behavior change (Nieuwenhuijsen et al., 2006; Prochaska & Velicer, 1997).

Health promotion as related to rehabilitation. Health-promotion activities include multiple health behaviors initiated by the individual and reinforce personal responsibility and dedication to living a healthy life. Health promotion/wellness promotion differs from disease management in that health promotion is not illness or injury specific, it is approach oriented versus illness avoidant, and it involves self-management as a mechanism for health promotion rather than illness or symptom management or prevention (Stuifbergen, Morris, Jung, Pierini, & Morgan, 2010).

Positive relationships have been found between health-promoting behaviors and functional outcomes among various populations with disabilities. For example, in a study of psychological and behavioral factors identified as potential contributors to the disablement process in multiple sclerosis, engagement in health-promoting behaviors, as measured by the Health-Promoting Lifestyle Profile II (HPLP-II), was inversely related to functional limitations in activities of daily living (Stuifbergen, Brown, & Phillips, 2009). Positive effects on health outcomes also have been found for health promotion interventions for individuals with chronic, disabling conditions (Stuifbergen et al., 2010).

Health and wellness is viewed as multifaceted by individuals with chronic and disabling conditions and includes functional and productivity abilities, independence, physical and mental well-being, and lack of pain (Putnam et al., 2003). Views of health and wellness also differ between individuals with disabilities compared to their non-disabled peers, with the presence of disability corresponding positively with importance of health-promoting behaviors and views of health-promoting behaviors as facilitating positive physical and psychosocial health outcomes (Putnam et al., 2003).

Self-Efficacy, Health Promotion, and Rehabilitation in ABI

Overall, the literature points to self-efficacy and health-promoting behaviors as being important for understanding widespread health outcomes as well as rehabilitation-specific outcomes. However, few studies have examined health-related self-efficacy and health-promoting behaviors in rehabilitation for ABI. One key study in this area by Braden et al. (2012) examined health and wellness constructs, including self-efficacy and health-promoting behaviors among persons with ABI. This study offered important insights about the relationships among these variables but also had important limitations. Braden et al. (2012) reported that health-related self-efficacy and health behaviors among adults with TBI were positively associated with perceived mental health status, life satisfaction and participation. Perceived health among these adults was lower than desirable levels but comparable to adults with other disabilities. These findings suggest that patterns of health self-efficacy and behaviors among people with brain injury are similar to those observed in other disabilities.

Although Braden et al. (2012) found important associations among health and wellness constructs in ABI, selection bias in this study favored motivated, health-focused individuals who were many years post injury, with relatively mild residual cognitive and physical disabilities. It did not capture the early phase of recovery from brain injury, which is when individuals with ABI typically experience the greatest cognitive impairment and are least entrenched in disability-related self-concepts. Other studies have examined self-efficacy generally and related constructs in ABI, such as locus of control (Moore & Stambrook, 1992), but few studies have examined specific aspects of self-efficacy, such as health-related self-efficacy, in this population. No known studies have examined health-related self-efficacy, health-promoting behaviors, and functional outcomes in ABI, which is an important gap in the literature that this study aims to address.

Summary and Rationale

Cognitive impairments caused by ABI frequently undermine adaptive responses required for independent management of those impairments. Thus, health behaviors essential to prevent and manage conditions may be specially hindered among people with ABI. Additional research is needed to expand understanding of health constructs among people with ABI, specifically among health-related self-efficacy, health-promoting behaviors, and rehabilitation outcomes. The disease-management approach supports the necessity of examining health-related self-efficacy and health-promoting behaviors after brain injury (Corrigan & Hammond, 2013). Understanding these issues in the early phase of recovery will inform interventions and research aimed at improving the long-term consequences of brain injury, and it will quite likely improve overall health outcomes as well.

Research on self-efficacy during rehabilitation for ABI is limited and inadequate, although there is initial support for a link between self-efficacy and health outcomes. The extant research also has generally limited investigations to self-efficacy and physical abilities, such as balance or falls. Within the general medical field, self-efficacy has been a valuable predictor of health-related outcomes. Qualitative analysis of individuals' experiences after ABI also supports the role of general health behaviors in promoting adaptation and adjustment to disability after brain injury (Robinson-Smith et al., 2000).

Although health-related self-efficacy is generally associated with health-related behaviors, there are many reasons why individuals with brain injuries may not demonstrate this same pattern. Specifically, cognitive impairment might function as a barrier to positive health behaviors. For example, cognitive impairment might impair ability to engage in health behaviors consistently and as directed. Memory, planning and organizational skills, impulse control, and comprehension all may undermine health behaviors, which can require complex and sustained activity over time. Cognitive impairment also could disrupt the relationship between self-efficacy and health behaviors via impaired self-monitoring (e.g., awareness of deficits and abilities), which would disrupt accurate self-assessment in forming realistic estimates of self-efficacy.

Identification of specific cognitive deficits that undermine health-related self-efficacy and/or health behaviors could lead to specific evidence-based interventions. In this regard, it is also important to consider overarching constructs that might be driving outcomes, such as global cognitive functioning or trait affectivity. Importantly, no prior studies have examined relationships of health-related self-efficacy and health promotion to functional rehabilitation outcomes, which is an important area for research on these health constructs in ABI.

Overview of Study

This was an observational study of individuals with acquired brain injury (ABI) who were starting a new course of occupational therapy through outpatient rehabilitation clinics. The main outcome of interest, functional status (e.g., activities of daily living), was assessed by therapists at the start of occupational therapy (baseline; Time 1) and again after six sessions (Time 2) using the Barthel Index and the Lawton Instrumental Activities of Daily Living Scale. At the start of therapy, participants were administered psychosocial questionnaires to assess the main predictors of interest, which included health-related self-efficacy (Self-Rated Abilities for Health Practices; SRAHP), health behaviors (Health-Promoting Lifestyle Profile-II; HPLP-II), trait affectivity (Positive and Negative Affect Schedule; PANAS), broad personality traits (Ten Item Personality Inventory; TIPI), a newly developed scale of ABI rehabilitation self-efficacy (Rehabilitation Self-Efficacy Scale; RSES), and a single item self-rating of health. Participants also were administered a select battery of neuropsychological tests to measure cognitive impairment, which was another key variable of interest.

Purpose and Hypotheses

Aim 1. The first aim of this study was to examine the relationships between health-related self-efficacy and health-promoting behaviors to rehabilitation outcomes among individuals with ABI, and the extent to which cognitive functioning moderates those relationships. It was hypothesized that health-related self-efficacy would correlate positively with health-promoting behaviors *(Hypothesis 1)*. It was hypothesized that health-related self-efficacy would correlate positively with rehabilitation outcomes *(Hypothesis 2)*. It was hypothesized that health-promoting behaviors would correlate positively with rehabilitation outcomes *(Hypothesis 3)*. It was hypothesized that cognitive impairment would moderate the relationship between self-efficacy and outcomes, such that among individuals with low to moderate cognitive impairment, self-efficacy would positively correlate with outcomes, whereas among individuals with severe cognitive impairment, self-efficacy would either have no relationship or would be inversely correlated with outcomes *(Hypothesis 4)*.

Aim 2. The second aim of this study was to examine the unique predictive utility of health-related self-efficacy to health-promoting behaviors and rehabilitation outcomes among individuals with ABI. It was hypothesized that among individuals with mild to moderate cognitive impairment, the unique predictive value of health-related self-efficacy and health-promoting behaviors to rehabilitation outcomes would hold after accounting for demographics and affectivity *(Hypothesis 5)*. It was hypothesized that among individuals with severe cognitive impairment, affectivity would have greater predictive value than health-related self-efficacy or health-promoting behaviors to rehabilitation outcomes after accounting for demographics

(Hypothesis 6).

Aim 3. A supplemental aim of this study was to examine the specific construct of *rehabilitation* self-efficacy. According to well-known theorists, particularly Bandura, measuring specific domains of self-efficacy leads to greater understanding and prediction of related behaviors as compared to measuring broader domains of self-efficacy. Also, research in medical rehabilitation, such as with orthopedic injuries, has supported the unique role of rehabilitation self-efficacy as a unique predictor of functioning compared to general health beliefs (Waldrop et al., 2001). However, generally there has been limited research on the role of self-efficacy in ABI rehabilitation and no known measure for rehabilitation self-efficacy in ABI. Thus, in addition to examining the role of health-related self-efficacy in ABI rehabilitation, this study examined the more specific construct of rehabilitation self-efficacy. A measure to assess rehabilitation self-efficacy was developed, piloted, and examined in relation to health beliefs, health behaviors, personality traits, and functional status.

CHAPTER 2 METHOD

Participants

Participants were 104 adults (60 men, 57.7%) with ABI in the post-acute phase of recovery who were beginning a course of occupational therapy as part of their rehabilitation plan. Participants received occupational therapy at clinics affiliated with the Rehabilitation Institute of Michigan (RIM) in Southeastern Michigan. Individuals were at least 18 years old at the time of participation. Individuals were excluded from this study if they were non-English speaking or if their cognitive or physical impairments were too severe for them to engage in the neuropsychological assessment. As shown in Table A1, this was a diverse sample of adults ages 18 to 82 (M = 52.5), who identified predominately as Black (53%) or White (40%). Participants varied in terms of educational attainment (M = 13.0, SD = 3.0), with 6.7% of the sample with 8 years or less of education, 13.5% with 9 to 11 years, 27.9% with 12 years, 31.7% with 13 to 15 years, and 20.2% with 16 years or greater of education. Overall, global cognitive functioning ranged from average to moderately to severely impaired (Table A1). The predominant cause of injury in this sample was stroke (76.9%), which was followed by TBI (20.2%). Other causes of injury (2.9%) included brain tumor and anoxic brain injury. Time since injury ranged from 11 days to 34 years, with a median of 6 months and mean of 25 months (Table A1). Time since injury was between 0 and 6 months for more than half of the sample (53%), up to 1 year for 60% of the sample, and up to 2 years for 72% of the sample. Table A1 presents sample characteristics.

Sample size and precision. The intended size of the sample for participants who would complete the primary measures of interest was 98, which was achieved. The sample size of 98 was determined initially in order to provide an adequate cases-to-IVs ratio to detect a medium effect with six predictors included in the model (Green, 1991), though models were adjusted to include fewer predictors based on preliminary analyses as discussed in the results section. For subsample analyses, a minimum standard of a 10 to 1 cases-to-IVs ratio was adopted.

Procedure

Sampling procedures. This was an observational study. The researchers coordinated with occupational therapists across the three sites to determine days and times that new patients with ABI were being evaluated. Participants were recruited during their first week of therapy sessions, usually after their first session while they were still in the clinic. Their occupational therapists introduced the study briefly to the individuals and asked them if a researcher could speak with them further about participating. Of 163 individuals who were approached, 136 (83%) consented to participate. At the time of consent, an appointment was scheduled for participants to complete the testing session in a private office at the same location as their rehabilitation clinic. Based on the individual needs and requests of participants, follow-up by phone was provided by the researchers to discuss the study, schedule the testing appointment, reschedule testing as needed, provide reminder calls for testing appointments, and/or speak with caregivers as requested by participants to facilitate engagement in the study. The testing appointments occurred within the first week of therapy sessions, usually before or after the participants' previously scheduled therapies. The testing appointments were scheduled for 1.5 to 2 hours and sometimes were split into two sessions to accommodate the scheduling needs of the participants. Split testing sessions were structured so that the neuropsychological tests were administered in one session and the self-report questionnaires were administered in another session, both of which took approximately 45 to 60 minutes to complete. Of 136 participants who consented, 104 (76%) individuals completed the testing with baseline OT functional ratings, and 101 (74%) individuals completed testing *and* returned for therapy sessions following their initial evaluation, thus allowing follow-up OT functional ratings. The 3 participants who did not complete therapy sessions after their initial evaluations were unable to continue their treatment due to problems with insurance authorizations. Participant difficulties with scheduling or maintaining the testing appointment within the first week of starting therapy, as outlined in the protocol, largely accounted for the disparity between the number of consented and tested individuals.

Occupational therapists who worked at the three outpatient rehabilitation clinics affiliated with RIM were recruited to participate in this study and were consented prior to recruiting their individual patients. The therapists who collaborated in this study did not receive compensation. The rating forms completed by therapists are commonly used in rehabilitation medicine, reflected common functional status assessments made by occupational therapists, and had specific instructions for completing the ratings scales written on each form. Occupational therapists were given a packet of rating forms at the time of participant consent (Time 1) and were given another packet of rating forms after the participants had completed six sessions of therapy (Time 2). For those participants who returned for therapy after the initial evaluation but completed fewer than six sessions of therapy (6%), occupational therapists were asked to complete the follow-up ratings based on their most recent knowledge of the participants' functional status. All consent and research procedures were in accordance with Wayne State University IRB approval and adhered to APA Ethical Standards.

Recruitment. Participants were recruited between March 2014 and July 2015, and functional ratings were collected from occupational therapists until August 2015.

Measures. The measures examined in this study included neuropsychological tests, self-report questionnaires, and clinician-rated measures. The neuropsychological tests were administered following standardized procedures outlined by the test developers. On self-report measures, items were read aloud to the participants to minimize difficulty completing measures due to vision or reading problems. The instructions and response options were reviewed with the participants for each self-report measure, which were enlarged and printed on response cards for the participant to reference during the questionnaires. Participants could respond to self-report questionnaires by pointing to their response on the card or verbalizing their response. One individual who had an ABI-related speech production deficit used a personally-adapted speech-assistive device to aid his responding in conjunction with verbal responding during the evaluation. This study was part of a larger study, which included measures in addition to those of focus for this particular study. Measures administered but not examined in this study included: Test of Premorbid Functioning, Recognition Memory Test, Modified Cumulative Illness Rating Scale, Short Michigan Alcohol Screening Test, Drug Abuse Screening Test, Brief Symptom Inventory 18, Pain Anxiety Symptoms Scale, Apathy Evaluation Scale Clinician Version, and Rehabilitation Therapy Engagement Scale.

The two researchers who worked on this study were graduate students with training and experience in neuropsychological evaluations. The researchers trained on all measures prior to data collection and cross-checked procedures as questions arose during the study to ensure reliable data collection methods.

Key predictors.

Self-Rated Abilities for Health Practices (SRAHP). The SRAHP was designed to assess health-related self-efficacy in populations with disabilities (Becker, Stuifbergen, Oh, & Hall, 1993) and was selected to represent this construct in the present study. This is a 28-item, self-report measure with subscales that assess the domains of nutrition, physical activity and exercise, psychological well-being, and responsible health practices. Each item is presented as, "How much are you *able* to…" and a specific health behavior is then described. Example items include, "How much are you *able* to eat a balanced diet, how much are you *able* to find ways to exercise that you enjoy," and "how much are you *able* to get help from others when you need it." Respondents rate on a 5-point scale, from 0 (*not at all*) to 4 (*completely*) how well they are *able* to do each of the health practices and directed not to indicate *how often* they actually do each practice. Scoring of this measure is such that high scores indicate high perceived functional independence, physical well-being, and/or psychosocial well-being based on the pattern of elevated scores across the subscales. Total scale (range 0 – 112) and subscale scores are available. Adequate reliability has been established for this measure for use with persons with and without disability (Becker et al., 1993).

The Health-Promoting Lifestyle Profile-II (HPLP-II). The HPLP-II was designed to assess health behaviors among disabled populations (Walker & Hill-Polrecky, 1996). This is a 52-item, self-report measure that has subscales for physical activity, spiritual growth, health responsibility, interpersonal relationships, nutrition, and stress management. Respondents rate each item on a 4-point scale, indicating the *frequency* with which they engage in each behavior. Response alternatives range from 1 (*never*) to 4 (*routinely*). Each item is presented as, "How *often* do you…" and a specific health behavior is then described. Example items include, "How *often* do you get enough sleep, how *often* do you spend time with close friends," and "how *often* do you use specific methods to control your stress." Total scale and subscale scores are available. This measure has good psychometric support generally (Walker & Hill-Polerecky, 1996) and for use with chronically-ill and disabled individuals (Stuifbergen, 1995; Stuifbergen et al., 2009; Stuifbergen et al., 2000).

Cognitive functioning indicators.

Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). The RBANS was initially designed as a cognitive screening tool for dementia (Randolph, 1998) and has since amassed considerable support as a relatively brief cognitive battery, which provides reliable and valid information on overall cognitive functioning and specific cognitive abilities across many clinical populations (McKay, Casey, Wertheimer, & Fichtenberg, 2007). The RBANS was selected for use in this study to assess a range of cognitive abilities based on the individual subscales, including verbal learning and memory, visuospatial learning and memory, processing speed and attention, and language, and to provide an overall index of cognitive functioning based on the total score. The RBANS includes 12 subtests that uniquely contribute to the subscales of the measure; List Learning and Story Memory form the Immediate Memory Index, Figure Copy and Line Orientation form the Visuospatial/Constructional Index, Picture Naming and Semantic Fluency form the Language Index, Digit Span and Coding form the Attention Index, and List Recall, List Recognition, Story Recall and Figure Recall form the Delayed Memory Index. The Total Score Index is comprised of these five specific abilities indices. All scores on the RBANS are standardized such that high scores correspond with high cognitive ability. This neuropsychological battery has demonstrated reliability and validity for assessment of cognitive functioning in a brain injury population and provides an efficient method for assessing a broad range of cognitive abilities (McKay et al., 2007).

Trail Making Test (TMT). The TMT was designed to assess basic attention and processing speed as well as executive abilities, such as set-shifting, planning, and response inhibition (Reitan & Wolfson, 1985). The TMT scores are based on completion time for the A and B trials; scores are standardized such that high scores correspond with high ability. The TMT has been identified as a core measure for assessing neuropsychological impairment after brain injury based on its reliability, utility in detecting cognitive impairment after brain injury, and brevity (Wilde et al., 2010).

Controlled Oral Word Association Test (COWAT; FAS). The COWAT (FAS version) was designed to assess word generation language abilities (Benton & Hamsher, 1989; Spreen & Strauss, 1998). This measure is scored based on number of words generated across the three trials; scores are standardized such that high scores correspond with high ability. This measure has been identified as a useful supplemental measure for assessing executive functioning after brain injury (Wilde et al., 2010).

Stroop Color and Word Test. The Stroop (Golden, 1978) was designed to assess executive abilities, such as response inhibition. This measure is scored based on performance on individual trials and discrepancy scores comparing trials; scores are standardized such that high scores correspond with high ability. The Stroop has been demonstrated to have good psychometric properties and utility in detecting cognitive impairment in populations with acquired brain injuries (Dimoska-Di Marco, McDonald, Kelly, Tate, & Johnstone, 2011).

Complex Ideational Material. The Complex Ideational Material subtest from the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983) was designed to assess abstract thinking and language comprehension and was selected to represent high-level language skills in this study. Scores are standardized such that high scores correspond with high ability. This task has been demonstrated to be useful in detecting cognitive impairment following acquired brain injury (Pastorek, Hannay, & Contant, 2004).

All standardized scores on neuropsychological tests were calculated using an approach in which the raw scores were converted to standardized (Z) scores based on the demographics of an average participant who is a 45-year-old, right-handed, white man with 12 years of education. This approach was used in order to control for the effects of demographic corrections on standardized scores for these tests, particularly given that there was variability in the extent to which demographic corrections were reflected in the normative data for these tests. This approach also allowed for examination of the effects of demographic variables separately from performances on cognitive tests in the analyses.

Rehabilitation outcomes.

The Barthel Index (BI). This measure was designed to assess ADLs based on clinician rating of 10 areas of functioning, including feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfer, ambulation, and chair transfer. This measure was selected to assess basic functional abilities after ABI that are relevant to rehabilitation goals and outcomes. This scale includes 10 items with one item per each ADL domain. Each item has response options that include two to four numerical ratings (0, 5, 10, 15) and specific descriptors for each rating level. Complex tasks include more rating categories than simpler tasks. For example, on the dressing item, *0* is dependent, *5* = needs help but can do about half unaided, and *10* is independent (including buttons, zips, laces, etc.). On the transfers item, *0* is unable, no sitting balance; *5* is major help (one or two people, physical), can sit; *10* is minor help (verbal or physical); and *15* is independent. High ratings correspond with independence and the total score ranges from *0* to *100*. This measure has been well-researched among brain injury and rehabilitation populations and has been shown to be a reliable and valid method of assessing physical functioning (Hobart et al., 2001).

The Lawton Instrumental Activities of Daily Living Scale. This measure was designed to assess instrumental activities of daily living (IADLs) based on clinician rating of eight areas of functioning, including using the telephone, shopping, preparing food, housekeeping, doing laundry, using transportation, handling medications, and handling finances. This measure was selected to assess complex functional abilities after ABI that are relevant to rehabilitation efforts. This measure has eight items with one item corresponding to each IADL category assessed. Each item has response options that include three to five descriptors with scores of 1 or 0 associated with each descriptor, reflecting whether the examinee is independent in the activity. One descriptor is selected for each item. Complex tasks include more descriptor options than simpler tasks. For example, the shopping item includes four descriptors with numerical scores listed with each one: *takes care of all shopping needs independently* (1), *shops independently for small purchases* (0), *needs to be accompanied on any shopping trip* (0), and *completely unable to shop* (0). High ratings correspond with independence and the total score ranges from *0* to *8.* This measure has been well-researched among rehabilitation populations and has been shown to be a reliable and valid method of assessing complex functional status (Graf, 2008).

Other variables of interest.

Demographic information. Demographic variables of interest included age, sex, race, education, type of injury, and time since injury. Demographic information was collected to characterize the sample, facilitate accurate comparisons of results of the current study with prior research, and account for variability in outcomes of interest.

The Positive and Negative Affect Schedule (PANAS). The PANAS was designed to assess positive and negative trait affectivity. This is a 20-item, self-report measure that uses a 5-point Likert scale from 1 (*very slightly or not at all*) to 5 (*extremely*). The Positive Affect (PA) and Negative Affect (NA) subscales have 10 items each, which are single words, such as “interested” or “nervous.” Items are presented with the instruction to *“indicate to what extent you felt this* *way over the past week"* using the provided Likert scale. The scale produces separate scores for positive and negative affectivity and high scores correspond with high levels of the trait. The PANAS has good psychometric support in nonclinical populations and has been used widely in brain injury research (Watson, Clark, & Tellegen, 1988).

Rehabilitation Self-Efficacy Scale (RSES). This measure was developed and piloted as an exploratory measure in this study. It was developed to assess aspects of self-efficacy that pertain to ABI rehabilitation specifically, as such a measure did not exist at the time of this study. The measure was constructed by following general guidelines proposed by Bandura (1977; 2006) for development of self-efficacy scales. This measure also was developed based on the qualitative work of Dixon and colleagues (2007), who identified self-efficacy constructs that were salient to individuals in ABI rehabilitation. The scale was initially developed and revised based on feedback from neuropsychologists and occupational therapists with domain knowledge for brain injury who work in a rehabilitation setting. This 24-item, self-report, scale has response options ranging from 1 *(not confident I can do)* to 3 *(moderately confident I can do)* to 5 *(highly confident I can do)*.

Self-Rated Health (SRH). The single item self-rating of health, which often has been called SRH, was designed as an opening to health-related interviews across sociological and epidemiological research. The SRH question since has acquired strong support as a measure of general health perception and has been show to relate to many important health outcomes (Bailis, Segall, & Chipperfield, 2003; Benyamini, 2008). The SRH question was selected as an adjunctive measure for this study to provide additional information related to self-perceptions of health. This item has five response options and is presented as, "In general, would you say your health is excellent, very good, good, fair, or poor?" The item is scored with high values corresponding to positive health ratings.

Ten-Item Personality Inventory (TIPI). The TIPI was designed as a brief measure of the Big-5 personality constructs, openness, conscientiousness, extraversion, agreeableness, and neuroticism (emotional stability, as labeled in the TIPI), and has adequate psychometric properties for use in research (Gosling, Rentfrow, & Swann, 2003). This 10-item, self-report, Likert scale has response options ranging from 1 *(disagree strongly)* to 7 *(agree strongly)*. The measure is scored such that high scores correspond with high levels of each respective trait. Each item contains two words or brief phrases and individuals are asked to rate the extent to which either or both of the words or phrases apply to them. Prior to each item is the prompt, "I see myself as…." Example items include, "critical, quarrelsome" and "calm, emotionally stable." Given the literature showing relationships between personality characteristics, such as conscientiousness, and health outcomes, the TIPI was selected as an adjunctive measure for this study to provide additional information on personality traits that may relate to the primary predictors and outcomes of interest in this study (Bogg & Roberts, 2013).

CHAPTER 3 RESULTS

Descriptive Characteristics

Functional status. The Time 2 Barthel and Lawton scales were used as outcome measures, both of which had very good reliability ($\alpha > .85$). Table A1 presents psychometric properties for the Barthel and Lawton scales. Time 1 and Time 2 Barthel scores were highly correlated in the sample, $r(101) = .91$, $p < .001$, as were Time 1 and Time 2 Lawton scores, $r(97) = .86$, $p < .001$. Therefore, it did not make sense to control for Time 1 scores. Also, it did not make sense to treat this study as a longitudinal design because there were only six sessions of therapy on average between Time 1 and Time 2 functional ratings. Time 2 functional ratings were used as the outcome measures because these scores captured therapists' ratings of patients after having several sessions to work with them and gain a good sense of their patients' abilities.

Overall, 75 of the 104 total participants (72.1%) had baseline ADL functional deficits (i.e., less than maximum scores) on the measure of basic ADLs (Barthel) and 82 participants (78.8%) had baseline IADL functional deficits on the measure of instrumental IADLs (Lawton). Thus, these individuals had room for measurable improvement at the start of occupational therapy. After examining these initial results, the subsample of participants with baseline ADL deficits was selected for the primary analyses of this study ($n = 75$). This approach reflects the primary aims of this study, which focused on outcome evaluation and prediction for individuals for whom it was implicitly understood had functional deficits at the start of treatment. Functional impairment was determined based on basic ADL ratings (Barthel) rather than IADL ratings (Lawton) in order to capture participants with respectively lower functional independence at the start of treatment. Within the subsample with baseline ADL deficits, 68 participants also had deficits in IADL functioning (Lawton).

Performances on cognitive testing. The results of neuropsychological testing are presented for the *subsample with baseline ADL deficits* in Table A2 (n = 75). Performances on measures of cognitive functioning were variable and relatively low. In all cognitive domains except Language, the sample performed on average at least one standard deviation below the mean as measured by Z scores. Scores were standardized such that they were unadjusted for demographics as described prior. Cognitive domains in order of most to least impaired were Processing Speed (M = -2.7), Executive Functioning (M = -2.1), Non-Verbal Recall (M = -2.0), Verbal Learning (M = -1.9), Visuospatial Constructional (M = -1.7), Verbal Recall (M = -1.6), Attention (M = -1.6), and Language (M = -0.8). The Global Cognition composite also indicated an overall relatively low performance on average (M = -1.8). With impairment defined as Z score < -2.00, about half of this sample (46.7%) was impaired on 8 or more of the 16 test scores, and there was a wide range in the number of tests impaired (M = 8.4, SD = 3.6, *range* = 1 – 15). Cognitive functioning was comparable across the subsample and total sample (see Table B1 for the results of neuropsychological testing in the total sample, N = 104).

Main predictors. The main measures of interest in this study were the SRAHP (Self-Rated Abilities for Health Practices) and HPLP-II (Health-Promoting Lifestyle Profile II). As shown in Table A1, the SRAHP had excellent reliability (α = .93), and the four subscales had acceptable to good reliability. The HPLP-II had excellent reliability (α = .95), and the six subscales had acceptable to good reliability. Item statistics were examined for the SRAHP and the HPLP-II, and Item 4 on the SRAHP (i.e., brush teeth) and Item 5 on the HPLP-II (i.e., enough sleep) were poorly fitting items as indicated by discriminant indices (< .30). However, deletion of these items did not improve the reliability of the respective scales and the items were retained to maintain the original forms of the scales. Examination of the response distributions for the SRAHP items indicated that all items except three (i.e., Items 2, 20, and 25) were endorsed across the full range of response options. The SRAHP average item endorsement was 3.0, which corresponds to “mostly” on the scale that ranged from “not at all” (0) to “completely” (4), and 53% of the sample had an average item endorsement > 3.0 (i.e., over half of the sample rated themselves as mostly capable with regard to health practices). On the HPLP-II, the response distributions indicated that all items were endorsed across the full range of response options. The HPLP-II average item endorsement was 3.7, which corresponds to “often” on the scale that ranged from “never” (1) to “routinely” (4), and 77% of the sample had an average item endorsement > 3.0 (i.e., a large majority of the sample rated themselves as often engaging in health-promoting behaviors). Table A1 presents psychometric properties for the SRAHP and HPLP-II. Of note, the PANAS was included as a moderator in the primary analyses of this study and had good psychometric properties (Table A1).

Results of Primary Analyses

Aim 1. The first aim of this study was to examine the relationships between health-related self-efficacy and health-promoting behavior to rehabilitation outcomes in ABI.

Hypothesis 1. It was hypothesized that health-related self-efficacy (Self-Rated Abilities for Health Practices; SRAHP) would correlate positively with health-promoting behaviors (Health-Promoting Lifestyle Profile-II; HPLP-II; H_o1). Table A3 presents the intercorrelations among the SRAHP and HPLP-II scales. This hypothesis was tested using bivariate correlations among the SRAHP and HPLP-II in the subsample of individuals who had functional deficits in ADLs at baseline. The SRAHP and HPLP-II were highly correlated in this subsample, $r = .70$, $p < .001$. As shown in Table A3, the SRAHP Total was highly correlated with all subscales of the HPLP-II, and the HPLP-II Total was highly correlated with all subscales of the SRAHP; these patterns were consistent across the subsample and the total sample. Although there was a consistent pattern of intercorrelations that showed relatively stronger relationships among scales of each measure separately than when comparing scales across the measures, these differences were not substantial enough to provide strong evidence of independence. SRAHP was uncorrelated with age and education at the total scale and subscale level (Table A3). HPLP-II was uncorrelated with age but showed a modest correlation with education, particularly the Interpersonal Relations and Stress Management subscales (Table A3). For ease of comparison, Table B2 presents the results of these intercorrelations for the subsample and total sample.

Hypothesis 2. It was hypothesized that health-related self-efficacy (Self-Rated Abilities for Health Practices; SRAHP) would correlate positively with rehabilitation outcomes (Barthel Index and Lawton Instrumental Activities of Daily Living Scale; H_o2). Table A4 presents the correlations of the SRAHP, HPLP, PANAS, age, education and Global Cognition with the Barthel and Lawton in the subsample with baseline ADL deficits ($N = 75$). SRAHP and Barthel were moderately correlated, $r = .32$, $p = .003$. Barthel was moderately correlated with SRAHP Nutrition, $r = .33$ and SRAHP Exercise, $r = .28$ (ps < .01). Barthel showed weaker correlation with SRHAP Responsible Health Practices ($r = .24$, $p = .019$) and Psychological Well-being ($r = .20$, $p = .046$) subscales. The correlation between SRAHP and Lawton was weak, $r = .20$, $p = .045$, as was the correlation between SRAHP Psychological Well-being and Lawton, $r = .24$, $p = .021$. The Lawton was not meaningfully correlated with other SRAHP subscales (rs < .20).

Hypothesis 3. It was hypothesized that health-promoting behaviors (Health-Promoting Lifestyle Profile-II; HPLP-II) would correlate positively with rehabilitation outcomes (Barthel Index and Lawton Instrumental Activities of Daily Living Scale; H_o3). In the subsample with baseline ADL deficits ($N = 75$), HPLP-II and Barthel showed small correlation, $r = .21$, $p = .044$.

Barthel was moderately correlated with HPLP-II Physical Activity, $r = .27$, $p = .011$. Barthel showed weaker correlation with HPLP-II Stress Management ($r = .21$, $p = .042$) and was not meaningfully correlated with other HPLP-II subscales (*r*s < .20). HPLP-II and Lawton were not meaningfully correlated overall or at the subscale level (*r*s < .20). Similar patterns of correlations with the SRAHP, HPLP, Barthel and Lawton were found in the total sample (Table B3).

Hypothesis 4. It was hypothesized that cognitive impairment (i.e., as measured by neuropsychological testing) moderated the relationship between self-efficacy (Self-Rated Abilities for Health-Practices; SRAHP) and rehabilitation outcomes (Barthel Index and Lawton Instrumental Activities of Daily Living Scale; H_o4). Curvilinear regression analyses were used to examine the relationship between global cognition and health-related self-efficacy. This approach was adopted after examination of the scatterplot of Global Cognition to SRAHP indicated that these data appeared to violate the expectation for linearity. Cubic and quadratic models were compared with the linear regression model in the subsample with baseline ADL deficits in order to optimize detection of a possible relationship between cognition and self-efficacy. The linear model did not reach statistical significance, $F(1, 73) = 3.37$, $p = .07$, $R^2 = .04$. The quadratic model was significant, $F(2, 72) = 3.91$, $p = .02$, $R^2 = .10$, as was the cubic model, $F(3, 71) = 3.80$, $p = .01$, $R^2 = .14$. The quadratic and cubic models were the best fitting models and accounted for a significant amount of variance in SRAHP, with 10% and 14% respectively. The quadratic model, which was the simplest model that explained the data, showed a decreasingly negative relationship between Global Cognition and SRAHP until the inflection point between -2 and -1.5 Z scores and then showed an increasingly positive relationship between Global Cognition and SRAHP. Thus, the quadratic model indicates the presence of one bend in the data, and changes in the strength of the relationship between variables occur before and after the bend, whereas the cubic model indicates two bends in the data. These results indicate the potential for two or three groups based on level of cognition. Therefore, moderation was examined in the subsample of individuals with baseline ADL deficits (*N* = 75) using two approaches.

The first approach used empirically-driven criteria and identified three groups that best illustrate the moderation effect, based on clinical cutpoints and informed by the examination of the scatterplot and curvilinear regression analyses. Of note, a three-group solution is consistent with a cubic model in the relationship between cognition and self-efficacy (i.e., two bends in the data). Global cognition was used as an index of the severity of cognitive impairment. The first approach involved splitting the respective samples into three groups based on level of cognitive impairment. Group 1 included individuals with a severity index within 1 SD below the mean (unimpaired), Group 2 included individuals with a severity index 1 – 2 SDs below the mean (mild to moderate impairment), and Group 3 included individuals with a severity index lower than 2 SDs below the mean (severe impairment). These cutpoints were adopted to maximize detection of group differences after examining the curvilinear regression analyses and comparing correlational matrices for SRAHP to Barthel and Lawton at various levels of Global Cognition. The relationship between self-efficacy and rehabilitation outcomes then was examined and compared across these groups, and notable differences in the correlation matrices were considered evidence of a moderation effect of cognitive impairment.

Cognitive impairment was examined as a moderator of the relationship between health-related self-efficacy (SRAHP) and ADL (Barthel) and IADL (Lawton) functional status. Table A5 presents these correlations for the three cognitive-impairment groups separately. In this subsample with baseline ADL deficits (*N* = 75), 16% (*n* = 12) of individuals were in Group 1 (unimpaired), 39% (n = 29) were in Group 2 (mild to moderate impairment), and 45% (n = 34) were in Group 3 (severe impairment). In Group 1, the correlation between SRAHP and Barthel was moderate to large, $r = .55$, $p = .033$, and the correlation between SRAHP and Lawton was moderate to large, $r = .52$, $p = .042$. In Group 2, the correlation between SRAHP and Barthel was moderate, $r = .34$, $p = .038$, and SRAHP and Lawton showed a moderate though statistically nonsignificant association, $r = .29$, $p = .068$. In Group 3, the SRAHP and Barthel showed a small and nonsignificant association, $r = .22$, $p = .113$, and the SRAHP and Lawton were not meaningfully associated, $r = -.02$, $p = .459$. Thus, there was evidence that cognitive impairment moderates the relationship between health-related self-efficacy and functional status in persons with baseline ADL deficits. Fisher's r-to-z tests were used as tests of the differences in the magnitudes of the correlations between the unimpaired and severely impaired groups. Though the small sample size for the unimpaired group was underpowered for ideal comparisons, a few of the test results approached significance. In the comparison between SRAHP Total and Lawton correlations, z = 1.47, $p = .07$; for the SRHAP Nutrition and Lawton comparison, z = 1.34, $p = .09$; for the SRAHP Psychological Well-being and Lawton comparison, z = 1.64, $p = .05$ (see Table A5 for correlational data). Similar results of the moderation analyses were found for the total sample (Table B4).

Fisher's r-to-z tests for the total sample were more robust than for the subsample. The correlation for SRAHP Total and Lawton was significantly greater in the unimpaired versus severely impaired group, z = 1.71, $p = .04$. The correlation for the SRAHP Psychological Well-being and Barthel was significantly greater in the unimpaired versus severely impaired group, z = 1.95, $p = .03$. The correlation for SRAHP Psychological Well-being and Lawton was significantly greater in the unimpaired versus severely impaired group, z = 2.30, $p = .01$. The results with the total sample were consistent with those of the subsample, and the difference in statistical significance of the findings likely reflects the contributions of larger subsamples, particularly for the unimpaired group. For interested readers, a separate presentation of the data pertinent to these moderation analyses is presented in Table B5, which shows the correlations between the SRAHP total and subscales with the Barthel and Lawton as functions of global cognition and sample selection.

The second approach tested for moderation using procedures aligned with Baron and Kenny's recommendations (Baron & Kenny, 1986). These procedures involved centering continuous predictor and moderator variables, creating interaction terms of these variables, and running hierarchical regressions entering the predictor and moderator variables in step one and the interaction term in step two. If the interaction term explained a significant amount of the variance in the outcome variable, then evidence of moderation was obtained.

This second approach examined cognitive impairment as a moderator of the relationship between health-related self-efficacy and ADL and IADL functional status in this subsample. Health-related self-efficacy and global cognitive impairment were entered into the first step of a hierarchical regression analysis predicting ADL functional status on the Barthel. The interaction term between health-related self-efficacy and global cognitive impairment was entered into the second step of the regression analysis, and it did not explain a significant increase in ADL functional status (Barthel), $\triangle R^2 = .04$, $F(1, 69) = 0.32$, $p = .571$. In a parallel hierarchical regression analysis predicting IADL functional status on the Lawton, the interaction term between health-related self-efficacy and global cognitive impairment did not explain a significant increase in IADL functional status (Lawton), $\triangle R^2 = .01$, $F(1, 69) = 2.83$, $p = .097$. These results are shown in Table A6. Thus, this stringent technique based on the assumption of linear relationships did not provide evidence that cognitive impairment moderates the relationship between health-related self-efficacy and functional status in persons with baseline ADL deficits. Similar results were found for the total sample (see Table B6). However, given the results indicating nonlinear relationship between Global Cognition to SRAHP, testing moderation using the interaction term for Global Cognition and SRAHP was deemed insufficient for detecting moderation with these data.

Aim 2. The second aim of this study was to examine the unique predictive utility of health-related self-efficacy and health-promoting behaviors to rehabilitation outcomes in ABI.

Hypotheses 5 and 6. It was hypothesized that in individuals with relatively less-severe cognitive impairment (e.g., unimpaired or mild to moderate cognitive impairment on neuropsychological testing) compared to persons with severe deficits, health-related self-efficacy (Self-Rated Abilities for Health Practices; SRAHP) and health-promoting behaviors (Health-Promoting Lifestyle Profile-II; HPLP-II) would uniquely predict rehabilitation outcomes (Time 2 functional ratings; Barthel Index and Lawton Instrumental Activities of Daily Living Scale) after accounting for demographics (age and education) and affectivity (Positive and Negative Affect Schedule; PANAS; *Hypothesis 5*). It was hypothesized that in individuals with severe cognitive impairment, affectivity would better predict rehabilitation outcomes compared to health-related self-efficacy or health-promoting behaviors, after accounting for demographics (*Hypothesis 6*). Examination of the correlations between age and education with Barthel and Lawton indicated that demographics were not meaningfully associated with functional status in this sample and thus were not included in these prediction models (Table A4). However, trait affectivity was correlated with Barthel and Lawton and thus was retained in these prediction models (Table A4). Moreover, due to the high correlation between SRAHP and HPLP in this sample and the relatively stronger correlations between SRAHP and functional measures compare to HPLP (Table A4), only the SRAHP was retained for these analyses.

Partial correlation analyses were used to examine the relationships between health-related self-efficacy (SRAHP) and ADL (Barthel) and IADL (Lawton) functional status controlling for trait affectivity (PANAS) among individuals with baseline ADL deficits (N = 75). Table A7 presents the results of these analyses for individuals with cognitive impairment ranging from unimpaired to moderately impaired (n = 41), and individuals with cognitive impairment in the severe range (n = 34). Among all individuals with baseline ADL deficits, the SRAHP showed a moderate correlation with the Barthel, r = .32, p = .003, though this relationship was attenuated after controlling for NA and PA (PANAS), pr = .21, p = .041. Among the same subsample, the SRAHP showed a weak correlation with the Lawton, r = .20, p = .045, which was eliminated after controlling for affectivity (PANAS), pr = .09, p = .226. In the unimpaired to moderate cognitive impairment group, the SRAHP showed a moderate correlation with the Barthel, r = .38, p = .007, which was maintained after controlling for trait affectivity (PANAS), pr = .36, p = .013. In this group, the SRAHP also showed a moderate relationship with the Lawton, r = .36, p = .012, which was maintained after controlling for trait affectivity, pr = .35, p = .016. In the severely impaired group, there was no significant relationship between the SRAHP and the Barthel, r = .22, p = .113, which was unchanged after controlling for affectivity, pr = .02, p = .454. In the severe impairment group, the SRAHP was not meaningfully correlated with the Lawton, r = -.02, p = .46, and after controlling for affectivity, the SRAHP showed a nonsignificant inverse correlation with the Lawton, pr = -.17, p = .18.

Parallel analyses were completed with the total sample (N = 104). As compared to the subsample with baseline ADL deficits, the main difference was that the correlations between the

SRAHP and Barthel and Lawton were attenuated after accounting for trait affectivity for individuals in the unimpaired to moderate cognitive impairment group (Table B7).

Follow-up analyses were conducted to examine mean self-ratings for SRAHP, HPLP-II, trait affectivity (PANAS), and functional status (Barthel, Lawton) between the cognitive groups for the subsample with baseline ADL deficits. One-way ANOVAs indicated that there were significant differences in functional status between the groups. The unimpaired to moderate cognitive impairment group scored higher on functional measures than the severe cognitive impairment group (Barthel Time 2, $F(1,71) = 6.45$, $p = .013$, $\eta^2 = .08$.; Lawton Time 2, $F(1,71) = 6.84$, $p = .011$, $\eta^2 = .09$). However, there were no significant differences in mean self-ratings for SRAHP, HPLP-II, PANAS-NA, or PANAS-PA between the cognitive groups. This pattern of results was consistent with three cognitive groups, as used in the moderation analyses (i.e., unimpaired, mild to moderate impairment, and severe impairment). Tukey post-hoc tests indicated that all group contrasts were significant for comparisons with Barthel and Lawton, with the exception of there being no significant difference between the unimpaired and mild to moderate impairment group on the Barthel. The unimpaired group scored highest on functional measures followed by the mild to moderate cognitive impairment group.

CHAPTER 4 RESULTS – PART 2

Results of Supplemental Analyses

Aim 3. The supplemental third aim of this study was to examine the specific construct of *rehabilitation* self-efficacy in ABI rehabilitation, to develop and pilot a measure of rehabilitation self-efficacy, and to examine its relationship with health beliefs, health behaviors, personality traits, and functional status in ABI rehabilitation.

Rehabilitation Self-Efficacy Scale (RSES). The RSES was developed and added to the study protocol as an additional area of interest following initiation of data collection. Thus, participants who completed the RSES were 48 adults with ABI. The demographic characteristics of this subsample were similar to those of the total sample with regard to mean age (52.7 years), education (13.1 years), and time since injury (22.6 months), gender breakdown (25 men, 52%), and mean global cognition (-1.50 Z). Table A8 presents psychometric properties for the RSES, the measure that was developed as part of this study to assess self-efficacy specific to the brain injury rehabilitation setting. Average item endorsement was 4.2 on a 5-point scale, which corresponds to Moderately to Highly confident. There was some negative skew for the total and each of the items in the scale. Response options range from 1 to 5 and are anchored at Not Confident (1), Moderately Confident (3), and Highly Confident (5). Thus, any score greater than 4 is closest to Highly Confident; 73% of the sample scored greater than 4.0 and 44% scored greater than 4.5 for the total scale. For 20 of 24 items, the highest category (Highly Confident) was endorsed by 50% or more of participants; 19 of 24 items had mean scores greater than 4.0. Across all items, few cases endorsed the lowest category. Overall, there were several indicators that respondents leaned toward rating their self-efficacy for rehabilitation activities as very high, thus maxing out the scale. Examination of the response distributions for the items indicated that

13 of 24 items were endorsed across all but the lowest response option (i.e., Items 2, 5, 6, 7, 8, 9, 10, 11, 14, 16, 20, 21, and 23), and the remaining items were endorsed across all response options. Furthermore, the scale showed excellent reliability (α = .94), and none of the items showed low corrected item-total correlation (none < .30). All of the items added to the scale reliability.

Table A9 presents the correlations of the RSES with measures of health-related self-efficacy (SRAHP), health-promoting behaviors (HPLP-II), affectivity and personality traits (PANAS; TIPI), perception of health (SRH question), global cognition, functional status (Barthel; Lawton) and demographics (age, education). In regard to health-related measures, the SRAHP, a measure of self-efficacy for general health behaviors, showed a modest association with the RSES, $r = .42$, $p = .001$. Similarly, the HPLP-II, a measure of engagement in general health behaviors, had a modest correlation with the RSES, $r = .34$, $p = .009$. The largest correlate of the RSES was positive affectivity (PANAS-PA; $r = .61$, $p < .001$). Other significant personality correlates included Big 5 personality traits extraversion, agreeableness, conscientiousness, and emotional stability (TIPI), which had modest associations with the RSES (*r*s = .24 – .32); however, these results should be interpreted in the context of evidence indicating poor scale functioning in this sample, as described later.

Correlates of the RSES also included global cognition ($r = .41$, $p = .002$) and, of special interest, functional status as measured by the Barthel ($r = .32$, $p = .013$) and Lawton ($r = .27$, $p = .033$). Interestingly, when split by level of cognitive impairment into unimpaired to moderate impairment and severe impairment groups, the RSES showed a stronger relationship with functional status in the less-impaired group (Barthel, $r = .40$, $p = .010$; Lawton, $r = .35$, $p = .026$) than in the severely impaired group (Barthel, $r = .16$, $p = .286$; Lawton, $r = .04$, $p = .446$).

Though subsample size limits the ability to make statistical comparisons, these patterns are consistent with the general expectation that cognitive functioning moderates the effects of self-efficacy on functional status.

The relationships between functional status and self-efficacy for health and rehabilitation were compared in the subsample who completed the RSES. In the less impaired group, the RSES and Barthel relationship (r = .40) was stronger than the SRAHP and Barthel (r = .29, p = .012), and the RSES and Lawton relationship (r = .35) was similar to SRAHP and Lawton (r = .29, p = .011). In the severely impaired group, the RSES and Barthel (r = .16) relationship was similar to SRAHP and Barthel (r = .19, p = .129), and the RSES and Lawton (r = .04) relationship was similar to SRAHP and Lawton (r = .00, p = .49). Furthermore, openness to experience (TIPI) and negative affectivity (PANAS-NA) were not significantly correlated with the RSES. Age, education, and general perception of health status as measured by the self-rated health question (SRH question) were not correlated with the RSES.

The validity of the RSES as a measure of rehabilitation self-efficacy among persons engaged in post-ABI rehabilitation was considered. For this purpose, the measure has good *face validity,* as the items directly ask about activities related to the rehabilitation process. The measure appears to have good *content validity,* as it assesses varied aspects of self-efficacy pertinent to success in rehabilitation for brain injury as identified in the qualitative work of Dixon and colleagues (2007) and supported by expert consensus in the development of the measure. The moderate correlation between the RSES and SRAHP provides some evidence of *convergent validity* in that both measures purport to tap self-efficacy for general and specific aspects of health, respectively; however, they are not so highly correlated as to indicate that they are tapping redundant constructs. Further evidence that these measures assess related but separate constructs is that the RSES and SRAHP show different patterns of correlations with respect to global cognition, positive affectivity (PANAS-PA), some aspects of Big 5 personality traits, such as emotional stability (Table A9). Both measures also are modestly associated with functional status consistent with expectations (Barthel, Lawton). Also of note, the RSES was highly correlated with positive affectivity (PANAS-PA); however, these measures differ with regard to correlations with functional status, such that the Barthel and Lawton were not associated with PA but were modestly correlated with the RSES.

Ten-Item Personality Inventory (TIPI). Table A8 also presents psychometric properties for the TIPI. For the TIPI scales, there was a somewhat restricted range for endorsed response options, with participants more often than not endorsing higher versus lower ratings on the items. This trend was reflected in mean trait levels for the scales that ranged from 4.4 to 5.7 on a 7-point Likert-type scale. Across the five Big 5 personality trait scales, reliability was poor (α = .10 – .56), which was not necessarily surprising given that these are two-item scales. However, 4 of the 10 items (i.e., Items 2, 6, 8, and 10), which corresponded to the one *reversed-coded* item for the subscales Agreeableness, Extraversion, Conscientiousness, and Openness, showed low corrected item-total correlations (< .30). A total score for the TIPI was calculated for comparison, which showed poor reliability (α = .62). With removal of the five reversed-coded items, the total score reliability for the TIPI increased (α = .76). This finding was unexpected given the purported multi-dimensional structure of the scale. The correlations among the TIPI scales generally were small to moderate. Extraversion was significantly correlated with Conscientiousness (r = .38, p = .004) and Openness (r = .33, p = .012). Emotional Stability also was significantly associated with Conscientiousness (r = .27, p = .003), as well as Agreeableness (r = .46, p = .000). These correlations should be interpreted in light of the low reliability of the scales, which likely underestimates the magnitude of the relationships.

Self-Rated Health (SRH). The mean score on SRH was between “fair” (1) and “good” (2), which was on a 4-point scale ranging from 0 to 4 (Table A8). The SRH was significantly correlated with the SRAHP (r = .29, p = .022). SRH was not significantly correlated with other variables of interest, such as the RSES, NA and PA (PANAS). It did not correlate as would be expected with age (r = -.11), and was not related to functional status (Barthel, Lawton) or Global cognition (rs < .12).

CHAPTER 5 DISCUSSION

Health beliefs and trait affectivity provide important information about functional independence after brain injury, and their relative contributions to outcome prediction vary as a function of severity of cognitive impairment. Rehabilitation self-efficacy provides novel considerations for understanding factors related to functional status after brain injury. Relationships between functional status and beliefs about health and rehabilitation point toward potential targets for interventions to improve rehabilitation outcomes for individuals with brain injury.

The initial findings of this study demonstrate that health beliefs and behaviors may be one in the same, practically. Among these adults with moderate to severe ABI, confidence in the ability to manage one's health corresponds with the frequency with which they reportedly engage in health-promoting behaviors. Theoretically, a modest relationship between these concepts would be expected among healthy adults with no cognitive impairment. However, the strong relationship between health-related self-efficacy and health-promoting behaviors after brain injury as measured by the SRAHP and HPLP-II indicates that these measures may assess overlapping constructs. Persons with brain injury may have special difficulty differentiating between health beliefs and behaviors, particularly given the similar content and structure of these scales. However, prior research with individuals with mixed disabilities (Stuifbergen & Becker, 1994), college students (Becker et al., 1993), and persons with mild cognitive difficulties after brain injury (Braden et al., 2012) has shown similarly strong relationships between these measures (e.g., *r*s .62 – .69). Thus, it seems unlikely that this finding is due solely to the effects of brain injury on how individuals engage with these measures. Moreover, the distinction between health beliefs and behaviors may be more useful theoretically than practically, particularly given theoretical support for a causal relationship between self-efficacy and related behavior (Bandura, 1977). It seems reasonable to assume that individuals evaluate their abilities (self-efficacy) based on their prior experiences (behaviors), which is consistent with one of the methods described by Bandura (1977) for how individuals acquire self-efficacy (i.e., performance accomplishments). It also is possible that self-efficacy measures are written so explicitly regarding behaviors that they are confounded with behavior. Thus, in the context of overlapping constructs and similar measures, it seems better to rely on self-reported beliefs, which can be directly assessed, rather than behaviors that cannot be readily assessed, such as when the evaluation is constrained to a formal clinical setting.

Furthermore, though health beliefs corresponded with functional independence after brain injury, reports of health behaviors generally did not. Of note, reported health behaviors do not necessarily reflect actual health behavior; thus, it remains quite plausible that actual health behaviors may influence functioning (e.g., effects of nutrition, weight, exercise, stress management, etc.). Overall, there was a modest relationship between health-related self-efficacy and ability to perform basic activities of daily living (ADLs) after brain injury and a weak relationship with ability to perform complex or instrumental activities of daily living (IADLs). However, these relationships varied as a function of cognitive impairment, which appeared to reflect the cubic relationship observed between health-related self-efficacy and cognition. Among cognitively intact individuals, health-related self-efficacy strongly related to both ADLs and IADLs; however, this relationship was attenuated among persons with mild to moderate cognitive impairments and became negligible among persons with severe cognitive deficits. Deficits common among persons with moderate to severe ABI, such as poor self-awareness and poor self-evaluation, might account for these findings and the prediction models to be discussed.

These findings indicate that confidence in the ability to manage one's health may serve as a protective factor in supporting positive outcomes after brain injury, specifically functional independence, in the absence of severe cognitive impairment. It is possible that health-related self-efficacy bolsters individuals' confidence in and ability to problem-solve and engage in efforts that support their maximal functioning and management of direct and indirect effects of brain injury. This conceptualization is consistent with research highlighting the need for clinical management of brain injury and the valued role of self-management in health promotion and disease management (Bandura, 1977; Bodenheimer et al., 2002; Corrigan & Hammond, 2013; Stuifbergen et al., 2010). These findings also are consistent with prior theory and research regarding the specific role of health-related self-efficacy for predicting physical health outcomes among individuals with mixed disabilities (Stuifbergen & Becker, 1994).

Moreover, beliefs about the ability to do what it takes to manage general aspects of health may parallel the confidence necessary for managing the effects of brain injury. In contrast, specific health behaviors themselves may be less directly relevant to this process, except when they pertain directly to management of psychosocial and/or physical aspects of recovery from ABI. From this perspective, it would make sense that health-promoting behaviors related solely to physical activity and stress management had a modest relationship with functional status after brain injury. Overall, these findings are consistent with a burgeoning literature showing important relationships between self-efficacy and rehabilitation outcomes, and the unique role of health-related self-efficacy in particular (Barlow, 2010; Chen et al., 1999; Stuifbergen & Becker, 1994). These findings also underscore how cognitive impairment may directly or indirectly affect functioning, such as by influencing self-appraisal abilities. This finding is consistent with prior research showing impaired self-awareness among individuals with moderate to severe TBI

(Hart, Seignourel, & Sherer, 2009) and specifically detrimental effects of cognitive deficits on self-evaluation of abilities (Rapport et al., 2008; Rapport et al., 1993; Ryan et al., 2009).

Further examination of these relationships revealed that health-related self-efficacy and trait affectivity differentially related to functional status after brain injury based on severity of cognitive impairment. The relationships between health-related self-efficacy and ADLs and IADLs were robust among individuals with minimal to moderate cognitive impairment regardless of general levels of positive or negative affect. In contrast, these relationships were weak among individuals with severe impairments and became negligible after taking into account negative affectivity. Notably, there was evidence that the SRAHP pulls for all individuals to endorse high level of health-related self-efficacy, which may in part reflect the presence of a skewed distribution in which people more often than not believe they are *able* to engage in health practices. This finding also might reflect a general weakness of the SRAHP, such that the scale is not able to capture fine-grained distinctions in self-efficacy at the high end of the spectrum (ceiling effect), or may reflect the influence of social desirability. Furthermore, there were no differences in health-related self-efficacy or trait affectivity across the cognitive groups, although functional status dropped significantly between the least and most cognitively impaired groups. This finding indicates that though the SRAHP may elicit optimistic ratings generally, these evaluations are particularly inaccurate for individuals with the greatest cognitive impairment.

These findings provide further support that health-related self-efficacy is a meaningful predictor of functional status after brain injury for individuals with relatively intact or moderately impaired cognition. However, among individuals with more severe cognitive deficits, negative affectivity becomes the more salient predictor of functioning, with higher negative affect corresponding with lower ADL functioning. Here again, the influence of cognition on self-appraisal of ability is evident. The fact that health-related self-efficacy did not diminish in parallel with functional status among the severely cognitively impaired group highlights the likely role of poor self-monitoring or poor awareness of deficits among individuals with severe deficits after ABI. Inaccurate self-appraisals of health abilities thus would be expected to be poorly associated with objectively rated functional independence. Perhaps the impaired ability to make subtle distinctions about one's health abilities leaves the global, overarching personality characteristic to drive prediction of functioning. For example, negative affect may affect functional status by reducing motivation to engage in behaviors that support health and rehabilitation, dampening optimism or hope that rehabilitation efforts are worthwhile, or depleting cognitive resources, such as attention and memory. These findings are consistent with expectations and prior research showing that trait affectivity often accounts for variability in outcomes after brain injury, and as such, should be considered as a parsimonious explanation.

In addition to examining the role of health-related self-efficacy in ABI rehabilitation, this study sought to examine the more specific construct of rehabilitation self-efficacy and developed a measure for this purpose. The Rehabilitation Self-Efficacy Scale (RSES) holds up well psychometrically as a measure of rehabilitation-specific self-efficacy for individuals with brain injury and relates to important functional outcomes. Given the prevalence of cognitive impairment among these individuals, it is particularly impressive that the RSES is highly reliable for use in this context. Given the tendency for individuals to rate themselves as highly confident in their abilities to manage aspects of their rehabilitation, the RSES likely would benefit from refinement of response options and/or items to better differentiate among persons with high levels of this construct. For example, the addition of items of increasing difficulty to endorse, or that occur with less frequency in this population, might enhance how well this measure is able to distinguish across the full range of the construct. Response options also might be modified to collapse or remove options on the low end that are rarely used and to add greater specificity with the options at the high end. Nonetheless, rehabilitation self-efficacy as measured by the RSES meaningfully relates to ADL and IADL functioning after brain injury, and appears to be particularly meaningful among individuals who are not severely impaired cognitively. However, it has a strong relationship with positive affectivity, and therefore future research should assess the unique value and discriminative validity of the RSES in this context. These findings extend upon the work of Dixon and colleagues (2007), who identified self-efficacy themes for individuals with ABI undergoing rehabilitation, which formed the basis of the RSES. The development of this measure provides initial evidence for the utility of evaluating rehabilitation self-efficacy in ABI and preliminary evidence that rehabilitation self-efficacy may better predict basic ADLs than health-related self-efficacy. However, it remains to be fully determined the extent to which rehabilitation-specific rather than general health self-efficacy uniquely contributes to understanding and prediction of outcomes after ABI, particularly given that the SRAHP and RSES assess related albeit separate constructs and similarly predict functional status.

These findings are somewhat surprising given that theoretically it would be expected that rehabilitation self-efficacy would have a clearly stronger relationship with functional status after rehabilitation than general health-related self-efficacy (Bandura, 2006). One possibility is that the statistically nonsignificant boost in prediction from rehabilitation versus health self-efficacy for ADLs may reflect a meaningful difference that would otherwise be significant in a larger sample. It also is possible that with further refinement of the RSES to capture greater differentiation of individuals with high ability, rehabilitation self-efficacy as measured by the RSES might better predict rehabilitation outcomes of ABI as compared to general health-related self-efficacy. Conversely, theory and research have established that self-efficacy related to broad domains of function may predict specific domains of function (Brink et al., 2012; Johnston-Brooks et al., 2002; Sullivan et al., 1998), particularly when there are shared abilities or when these beliefs and abilities are learned concurrently (Bandura, 1989). It may be that confidence in the ability to manage health generally encompasses the same set of beliefs or predispositions underlying rehabilitation self-efficacy, and thus may offer greater benefit for predicting and supporting outcomes across health and rehabilitation settings.

An additional interest of this study was to explore how personality traits beyond those captured by positive and negative affectivity might relate to health beliefs and functioning after ABI. Thus, the Big 5 personality traits were examined, which showed small to modest relationships with health and rehabilitation self-efficacy, and to some extent functional status after brain injury. However, the reliability and thus validity of the Big 5 measure (TIPI) in this context was limited due to individuals having apparent difficulty with the reverse-coded items embedded in the scale. Of note, the reliability estimates for the TIPI scales in this study were markedly lower than found in the TIPI normative studies (Gosling et al., 2003). One explanation is that the reverse-coded items required more cognitive flexibility to shift the directionality of thinking than these individuals could accommodate. Given that this measure has not been validated for use with ABI and the extent of cognitive deficits present in this sample, these findings are not particularly surprising. In the context of reliable measurement, it might be expected that conscientiousness would relate to health and rehabilitation self-efficacy as well as functional status after injury (Bogg & Roberts, 2013). Emotional stability also would be important to examine, particularly to compare with findings regarding the relationships between negative affectivity and functional status in those with severely impaired cognition.

A final interest of this study was to explore the relationships between self-reported health and health and rehabilitation beliefs, behaviors, and functioning. As such, it was found that self-rated health showed a small relationship to health-related self-efficacy but not with other psychosocial and functional factors after brain injury. This finding is consistent with research indicating that self-rated health contributes to one's sense of identity and therefore may influence one's sense of ability to set and pursue goals, such as related to health (Bailis et al., 2003; Benyamini, 2008). It was surprising, however, that self-rated health did not relate to functional status or affectivity given the ample research linking health perception with an array of mental health, physical health, positive and negative affect, and functioning. Perhaps self-rated health encompassed a sufficiently broad concept for individuals in this study that it did not relate to most other specific constructs of interest. Alternatively, perhaps here again individuals with brain injury have difficulty appraising their overall health in the context of significant cognitive deficits. However, though reliability could not be assessed with this one-item scale, the lack of expected associations, such as with age, might reflect that it is not a reliable or valid assessment of health in this population.

Limitations and Future Directions

One limitation of this study relates to the length of follow-up time; ideally, researchers would be able to follow participants through an extended course of rehabilitation to allow for enhanced monitoring of function status and change over time. It might also be helpful to track them past the point of discharge from therapy to determine how well they function in their typical environment and to assess the stability of functional gains. Another limitation to this study relates to the heterogeneity of the sample with regard to injury type, severity (using global cognition and functional deficits as proxies), and time since injury, which make it difficult to specify precisely when and for whom the findings are most applicable. Lastly, sample size restraints for the subgroup and supplemental analyses limited the types of questions that could be addressed statistically, such as the ability to look at group differences based on injury type and time since injury, which might have real-world implications for how rehabilitation providers might implement findings from this line of research.

Future research might examine health and rehabilitation self-efficacy in the acute phase of ABI rehabilitation in order to determine how it predicts functional status over the course of recovery, particularly given that self-efficacy and functional abilities over time may have a dynamic relationship. Thus, further research and development with the RSES is warranted in order to improve upon the measurement of and thus clinical applicability of rehabilitation self-efficacy. Further exploration of health-related self-efficacy and health-promoting behaviors in ABI may lead to improved understanding and facilitation of factors contributing to functional independence during and after rehabilitation, though careful consideration should be given in the selection of methods for assessing health behaviors given the measurement issues raised in this study regarding the use of the SRAHP and HPLP-II jointly. It would be particularly useful for future research to include alternative methods to traditional self-report for assessment of health behaviors in order to increase the likelihood for accurate assessments (e.g., ecological momentary assessment (EMA) via electronic or paper diaries; collateral report).

Although overestimation of health and rehabilitation abilities that are implausible due to injury severity and residuals may be harmful to one’s rehabilitation progress, many modifiable factors also affect rehabilitation progress, including self-efficacy. Thus, research is needed to examine the modifiability of health and rehabilitation self-efficacy in individuals with ABI, such as brief interventions in the acute phase of injury. Such interventions should screen for cognitive functioning in order to determine which individuals with ABI are most likely to have realistic versus unrealistic appraisals of health and rehabilitation behaviors. Among those with realistic appraisals, even small changes in self-efficacy may translate to meaningful gains in functioning. These benefits may be compounded through the rehabilitation process, such as potentially enhancing motivation to engage fully in rehabilitation, decreasing fear and anxiety surrounding challenging physical and/or psychosocial activities, or increasing a general sense of personal agency that may support a flexible, adaptive approach to managing primary and secondary effects of brain injury. Heightened self-efficacy also may serve to increase one's ability to request assistance from others or facilitate exploration and use of adaptive equipment and strategies, which may further support functional independence among those with realistic self-appraisals. Little research has been done in this area, with one known study addressing some of these issues. Subsequent to the Braden et al. (2012) study examining health and wellness in TBI, (Brenner et al., 2012) piloted an intervention for individuals with moderate to severe TBI designed to augment health-related self-efficacy and behaviors; health behaviors increased comparably across treatment and control conditions, though the direct effects on self-efficacy were unclear. One explanation provided by the authors was that simply participating in the study might have led to greater engagement in health behaviors in the control group. As such, perhaps interventions designed to raise awareness about health beliefs and behaviors, such as through completion of measures in the prior study, may provide initial methods to facilitate positive health and functional behaviors during brain injury rehabilitation.

Conclusions and Implications

Overall, this study reinforces the importance of psychosocial factors for understanding and predicting outcomes of ABI with emphasis on the beliefs and self-perceptions held by these individuals about their health and rehabilitation abilities. This study extends the narrow literature on self-efficacy and rehabilitation outcomes in ABI and provides novel contributions regarding the unique influences of cognitive impairment and affectivity. This study also highlights the importance of identifying the extent to which individual's self-perceptions are realistic, for which cognitive evaluation can be useful, and considering the implications for potential interventions. As such, further work on the modifiability and utility of health and rehabilitation self-efficacy to support ABI rehabilitation is warranted. Additionally, this study reinforces the concept of self-management for health promotion and disease prevention that is well-established in the medical field and extends its application to brain injury rehabilitation. Ultimately, this study may serve as a reminder of the potentially modifiable factors determining brain injury outcomes, the necessity for individualized assessment, and the powerful effects of self-confidence and mood.

APPENDIX A PRIMARY TABLES

Table A1. *Sample Characteristics and Psychometric Properties of Primary Measures (N = 104)*

Variable	*M*	(*SD*)	Range	α
Age (years)	52.5	(15.1)	18.0 – 82.0	
Education (years)	13.0	(3.0)	4.0 – 20.0	
Time Since Injury (months)	25.2	(53.5)	0.0 – 416.0	
Global Cognition (*Z* scores)	-1.7	(0.7)	-2.9 – 0.0	
Barthel	83.1	(21.2)	10.0 – 100.0	.90
Lawton	4.7	(2.5)	0.0 – 8.0	.86
SRAHP Total	3.0	(0.6)	1.4 – 4.0	.93
Nutrition	3.0	(0.6)	1.1 – 4.0	.72
Well-being	2.8	(0.8)	0.3 – 4.0	.88
Exercise	2.8	(0.8)	0.6 – 4.0	.89
Health Practices	3.3	(0.6)	0.9 – 4.0	.83
HPLP-II Total	2.7	(0.5)	1.4 – 3.9	.95
Health Responsibility	2.6	(0.6)	1.3 – 4.0	.84
Physical Activity	2.5	(0.7)	1.0 – 4.0	.86
Nutrition	2.5	(0.6)	1.0 – 3.9	.81
Spiritual Growth	3.1	(0.7)	1.1 – 4.0	.89
Interpersonal	3.0	(0.6)	1.4 – 4.0	.85
Stress Management	2.6	(0.6)	1.1 – 3.9	.77
PANAS				
Negative Affectivity	19.7	(7.9)	10.0 – 44.0	.87
Positive Affectivity	34.4	(8.8)	10.0 – 50.0	.89

Note. Barthel = *Barthel Index;* Lawton = *Lawton Instrumental Activities of Daily Living Scale*; SRAHP = *Self-Rated Abilities for Health Practices*; HPLP-II = *Health-Promoting Lifestyle Profile-II (HPLP-II)*; PANAS = *Positive and Negative Affect Schedule.*

Table A2. *Cognitive Functioning of Individuals with Baseline ADL Deficits (N = 75)*

Variable	*M*	*(SD)*	*Range*
Attention	-1.6	(0.9)	-3.0 – 0.0
Digit Span (RBANS)			
Processing Speed	-2.7	(0.9)	-3.7 – -0.5
Coding (RBANS)	-2.7	(0.7)	-3.0 – -0.0
Trail Making Test – Part A	-2.8	(1.3)	-4.3 – -0.3
Verbal Learning	-1.9	(0.8)	-3.0 – 0.0
List Learning (RBANS)	-2.0	(0.9)	-3.0 – 0.3
Story Memory (RBANS)	-1.8	(0.8)	-3.0 – 0.3
Visuospatial-Constructional	-1.7	(0.8)	-2.7 – 0.2
Figure Copy (RBANS)	-2.5	(0.9)	-3.0 – 0.7
Line Orientation (RBANS)	-1.0	(1.0)	-2.3 – 1.3
Verbal Recall	-1.6	(0.9)	-2.7 – 0.5
List Recall (RBANS)	-1.6	(0.9)	-2.3 – 1.3
Story Recall (RBANS)	-1.7	(1.0)	-3.0 – 1.0
Non-Verbal Recall	-2.0	(1.1)	-3.0 – 1.0
Figure Recall (RBANS)			
Language	-0.8	(0.8)	-2.5 – 1.1
Picture Naming (RBANS)	-0.1	(1.0)	-2.3 – 0.7
Semantic Fluency (RBANS)	-2.2	(1.0)	-3.0 – 0.7
Complex Ideation (BDAE)	-0.3	(1.2)	-2.3 – 1.8
Executive Functioning	-2.1	(1.1)	-3.9 – 1.2
Trail Making Test – Part B	-2.9	(1.6)	-4.4 – 0.5
FAS Letter Fluency	-1.7	(1.2)	-3.5 – 1.6
Stroop Color-Word	-1.7	(1.1)	-3.8 – 2.2
Global Cognition [a]	-1.8	(0.7)	-2.9 – 0.0

Note. Z scores are unadjusted for demographics. RBANS = *Repeatable Battery for the Assessment of Neuropsychological Status*; BDAE = *Boston Diagnostic Aphasia Examination*.
[a] Global cognition score is the average of individual test scores.

Table A3. *Intercorrelations of Predictors, Demographics, and Global Cognition in Individuals with Baseline ADL Deficits (N = 75)*

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1. SRAHP Total	–														
2. Nutrition	.76**	–													
3. Well-being	.84**	.49**	–												
4. Exercise	.83**	.56**	.56**	–											
5. Health Practices	.85**	.51**	.68**	.62**	–										
6. HPLP-II Total	.70**	.51**	.61**	.60**	.59**	–									
7. Health Responsibility	.52**	.36**	.45**	.41**	.39**	.87**	–								
8. Physical Activity	.57**	.45**	.38**	.65**	.46**	.76**	.56**	–							
9. Nutrition	.59**	.52**	.43**	.54**	.46**	.80**	.74**	.60**	–						
10. Spiritual Growth	.58**	.39**	.59**	.44**	.49**	.85**	.67**	.49**	.59**	–					
11. Interpersonal	.65**	.39**	.62**	.51**	.62**	.81**	.63**	.48**	.50**	.74**	–				
12. Stress Management	.51**	.37**	.52**	.39**	.42**	.80**	.65**	.57**	.48**	.68**	.58**	–			
13. Age	-.16	-.13	-.14	-.08	-.17	-.14	-.06	-.18	-.16	-.15	-.03	-.10	–		
14. Education	.15	.13	.13	.12	.12	.26*	.22*	.16	.08	.19	.34**	.31**	.08	–	
15. Global Cognition	.21*	.27*	.08	.17	.20*	.05	- .08	.12	.05	.01	.10	.06	.01	.21*	–

Note. SRAHP = Self-Rated Abilities for Health Practices; HPLP-II = the Health-Promoting Lifestyle Profile-II.
*$p < .05$, ** $p < .01$

Table A4. *Correlations between Predictors, Demographics, Global Cognition and Functional Status in Individuals with Baseline ADL Deficits (N = 75)*

Variable	Barthel	Lawton
SRAHP Total	.32**	.20*
Nutrition	.33**	.18
Well-being	.20*	.24*
Exercise	.28**	.09
Health Practices	.24*	.14
HPLP-II Total	.21*	.12
Health Responsibility	.02	.04
Physical Activity	.27*	.11
Nutrition	.18	.13
Spiritual Growth	.16	.09
Interpersonal	.17	.13
Stress Management	.21*	.10
PANAS		
Negative Affectivity	-.21*	-.16
Positive Affectivity	.14	.14
Age	-.08	.21*
Education	.11	.07
Global Cognition	.36**	.32**

Note. SRAHP = Self-Rated Abilities for Health Practices; HPLP-II = the Health-Promoting Lifestyle Profile-II. PANAS = Positive and Negative Affect Schedule.
*$p < .05$, ** $p < .01$.

Table A5. *Correlations of Self-Efficacy and Functional Status by Global Cognition in Individuals with Baseline ADL Deficits (N = 75)*

	Unimpaired (n = 12)		Mild to Moderate (n = 29)		Severe (n = 34)	
Variable	Barthel	Lawton	Barthel	Lawton	Barthel	Lawton
SRAHP Total	.55*	.52*	.34*	.29	.22	-.02
Nutrition	.55*	.52*	.35*	.28	.24	-.07
Well-being	.63*	.60*	.17	.28	.13	.07
Exercise	.39	.36	.26	.18	.27	-.11
Health Practices	.17	.17	.30	.17	.13	.01

Note. Unimpaired, within 1 SD below the mean. Mild to Moderate, 1-2 SDs below the mean. Moderate to Severe, > 2 SDs below the mean. SRAHP = Self-Rated Abilities for Health Practices.

*p < .05, ** p < .01.

Table A6. *Predictors of Functional Status in Individuals with Baseline ADL Deficits (N = 75)*

	Barthel							Lawton						
Predictor	*B*	*t*	sr^2	R^2	*F*	$\triangle R^2$	$\triangle F$	*B*	*t*	sr^2	R^2	*F*	$\triangle R^2$	$\triangle F$
Step 1				.16	6.62**						.11	4.45*		
Global Cog	-10.98	-2.23*	.06					-1.25	-2.40*	.07				
SRAHP	0.38	2.51*	.08					0.02	1.40	.02				
Step 2				.16	4.48**	.00	0.32				.15	3.99*	.04	2.83
Global Cog	-10.98	-2.22*	.06					-1.25	-2.43*	.07				
SRAHP	0.48	2.10*	.05					0.05	2.20*	.06				
Global Cog x SRAHP	-0.18	-0.57	.00					-0.05	-1.68	.03				

Note. SRAHP = Self-Rated Abilities for Health Practices; Global Cog = Global Cognition.
$^{*}p < .05$, $^{**}p < .01$

Table A7. *Health-Related Self-efficacy and Activities of Daily Living (ADL) Outcomes for Individuals with Baseline ADL deficits (N = 75): Zero-Order and Partial Correlations Accounting for Negative and Positive Affectivity*

	ADL (Barthel)		IADL (Lawton)	
	Zero-order	Covariates Negative Affectivity Positive Affectivity	Zero-order	Covariates Negative Affectivity Positive Affectivity
Total				
Negative Affectivity (PANAS)	-.21*		-.16	
Positive Affectivity (PANAS)	.14		.14	
Health-Related Self-Efficacy (SRAHP)	.32**	.21*	.20*	.09
Unimpaired to Moderate (*n* = 41)				
Negative Affectivity (PANAS)	-.17		-.19	
Positive Affectivity (PANAS)	.14		.10	
Health-Related Self-Efficacy (SRAHP)	.38**	.36*	.36*	.35*
Severe Impairment (*n* = 34)				
Negative Affectivity (PANAS)	-.29*		-.14	
Positive Affectivity (PANAS)	.03		.06	
Health-Related Self-Efficacy (SRAHP)	.22	.02	-.02	-.17

Note. PANAS = Positive and Negative Affect Schedule. SRAHP = Self-Rated Abilities for Health Practices.
*$p < .05$, **$p < .01$.

Table A8. *Psychometric Properties of the Rehabilitation Self-Efficacy Scale (RSES), Ten-Item Personality Inventory (TIPI), and Self-Rated Health Question (SRHQ)*

Variable	*M*	(*SD*)	Range	α
RSES (*n* = 48)	4.2	(0.6)	2.1 – 5.0	.94
TIPI Total (*n* = 75)	51.0	(8.2)	29 – 70	.62
Extraversion	4.4	(1.4)	1.5 – 7.0	.12
Agreeableness	5.3	(1.3)	2.0 – 7.0	.24
Conscientiousness	5.7	(1.1)	2.0 – 7.0	.16
Emotional Stability	5.0	(1.5)	2.0 – 7.0	.56
Openness to Experiences	5.2	(1.3)	2.0 – 7.0	.10
SRHQ (*n* = 75)	1.8	(0.9)	0 – 4	

Note. SRHQ is 1 item; TIPI subscales each have 2 items.

Table A9. *Correlates of the Rehabilitation Self-Efficacy Scale (N = 48)*

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
1. RSES	–																
2. SRAHP	.42**	–															
3. HPLP	.34**	.70**	–														
4. NA (PANAS)	.20	-.19	-.08	–													
5. PA (PANAS)	.61**	.39**	.48**	.18	–												
6. TIPI (Total)	.45**	.37**	.38**	-.28*	.48**	–											
7. Extraversion (TIPI)	.26*	.18	.20	.01	.26*	.61**	–										
8. Agreeableness (TIPI)	.32*	.21	.25*	-.20	.34**	.51**	-.02	–									
9. Conscientiousness (TIPI)	.24*	.02	.09	-.08	.27*	.60*	.38**	.09	–								
10. Emotion Stability (TIPI)	.32*	.41*	.40**	-.49**	.38**	.75**	.14	.46***	.27**	–							
11. Openness (TIPI)	.18	.25*	.13	.01	.12	.45**	.33*	-.17	.08	.23	–						
12. Health (SRH)	-.17	.29*	.09	-.11	.06	.09	.23	-.20	.08	-.02	.26	–					
13. Global Cognition	.41**	.13	.12	-.20	.25*	.29*	.29*	.05	.19	.19	.12	.04	–				
14. Barthel	.32*	.42**	.24	-.25*	.09	.37**	.21	.26*	.03	.44**	.07	.12	.39**	–			
15. Lawton	.27*	.24	.11	-.20	.14	.30*	.26*	.09	.16	.26*	.10	.02	.49**	.72**	–		
16. Age	-.13	-.18	-.13	.10	-.19	-.18	-.07	.09	-.09	-.23	-.26	-.11	-.06	-.10	.09	–	
17. Education	.05	.06	.22	-.03	.01	.20	.35**	-.18	.20	.10	.16	.19	.20	-.03	.09	.12	–

Note. RSES = Rehabilitation Self-Efficacy Scale; SRAHP = Self-Rated Abilities for Health Practices; HPLP-II = the Health-Promoting Lifestyle Profile-II; PANAS = Positive and Negative Affect Schedule; TIPI = Ten-Item Personality Inventory; SRHQ = Self-Rated Health Question.
$^{*}p < .05$, $^{**}p < .01$.

APPENDIX B SUPPLEMENTAL TABLES

Table B1. *Cognitive Functioning in the Total Sample (N = 104)*

Variable	*M*	*(SD)*	*Range*
Attention	- 1.4	(1.0)	-3.0 – 1.7
Digit Span (RBANS)			
Processing Speed	- 2.6	(0.9)	-3.7 – -0.5
Coding (RBANS)	- 2.6	(0.7)	-3.0 – 0.0
Trail Making Test – Part A	- 2.6	(1.3)	-4.3 – -0.3
Verbal Learning	- 1.8	(0.8)	-3.0 – 0.0
List Learning (RBANS)	- 1.9	(0.8)	-3.0 – 0.3
Story Memory (RBANS)	- 1.7	(1.0)	-3.0 – 1.3
Visuospatial-Constructional	- 1.6	(0.8)	-2.7 – 1.0
Figure Copy (RBANS)	- 2.4	(1.0)	-3.0 – 0.7
Line Orientation (RBANS)	- 0.9	(1.0)	-2.3 – 1.3
Verbal Recall	- 1.5	(0.9)	-2.7 – 0.5
List Recall (RBANS)	- 1.5	(0.9)	-2.3 – 1.3
Story Recall (RBANS)	- 1.5	(1.0)	-3.0 – 1.0
Non-Verbal Recall	- 1.9	(1.1)	-3.0 – 1.0
Figure Recall (RBANS)			
Language	- 0.8	(0.9)	-2.5 – 1.1
Picture Naming (RBANS)	- 0.2	(1.0)	-2.3 – 0.7
Semantic Fluency (RBANS)	- 2.0	(1.1)	-3.0 – 1.3
Complex Ideation (BDAE)	- 0.1	(1.3)	-2.3 – 1.8
Executive Functioning	- 1.9	(1.1)	-3.9 – 1.2
Trail Making Test – Part B	- 2.7	(1.6)	-4.4 – 0.5
FAS Letter Fluency	- 1.5	(1.2)	-3.5 – 1.6
Stroop Color-Word	- 1.5	(1.1)	-3.8 – 2.2
Global Cognition [a]	- 1.7	(0.7)	-2.9 – 0.0

Note. Z scores are unadjusted for demographics. RBANS = *Repeatable Battery for the Assessment of Neuropsychological Status*; BDAE = *Boston Diagnostic Aphasia Examination*.
[a] Global cognition score is the average of individual test scores.

Table B2. *Intercorrelations of Predictors, Demographics, and Global Cognition as a Function of Baseline Functional Status*

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1. SRAHP Total	–	.78**	.87**	.84**	.84**	.72**	.50**	.58**	.55**	.64**	.68**	.56**	-.12	.17*	.20*
2. Nutrition	.76**	–	.57**	.58**	.52**	.55**	.37**	.44**	.53**	.46**	.44**	.42**	-.08	.16*	.23**
3. Well-being	.84**	.49**	–	.59**	.71**	.65**	.44**	.41**	.42**	.65**	.64**	.56**	-.10	.16	.14
4. Exercise	.83**	.56**	.56**	–	.58**	.62**	.37**	.66**	.50**	.49**	.55**	.43**	-.07	.12	.13
5. Health Practices	.85**	.51**	.68**	.62**	–	.60**	.49**	.38**	.39**	.53**	.63**	.46**	-.14	.12	.19*
6. HPLP-II Total	.70**	.51**	.61**	.60**	.59**	–	.82**	.77**	.77**	.84**	.79**	.82**	-.10	.26**	.05
7. Health Responsibility	.52**	.36**	.45**	.41**	.39**	.87**	–	.54**	.64**	.58**	.53**	.62**	-.05	.17*	-.17*
8. Physical Activity	.57**	.45**	.38**	.65**	.46**	.76**	.56**	–	.60**	.51**	.48**	.59**	-.18*	.11	.07
9. Nutrition	.59**	.52**	.43**	.54**	.46**	.80**	.74**	.60**	–	.53**	.46**	.48**	-.06	.08	.05
10. Spiritual Growth	.58**	.39**	.59**	.44**	.49**	.85**	.67**	.49**	.59**	–	.73**	.71**	-.09	.23**	.12
11. Interpersonal	.65**	.39**	.62**	.51**	.62**	.81**	.63**	.48**	.50**	.74**	–	.58**	-.04	.35**	.16
12. Stress Management	.51**	.37**	.52**	.39**	.42**	.80**	.65**	.57**	.48**	.68**	.58**	–	-.07	.23*	.08
13. Age	-.16	-.13	-.14	-.08	-.17	-.14	-.06	-.18	-.16	-.15	-.03	-.10	–	.07	.02
14. Education	.15	.13	.13	.12	.12	.26*	.22*	.16	.08	.19	.34**	.31**	.08	–	.22*
15. Global Cognition	.21*	.27*	.08	.17	.20*	.05	- .08	.12	.05	.01	.10	.06	.01	.21*	–

Note. Total sample (N = 104) values are above diagonal. Subsample with baseline ADL deficits (n = 75) values are below diagonal. SRAHP = Self-Rated Abilities for Health Practices; HPLP-II = the Health-Promoting Lifestyle Profile-II.
*$p < .05$, ** $p < .01$

Table B3. *Correlations between Predictors, Demographics, Global Cognition and Functional Status as a Function of Baseline Functional Status*

	Subsample (n = 75)		Total (n = 101)	
Variable	Barthel	Lawton	Barthel	Lawton
SRAHP Total	.32**	.20*	.26**	.19*
Nutrition	.33**	.18	.26**	.17*
Well-being	.20*	.24*	.20*	.25*
Exercise	.28**	.09	.20*	.07
Health Practices	.24*	.14	.20*	.12
HPLP-II Total	.21*	.12	.19*	.15
Health Responsibility	.02	.04	-.05	-.02
Physical Activity	.27*	.11	.23*	.13
Nutrition	.18	.13	.10	.07
Spiritual Growth	.16	.09	.22*	.20*
Interpersonal	.17	.13	.20*	.14
Stress Management	.21*	.10	.23*	.18*
PANAS				
Negative Affectivity	-.21*	-.16	-.22*	-.21*
Positive Affectivity	.14	.14	.18*	.21*
Age	-.08	.21*	-.11	.10
Education	.11	.07	.14	.13
Global Cognition	.36**	.32**	.39**	.34**

Note. Subsample with baseline ADL deficits. Total sample that completed therapy. SRAHP = Self-Rated Abilities for Health Practices; HPLP-II = the Health-Promoting Lifestyle Profile-II. PANAS = Positive and Negative Affect Schedule.
*$p < .05$, ** $p < .01$.

Table B4. *Correlations of Self-Efficacy and Functional Status by Global Cognition Level in the Total Sample (N = 104)*

	Unimpaired (n = 22)		Mild to Moderate (n = 42)		Severe (n = 40)	
Variable	Barthel	Lawton	Barthel	Lawton	Barthel	Lawton
SRAHP	.42*	.45*	.22	.21	.19	- .00
Nutrition	.32	.38*	.24	.23	.20	- .05
Well-being	.63**	.61*	.13	.26	.19	.06
Exercise	.12	.19	.16	.12	.22	- .06
Health Practices	.10	.19	.21	.08	.12	.02

Note. Unimpaired, within 1 SD below the mean. Mild to Moderate, 1-2 SDs below the mean. Moderate to Severe, > 2 SDs below the mean. SRAHP = Self-Rated Abilities for Health Practices.

*$p < .05$, ** $p < .01$.

Table B5. *Correlations between Self-Efficacy and Functional Status as a Function of Global Cognition and Baseline Functional Status*

	Unimpaired to Moderate		Severe Impairment	
Variable	Barthel	Lawton	Barthel	Lawton
	Total Sample			
	(n = 64)		(n = 40)	
SRAHP Total	.29*	.29*	.19	- .00
Nutrition	.30**	.30**	.20	- .05
Well-being	.24*	.38**	.10	.06
Exercise	.19	.15	.22	- .06
Health Practices	.22*	.13	.12	.02
	Subsample			
	(n = 41)		(n = 34)	
SRAHP Total	.38**	.36*	.22	- .02
Nutrition	.39**	.35*	.24	- .07
Well-being	.24	.38**	.13	.07
Exercise	.29*	.22	.27	- .11
Health Practices	.30*	.17	.13	.01

Note. Unimpaired to Moderate, within 2 SD below the mean. Moderate to Severe, > 2 SDs below the mean. Subsample with baseline ADL deficits. SRAHP = Self-Rated Abilities for Health Practices.
*$p < .05$, ** $p < .01$.

Table B6. *Predictors of Functional Status in the Total Sample (N = 104)*

	Barthel							Lawton						
Predictor	*B*	*t*	sr^2	R^2	*F*	△ R^2	△ *F*	*B*	*t*	sr^2	R^2	*F*	△ R^2	△ *F*
Step 1				.15	8.53^{***}						.12	6.76^{**}		
Global Cog	-12.49	-3.07^{**}	.08					-1.53	3.11^{**}	.09				
SRAHP	0.30	2.46^{*}	.05					0.02	1.66	.02				
Step 2				.15	5.64^{**}	.00	0.03				.14	5.23^{**}	.02	2.02
Global Cog	-12.52	-3.06^{**}	.08					-1.56	-3.18^{**}	.09				
SRAHP	0.32	1.96^{*}	.03					0.04	2.19^{*}	.05				
Global Cog x SRAHP	-0.04	-0.17	.00					-0.04	-1.42	.02				

Note. SRAHP = Self-Rated Abilities for Health Practices; Global Cog = Global Cognition.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table B7. *Health-Related Self-Efficacy and Activities of Daily Living (ADL) Outcomes in the Total Sample (N = 104): Zero-Order and Partial Correlations Accounting for Negative and Positive Affectivity*

	ADL (Barthel)		IADL (Lawton)	
	Zero-order	Covariates Negative Affectivity Positive Affectivity	Zero-order	Covariates Negative Affectivity Positive Affectivity
Total				
Negative Affectivity (PANAS)	-.22*		-.21*	
Positive Affectivity (PANAS)	.18*		.21*	
Health-Related Self-Efficacy (SRAHP)	.26**	.11	.19*	.01
Unimpaired to Moderate (*n* = 62)				
Negative Affectivity (PANAS)	-.22*		-.27*	
Positive Affectivity (PANAS)	.17		.17	
Health-Related Self-Efficacy (SRAHP)	.29*	.19	.29*	.18
Severe (*n* = 39)				
Negative Affectivity (PANAS)	-.23		-.10	
Positive Affectivity (PANAS)	.09		.15	
Health-Related Self-Efficacy (SRAHP)	.19	.00	.00	-.15

Note. PANAS = Positive and Negative Affect Schedule. SRAHP = Self-Rated Abilities for Health Practices.
*$p < .05$, **$p < .01$

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ABSTRACT

SELF-EFFICACY, HEALTH PROMOTION, AND REHABILITATION IN ACQUIRED BRAIN INJURY

by

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Health self-efficacy is important to health behaviors and self-management of chronic conditions. It has been associated with positive health and rehabilitation outcomes generally but has been understudied in acquired brain injury (ABI). Given the high rates of disability and long-term impairments associated with ABI, health self-efficacy and health behaviors are promising factors to evaluate in the assessment and management of ABI. This study examined the relationships among health self-efficacy, health behaviors, and functional independence in ABI rehabilitation, and the extent to which cognitive impairment and trait affectivity affected these relationships. This study also examined the unique role of rehabilitation self-efficacy as measured by the newly developed *Rehabilitation Self-Efficacy Scale.* Overall, this study found that health beliefs and trait affectivity provided important information about functional status after brain injury, their relative contributions to outcome prediction varied as a function of severity of cognitive impairment, and rehabilitation self-efficacy provided novel considerations for understanding these relationships. These findings highlight areas for potential interventions focused on health and rehabilitation beliefs to augment outcomes of brain injury rehabilitation.

AUTOBIOGRAPHICAL STATEMENT

Hillary (Greene) Parker graduated from Le Moyne College in Syracuse, New York in 2009 with a bachelor's degree in psychology. She currently is completing her PhD in clinical psychology with a minor in neuropsychology at Wayne State University in Detroit, Michigan. She also is completing a 1-year pre-doctoral clinical psychology internship at the Clement J. Zablocki VA Medical Center in Milwaukee, Wisconsin.

As a scientist-practitioner, Hillary has a strong commitment to the integration of clinical work, research, and training. Her research has focused on the assessment and prediction of recovery from brain injury and the psychometric evaluation of measures for use in brain injury. She has presented and published in the areas of neuropsychology and rehabilitation psychology. She previously completed clinical training at the Rehabilitation Institute of Michigan, Detroit Medical Center, and William Beaumont Hospital. She also has a strong teaching background as an undergraduate psychology instructor at Wayne State University.

Following completion of her PhD program in August 2016, Hillary plans to complete a 2-year post-doctoral fellowship in clinical neuropsychology at the Clement J. Zablocki VA Medical Center in Milwaukee, Wisconsin. In addition to obtaining specialized training in neuropsychology at the Clement J. Zablocki VA and affiliated Medical College of Wisconsin, she plans to continue her research examining factors related to recovery from brain injury. Hillary plans to pursue a career as a board-certified clinical neuropsychologist.