Application of learned industriousness theory to brain injury rehabilitation: Examining the effect of effort training on task engagement

Aimee M. Giammottorio

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Application of Learned Industriousness Theory to Brain Injury Rehabilitation:
Examining the Effect of Effort Training on Task Engagement

by

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Dissertation

Submitted to the Department of Psychology

Eastern Michigan University

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Clinical Psychology

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November 4, 2016

Ypsilanti, MI
Dedication

This work is dedicated to the individuals affected by traumatic brain injury, and particularly, those who have inspired this research. It takes a great deal of courage to trust in the rehabilitation process, and I continue to be inspired by your patience and dedication.
Acknowledgements

Foremost, I would like to thank my mentor and committee chair, Dr. James Todd, for his inspiration, guidance, and consistent and unwavering support throughout my graduate training. I appreciate his commitment to the development and execution of this research and his mentorship that has contributed to my growth as a clinical psychologist over the past several years.

Next, I would like to thank each of my committee members: Dr. Renee-Lajiness-O’Neill, Dr. Thomas Waltz, and Dr. Thomas Gola. I am very grateful for the unique expertise and perspective each of them contributed to this research. I would also like to thank Dr. Angela Staples for providing methodological and statistical support.

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Finally, to my family—words cannot express how grateful I am for your unrelenting love and support. I am blessed to have a network of loved ones who have stood behind me 110%, providing words of encouragement and continuing to inspire me to achieve my goals. Without your unwavering faith in me, I would not be where I am today. Thank you.
Abstract

Traumatic brain injury (TBI) is a form of acquired brain injury that impacts millions of individuals annually. The severity of TBI can range from mild to moderate and severe, with moderate to severe injuries associated with significant and prolonged impairment within cognitive, behavioral, and emotional functioning domains. Moderate to severe TBI, thus, has long-lasting effects that demand life-long accommodations and care. Many behavioral interventions aim to compensate for skill deficits, but these techniques increase reliance on external cues and may not serve to enhance internal, self-motivated action. Interventions that aim to improve internal motivation are therefore desirable, but are lacking within the current TBI rehabilitation literature. The current study aimed to increase adaptive functioning for three individuals with moderate to severe TBI following exposure to an effort training paradigm grounded in learned industriousness theory. Specifically, the current study aimed to (a) replicate the learned industriousness effect pioneered by Eisenberger and his colleagues in participants with a history of moderate to severe TBI who exhibit low levels of engagement in activities of daily living (ADLs), (b) investigate the effect of effort training as an intervention to increase engagement in ADLs among participants who exhibit low levels of engagement in performing ADLs, and (c) expand upon learned industriousness literature by examining the effect of effort training on reports of self-efficacy, self-reported emotional functioning, and quality of life. Results showed modest support for the learned industriousness phenomenon, where aspects of persistence and generalization of effort were observed on card-sorting performances, but transfer of persistence to ADLs and improvements in emotional functioning were minimal. The findings provide foundational support for future effort training investigations serving to improve adaptive functioning among individuals with brain injury.
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Chapter 1: Introduction & Background to Study

Traumatic brain injury (TBI) is a public health concern impacting approximately 1.7 million people annually and a contributing factor to nearly one-third of all injury-related deaths in the United States (Faul, Xu, Wald, & Coronado, 2010). TBI is a form of acquired brain injury that occurs from sudden trauma to the head. The cost of incurring a TBI is significant from an individual and collective standpoint, with intensive medical care for those sustaining a severe TBI costing upwards of $85,000 per patient. Total lifetime expenses for TBI rehabilitation have been estimated to be $44 billion in the United States, including $4.5 billion in direct treatment costs and nearly $21 billion in work-related loss and disability. Since approximately 40% of patients sustain injuries that lead to long-term disability, a significant proportion of patients require post-acute rehabilitative services that address prolonged impairments in physical, cognitive, behavioral, and emotional domains (Brasure et al., 2012; Ricker, 1998).

Moderate to severe TBI results in physical damage to the brain that impacts cognitive, behavioral, and emotional functioning. Cognitive dysfunction has been described as the “essence of brain injury” because it impacts the domains of attention, learning, memory, processing speed, reasoning, language, and executive functions (Karol, 2003, p. 33; Novack, Bush, Meythaler, & Canupp, 2001). Thus, individuals with moderate to severe TBI exhibit impairments in lower level cognitive processes (e.g., attention and working memory) that support higher order cognitive abilities such as planning, problem-solving, sequencing, and self-monitoring (Catroppa, Anderson, & Muscara, 2009; Chan, Shum, Toulopoulou, & Chen, 2008; Cicerone, Levin, Malec, Stuss, & Whyte, 2006; Constantinidou, Wertheimer, Tsanadis, Evans, & Paul, 2012; Jurado & Rosselli, 2007). Higher order cognitive difficulties post-TBI significantly impact an individual’s ability to engage in independent and purposeful goal-directed behavior, which
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subsequently affects engagement in activities of daily living (ADLs) such as grooming and return to work/school, as well as overall community re-integration (Raskin, 2000).

Moderate to severe TBI is also accompanied by behavioral and emotional symptoms that impact an individual’s recovery trajectory. The neurobehavioral symptoms of moderate to severe TBI vary depending on the nature and severity of the injury, where variable combinations of behavioral excesses and deficits may characterize an individual’s behavioral profile. Generally, symptoms can be characterized as externalizing and internalizing, such that externalizing behaviors are more readily observable and perhaps more socially disruptive than internalizing symptoms. Externalizing symptoms may include behavioral presentations such as non-cooperation or opposition, impulsivity, excitability, frustration/irritability, aggression, disinhibition, confabulation, or sexually inappropriate behaviors. Internalizing symptoms may include apathy, demoralization, initiation impairment, reduced confidence or self-esteem, or social withdrawal (Cattelani, Zettin, & Zoccolotti, 2010). Behavioral and personality changes following injury have been identified as a major obstacle to community reintegration and resuming life as usual (Moore & Stambrook, 1995).

Depression is common among individuals following TBI, and has been identified as the most common psychiatric complication of TBI. Prevalence of depression following TBI ranges widely (17–61%), with prevalence of approximately 35% in the year following a moderate to severe injury. The risk factors for experiencing depression following TBI are poorly understood. But, past psychiatric history, frontal lobe injury, and family dysfunction have been identified as influential factors (Demakis, Hammond, & Knotts, 2010; Rapoport, 2012). Studies suggest that estimates of depression following injury, however, may be difficult to accurately predict or diagnose given the challenges of differentiating symptoms of apathy and depression. Seel et al.
(2010) estimated that depression affects 26–36% of individuals who have sustained a TBI, where other individuals may be impacted by post-TBI apathy. Post-TBI apathy is behaviorally characterized by under-arousal, lack of engagement in rehabilitation, and diminished support-seeking behavior (as compared to those that actively resist or withdraw from rehabilitation and use avoidant coping strategies). Regardless of how these respective behavioral profiles are diagnosed, individuals that exhibit a depressed mood and activity profile cope less effectively with catastrophic injury such as TBI. These individuals exhibit fluctuations in perceived quality of life, social roles and responsibilities, and behavioral symptoms that ultimately negatively impact daily engagement in self-care activities (Hibbard et al., 2004). Depression and more general issues with emotion regulation become apparent when individuals who have sustained a moderate to severe TBI realize the impact of their injuries, such as acknowledging significant alterations in independence with daily activities (Wilson, Herbert, & Shiel, 2003).

Degree of self-awareness following TBI, therefore, has been identified as an influential factor in determining an individual’s degree of perceived distress and dysfunction following TBI. Demakis et al. (2010) showed that patients one year following a moderate to severe TBI exhibited poor awareness of psychological functioning, simultaneously endorsing low levels of depression and anxiety, yet earning a high disability rating from an outside observer on the Disability Rating Scale (DRS). One’s awareness and appreciation of deficits following a moderate to severe TBI have similarly been shown to affect self-reported ratings of quality of life. Lower self-awareness following TBI has been associated with higher ratings of health-related quality of life (HRQL), where individuals were most likely to overestimate abilities on a brain injury specific measure of health-related quality of life (i.e., Quality of Life After Brain Injury or QOLIBRI) within cognitive and self-image domains (Sasse et al., 2013). Given the
influence of self-awareness on perceived psychological and cognitive status, it is noteworthy that self-reported HRQL has been shown to be relatively stable within two years of sustaining a TBI (Forslund, Roe, Sigurdardottir, & Andelic, 2013) and remain relatively consistent up to 5 years following TBI (J. D. Corrigan, Smith-Knapp, & Granger, 1998). Although self-reported symptoms may not accurately characterize the behavioral presentation of individuals with moderate to severe TBIs, ratings have been shown to remain relatively consistent over time.

The research literature shows that the sequelae of brain injury, including the physical, cognitive, behavioral, and emotional symptoms observed following a moderate to severe TBI, impact one’s ability to effectively cope with injury and return to life as usual. A learned helplessness model has been proposed to explain the constellation of symptoms commonly observed after a moderate to severe brain injury. The learned helplessness model suggests that the experience of sustaining the TBI is perceived as an “uncontrollable” event that results in physical trauma to the brain. As a result of the uncontrollable event that has resulted in a moderate to severe TBI, the individual subsequently experiences cognitive deficits that impede his or her ability to engage in tasks as usual (e.g., difficulty completing day to day tasks that he or she independently completed prior to injury). Consequently, the individual with TBI perceives his or her attempts to engage in life as usual as futile, experiencing the negative outcome (e.g., inability to complete routine task) as unrelated to their attempts to control the consequences. An individual’s perceived inability to control his or her circumstances fosters the perception that outcomes are non-contingent on behavior, which further generates negative cognitive schemas that are characterized by an external locus of control and stable, global, and internal attributional style. This self-deprecat ing cognitive style, which includes reduced beliefs in self-efficacy, leads to generalized expectancies for negative outcomes and facilitates depressed mood. Low mood
further feeds into the maladaptive cognitive style and influences low motivation for engagement, since consequences are perceived as independent of behavior. Thus, the cycle is perpetuated by a culmination of influencing factors and adaptive coping strategies are not adopted (Moore & Stambrook, 1995).

The learned helplessness model proposed by Moore and Stambrook (1995) provides a framework for understanding the relationship between physical, cognitive, behavioral, and emotional symptoms of moderate to severe TBI. The model shows that one “symptom” in the chain has the propensity to negatively influence several other symptoms commonly occurring post-TBI. The literature examining the relationship among these variables, including cognitive distortions, self-efficacy (i.e., one’s belief in his or her ability to achieve outcomes consistent with one’s expectations), and learned helplessness behavior has supported the hypotheses put forth by this model. Individuals experiencing traumatic and chronic debilitating diseases, such as multiple sclerosis and spinal cord injury, have demonstrated strong associations between low levels of self-efficacy, high levels of helplessness and cognitive distortions, and depression (Shnek et al., 1997). Self-efficacy has been observed to affect cognitive, affective, and motivation in a sample of predominantly severe TBI, where self-efficacy mediated the relationship between community functioning and general life satisfaction (Cicerone & Azulay, 2007). Functional activities, such as return to work, have also been associated with specific belief structures among individuals who sustained more severe TBIs. Lubusko, Moore, Stambrook, and Gill, (1994) showed that individuals who did not return to pre-injury work exhibited lower internal locus of control, higher perceived external control, and increased hopelessness, in addition to holding “lower prestige” occupations prior to injury (p. 65).
Considering the widespread impact of low levels of perceived self-efficacy, interventions aimed at targeting improvements in cognitive schemas are desirable and necessary. Psychotherapy provided individually or within a group setting has been purported to be a useful component of neuropsychological rehabilitation for some individuals after TBI. However, the cognitive deficits associated with moderate to severe TBI often pose challenges that may preclude productive participation in traditional forms of psychotherapy (i.e., psychodynamic or cognitive/cognitive behavioral therapy), particularly due to an inability to establish verbal or behavioral control. Additionally, reduced self-awareness (e.g., lack of appreciation for current deficits) and disinhibited behavior may prevent the individual from entering into productive dialogue with a psychotherapist. Rather, interventions that address mood in individuals with moderate to severe TBI, such as positive event scheduling or coping skills training, are seen as better options (Prigatano, 1999a; Wilson et al., 2003). That is, use of effective interventions for mood are crucial for an individual’s recovery and prognosis post-TBI due to the negative impact of psychological status (e.g., depression and coping ability) on productivity outcomes (Dawson, Schwartz, Winocur, & Stuss, 2007).

Despite the importance of interventions to address psychological and behavioral issues following moderate to severe TBI, the current state of rehabilitation does not provide clear instructions for intervention. Medical care guidelines within this subpopulation of TBI are well defined, delineating specific standards for acute (e.g., pre-hospital and hospital) medical care and surgical management of patients with severe TBI (American Association of Neuroscience Nurses [AANN], 2012; Brain Trauma Foundation, 2013). But, guidelines for rehabilitative care are considerably less specific. That is, they feature, broad recommendations for interdisciplinary and comprehensive rehabilitation comprised of general recommendations for cognitive and
behavioral assessment and intervention, as well as community participation and re-integration. According to the NIH Consensus Development Panel on Rehabilitation of Persons with Traumatic Brain Injury (1999), “rehabilitation should be matched to the needs, strengths, and capacities of each person with TBI and modified as those needs change over time” (p. 980). The National Academy of Neuropsychology (NAN) echoes the guidelines put forth by the NIH consensus panel. It emphasizes the need for rehabilitation to not only address a patient’s medical and physical needs, but also his or her needs for cognitive rehabilitation (i.e., behavioral and psychological intervention; Axelrod et al., 2002). The recommendations put forth by the NIH and NAN are further supported by Society for Cognitive Rehabilitation, which similarly recommends comprehensive, interdisciplinary rehabilitation that incorporates multimodal individualized treatment and standardized means of assessment. The guidelines offered by professional organizations provide information regarding the general structure, purpose, and aims of cognitively-based rehabilitation for patients with TBI. However, as noted, details of how to effectively accomplish these aims (i.e., which assessment measures or intervention techniques should be used) remain highly ambiguous and the responsibility of the treatment provider to determine (Malia et al., 2004). Systematic literature reviews have attempted to resolve the elusiveness of treatment standards, resulting in various recommendations for practice standards, guidelines, and options for remediation of attention, memory, executive functioning, language and communication deficits, and comprehensive-holistic neuropsychological rehabilitation to reduce cognitive and functional disability (Cicerone et al., 2011). However, these standards have not yet been systematically employed, and interventions delivered within the context of rehabilitation differ widely.
Despite this lack of generalized standardization of care, interventions grounded in behavioral psychology aiming to decrease maladaptive behavior (e.g., aggression, self-injury, sexually inappropriate behaviors) or training adaptive skills are commonplace within the TBI literature. Several interventions targeted at behavior modification and skill building are heavily influenced by applied behavior analysis (ABA), which is based upon principles of learning theory as developed primarily by (Skinner, 1938, 1953, 1957) and expanded on by many. In these interventions we find the systematic application of the principles such as reinforcement, extinction, shaping, chaining, contingency management and contracting, differential reinforcement, antecedent variables and interventions, and generalization (Ashley, Krych, Persel, & Persel, 1995; Cooper, Heron, & Heward, 2007; Hartley, 1995; Ullmann & Krasner, 1965; Weiss, Krasner, & Ullman, 1963). Available intervention techniques can be broadly characterized as compensatory or restorative techniques, where compensatory approaches aim to reduce the amount of burden placed upon an individual’s compromised cognitive abilities by altering the environment. Compensatory techniques have demonstrated strength in generalization, whereas restorative approaches aim to “restore” function by retraining deficient systems and influence circumscribed, task-specific improvements and lack generalization to untrained tasks (Fish et al., 2007; Sohlberg & Mateer, 2001). Optimal use of a treatment modality depends on individual circumstances and needs, and a “synergistic” approach that integrates compensatory and restorative techniques is recommended for rehabilitation with individuals with TBI (Dams-O’Connor & Gordon, 2013; Wiseman-Hakes, MacDonald, & Keightley, 2010). Several ABA-based intervention modalities have shown strength by supporting sustained improvements in independence among individuals with severe TBIs, including improvements in washing and dressing behavior (Giles & Clark-Wilson, 1988); meal
preparation; laundry; and showering, dressing, and grooming behaviors (Parish & Oddy, 2007), and functional skills such as learning to use an email interface (Ehlhardt, Sohlberg, Glang, & Albin, 2004). External aids and electronic devices have also been shown to improve adaptive functioning for patients with moderate to severe TBI who experience deficiencies in higher order cognitive processing (Fish, Manly, Emslie, & Wilson, 2008; Fish, Manly, & Wilson, 2008; Fish et al., 2007; Turkstra & Flora, 2002). Although application of these interventions have resulted in increased engagement and adaptive functioning, they have served to enhance functioning by increasing dependence on external, environment stimulation and reducing necessity for internal, self-determined action (von Cramon & Matthes-von Cramon, 1992).

Furthermore, research has shown that the culture of hospital and residential settings can breed learned helplessness behavior by incorporating and supporting contingencies that reward dependent behavior. Within these contexts, patients succumb to the demands and contingencies of the setting, which reward dependency for daily tasks, and come to perceive situations as uncontrollable (Foy & Mitchell, 1990; Polenick & Flora, 2012; Raps, Peterson, Jones, & Seligman, 1982). Considering the likelihood for this learned helplessness phenomenon to occur within a residential setting, coupled with the high proportion of individuals experiencing depression or post-TBI apathy symptoms following a moderate to severe TBI, interventions that target improvement in adaptive functioning through self-initiated action are highly desirable.
Chapter 2: Etiology, Diagnosis, & Classification of Traumatic Brain Injury

Etiology

As noted in the earlier section, Traumatic brain injury (TBI) is one form of acquired brain injury that results after some form of mechanical force to the head, including injury that occurs because of falls, motor vehicle accidents, falling objects, or assaults. Brain damage that occurs after birth falls is characterized as an acquired brain injury, which can be distinguished from brain dysfunction that results from a genetic disorder or congenital malformation. TBI can result from two primary mechanisms of injury: acceleration and deceleration. Acceleration injuries occur when a moving object strikes a stationary head. Deceleration injuries arise from a moving head striking a stationary object. These mechanisms of injury may result in either open or closed head injuries, which are defined by the presence or absence of a penetrating object to the skull. Open and closed head injuries may also be referred to as penetrating and non-penetrating injuries, signifying the nature of brain insult (Struchen, Davis, McCauley, & Clark, 2009; Uomoto, 2000).

Consequently, brain damage resulting from traumatic injury may present in a variety of forms, including brain contusions (i.e., bruises to the brain), hematomas (i.e., collection of blood in a confined space in the brain) and increased intracranial pressure, and diffuse axonal injury (i.e., global damage to neurons). Depending on the mechanism and nature of injury, different forms of brain damage may result. For example, a gun shot wound may penetrate the skull and brain tissue, leading to immediate structural damage, whereas a motor vehicle accident may result in contusions and diffuse axonal injury. Thus, the nature of the initial injury is instrumental in determining the respective primary (immediate) and secondary injuries (delayed physiological responses that occur after the initial mechanism of injury; Ricker, 2010; Uomoto, 2000).
TBI can occur among individuals of all age groups, although children (age 0–4), adolescents and young adults (ages 15–19), and the elderly (age 65 and older) are most likely to sustain a TBI. Certain events or situations place individuals within these specific age groups at greater risk for sustaining a TBI. Falls are the leading cause of injury among all age groups and contribute to the highest number of TBI-related emergency room visits and hospitalizations among children and the elderly. The second leading cause of TBI among children is “struck by/against events” (i.e., colliding with a stationary or moving object), where these events account for 16.5% of TBIs among all age groups. Assaults are another type of event that precede TBI, accounting for 10% of TBIs within the general population, and the leading cause of TBI-related deaths (31.8%) occur as result of motor vehicle and traffic injuries, which are highest among adults between the ages of 20–24 (Faul et al., 2010).

In addition to age, several other factors are believed to increase the likelihood of sustaining a TBI. Males have been identified as being two to three times more likely than females to sustain a TBI. Individuals with history of learning disability, unemployment, lower socioeconomic status, and those who are single or in relationships characterized by high marital discord, are more at risk of sustaining a TBI. Additionally, individuals living in congested urban areas and those that engage in high-risk behaviors, such as riding motorcycles and horses—with the latter being responsible for 45.2% of sports-related TBI—are at increased risk (Crowe, 2008; Winkler et al., 2016). Substance abuse (e.g., alcohol and illicit drug use) and dependency have also been found to be a major risk factor for TBI (Bombardier, Rimmle, & Zintel, 2002). Notably, premorbid factors can serve to protect individuals against injury and influence a better prognosis or recovery trajectory following injury. Premorbid employment, for instance, has been
shown to favorably impact outcomes such as functional skills, cognitive status, and productivity following injury (Novack et al., 2001).

**Diagnosis**

Understanding the severity of a patient’s brain injury is crucial to appropriate rehabilitative care, and rating scales are commonly used to determine TBI severity (Caetano & Christensen, 1997; Hannay, Howieson, Loring, Fischer, & Lezak, 2004; Maas et al., 2011). Following injury, patients participate in an assortment of assessments to not only identify the severity of injury but also predict global outcomes following brain trauma. There are several well-established measures routinely used to gauge injury severity, global outcome, and the psychosocial implications of incurring a TBI.

**Rating scales to assess TBI severity.** Assessment of TBI severity can be completed through use of several assessment measures that seek to objectively classify the degree to which an individual experiences altered consciousness, post-traumatic amnesia, and impaired cognitive functioning. The Glasgow Coma Scale (GCS; Teasdale & Jennett, 1974) is one of the most widely used measures for designating post-traumatic states of altered consciousness by rating eye, verbal, and motor abilities along a continuum, where higher ratings correspond to better functioning. The GCS yields scores that delineate injury severity, ranging from mild (score of 13 or greater) to severe (scores of 8 or less), and has been found to be a good predictor of outcome (J. Fischer, Hannay, Loring, & Lezak, 2004; Saatman et al., 2008). Other rating scales that are commonly employed to examine altered consciousness and mental status during acute rehabilitative care (i.e., during the first few weeks and possibly for 2 to 3 months after injury; Prigatano, 1999a) include the Galveston Orientation and Amnesia Scale (GOAT; Levin, O’Donnell, & Grossman, 1979), Oxford Test (Fortuny, Briggs, Newcombe, Ratcliff, & Thomas,
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1980), Westmead Post-Traumatic Amnesia (PTA) Scale (Shores, Marosszeky, Sandanam, & Batchelor, 1986), and Ranchos Los Amigos Scale (Hagen, Malkmus, & Durham, 1972). The GOAT assesses an individual’s level of orientation and recall of events subsequent TBI and provides an estimate of the individual’s current level of confusion and PTA. The GOAT has shown to be strongly associated with GCS, and has demonstrated utility in assessing responsiveness in recently brain-injured individuals. The Oxford Test similarly assesses duration of PTA but also more formally tests memory through use of questionnaires about personal demographics, in addition to recall and recognition testing of pictures as well as face and name. The Oxford Test provides no formal standardized procedures for scoring or assessing progress, which is a major strength of a similar measure, the Westmead PTA Scale. The Ranchos Los Amigos Scale is another commonly administered measure that assesses level of cognitive functioning through use of behavioral observations and assignment of a functional rating (J. Fischer et al., 2004).

**Diagnostic imaging methods.** Improved technology and decreasing costs have made imaging methods, in conjunction with behavior rating scales, an increasingly common means of determining TBI severity. Computed tomography (CT) is the modality of choice for acute assessment of head trauma within emergency departments across the country, given its ease of use and high degree of accuracy in detecting skull fractures and acute intracranial hemorrhage. Magnetic resonance imaging (MRI) is another means of evaluating TBI, and is typically used to evaluate the degree of injury during subacute or chronic phases. Although MRI has been identified as comparable to CT for detecting acute epidural hematoma and subdural hematoma, MRI has been shown to be superior at detecting subtle forms of brain injury, including extra-axial smear collections, nonhemorrhagic lesions, brain stem injuries, and subarachnoid
hemorrhages. Several other advanced imaging methods may be used to characterize brain
damage, including diffusion-weighted imaging (DWI) and diffusion tensor imaging (DTI), which
have demonstrated sensitivity in identifying the structural integrity of white matter tracts, thus
aiding in diagnosis of diffuse axonal injury. Magnetic resonance spectroscopy (MRS) is another
technique used to examine brain damage and severity, identifying the relative amounts of
metabolites in brain tissue after TBI (Le & Gean, 2009; Provenzale, 2010; Xiong, Zhu, & Zhang,
2014).

**Categories of TBI severity.** Given the varying degrees and types of brain damage that
may arise following a traumatic injury, the severity of the TBI will range from mild to moderate
or severe. There is no standard classification of TBI severity. But, the National Institutes of
Health, Centers for Disease Control and Prevention, American Congress of Rehabilitation
Medicine, and US Departments of Defense/Veterans Affairs (DoD/VA) generally agree that loss
of consciousness (LOC), alteration of consciousness (AOC), post-traumatic amnesia (PTA), and
Glasgow Coma Scale (GCS) scores define the severity of injury. The DoD/VA specifically
characterizes a mild TBI as a LOC for 30 minutes or less, AOC lasting a moment to 24 hours,
PTA up to one day, and GCS scores of 13–15. In contrast, moderate and severe TBI vary in LOC
(30 minutes to 24 hours and greater than 24 hours, respectively), AOC for more than 24 hours,
PTA for 1–7 days or longer than 7 days, and GCS scores of 9–12 and 3–8, respectively
(Departments of Defense/Veterans Affairs [DoD/VA], 2008).

**Assessment of global outcome following TBI.** Outcome measures are typically
employed within acute rehabilitation settings following TBI to assess a patient’s current level of
functioning and predict outcome. One of the first measures used to characterize adaptive
functioning (i.e., current and potential) was the Glasgow Outcome Scale (GOS; Jennett & Bond,
The GOS has been revised (Glasgow Coma Scale- Extended; Jennett, Snoek, Bond, & Brooks, 1981) to classify eight levels of functioning, and is sensitive to change in mild and moderate brain injury (Weir et al., 2012). The Disability Rating Scale (DRS; Rappaport, Hall, Hopkins, Belleza, & Cope, 1982) similarly assesses functioning in patients with severe TBI, examining emergence from coma to disability in ADLs (e.g., feeding, toileting, grooming, etc.; Fischer et al., 2004). The Functional Independence Measure (FIM; Keith, Granger, Hamilton, & Sherwin, 1987) further examines personal independence with daily activities and provides an estimate of cognitive functioning by rating the quality of social cognition and communication (Houlden, Edwards, McNeil, & Greenwood, 2006). These measures examine aspects of functional independence during the acute care process to provide a prediction of global outcome and facilitate goal-directed rehabilitation.

Assessments of psychosocial consequences following TBI. Similar to assessments of global outcome following TBI, measures that examine aspects of psychosocial functioning provide valuable data for the rehabilitation planning process. The Mayo-Portland Adaptability Inventory (MPAI-4; Malec & Thompson, 1994) enables clinicians to evaluate a patient’s degree of psychosocial functioning and potential obstacles to community re-integration by examining the full range of physical, emotional, cognitive, and behavioral issues the patient is likely to encounter following injury (J. Fischer et al., 2004). The Neurobehavioral Rating Scale-Revised (NRS; Levin et al., 1987; McCauley et al., 2001) also provides a framework for assessing common cognitive, behavioral, and emotional features post-TBI to estimate a patient’s level of neurobehavioral impairment (Vanier, Mazaux, Lambert, Dassa, & Levin, 2000). These multidimensional measures provide a means for rehabilitation professionals to comprehensively
evaluate psychosocial adaptation following brain injury, identifying deficits that influence goals for rehabilitation. They are commonly used as outcome measures within the TBI literature.

**Classification**

Traumatic brain injury is classified in the World Health Organization’s International Statistical Classification of Diseases and Related Health Problems or International Classification of Diseases (ICD) diagnostic coding system. The most recent clinical modification of the ICD, the ICD-10-CM, includes TBI under the category of “Intracranial Injury” (S06). This category includes codes to characterize “Diffuse traumatic brain injury.” Several codes are included that note varying degrees of loss of consciousness (e.g., unspecified duration, 30 minutes or less, 31 to 59 minutes, 1 hour to 5 hours 59 minutes, 6 hours to 24 hours, greater than 24 hours with/without return to pre-existing conscious levels, and any duration with death due to brain injury prior to gaining consciousness; World Health Organization, 1992).

Although a diagnostic characterization of TBI has been included in past editions of the ICD (e.g., ICD-9-CM), it has not always been present in other classification systems such as the Diagnostic and Statistical Manual of Mental Disorders (DSM). The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013), the most recent revision, has improved drastically since previous editions with respect to mere inclusion and characterization of TBI. TBI was not contained within the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000), but rather this edition made vague reference to head trauma within the context of other diagnoses, including delirium, amnestic disorder, dementia, cognitive disorder not otherwise specified, and personality change due to a general medical condition.
Within the *DSM-5*, however, a specific diagnostic criteria for TBI is included under the category of “Major and Mild Neurocognitive Disorders.” According to the *DSM-V (2013)* 5\textsuperscript{th} ed., major and minor neurocognitive disorder are delineated by evidence of significant or modest cognitive decline, respectively, from a previous level of performance in one or more cognitive domains (including complex attention, executive function, learning and memory, language, perceptual-motor, or social cognition) based on a) the concern of cognitive decline from the individual, knowledgeable informant, or clinician, and b) a substantial impairment in cognitive performance, preferably documented by standardized neuropsychological tests, or other quantified clinical assessment. Significant cognitive decline is defined as a z-score of less than or equal to 2 standard deviations below the mean (at or below the 3\textsuperscript{rd} percentile), whereas modest cognitive decline is defined as 1–2 standard deviations below the mean (between the 3\textsuperscript{rd} and 16\textsuperscript{th} percentile) on standardized cognitive tests. Major and mild neurocognitive disorder may be diagnosed if cognitive deficits do not occur within the context of a delirium and are not better explained by another mental disorder, such as depression or schizophrenia. Major and mild neurocognitive disorders differ with respect to impact on independence in everyday activities. Cognitive deficits experienced in the context of major neurocognitive disorder interfere with an individual’s ability to independently complete activities, requiring at minimum, assistance with complex instrumental activities of daily living. In contrast, cognitive deficits experienced as part of mild neurocognitive disorder do not interfere with an individual’s independence with daily activities but may require greater effort, compensatory strategies, or other accommodations (American Psychiatric Association, 2013).
Prognosis for Recovery Following TBI

Determining a patient’s prognosis for recovery is complex and requires consideration of multiple, patient-specific factors. Nonetheless, recovery of cognitive function following a moderate to severe TBI has been found to occur within a relatively brief window of time. Most recovery of cognitive function has been found to occur within 2 years of the injury, where the most significant period for recovery of cognitive functioning has been found to occur within the first 3 to 6 months after injury (Schretlen & Shapiro, 2003). Patients at 3 to 5 years post-moderate to severe injury have continued to report substantial functional limitations in not only cognitive competency but also several aspects of daily life, such as personal care, major activity, and leisure/recreation. Nearly one-third of patients also reported that they were unable to work or attend school, 10% experienced a substantial alteration in their job responsibilities (e.g., demotion or pay cut), and 20% experienced difficulty performing job obligations (e.g., completing job or problematic co-worker relationships). Social difficulties were also found at 3 to 5 years post-injury, such that 25% of patients experienced a significant reduction of friendships or difficulty forming friendships and another 10% of patients were socially isolated (Dikmen, Machamer, Powell, & Temkin, 2003). Considering the long-term impact of a moderate to severe injury on adaptive functioning, it is important that the cognitive and behavior sequelae of injury are an early and ongoing focus of rehabilitation, especially given the implications for social and emotional functioning and overall community re-integration post-injury.
Chapter 3: Continuum from Learned Helplessness to Learned Industriousness

Learned helplessness theory has been extensively studied from a behavioral standpoint, especially as it relates to the manifestation of maladaptive behavior and emotional well-being (Abramson, Seligman, & Teasdale, 1978; Alloy, Peterson, Abramson, & Seligman, 1984; Hiroto & Seligman, 1975; Klein, Fencil-Morse, & Seligman, 1976; Maier & Seligman, 1976; Miller & Seligman, 1975; Seligman & Beagley, 1975; Seligman, 1972). Learned industriousness theory, in contrast, is far less distinguished within the literature, and even less attention has been devoted to examining the relationship between learned helplessness and industriousness behavior (Eisenberger, Carlson, & Frank, 1979; Eisenberger, Leonard, Carlson, & Park, 1979; Eisenberger, Weier, Masterson, & Theis, 1989; Eisenberger, 1992; Raps, Reinhard, & Seligman, 1980). This chapter will identify the relationship between learned helplessness and learned industriousness by first examining the theory and research of each concept in isolation and then discussing the commonalities between them. The clinical significance and implications of considering the continuum from learned helplessness to industriousness behavior will be identified and discussed within the context of the current study.

Learned Helplessness

Learned helplessness has been described as generalized passivity, reduced awareness of the relationship between behavior and outcome, and increased stress in the face of trauma as a reaction to a history of uncontrollable situations. Early learned helplessness writings were based on behavioral experiments performed with non-humans of several species (e.g., mice, cats, fish, and dogs) in which uncontrollable situations (e.g., inescapable shock) produced a reduction in generalized adaptive behavior (Seligman, 1972). These writings span more than 30 years of research, and findings are adequately represented by seminal research by Seligman (1972) in
which naïve and typical dogs were exposed to escapable and inescapable electric shocks. Naïve dogs given typical escape-avoidance training in a shuttle box were found to exhibit a stress response after exposure to painful, electric shock. Howling, running frantically, and defecating/urinating characterized their behavior until they accidently passed over the barrier to terminate the shock. On later trials, these dogs exhibited learning, and terminated the shock by moving quickly to the non-shock side of the box. In contrast, other dogs that experienced uncontrollable shocks prior to escape-avoidance training exhibited a similar stress response, but quickly gave up escape efforts, and passively accepted shocks. These observations demonstrate the impact of “controllable” versus “uncontrollable” situations on subsequent learning and behavior, where the latter results in “learned helpless” behavior (Maier & Seligman, 1976; Seligman & Beagley, 1975; Seligman, 1972).

These observations led to Seligman’s hypotheses about how to “cure” these passive, helpless behaviors (Seligman, 1972, p. 409). Seligman (1972) demonstrated the benefits of exposing dogs to the reinforcing, specifically, negatively reinforcing properties of physically escaping the shock, as this exposure influenced new learning and eliminated helpless behavior. While, the learned helplessness effect was first observed and resolved in non-humans, it was recognized to occur in humans under similarly adverse conditions (Hiroto & Seligman, 1975; Miller & Seligman, 1975). Although Seligman (1972) speculated on the similarity between learned helplessness and depression in humans, characterizing both as reduced response initiation and a “negative cognitive set” (i.e., difficulty in believing or learning that one’s own responses will produce a favorable outcome, even when they do), efforts were later taken by researchers to investigate the conditions in which learned helplessness manifests in humans (Abramson et al., 1978; Alloy et al., 1984; Flannery, 2002; Klein et al., 1976; Maier & Seligman,
As in the non-human studies, early learned helplessness research in humans examined the effect of uncontrollable situations by using inescapable, aversive stimuli or highly difficult or unsolvable problems (e.g., anagrams). One such study examined varying combinations of pre- and post-treatment tasks and demonstrated that problem insolubility and inescapability were associated with poor task performance in college students (Hiroto & Seligman, 1975). Specifically, Hiroto and Seligman (1975) showed that pre-treatment with an inescapable, aversive tone created conditions for learned helplessness, as it significantly reduced tone-escape performance in a subsequent shuttle box task. In contrast, control participants and those participants experiencing an escapable, aversive tone prior to treatment exhibited adequate performance during a post-test shuttle box task. Similarly, participants receiving insoluble discrimination problems during pre-treatment subsequently exhibited poor performance on later anagram tasks, especially as compared to control participants and those receiving soluble problems during the pre-treatment period. These findings demonstrate that under conditions in which participants experienced lack of “control” over the outcome of their behavioral responses, such that the outcome was non-contingent on their behavior, they were likely to experience learned helplessness as characterized by poorer task performance.

Findings of the Hiroto and Seligman (1975) study have been systematically replicated by Miller and Seligman (1975) who examined the effect of helplessness training on anagram performance in non-depressed and depressed patients. Non-depressed patients that underwent helplessness training were found to exhibit impaired performance on an anagram task that was consistent with the performance of depressed patients (i.e., those patients who did not experience the pre-treatment, inescapable noise condition). Similarly, Klein, Fencil-Morse, and Seligman
observed that unsolvable discrimination problems produced a learned helplessness effect in non-depressed participants. When non-depressed participants were faced with these unsolvable problems, they performed poorly on a subsequent anagram task, exhibiting a performance pattern similar to participants in the “depressed” group. It is notable that participants in the depressed group demonstrated improved performance on the anagram task when failure was attributed to the task itself (i.e., task difficulty), as opposed to personal incompetence at completing the anagrams (Klein et al., 1976). When faced with situations that are perceived as “uncontrollable,” individuals learned to disassociate the relationship between behavior and outcome, and perceive lack of “control” over the outcome of their behavior. Human and non-human investigations of learned helplessness provided foundational support for the theory of learned helplessness as a viable conceptualization of depression, which is influenced by both learning history and maladaptive cognitive schemas.

Since learned helplessness has thus far been characterized behaviorally as a lack of response initiation and overt lack of behavior within the context of uncontrollable events, it is important to recognize that cognitive, motivational, and affective processes influence this behavior change. Specifically, Maier and Seligman (1976) described learned helplessness as cognitive, motivational, and behavioral deficits that ensue after an organism experiences an uncontrollable event. Upon exposure to an aversive, uncontrollable event, individuals are believed to cognitively experience belief in response inefficiency, such that they believe that behavioral responses cannot influence the outcome of an aversive event (e.g., reduce/eliminate the aversive nature of the event). Consequently, this expectation of response inefficiency negatively impacts affect (i.e., depressed mood) and reduces motivation to engage in a voluntary
behavioral response, resulting in learned helplessness (Flannery, 2002; Maier & Seligman, 1976; Moore & Stambrook, 1995; Raps et al., 1982; Shnek et al., 1997).

The initial conceptualization of learned helplessness provided a basis for understanding behavior in the context of uncontrollable outcomes; however, the early model failed to adequately explain the conditions under which different degrees of learned helplessness manifest (i.e., “Does learned helplessness occur within the context of general or specific situations?” “Does it have an acute versus chronic course?”). Learned helplessness theory, therefore, was later reformulated by Abramson, Seligman, and Teasdale (1978) by drawing from the influence of other attribution theorists (e.g., Heider, 1958; Kelley, 1967; Weiner, 1974) to account for the specific conditions under which different symptoms of learned helplessness occur. Abramson et al. (1978) indicated that how one perceives the relationship between one’s actions and consequences in a given situation influences one’s future expectations about the relationship between one’s behavioral response and subsequent outcome. Attributions can be characterized as either internal or external, such that individuals who attribute outcomes as contingent on another’s actions, as opposed to actions of their own, exhibit “personal helplessness” (i.e., “I don’t have the skills to solve the problem, but someone else does.”). In contrast, individuals who make external attributions hold expectations that outcomes are contingent neither on their nor someone else’s actions, and consequently exhibit “universal helplessness” (i.e., “I don’t have the skills to solve this problem, because nobody does.”). Attributions regarding the stability of a trait (e.g., stable or unstable) and degree of specificity or generalizability across situations influences whether helplessness can be expected to be acute or chronic, or occur across a narrow or broad range of circumstances. Additionally, these attributions can serve as a general gauge of self-esteem and emotional well-being. People attributing a cause as stable, global, and internal are
more likely to exhibit reduced self-esteem and depressed mood, as opposed to organisms that attribute cause to unstable, specific, and external events (Abramson et al., 1978). Consistent with this theory, research shows that individuals with a global attributional style for negative outcomes are likely to experience learned helplessness across situations, including greater generalization of learned helplessness to new situations that are either similar or dissimilar to the initial situation in which they experienced helplessness (Alloy et al., 1984). Attributional style, therefore, is a primary feature that distinguishes individuals who exhibit learned helplessness from those who do not. The attributions need not be accurate, and are sometimes notable in their lack of correspondence with reality.

Early speculation and pioneering research by Seligman (1972) and reformulation of learned helplessness theory by Abramson et al. (1978) have contributed to current conceptualization of depressive symptomology in humans. Consistent with the theory and approach used by Seligman (1972) for “curing” learned helpless behavior in dogs, research by Raps, Reinhard, and Seligman (1980) hypothesized that the learned helplessness effect or depressed mood in humans can be directly altered or alleviated. Raps et al. (1980) investigated the effect of mood elation (e.g., positive self-referent statements) or neutral procedures (e.g., neutral statements) on affective and cognitive functioning in participants classified as non-depressed, clinically depressed, and those experiencing experimentally-induced learned helplessness. Findings revealed that the elation-induction procedure was associated with improvements in mood and cognition in both the clinically depressed and experimentally-induced learned helplessness participants, which suggests that targeting improvement in affect and cognition leads to improvements in learned helpless and depressed behavior.
Learned Helplessness Continuum?

Learned helplessness can be characterized as a generalized behavioral repertoire that exists along a continuum of behavioral presentations. Along one end of the spectrum, presentation of non-contingent reinforcement and punishment negatively affects future learning and behavioral outcomes by dissociating actions from results. Eisenberger, Park, and Frank (1976), for instance, suggested that even in instances in which positive reinforcement (e.g., approval) was introduced non-contingently, this presentation would be associated with individuals learning that approval is independent of their behavior. At the opposite end of the behavioral spectrum, Eisenberger and et al. (1976) proposed the notion of “learned industriousness” in which generalized enhancement of rewards contingent upon increased effort in specific areas spread to other parts of behavior. That is, Eisenberger et al. (1976) posited that effort learning is symmetrical and exists along the same continuum from learned helplessness to industriousness, asserting, “symmetry would require that the learning of a reinforced response improve the subsequent acquisition of new responses for the reinforcer” (p. 228). This is in some ways analogous to the learned variability effect in which we see a generalized variable in behavior contingent upon reinforcement for behavior dissimilar to earlier instances (Goetz & Baer, 1973; Napolitano, Smith, Zarcone, Goodkin, & McAdam, 2010; Neuringer, 2004; Page & Neuringer, 1985).

At approximately the same time seminal studies in learned helplessness theory were conducted, Eisenberger et al. (1976) investigated hypotheses regarding the manifestation of learned industriousness behavior. Their hypotheses stemmed from beliefs that organisms may move along the continuum from learned helpless behavior to “learned industrious” behavior depending on the degree of interchangeable reinforcement that is available (i.e., degree of simultaneously available reinforcement opportunities for different responses that have equal
probability of receiving reinforcement). According to the interchangeable reinforcement hypothesis, the smaller the number of responses that regularly receive reinforcement (as opposed to a larger number of responses that receive reinforcement), the greater likelihood that the organism will move toward the learned industriousness end of the helplessness-industriousness continuum. Consistent with this perspective, Eisenberger et al. (1976) hypothesized that individuals receiving a narrow range of reinforcement opportunities would demonstrate learned industriousness, as compared to those individuals who received a broader range of reinforcement opportunities and would be likely to exhibit learned helplessness.

In one relevant investigation, Eisenberger et al. (1976) showed second and third grade students pictures of four stimulus classes (e.g., humans, foods, plants/flowers, and furniture) and differentially reinforced their responses by using approval comments (e.g., “good”). One group of students received reinforcement for selecting one (narrow) stimulus class, and another group got rewards for selecting any stimulus class (e.g., broad range of stimuli). Control groups were also included in which students viewed the photographs either alone or with an experimenter present and social engagement or approval was withheld. After this training task, students completed a test task in which they were shown a different set of stimuli (e.g., circles) and consistently received reinforcement for choosing the circle in a particular quadrant. Findings showed that contingent reinforcement of a small class of responses during a training procedure produced learned industriousness: The group of students that received reinforcement for responses to a narrow range of responses performed significantly better on a subsequent task (i.e., reached criterion in significantly fewer trials) than the broad range training group or the control groups that did not receive approval comments in training. The hypotheses that reinforcement for a broad range of responses produced learned industriousness was not
supported, since the broad-range group did not perform worse than the control group. Nonetheless, these findings generally support the notion of a continuum from learned helplessness to industriousness, as reinforcement to a narrow range of responses (as opposed to a broad range of responses) is more likely to move one toward the learned industriousness end of the helplessness-industriousness continuum, increasing the likelihood for new learning (Eisenberger et al., 1976). Subsequent research using this methodology specifically examined the effect of contingent and noncontingent reinforcement on learned industriousness responses. Children reinforced for contingent responses were found to learn at a faster rate than children in a control group (i.e., no approval comments given), who actually learned at a faster rate than children in the non-contingent approval group (Eisenberger, Leonard, et al., 1979).

**Learned Industriousness**

According to Eisenberger (1992), “learned industriousness” refers to an increase in general effort that can be learned and perpetuated by establishing conditions in which contingent reinforcement is available for specific instances high-effort behavior. The phenomenon of learned industriousness, thus, and as noted earlier, differs and lies at the opposite end of the continuum from learned helplessness, which manifests due to a maladaptive learning pattern in which behavioral responses are perceived to be independent of consequences and influences observations of low-effort behavior. Given the previous research that shows that exposure to contingencies between behavior and consequences has the likelihood to progress an organism up the continuum from the low-end helplessness, the concept of learned industriousness is certainly a clinically relevant construct.

Procedurally, the phenomenon of learned industriousness occurs when exposure to reinforcement under high-effort conditions increases the probability of engaging in future, high-
effort behavior in other, seemingly unrelated domains of behavior. The previous history of high-effort conditions is purported to cause future instances of high-effort circumstances to be perceived as less aversive, which serves to perpetuate participation in effortful behavior (Eisenberger, 1992). Inherent within the conceptualization of learned industriousness are assumptions regarding the notion of “effort,” in addition to its degree of aversiveness. With respect to effort, it can present in different forms and measured in several ways. One form of effort is cognitive in presentation and draws upon intellectual and academic skills (e.g., visual, verbal, and perceptual reasoning abilities). Common cognitive effort tasks include anagrams, mathematical computations, and visual perceptual tasks (e.g., identifying differences between two photographs or a mirror tracing task). A second form of effort includes physical effort, which is a measure of motor response (e.g., lever press in non-human research). These forms of effort can be measured through different modalities, including frequency, speed, precision/accuracy, complexity, intensity, and duration (Eisenberger, 1992). These two forms certainly do not exhaust the varieties of effort, but should be sufficient for a general understanding.

Principles of learning theory, and more specifically operant conditioning, are conceptualized as foundational to the phenomenon of learned industriousness (Eisenberger, 1992). Operant behavior can occur within the context of different contingencies (e.g., regular/continuous and partial/intermittent reinforcement), which affect the rate of acquisition and maintenance of behavior. Intermittent reinforcement most closely resembles naturally occurring contingencies, as reinforcement is available part of the time, or intermittently, to strengthen and intensify behavior (Ferster & Skinner, 1957; Keller, 1969; Morse, 1966; Skinner, 1953). This process of strengthening behavior by virtue of reinforcement is “conditioning,”
whereas “extinction” refers to the decline in the probability that behavior will occur when reinforcement is subsequently discontinued (Keller, 1969; Morse, 1966). Although conditioning is relevant to acquisition of learning, an extinction-based phenomenon, the partial reinforcement extinction effect (PREE), is particularly relevant to maintaining the learned industriousness effect (Amsel, 1967). The PREE refers to the resistance to extinction that occurs after exposure to intermittent reinforcement (i.e., delivery of reinforcement at irregular intervals). Due to the apparent irregularity of reinforcement delivery, responses are more difficult to extinguish than continuous or fixed partial or interval schedules. The PREE phenomenon is believed to contribute to and support observations of learned industriousness, as reinforcement gained from high-effort behavior is believed to acquire secondary reward value, consequently making the conditioned response resistant to extinction (Boughner & Papini, 2006; Calef et al., 2007; Haselgrove, Aydin, & Pearce, 2004). Eisenberger (1992) noted:

Reinforcement of increased physical or cognitive performance, or the toleration of aversive stimulation, would classically condition reward value to the sensation of high effort, thereby reducing its aversiveness and extinguishing some of the preexisting secondary reward value of low effort. (p. 250)

Eisenberger (1992) asserted that the same phenomenon is true when a task requiring a lower level of cognitive and physical effort is introduced. He described that after exposure to high-effort tasks, the introduction of a low-effort task would condition secondary reward value to the “sensation of low effort and would extinguish some of the previously established secondary reward value of high effort” (p. 250).

Eisenberger has supported his theory of learned industriousness with a series of empirical investigations in non-humans and humans. Eisenberger, Carlson, and Frank (1979) examined the
probability that effortful behavior would generalize to the acquisition of a new behavior in rats. Specifically, the study examined the relationship between various modes of food pellet presentation (e.g., fixed-ratio food delivery for lever press, free delivery of food with no instrumental response required, or no food pellet presentation) and the acquisition and rate of runway shuttling behavior. Rats in the fixed-ratio (FR) group performed superior to the other groups on the shuttling task, demonstrating positive transfer of behavior from the initial training task to acquisition and performance of a secondary task. The relationship between effort and shuttling performance was also examined in a subsequent experiment. Effort was examined among groups of rats that were rewarded with a pellet for lever pressing on an intermittent (e.g., FR-9 schedule) or continuous schedule, or for merely approaching the magazine (i.e., one group received all pellets at once and a second group received a pellet per trip). Upon examination of shuttle performance, all four groups produced similar shuttle patterns within the first five minutes of the task. Performance patterns then diverged to show that the FR group performed superior to the continuous reinforcement group, and the magazine group performed better than the massed reinforcement group. These findings support the viewpoint that reinforcement for greater effort produces a persistent and relatively stable general pattern of behavior.

A similar study by Eisenberger, Weier, Masterson, and Theis (1989) examined the effect of reinforcement for high-effort behavior on subsequent “self-control” in rats. During the training phases, rats were given reinforcement (on a continuous or ratio reinforcement schedule) for high- or low-force lever presses, where required effort and reinforcement were progressively increased. Choice (i.e., between low- and high-force conditions) and runway training conditions were then completed in which reinforcement contingencies were progressively altered to provide increased reinforcement for a higher level of performance. Rats exposed to FR reinforcement
conditions exhibited greater self-control on later effort tasks, such that those reinforced for an increasing ratio of runway traversals subsequently preferred a large food reward requiring high lever force as opposed to a smaller food reward requiring low lever force. A second experiment showed that FR reward in the runway also increased preference for food-contingent lever pressing that required periodic shock (i.e., punishment) as opposed to the absence of both food and shock. In a third experiment, FR reward was also associated with preference for large food reward associated with periodic shock, as opposed to a small amount of food in the absence of shock. This series of studies demonstrated a preference for increased effort expenditure for receipt of greater reward. These findings are consistent with learned industriousness theory, as reward for increased effort generalized across performance domains (e.g., greater effort expenditure with respect to lever press, runway traversals, and shocks sustained).

Based upon observations that reinforcement of high-effort behaviors reinforced on an intermittent schedule of reinforcement improved performance on later, unrelated tasks (e.g., runway traversals) in rats, Eisenberger and his colleagues (1979) advanced additional hypotheses about the learned industriousness phenomenon in humans. Since the number of performances required for the reinforcement of one behavior has been found to affect subsequent effort expenditure among other instrumental behaviors, the “transfer of effort effect” or TEE was proposed. According to the TEE, intermittent reinforcement of one behavior should increase the performance of a topographically different behavior. Consistent with this hypothesis, Eisenberger, Heerdt, Hamdi, Zimet, and Bruckmeir (1979) investigated the effect of contingent reinforcement for high-effort behavior on subsequent performance of a topographically different behavior. They independently studied this relationship with adult psychiatric patients and pre-adolescent children with learning disorders. In the first experiment, depressed adult psychiatric
patients were asked to complete a card-sorting test during baseline in which they were provided verbal praise (e.g., “Great, I really appreciate your help.”) for sorting one or packets of cards, or asked to try their best to sort packets. During the training phase, participants were asked to help complete chore-like cleaning and maintenance tasks. The high-effort group was asked to complete four to five sets of tasks (i.e., sets included three to four tasks) each day over two days, whereas the low-effort group was asked to complete one task. Verbal praise was provided to both groups contingent on performance (e.g., mention how helpful the participant had been). The control group was treated as usual at the ward. Each group then completed the card-sorting task. Results showed that the high-effort group persisted longer and sorted more packets compared to the low-effort or control group, although performance of the high-effort group was found to decrease across the four post-training sorting sessions.

The second experiment (Eisenberger, Heerdt, et al., 1979) conducted in children with learning disabilities similarly demonstrated that reinforcement of high-effort behavior positively impacted performance on a subsequent task. During the baseline condition, children were asked to copy nonsense syllables for 50 minutes before the training sessions were initiated. Children were then assigned to high- and low-effort conditions where they were asked to learn to read and spell new words over the course of 11 sessions. The low- and high-effort groups were initially reinforced under similar conditions (e.g., 1 point per new word read, and then 1 point per two old words correctly read or spelled). Notably, once a word was correct four times, it was no longer used. The performance demands of the high ratio group progressively increased such that the demands during Session 3 (e.g., 1 point per two correct new words, and 1 point per 3 correct old words) were different from that of Sessions 4–6 (e.g., 1 point per three correct new words, and 1 point per 4 correct old words) and the demands increased up until Session 11. At the conclusion
of each session, each child was informed of the number of points they had earned. Both groups of children then participated in a math test three days after training and the handwriting task was then administered two days later. Results showed that the children in the high-ratio group spent more time and accomplished more on the handwriting and mathematics test than the low-ratio group. These findings demonstrate that rewarded high-effort behavior can positively influence performance measures in other domains.

**Variables influencing learned industriousness.** Early research into learned industriousness demonstrated that humans do in fact exhibit the phenomenon. Subsequent studies further investigated the conditions in which this adaptive behavior pattern is likely to occur. Initial studies identified the importance of contingent reinforcement to the presentation of learned industriousness, demonstrating that individuals provided with contingent reinforcement to a narrow range of behaviors are likely to exhibit better performance than those reinforced non-contingently or contingent upon a broad range of responses (Eisenberger, Leonard, et al., 1979; Eisenberger et al., 1976). Evidence for the importance of stringent implementation of contingent reinforcement strategies is also supported by the behavioral variability literature, which shows that variability in behavior results from specific contingent reinforcement efforts as opposed to it emerging as an artifact of non-specific or unintentional reinforcement procedures (Page & Neuringer, 1985). That is, the conditions under which learned industriousness emerges has been investigated and found to result when contingent reinforcement is delivered under specific conditions, including use of various tasks that are characteristic of a certain degree of difficulty.

Task variety has received considerable attention as it pertains to transfer of learning and persistence observed in learned industriousness. Generalization of effort increases as task variety increases. Eisenberger, Masterson, and McDermitt (1982) provided evidence that task variety is
associated with generalization of effort by conducting a study in college women, who were asked to participate in various tasks requiring different degrees of effortful responding. Groups were differentiated based upon degree of task variety and required effort. During the baseline condition, the participants were asked to write an essay to gain a measure of verbosity. Participants then either completed low- or high-variety tasks within the context of tasks that required low- or high-effort. For instance, participants in the low-variety group completed mathematics problems, anagrams, or perceptual identification tasks that were of different degrees of difficulty (i.e., mathematics problems that required either two digit, low-effort or seven digit, high-effort problems). Participants in the high-variety group completed all three tasks, which required either low- or high-effort. All participants then wrote a second essay on a different topic. Results showed that task variety increased effort generalization to another behavior, such that participants in the high-variety, high-effort group exhibited generalized effort on two performance dimensions, producing significantly longer and more quality essays than all other groups (i.e., low-effort groups, as well as the high-effort group with low task variety).

Dimensions of task-specific trained behavior have also been found to generalize, as evidenced by Eisenberger, Mitchell, McDermitt, and Masterson (1984), who examined the transfer effect of trained speed and accuracy, and later performance on these dimensions during tests in adolescents with learning disabilities. Generalization of accuracy was more durable than speed.

The degree of effort required on a task has also been found to largely contribute to transfer of learning and generalization of the learned industriousness effect. Learned industriousness studies with rats employed physical measures of effort, showing that performance on tasks involving higher effort (e.g., press lever on a fixed ratio schedule for food delivery, as opposed to continuous reinforcement) generalized to increased effort on a different
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human investigations of learned industriousness more commonly employ effort tasks that draw upon cognitive skills. These investigations have varied the degree of cognitive difficulty, utilizing tasks characterized as simple, complex, or “impossible” (i.e., unsolvable) to examine the effect of task difficulty on the learned industriousness phenomenon. Findings have shown that although participants appear motivated by tasks deemed as impossible (as evidenced by greater time spent on these tasks), tasks of extremely high difficulty or those that were “unsolvable” reduced persistence on subsequent tasks. In contrast, superior persistence was generally observed when tasks were complex or of medium to high difficulty, as opposed to those that were simple (Eisenberger & Leonard, 1980). One group of researchers examined the effect of task difficulty on later task persistence by first administering a digit memory task in which degree of task difficulty was varied by altering digit length (i.e., between 5–11 digits). Longer digit sequences were associated with reduced persistence on a subsequent timed anagram task. Drucker, Drucker, Litto, and Stevens (1998) concluded that persistence characteristic of the learned industriousness phenomenon was demonstrated after digit tasks that used between five to eight digits. Learned helplessness behavior was likely to follow tasks that incorporated a digit presentation that exceeded eight digits (i.e., 9–11 digits).

Other studies have shown that tasks of medium or moderate difficulty are likely to produce a learned industriousness effect. In Hickman, Stromme, and Lippman's (1998) study, participants underwent low- or high-effort training on a variety of tasks (e.g., anagrams, addition problems, and perceptual difference tasks), and persistence was examined by administration of pencil-and-paper maze tasks. Although overall persistence on maze performance did not statistically differ between the two groups, participants in the low-effort and control conditions
passed on significantly more mazes (i.e., skipped the mazes) than did the high-effort group, suggesting that high-effort training reinforces effortful behavior. Cameron, Pierce, and So (2004) have also demonstrated that participants perform better (i.e., more correct answers) and exhibit greater effortful behavior on a later task when they are first trained on a task of moderate difficulty as compared to a low-effort task. Cameron et al. (2004) similarly used a “find the difference” task (FTD) task, which included two cartoons with a possible of six possible differences. The low-effort group was asked to find two differences, whereas the high-effort or moderate difficulty group was asked to find four differences. The effect of reward was examined in which it was provided (i.e., a small sum of money) contingent on correct responses. Following the training phase, participants were tested with new FTD problems and then given a choice to continue completing other FTD problems or engage in alternate activities, such as reading a magazine. Results show that participants rewarded for success of high-effort behavior during training did better during the test than those who were not rewarded. In contrast, participants rewarded for low-effort behavior during training performed worse during the test than those who were not rewarded and spent less free time on FTD tasks than non-rewarded participants during the free choice period; these findings suggest that reward for low-effort behavior impairs performance below the level of control participants. The rewarded high-effort group, however, spent more time engaged in FTD tasks during the free choice period than the non-rewarded group and reported greater levels of task enjoyment, demonstrating the value of rewarding tasks of moderate difficulty as opposed to those that are more basic.

In addition to task variety and task difficulty, the presence of reinforcing agents has been shown to influence learned industriousness. Specifically, reinforcing agents (i.e., agents delivering contingent reinforcement) determine the rate in which response patterns are learned,
such that these agents hold a degree of stimulus control with respect to acquisition of learning. It is notable, however, that the rate at which learning is transferred to another task is unaffected in circumstances in which reinforcing agents are replaced by novel agents (Eisenberger, Leonard, et al., 1979).

As noted thus far, the learned industriousness effect has been found to emerge only when certain conditions are met. Response acquisition and transfer of learning observed in learned industriousness results in an adaptive behavioral pattern, characterized by productive, persistent, effortful behavior. Research within this area has found associations between learned industriousness and goal-directed behavior, finding that those individuals who are rewarded for effortful behavior demonstrate an increase in goal-oriented behavior (Eisenberger, Kuhlman, & Cotterell, 1992). Similarly, when participants are subject to task demands and performance standards that progressively increase in difficulty, they exhibit greater intrinsic motivation and task engagement during free response periods (when no external rewards were available) than those who were rewarded for maintaining a consistent level of behavior (Gear, 2007; Pierce, Cameron, Banko, & So, 2003). Although no group differences were observed with respect to perceived self-efficacy or competence, these findings show the positive, adaptive effects of rewarding effortful behavior (Pierce et al., 2003).

In summary, the literature suggests that a lean schedule of reinforcement generates the learned industriousness effect, which produces a relatively higher rate of responding. In order to heighten the probability for industriousness to be displayed, it is necessary that the discriminative properties of the industrious-generating experience be replicated, to some extent, in a new setting. However, it is important to note that if the discriminative conditions are too specific, a more specific discriminated rate-enhancing effect would be observed as opposed to the "learned
industriousness effect.’’ Thus, it is the relatively non-specific discriminative stimuli that enhance opportunities for industriousness to occur, leading to the effect being seen in a broader range of circumstances.

**Clinical Applications of Learned Industriousness Theory**

The learned industriousness effect has been investigated in different populations and as it relates to several relevant domains. For instance, learned industriousness theory was examined in relation to academic cheating, such that high-effort training was associated with greater persistence, better performance, and less cheating behavior among college students (Eisenberger & Masterson, 1983). Given its apparent utility in facilitating adaptive behavior, learned industriousness theory has been studied in regard to other functional and clinical applications, including as an intervention for smoking cessation (Brandon et al., 2003; Quinn, Brandon, & Copeland, 1996; Quinn, 1996), attention deficit hyperactivity disorder (ADHD; Miello, 2005), unemployment (Plumly & Oliver, 1987), and enhancing behavior among individuals residing in residential communities (Polenick & Flora, 2012).

Recent work has examined the relationship between effort training and persistence as it relates to smoking cessation, finding mixed support for use of this paradigm to enhance the likelihood for high-effort behavior and persistence required for smoking cessation (Brandon et al., 2003; Quinn et al., 1996; Quinn, 1996). A preliminary study used an anagram task to examine persistence at pre- and post-training, perceptual identification and problem-solving tasks (to remove an aversive tone) during the low- and high-effort training phase, and a coding task as a measure of persistence post-training. Effort training was found to be minimally effective at increasing persistence among smokers, such that transfer of learning did not occur, but rather persistence was negatively correlated with latency to cigarette smoking (i.e., those who
exhibited greater persistence smoked sooner than less persistent individuals; Quinn, 1996). A related investigation later showed that non-smokers characteristically exhibited greater persistence on behavioral measures than smokers, which was consistent with findings demonstrating a lack of the learned industriousness phenomenon among this clinical group (Quinn et al., 1996). However, Brandon et al. (2003) later found that pre-treatment persistence on a mirror-tracing task was a predictor of sustained abstinence from cigarette smoking throughout the one year of the study, showing that although anagram tasks are widely used as a measure of persistence within the learned industriousness literature, they were not found to be predictive of abstinence in that respective study. This finding suggests that the anagram persistence task may not be an appropriate measure of persistence use with all individuals, especially samples that are non-collegiate.

Learned industriousness theory has also been examined as it relates to impulsivity, self-regulation, and attention deficit hyperactivity disorder (ADHD; Miello, 2005; Peterson, Hill, Marshall, Stuebing, & Kirkpatrick, 2015). In particular, individuals with ADHD have been characterized as exhibiting lower task persistence, effort, and use of cognitive strategies, in addition to an external locus of control. This constellation of symptoms is pertinent to studies of learned industriousness theory, which presumes that high-effort training can influence adaptive change in behavior. Miello (2005) hypothesized that individuals with symptoms characteristic of ADHD would perform poorer on effortful tasks than individuals with no history of ADHD, given the nature of the symptoms associated with ADHD (e.g., inattention, impulsivity, and hyperactivity). Results from this study showed that individuals with ADHD, indeed, exhibited a pattern of poor effort and persistence on effortful tasks in addition to endorsing a self-reported profile that was reflective of poorer adjustment to the social and academic aspects of college than
individuals with no history of ADHD symptoms (Miello, 2005). Perhaps participants with history of ADHD in this particular study would have demonstrated the learned industriousness phenomenon had they been exposed to a more rigorous and extensive course of effort training (i.e., training conducted over multiple sessions). The potential utility of interventions aimed at facilitating the learned industriousness effect in a population of individuals with impulse control issues, such as over-eating and obesity remains a current area of investigation (Peterson et al., 2015).

Unemployment, job-seeking, and related behavior patterns among residential community dwellers have been investigated in relation to learned industriousness theory (Foy & Mitchell, 1990; Plumly & Oliver, 1987; Polenick & Flora, 2012). Plumly and Oliver (1987) discussed the implications of unemployment and job-seeking on individuals who exhibit an “external locus of control” (i.e., belief that rewards of life are controlled by outside forces and tend to occur independently of one’s efforts). When individuals with an external locus are placed in a helpless situation over a period of time, they have a more difficult time securing employment. Plumly and Oliver (1987) discuss this finding in relation to possible intervention strategies, proposing that learned industriousness and learned competence have facilitated adaptive behavior (i.e., successful use of behavior modification techniques among participants). More recently, learned industriousness has been studied in relation to elderly individuals living within a joint, skilled nursing home and residential care facility. Polenick and Flora (2012) examined the effect of contingent social praise for creative, unconventional response to an object use task. Results showed that rewarding unusual and unique responses served to increase creativity among participants on subsequent activities in which social praise was not provided. The implications of these findings are discussed with respect to the potential relationship between the facilitation of
creativity and independent functioning. It is believed that enhancing creativity may serve to increase independent, adaptive functioning among the elderly and reduce dependence within residential care facilities.

**Considerations: Alternative Explanations for Transfer of Persistence**

A variety of studies have demonstrated that the learned industriousness phenomenon can be facilitated in non-humans and humans. The learned industriousness effect, or transfer of persistence phenomenon, has been observed in children, adolescents, and adults, and among those with normative and clinically relevant behaviors (e.g., learning disabilities, psychiatric patients, and nicotine addiction). Although the learned industriousness effect has been observed in several different populations, there are a variety of alternative explanations that have been proposed to account for this effect, including the law of least effort, frustration tolerance, conditioning to reinforcement contingencies/sequences and motoric activity, rule learning, cognitive dissonance, and self-efficacy. These alternative explanations will be briefly considered below.

The law of least effort as proposed by Hull (1943) may most clearly appear to lie in opposition to learned industriousness theory. The law of least effort states that organisms generally expend the least amount of effort in order to obtain the greatest effect, such that the behavior with the least effort will be chosen if a discriminable choice is available. This concept is also embodied in various versions of the matching law, in which organisms typically choose higher rates of return relative to lower ones when other variables, such as delay of reinforcement, are constant (Herrnstein, 1961, 1970; Reed & Kaplan, 2011). Eisenberger (1992) accepts this notion, but also acknowledges that equivalently clear reinforcement contingencies do not usually occur in the natural environment. Rather, he proposed that organisms typically have to choose
between reinforcement contingencies, explaining that organisms will perform a high-effort behavior if it is associated with a bigger reward than a low-effort behavior that is associated with a smaller reward. Eisenberger (1992) articulates this point:

Seldom does the organism face a choice between two degrees of effort that produce roughly the same magnitude of reinforcement. Typical everyday contingencies involve a single task, or a choice among several tasks, in which increased performance leads to a greater magnitude of reinforcement. The law of least effort is silent concerning the required trade-off between keeping performance low and keeping the magnitude of reinforcement high. (p. 249)

Frustration-based explanations have also been proposed to account for the transfer of persistence phenomenon (e.g., Dollard, 1939; Berkowitz, 1978). Early investigations by Amsel (1958) identified that transfer of persistence results from intermittently reinforcing behavior, which produces a general tolerance to frustration through counterconditioning. This theory hinges on the assumption that frustration results when previous rates of reinforcement are not obtained for the same behavior. Amsel (1992) proposed that organisms progress through four stages, initially exhibiting a vigorous task approach and subsequently appearing emotionally reactive (e.g., biting, urinating, and defecating) when reward is withheld within a partial reinforcement schedule. Progression from the third to fourth stage has been identified as the crucial point of transition from conflict to effortful behavior, as organisms first exhibit an increase in conflicted behavior (e.g., retracing path and urination) and then resolve and resume vigorous and consistent effortful behavior. Behavior analysts refer to this constellation of effects non-specifically as “extinction bursts” although the emotionality associated with extinction has also be recognized and characterized as “extinction-induced aggression” or “emotionality”
Azrin & Holz, 1961; Azrin, Hutchinson, & Hake, 1966; Hutchinson, 1972; J. F. Kelly & Hake, 1970; Todd, Morris, & Fenza, 1989). Wong (1977, 1978, 1979) extended Amsel’s frustration theory to persistence, showing that a high ratio of responses facilitates goal-directed responding in the presence of frustration. Wong explained the generalized increase in goal-directed behavior as a “try strategy” that manifested in the presence of frustration cues. However, Eisenberger, Terborg, and Carlson (1979) noted a significant difference between frustration-tolerance and learned industriousness theory. Findings show that generalized persistence may be increased or decreased under assumptions of learned industriousness theory but cannot be manipulated under mechanisms purported to underlie frustration-tolerance theory.

The sequence in which reinforcement is delivered has also been proposed to account for the transfer of persistence that occurs in learned industriousness. Capaldi (1966) proposed that sequential analysis of reinforced and nonreinforced behaviors is important to understanding the extinction phenomenon that occurs in the PREE. Capaldi (1996) also described that resistance to extinction is impacted by reinforcement patterns, such as the nonreinforcement-length (N-length), number of different N-lengths, and number of occurrences of each N-length. The theory assumes that organisms become conditioned to the sequence of reinforcement, therefore influencing expectancies about subsequent reinforcement and impacting resistance to extinction. Sequence effects were examined, however, by Eisenberger and Leonard (1980) who controlled for the pattern of successes and failures among groups of participants during the effort training phase to determine whether order influenced persistence. This was examined by yoking a participant in the negative-effort group to a participant in the high-effort group such that when the high-effort group member solved an anagram correctly, the yoked participant was given a simple anagram to solve. When the high-effort participant failed to solve an anagram, the yoked
participant was given an unsolvable anagram. Although the patterns of successes and failures among negative-effort and high-effort groups were the same, results showed that the high-effort group persisted significantly longer than the negative-effort group. Thus, the results demonstrate that differences in persistence are best explained by rewarded high-effort as opposed to sequence effects, since the sequence of reward was the same among negative-effort and high-effort groups.

Similarly, conditioned activity and rule learning have also been proposed to account for the transfer of persistence effect. Eisenberger, Terborg, et al. (1979) explored the possibility that transfer of persistence occurs as a result of conditioned activity. Rats were first trained to bar press and then delivered food pellets after exhibiting varying degrees of effort (i.e., fixed ratio schedule, continuous reinforcement, and magazine group yoked to fixed ratio group). Rats in the high-effort, fixed ratio reward group exhibited a higher rate of bar pressing behavior than the other two lower-effort groups. A second experiment was then conducted to determine whether the differences between groups could be attributed to a conditioned increase in activity and conditioning to food cues. Rats in each group were exposed to food in the conditioning chamber both before and after the fixed ratio or magazine treatment conditions. Results showed that high activity among the fixed ratio group was not due to increased general activity conditioned to food presentation, since there were no significant differences between rat activity (e.g., grid crossings) among rats in each group. Eisenberger (1992) also notes that rule learning (i.e., abstraction of rule related to requirements to sustain reinforcement) has been proposed to account for the transfer of persistence effect. However, he maintains that rule learning may supplement the secondary reward processes but is unlikely to wholly account for the transfer of persistence effect observed when organisms are rewarded for exhibiting high effort.
Cognitive interpretations of the learned industriousness or transfer of persistence effect have also been offered. Self-efficacy theory suggests a strong relationship between cognition and behavior, such that cognitive processes mediate behavioral change. Bandura (1977) proposed that expectations self-efficacy influence the likelihood that coping behaviors will be initiated in the face of adversity. Multiple sources of information have been proposed to inform expectations of self-efficacy, including performance accomplishments, vicarious experiences, verbal persuasion, and physiological states. These sources of information that inform expectations of self-efficacy vary in magnitude, strength, and generality, and so influence the quality (e.g., strength and duration) of one’s coping behaviors in the face of adversity. Self-efficacy is closely related to learned industriousness, as one’s perception and personal experience of mastery enhances subjective expectations of what one is able to endure and overcome in subsequent, potentially threatening situations. In this way, cognitions of self-efficacy are closely related to behavior and the learned industriousness phenomenon, influencing the intensity and persistence of effort (Bandura, Adams, & Beyer, 1977; Deci & Ryan, 1987; Ryan & Deci, 2008).

Relevance of Learned Helplessness-Industriousness Continuum to TBI Rehabilitation

The learned industriousness literature has shown support for the persistence of effort phenomenon, which manifests as productive behavior in non-humans and humans. Given that the learned industriousness phenomenon has utility in producing adaptive behavioral responses, it is highly relevant to circumstances in which effort is low or lacking. Studies show that individuals in hospital or residential community settings are especially vulnerable to falling victim to the learned helplessness effect, demonstrating that these settings foster dependence as opposed to independence in middle-aged adults and elderly patients (Foy & Mitchell, 1990; Polenick & Flora, 2012; Raps et al., 1982). Raps et al. (1982) found that when cognitive skills of inpatient
and outpatient male veterans were examined at varying time points in treatment (i.e., 1, 3, and 9-weeks), cognitive skills believed to index learned helplessness increased as patients spent greater time in inpatient or outpatient treatment. Interestingly, these patients were improving medically but were found to endorse depressive symptomology that was related to poor performance on cognitive tasks (e.g., anagram and hand shuttle noise cancellation task) as time spent in the hospital increased. These results suggest that perceived lack of control within hospital settings may facilitate the manifestation of depressive symptomology that negatively impacts cognitive abilities.

Similarly, elderly patients residing within residential assisted care facilities have also shown vulnerability to the learned helplessness effect (Foy & Mitchell, 1990; Polenick & Flora, 2012). Since the reinforcement contingencies in this type of facility generally offer greater opportunities for social reinforcement for dependent behavior, as opposed to independent, autonomous behavior, patients are believed to develop behavior characteristic of learned helplessness, perhaps exacerbated by the other conditions that resulted in their placements. Despite this vulnerability to fall victim to the learned helplessness effect, clinical applications of learned industriousness theory have demonstrated promising results. For instance, Polenick and Flora (2012) investigated the effect of contingent reinforcement for unique, creative (i.e., independent) behaviors on general behavioral patterns. Results showed that when elderly individuals were socially reinforced for unconventional behaviors, this pattern of unique and creative responding generalized to other tasks and situations. Taken together, the literature shows that contingencies within hospital or residential care settings generally facilitate dependent and conventional behavior and thwart ingenuity and independence, but creative interventions can
help to compensate for the influence of environmental control (Polenick & Flora, 2012; Raps et al., 1982).

Given the negative implications of the learned helplessness phenomenon, efforts have been made to develop intervention strategies to combat its effects. The widespread impact of learned helplessness is well-known and well accepted, manifesting in individuals with low levels of perceived mastery, self-control, self-confidence, in addition to global and stable negative world views. In an effort to address the negative implication of learned helplessness across individuals of varying clinical groups, Flannery (2002) proposed that interventions providing stress-resistance training would serve as a buffer against factors that influence the occurrence of learned helplessness. Indeed, Program SMART (stress management and relaxation training) has been efficacious in restoring mastery, resolving behavior characteristic of learned helplessness, and facilitating stress-resistance in several clinical groups, including individuals with anxiety, depression, psychological trauma, and other serious forms of mental illness. It has also been suggested to improve psychological well-being in elderly dementia patients. The program focuses on teaching personal control and mastery, commitment to personally meaningful tasks, adoption of healthy lifestyle choices, and incorporation of social involvement to facilitate adaptive problem solving and reduce the likelihood for learned helplessness. Given the success of Program SMART in reducing depression and resolving learned helplessness symptoms (Flannery, 2002), it is plausible that an intervention built upon a similar premise would be efficacious with individuals with TBI who similarly struggle with self-esteem and motivational deficits.
Purpose of the Current Study

Building from Flannery’s (2002) perspective, in conjunction with the aforementioned body of literature on learned industriousness (Eisenberger, Carlson, et al., 1979; Eisenberger, Heerdt, et al., 1979; Eisenberger et al., 1992, 1982, 1984, 1976, 1989; Eisenberger, Leonard, et al., 1979; Eisenberger & Leonard, 1980; Eisenberger & Masterson, 1983; Eisenberger, Terborg, et al., 1979; Eisenberger, 1992; Hickman et al., 1998), the current study proposes that behavior characteristic of learned helplessness, such as low engagement and productivity, can resolve following exposure to contingencies that reward effortful behavior. It is hypothesized that intervening at the behavioral level can influence change in cognitive and emotional processing and positively impact adaptive engagement. The effort training paradigm pioneered by Eisenberger is hypothesized to favorably affect cognitive schemas by creating experiences in which individuals with moderate to severe injuries experience success, which thereby initiates a cascade that positively impacts change in cognition (e.g., self-efficacy and intrinsic motivation) and behavioral and emotional functioning (e.g., increases adaptive participation and minimizes or reduces pre-existing mood issues). The implications of the current study are widespread, as it may serve to identify an intervention strategy that targets improvement across several life domains, increasing engagement in daily tasks and enhancing overall quality of life for individuals with moderate to severe TBI.
Chapter 4: Aims & Hypotheses

Aims

1. To replicate learned industriousness effect (pioneered by Eisenberger and colleagues) in participants with a history of moderate to severe traumatic brain injury (TBI) who exhibit low levels of engagement in activities of daily living.

2. Investigate the effect of effort training as an intervention to increase engagement in activities of daily living among participants with moderate to severe TBIs who exhibit low levels of engagement in performing activities of daily living.

3. Expand upon learned industriousness literature by examining the effect of effort training on reports of self-efficacy, self-reported emotional functioning, and quality of life.

Hypotheses

1. Individuals who participate in high-effort training will subsequently exhibit increased persistence on a card-sorting task post-intervention, as measured by duration of time engaged with task.

2. Persistence on post-intervention card-sorting task will be maintained at 6-week follow-up.

3. Individuals who participate in high-effort training will subsequently exhibit generalization of effort as increased engagement in activities of daily living during the intervention period, as measured by increased frequency of independent participation in activities of daily living in which performance is rated “good” more frequently than “poor.”

4. Level of engagement with activities of daily living observed during the intervention phase will be maintained during the 6-week follow-up period.
5. Self-reported ratings of self-efficacy, depression, and quality of life are anticipated to improve from pre- to post-intervention.
Chapter 5: Methods

Design

A single case reversal design was used for the current study. A single case experiment is an intensive, prospective study of an individual or group of individuals using a priori methodology that includes systematic observation, manipulation of variables, repeated measurement, and data analysis (Tate et al., 2008). Heterogeneity (e.g., demographic and injury-related differences) across individuals with traumatic brain injury (TBI) and difficulties associated with implementation with large numbers of individuals creates conditions that make single case experimental designs (SCEDs) more appropriate for investigating hypotheses regarding patient-level improvement and treatment efficacy than the traditional “gold standard,” randomized control trial (RCT), or other designs examining group response to intervention (Wilson, 2011). The SCED permits patient-level examination of change over time, providing a framework for investigating individual differences across participants with TBI and response to intervention. Thus, internal validity is considered to be an advantage of SCED’s while external validity is believed to be a disadvantage of this design (Wilson, 2009).

Setting

Participants were recruited from a Midwestern residential brain injury facility. The residential brain injury facility advocates for an “individualized, multi-disciplinary, personal care” model within a community campus setting that supports a “goal-oriented approach” to care. The core services offered to each client include: supported employment, substance abuse prevention program, nursing/health education, behavior analysis, recreational activities, and transportation among opportunities for enrichment activities and recreational and music therapy. Residents reside in various types of settings, including those are more supervised or independent.
All recruited participants resided in supervised, independent living settings in which they lived in a single apartment and were routinely checked at 30–60 minute intervals by staff.

**Participants**

One female and two male residents of a Midwestern residential TBI facility. Participants were between 45 and 48 years of age. Specific aspects of the participants’ diagnoses and other factors are detailed below. Sample size was determined based upon standards put forth by a panel of experts in single case design research who denote that “cases” can include a single participant or group of participants (Kratochwill et al., 2010). Due to the rigorous nature of the intervention, a small group of participants was preferred. Participants were nominated by clinical staff (e.g., behavior analyst, clinical director, occupational therapist, or physical therapist) to participate in the study due to a consistent, low level of independent engagement in activities of daily living, including hygiene, grooming, and dressing behaviors. Eastern Michigan University’s Human Subjects Review Committee approved this project (see Appendix A). Nine participants were nominated to enter the study, but five individuals did not meet study criteria. Four participants were consented. One participant did not enter the study due to lack of time availability and frequent vacation travel, limiting his availability for participation in the on-campus research study.

**Inclusions.** Participants were required to be between 18–50 years of age and have medical records available for review to be included in the study. Since each of the potential participants nominated for the study had a legal guardian, consent from all relevant parties was required before the nominated participants entered the study. Participants that had a documented history of moderate to severe TBI were sought for the current study, as evidenced by positive imaging (e.g., fracture or bleed), documented loss of consciousness (LOC) between 30 minutes
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to 24 hours (moderate TBI) or greater (severe TBI), or Glasgow Coma Scores (GCS) rating of less than 13 (9–12 moderate and 3–8 severe). Additionally, participants with records to indicate alteration of consciousness (AOC) for more than 24 hours and post-traumatic amnesia (PTA) for 1–7 days (moderate TBI) or longer (severe TBI), and those that had previous neuropsychological testing data were highly desirable; however, detailed medical records for the acute hospital course were generally unavailable for each of the nominated participants. Thus, documented loss of consciousness served as a primary indicator of injury severity for inclusion into the study.

Participants were at least 2 years post-injury in an effort to control for potential confounds, as the literature suggests that most spontaneous recovery occurs within the first 2 years following injury (Schretlen & Shapiro, 2003). Although participants were nominated to participate in the study due to a low level of engagement with activities of daily living, participants were required to possess the capability to independently complete ADLs given cues or prompts. As part of the screening process, the Barthel Index (Collin, Wade, Davies, & Horne, 1988; Mahoney & Barthel, 1965) and Overt Behaviour Scale (OBS; Kelly, Todd, Simpson, Kremer, et al., 2006) were administered to ensure that all participants recruited into the study exhibited a low level of initiation and were capable of independently completing ADLs.

Exclusions. Nominated participants were excluded from the study if they were independent with ADLs (i.e., complete activity without prompts or cues) or if they were functionally blind or had physical impairments, including paralysis (e.g., quadriplegic or paraplegic), tremor, or other movement disorder that prevented functional engagement and independent completion of activities of daily living. Participants were also excluded if they were noted to exhibit problematic behaviors such as physical aggression on the OBS, as these behaviors would have impeded implementation of the intervention or confound inferences that
could be drawn from the completed study. Additionally, participants were required to speak, read, and write English, and had to possess adequate vision and visual reasoning skills (i.e., score within 2 standard deviations of the mean on WAIS-IV Matrix Reasoning and no qualitative evidence of visual neglect on WAIS-IV Cancellation and CLOX-1/CLOX-2).

**Participant 1.** Participant 1 was a 46-year-old, single, Caucasian male who had sustained a TBI following a motor vehicle accident (MVA) when he was 9-years-old. He had been living in a supervised independent living apartment setting since November 2011. Per record review, Participant 1 was involved in a MVA vs. MVA in January 1978 in which he was in a coma for 49 days. Prior to his injury, Participant 1 had history significant for hernia surgery, nearsightedness (wore eyeglasses), and “wheezing.” Secondary to his injury, records show that Participant 1 developed a seizure disorder, Hepatitis C related to blood transfusion, and internal bleeding (per client report). Given his age of injury, Participant 1 was documented to experience developmental and emotional delay. Participant 1 was admitted to his current placement in the residential rehabilitation facility in March 1998. Upon admission, he was noted to have mild dysarthria, anxiety, and depression. Participant 1 was noted to have participated in two neuropsychological evaluations during his course in rehabilitation (during years 1987 and 1992), but these results were not available for review.

Treatment recommendations at the time of admission indicated that he participate in psychological counseling for adjustment concerns, exercise program, vocational employment, receive prompting for ADLs and instrumental activities of daily living (e.g., laundry), and behavioral intervention to target social inappropriate behavior. He was prescribed phenytoin for seizure control, and seizures have reportedly been controlled for over 10 years. His psychiatric medications throughout the course of the study included: lamotrigine 100 mg (daily), risperidone
1 mg (daily), and zolpidem 12.5 mg (daily for sleep). It is notable that he experienced two medication changes during the early portion of the study. His dosage of risperidone was reduced from 2 mg to 1 mg daily a few days after he was consented into the study. Approximately a month and a half later, and a week after he completed the baseline card-sorting task, Participant 1’s dosage of lamotrigine decreased from 200 mg to 100 mg daily. Medically, Participant 1 has also been followed for diabetes, onychomyocosis, severe generalized gingivitis, and chronic liver disease and cirrhosis (secondary to Hepatitis C). Concurrent with the study, Participant 1 was actively involved in two vocational placements (7 hours per week), men’s group (psychosocial group format, 1 hour per week), and scheduled recreational activities onsite at the rehabilitation facility (4 hours per week).

The demographic questionnaire revealed that Participant 1 graduated high school and completed one year of community college in computer banking and retail merchandise. Participant 1 endorsed learning problems, identifying that he was “slow” to complete work (including homework) and required extra time in order to successfully complete it. He also acknowledged that he found math, such as algebra, challenging and he received tutoring services throughout his schooling. With regard to employment history, Participant 1 reported that he previously held a position as a warehouse worker, where he sorted mail and cleaned mail bins and trucks. He also noted that he had previously worked in retail and also at an ice cream shop. He denied any substance use history.

Participant 1 obtained a Barthel Index score of 18, suggesting a high degree of independence with basic ADLs, but he required assistance with grooming and bathing activities. He received an OBS Cluster score of 4, Total Levels score of 6, and Clinical Weighted Severity score of 12 to reflect problem behaviors within the following categories: verbal aggression,
perseveration/repetitive behavior, inappropriate social behavior, and initiation. Please note that the following descriptions and examples of problem behavior are consistent with the OBS phrasing. Within the verbal aggression domain, Participant 1 was noted to engage in mild personal insults (i.e., statements clearly directed at some other person, but those that did not include swearing or offensive sexual comments). He was also reported to engage in swearing, use of foul language, and moderate threats clearly directed at others or self about once per month, but these behaviors were not identified as negatively impacting individuals in his environment. With regard to perseveration/repetitive behavior, Participant 1 was noted to engage in prolonged continuation and repetition of a behavior that did not result in physical harm once or more per week and to a degree that was having a minor impact on his environment. Within the inappropriate social behavior domain, Participant 1 was described as exhibiting socially awkward behavior (e.g., inappropriate laughter, failure to monitor personal hygiene, excessive apologizing or thanking, standing too close to strangers, failure to pick up on nonverbal cues) that occurred once per day, impacting his environment to a moderate degree. Additionally, he was noted to exhibit noncompliant or oppositional behavior (e.g., responds “no!” to prompts to do things, refuses to discuss problem behaviors with staff, will not follow toilet or shower routines, rejects or dismisses service providers who are helpful with home care, intentional lying that is not due to poor memory) once or more per week and to an extent that it was negatively impacting his environment. Participant 1 also exhibited problems with lack of initiation approximately once per day, which was moderately impacting/disrupting to his environment.

On cognitive screening measures, Participant 1 performed within the high average range on a reading test of premorbid intellectual ability. His performance on a mathematical computation task fell within the low average range. With respect to executive functioning,
performance on tasks of cognitive flexibility and attention and inhibitory control was within the borderline to mild impairment range. On a task of visual-perceptual reasoning, Participant 1 performed in the borderline impairment range. His performance on tasks administered to assess visual neglect showed no evidence of impairment. Refer to Table 1 for score profile. It is also notable that Participant 1 scored a 24 on a measure of social desirability when assessed at baseline, which is reflective of a high degree of socially desirable responses.

Table 1

*Performance on Cognitive Screening Measures by Participant ID*

<table>
<thead>
<tr>
<th>ID</th>
<th>WTAR</th>
<th>WRAT-4 Math</th>
<th>NIH Flanker</th>
<th>NIH DCCS</th>
<th>CLOX-1/ CLOX-2</th>
<th>WAIS-IV MR</th>
<th>WAIS-IV CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>113</td>
<td>80 low average</td>
<td>66 mild impairment</td>
<td>79 borderline impairment</td>
<td>-0.13/0.67 average</td>
<td>5 borderline impairment</td>
<td>2 profound impairment</td>
</tr>
<tr>
<td>2</td>
<td>98 average</td>
<td>87 low average</td>
<td>86 low average</td>
<td>78 borderline impairment</td>
<td>-0.13/-0.17 average</td>
<td>4 borderline impairment</td>
<td>5 borderline impairment</td>
</tr>
<tr>
<td>3</td>
<td>117 high average</td>
<td>78 borderline impairment</td>
<td>72 borderline impairment</td>
<td>81 low average</td>
<td>-5.75/-1 severe impairment/low average</td>
<td>6 low average</td>
<td>7 low average</td>
</tr>
</tbody>
</table>


**Participant 2.** Participant 2 was a 45-year-old, divorced, Caucasian female who sustained a TBI in a MVA vs. MVA in October 1999 when she was 30-years-old. Per record review, Participant 2 experienced a moderate closed head injury (CHI) in which loss of consciousness was reported, although the details of her acute course were not available. Participant 2 reported
that she sustained shoulder injuries and “swollen brain,” and indicated that she was in the hospital for about 3 days. Prior to her injury, Participant 2 was noted to have history of bipolar disorder (diagnosed at 18 years-old), suicidal ideation and cutting behavior, panic attacks, anxiety, platelet issues, and endometriosis. Secondary to the injury, records showed that she experienced Grand Mal seizures, kidney failure, and several surgeries on her left shoulder and left knee, including reconstruction of her rotator cuff and scapula. Participant 2 was admitted to her current placement in the residential rehabilitation facility in September 2011 for drug and alcohol rehabilitation secondary to her CHI. Upon admission she was noted to have a history of alcohol, crack cocaine, heroin, and prescription pain pill abuse. She was also noted to experience depression, with possible diagnosis of personality disorder. Participant 2 was noted to have participated in two neuropsychological evaluations in 2007 and one in 2009, but these results were not available for review.

Treatment recommendations at the time of admission included occupational therapy, psychological counseling, speech therapy, and substance abuse counseling. Throughout the course of the study, Participant 2 was reported to hold a vocational employment in which she was not actively involved. She was semi-active in weekly, individual psychological counseling and group substance abuse treatment group. Her psychiatric medications throughout the course of the study included: clonazepam 1 mg (twice daily), clozapine 150 mg (daily), duloxetine 40 mg (daily), and quetiapine 50 mg (once daily and PRN). Notably, her dosage of quetiapine was tapered down and ultimately removed from her regimen and a PRN clozapine was added. The discontinuation of quetiapine corresponded with the end of the intervention period. Medically, Participant 2 has been followed for occipital neuralgia, pre-existing conditions (e.g., endometriosis), abdominal pain, and nausea.
The demographic questionnaire revealed that Participant 2 graduated from high school and completed occupational health classes to become a dental assistant. Participant 2 reported that she was a “C/D” student, indicating that she did not apply herself and was “too much of a socialite.” Specifically, she reported that she experienced learning difficulties in the area of math and received math tutoring during her senior year of high school after failing a course. With regard to employment history, Participant 2 reported that she had worked as a dental assistant for 2 years, and she was employed at the time of the accident. Social history revealed that Participant 2 was married for 11 years and divorced one year prior to her injury. She has two, adult children from her marriage. Regarding substance use, Participant 2 acknowledged a 5-year history of tobacco use (quit in June 2015). She also reported abusing alcohol and pain pills for the year following her accident, in addition to use of crack cocaine for several years following her injury, requiring intermittent participation in substance use rehabilitation.

Participant 2 obtained a Barthel Index score of 20, suggesting independence with all basic ADLs. She received an OBS Cluster score of 2, Total Levels score of 4, and Clinical Weighted Severity score of 11 to reflect problem behaviors within the following categories: inappropriate social behavior and initiation. Please note that the following descriptions and examples of problem behavior are consistent with the OBS phrasing. With respect to inappropriate social behaviors, Participant 2 was noted to exhibit socially awkward behavior (e.g., inappropriate laughter, failure to monitor personal hygiene, excessive apologizing or thanking, standing too close to strangers, failure to pick up on nonverbal cues) multiple times per day that was negatively impacting her environment to a moderate degree. Participant 2 was also reported to display nuisance/annoyance behaviors (e.g., interrupts other people’s conversations, actively does things to seek attention, inconsiderate of other people, nagging/inpatient behavior) once or
more per month, negatively impacting her environment to a minor degree. She was also noted to exhibit noncompliant or oppositional behavior (e.g., responds “no!” to prompts to do things, refuses to discuss problem behaviors with staff, will not follow toilet or shower routines, rejects or dismisses service providers who are helpful with home care, intentional lying that is not due to poor memory) multiple times per day and negatively impacting her environment to an extreme degree. With regard to initiation, Participant 2 was described as requiring prompting to complete all tasks on an everyday basis, which was negatively impacting/disrupting to her environment to an extreme degree.

On cognitive screening measures, Participant 2 performed within the average range on a reading test of premorbid intellectual ability. Her performance on a mathematical computation task fell within the low average range. With respect to tasks of executive functioning, performance on tasks of attention and inhibitory control and cognitive flexibility were within the low average to borderline impairment range, respectively. On a task of visual-perceptual reasoning, Participant 2 performed in the borderline impairment range. Her performance on tasks administered to assess visual neglect showed no evidence of impairment. Refer to Table 1 for score profile. It is also notable that Participant 2 scored a 23 on a measure of social desirability when assessed at baseline, which is reflective of a high average degree of socially desirable responses.

**Participant 3.** Participant 3 was a 48-year-old, single, African American male who sustained a TBI when he was 22-years-old. Per record review, Participant 3 was driving a motor vehicle when he fell asleep at the wheel and was ejected from the car in July 1989. Participant 3 reported that he was in a coma for 2 months, although the details of his acute course were not available. His medical history is unremarkable pre-injury, but significant for upper and lower left
extremity hemiparesis, dysarthria, anxiety, depression, and dysexecutive syndrome secondary to his injury. His medical history post-injury was also remarkable for dental issues with chronic anticholinergic side effects and fungal foot infections. Assistive devices including a cane, shower chair, and motorized scooter were used to aid in mobility. With regard to objective data regarding neurocognitive status, Participant 3 was noted to have participated in two neuropsychological evaluations in 2008, but these results were not available for review.

Participant 3 was admitted to his current placement in residential rehabilitation in September 2000. Upon admission he had been engaged in illicit drug use (e.g., marijuana), verbal aggression, and had experienced homicidal and suicidal ideation. At his prior placement, he was reportedly engaged in bi-weekly individual counseling and had a vocational position. He continued psychological counseling and maintained a vocational placement upon admission to his current rehabilitation facility, although he was not actively engaged in these activities throughout the majority of the study. It is notable that he resumed his vocational placement during the last week of the intervention in which he worked 2.5 hours twice per week, although sporadically. Psychiatric medications throughout the course of the study included: bupropion XL 300mg (daily), escitalopram 20 mg (twice daily), lamotrigine 50 mg (twice daily), quetiapine 150 mg (daily, and 100mg PRN for agitation), ziprasidone 80 mg (twice daily), and diazepam 10 mg (PRN for anxiety/agitation). During the course of the study, Participant 3 experienced a medication change and his quetiapine was reduced from 200 mg to 150 mg approximately two months prior to the start of the intervention. Medically, he underwent a toe amputation due to gangrene following the first session of the intervention and resumed the intervention 10 days later.
The demographic questionnaire revealed that Participant 3 graduated high school and completed two years of college. He denied any learning problems and reported that he maintained a 3.0–3.5 GPA throughout his educational career. With regard to vocational history, Participant 3 reported that he served in the Army for two years and indicated that he worked as a manager of a fast-food chain for approximately eight months prior to his injury. Regarding substance use, Participant 3 endorsed history of tobacco use but denied any current use. He also acknowledged alcohol use in college but denied any current use. He denied any history of illicit drug use; however, it is notable that his contradicts information noted in his admission paperwork.

Participant 3 obtained a Barthel Index score of 18, suggesting a high degree of independence with basic ADLs with the exception of requiring some assistance with grooming and bathing. He received an OBS Cluster score of 4, Total Levels score of 8, and Clinical Weighted Severity score of 20 to reflect problem behaviors within the following categories: verbal aggression, inappropriate sexual behavior, inappropriate social behavior, and initiation. Please note that the following descriptions and examples of problem behavior are consistent with the OBS phrasing. With respect to verbal aggression, Participant 3 was noted to engage in mild personal insults (i.e., statements clearly directed at some other person, but those that did not include swearing or offensive sexual comments), in addition to swearing, use of foul language, and moderate threats clearly directed at others or self that occurred once or more per month and negatively impacting his environment to a minor degree. He was also noted to make clear threats of violence directed towards others or self less than once per month and to an extent that had a minor negative impact on his environment. In regard to inappropriate sexual behavior, Participant 3 was noted to make comments of a sexual nature once per week or more and to a
degree that had a minor, negative impact on his environment. He was also noted to engage in inappropriate touching (e.g., occasion in which he was reported to touch a staff’s breast), but this type of behavior was noted to occur less than once per month and to an extent that it had a moderate, negative impact on his environment. With respect to inappropriate social behavior, Participant 3 was described as exhibiting socially awkward behavior (e.g., inappropriate laughter, failure to monitor personal hygiene, excessive apologizing or thanking, standing too close to strangers, failure to pick up on nonverbal cues) multiple times per day that were negatively impacting his environment to an extreme degree. Additionally, he was noted to exhibit noncompliant or oppositional behavior (e.g., responds “No!” to prompts to do things, refuses to discuss problem behaviors with staff, will not follow toilet or shower routines, rejects or dismisses service providers who are helpful with home care, intentional lying that is not due to poor memory) once per day to a degree that it was having a severe negative impact on his environment. Participant 3 was also noted to exhibit lack of initiation, requiring prompting more than twice per day to complete activities, causing a severe negative impact and disruption to his environment.

On cognitive screening measures, Participant 3 performed within the high average range on a reading test of premorbid intellectual ability. His performance on a mathematical computation task fell within the borderline impairment range. With respect to executive functioning, his performance on a task of attention and inhibitory control was within the borderline impairment range, whereas his performance on a task of cognitive flexibility was within the low average range. On a task of visual-perceptual reasoning, Participant 3 performed in the low average range. His performance on tasks administered to assess visual neglect showed no evidence of impairment. Refer to Table 1 for score profile. It is also notable that Participant 3
scored a 21 on a measure of social desirability when assessed at baseline, which is reflective of a mid to high average degree of socially desirable responses.

**Measures**

**Screening measures.** The Barthel Index (Collin et al., 1988; Mahoney & Barthel, 1965) and Overt Behaviour Scale (Kelly, Todd, Simpson, Kremer, et al., 2006) were used to determine participant eligibility before participants were recruited into the study.

**Barthel Index.** The Barthel Index (BI; Collin et al., 1988; Mahoney & Barthel, 1965) is a 10-item questionnaire that assesses an individual’s mobility and ability to perform self-care activities (e.g., regulation of bowels and bladder, bathing, grooming, dressing, toileting, feeding, transfers, mobility, and stair use). Items on the BI vary with respect to rating scale but are generally rated on a scale from 0 to 3, where lower scores reflect dependent behavior and higher scores signify independent behavior. The highest possible score on the BI is 20, which suggests that the individual has adequate mobility and is fully able to independently complete activities of daily living. Lower scores reflect increased disability. The BI can be completed relatively quickly by way of self-report or observer ratings, and each rating method has shown reliability (Collin et al., 1988; Wade & Collin, 1988). The Barthel Index has been found to demonstrate adequate predictive validity ($r = .42$) in brain injury patients with admission scores on the BI predictive of discharge scores (i.e., the lower the admission score, the greater the change with rehabilitation; Liu, McNeil, & Greenwood, 2004).

**Overt Behaviour Scale.** The Overt Behaviour Scale (Kelly, Todd, Simpson, Kremer, et al., 2006) has been designed as a means to rate overt, challenging behaviors that can occur following a TBI to track behavior change and inform decisions for intervention. The OBS was specifically designed to measure challenging behaviors as they occur among individuals with
TBI in the community setting, measuring behavior across nine categories, including verbal aggression, physical aggression against objects or against other people, physical acts against self, inappropriate sexual and social behavior, perseveration/repetitive behavior, wandering/absconding, and lack of initiation. An observer (e.g., clinical staff or other informant familiar with the individual’s behavior) rates the severity, frequency, and impact (e.g., disruption or stress related to the occurrence of the behavior) of each behavior category with respect to whether or not the behavior has occurred within the past three months. A behavior category may be omitted if it does not apply to the individual in question. The OBS yields three scores, including the “Cluster” score (range 0–9) identifying the presence/absence of behaviors, “Total Levels” (range 0–34) identifying the severity of the behavior and type of behavior exhibited within a behavioral category, and the “Total Clinical Weighted Severity” (range 0–84) identifying which behaviors may present as more severe (based upon clinical opinion) than other behaviors. Higher scores indicate problematic behaviors (Kelly, Todd, Simpson, & the ABI Behaviour Consultancy team, 2006). The OBS has been found to have very strong inter-rater reliability for both the OBS Cluster \((r = .99)\) and Total Levels score \((r = .97)\). Test-retest reliability over a one-week period was also strong for Cluster and Total Levels, with coefficients ranging from .72–.77, respectively. Moderate to strong convergent validity was shown between the OBS and other measures that assess behavior (e.g., Mayo-Portland Adaptability Inventory, Current Behaviour Scale, and Neurobehavioural Rating Scale-Revised) with coefficients ranging from .37–.66. The OBS has also demonstrated sensitivity in detecting change in behavior over time (i.e., pre-intervention to four months into behavioral intervention; Kelly, Brown, Todd, & Kremer, 2008; Kelly, Todd, Simpson, Kremer, et al., 2006).
**CLOX: Executive Clock Drawing Test.** The CLOX: Executive Clock Drawing Test (Royall, Cordes, & Polk, 1998) is a clock drawing task designed to examine executive impairment and discriminate it from non-executive visual constructional failure. The task is comprised of two parts, CLOX-1 and CLOX-2, where the former assesses executive control under novel and ambiguous conditions and the later examines visual constructional abilities. During CLOX-1 participants are instructed to “Draw me a clock that says 1:45. Set the hands and numbers on the face so that a child could read them.” As part of CLOX-2, the examiner constructs a clock, placing the 12, 6, 3, and 9 first and then the examinee is instructed to copy the image. Internal consistency of the CLOX was found to be high (Chronbach’s alpha=.82) with a high degree of inter-rater reliability found for CLOX-1 and CLOX-2 (r = 0.94 and r = 0.93, respectively). CLOX-1 and CLOX-2 also showed strong convergent validity with scales examining cognitive impairment, including the Mini Mental Status Exam (MMSE, r = .82 and r = .85, respectively) and the Executive Interview (EXIT25, r = -.83 and r = -.79, respectively; Royall et al., 1998).

**Wechsler Adult Intelligence Scale- Fourth Edition (WAIS-IV) Matrix Reasoning.** The Matrix Reasoning subtest of the Wechsler Adult Intelligence Scale (WAIS-IV; Pearson 2008) assesses spatial ability, knowledge of part-whole relationships, and perceptual organization. It contains 26-items, which are worth a total of one point for each correct response. The Matrix Reasoning subtest has demonstrated excellent internal consistency, with Cronbach’s alpha coefficients ranging from .86 to .94 for adults 18–90 years old. It also shows good validity convergent validity with other tasks assessing perceptual reasoning (e.g., WAIS-IV Visual Puzzles, r = .53 and Block Design, r = .54). A sample of participants with traumatic brain injury
was found to perform within the two standard deviations of the mean ($M = 7.1, SD = 3.3$; Wechsler, 2008).

**Wechsler Adult Intelligence Scale- Fourth Edition (WAIS-IV) Cancellation.** The Cancellation subtest of the Wechsler Adult Intelligence Scale (WAIS-IV; Pearson, 2008) examines visual selective attention, visual neglect, and response inhibition within the context of a structured arrangement of colored target and non-target shapes. Participants are asked to find and mark the target shapes within a pre-determined time limit. The Cancellation subtest has demonstrated acceptable internal consistency, with test-retest stability coefficients ranging from .71 to .80 for adults 18–69 years old. It also shows good convergent validity with processing speed tasks on the WAIS-IV (e.g., Coding $r = .42$ and Symbol Search $r = .46$). A sample of participants with traumatic brain injury has been shown to perform within the two standard deviations of the mean ($M = 7.1, SD = 4.7$; Wechsler, 2008).

**Baseline measures.** Participants completed several measures once they were recruited into the study, including measures that assessed: persistence, demographic information, intelligence and mathematic achievement, attention, memory, executive functioning, emotional functioning, and social desirability traits. Rehabilitation professionals also monitored participants’ ADL engagement throughout the duration of the study.

**Card-sorting task.** The card-sorting task is a non-standardized measure of persistence that involves arranging packets of 15-cards in numerical order. The card-sorting task was originally used by Eisenberger, Heerdt, et al. (1979) as a measure of persistence, and was adapted for use in the current study. This task was originally completed with IBM punch cards that contained two, 9-digit numbers. The original task paradigm presented participants with a box of 500 cards and asked if they would be willing to sort the cards, which were packed in sets
of 15 cards, in numerical order. The current study modified the original task by incorporating “puzzles” into the sorting paradigm. Participants were asked to sort packets of 15, 4 x 6 inch cards in numerical order after solving puzzles that yielded the number to be sorted. For example, one packet of cards may have included cards that contained numbers printed as words (e.g., “two four eight”) in the top portion and blanks printed within a box in the lower portion of the card, requiring participants to transcribe the number (e.g., 248). After completing the “puzzle” on each card, the participant was then required to sort the cards in numerical order. They were then asked to place a binder clip or rubber band around the cards and place them in a box. The nature of the puzzles printed on the cards was designed to change with each packet (e.g., solve 4-digit math problems or count shapes to yield number) to reduce the likelihood that boredom would arise from the monotony of sorting 9-digit numbers. See Appendix B for example card. Changing the card-sorting requirements and requiring a form of active problem solving was believed to demand a certain degree of effort that basic sorting may not necessitate. In accordance with the original task, the participants were informed that participation was optional, and they were given a maximum of 120 minutes to sort cards.

Demographic questionnaire. Participants completed a brief questionnaire that included questions pertaining to: identifying information (e.g., name, gender, age, birth date, ethnicity), marital status, education, occupation, substance use, and injury-related variables.

Independent Living Scale (ILS), Adapted Activity of Daily Living (ADL) Rating Form, and Extended ADL Rating Form. The Independent Living Scale (Ashley, Persel, & Clark, 2001) is a rating form that assesses activities of daily living (ADLs), behavior, and initiation. The ILS is made up of three subscales: ADL, behavior, and initiation. Behavior across each of these subscales is rated by means of a task analysis (i.e., task is broken down into component parts).
The ADL subscale assesses behavior across 17 domains, including: hygiene/grooming, dressing, meal preparation, eating, toileting, medication management, dishes, time management, travel, security and safety, cleaning, laundry, shopping, phone, mail, leisure, and alarm clock. Raters ascribe points depending on assistance level required for task completion. The Behavior scale assesses the occurrence of 11, operationally defined behaviors (physical aggression, property abuse, angry language, exiting, stealing, over-familiarity, bizarre talk, non-participation, self-abuse, sexually aberrant behavior, perseverative speech) on an hourly basis. The Initiation scale assesses whether or not prompts were required for a task to be initiated within 15 minutes of the expected time. The participants’ initiative is assessed across the ADL subscales. The total ILS score is based out of 100 points, with the ADL scale worth 61 points, Behavior scale worth 30 points, and initiative scale worth 9 points. Behavior on each scale is rated during a week period and was developed with the intent of tracking progress over time. The ILS scale has demonstrated strong inter-rater reliability ($R^2 = .77–.93$) for all subscales, test-retest reliability ($R^2 = .72$), and convergent validity with other adaptive behavior scales, such as the Vineland Adaptive Behavior Scale ($R^2 = .82$) and the American Association for Mental Deficiency (AAMD) Adaptive Behavior Scale ($R^2 = .87$; Ashley, Persel, & Clark, 2001).

Due to unforeseen institutional limitations and issues with obtaining data using the ILS (as explained in Procedures), the Activities of Daily Living (ADL) Rating Form was instituted in place of the ILS. The Adapted ADL Rating Form is a non-standardized rating form that was adapted from the Independent Living Scale. The ADL rating form includes checkboxes to identify the quality of the participant’s hygiene, grooming, and dressing behavior on a 4-point rating scale with anchors used to denote “poor” and “good.” Additionally, checkboxes are included to identify the level of prompting required (e.g., no prompt, prompted and completed
activity, or prompted and refused to complete activity) for participants to complete activities in each of the respective domains. The ADL rating form includes a section to indicate whether the participant remained in bed all shift, prompting staff to discontinue the rating if the response is “Yes.” “Yes” and “No” checkboxes are also included to indicate whether the participant engaged in an “out of apartment” activity. Three rating segments are included on the rating form for rehabilitation staff on all three shifts to provide ratings. See Appendix C for the Daily ADL Rating Form.

The Extended ADL Rating Form is a non-standardized rating form that was adapted from the Independent Living Scale. The extended ADL rating form prompts staff to rate each participant’s engagement in hygiene, grooming, and dressing behaviors within a 7-point Likert scale format (e.g., strongly disagree to strongly agree, never prompt to prompt every time, and never to always). The extended ADL rating form inquires about level of prompting and assistance required for participants to complete activities within the domains of hygiene, grooming, and dressing, in addition to level of engagement exhibited within each of these domains. Total scores for each of the three respective subscales is 49 points, with higher scores reflective of a more favorable staff impression regarding hygiene, grooming, or dressing behavior (i.e., better cooperation and success at completing respective activities). See Appendix D for the Extended ADL Rating Form.

**Wechsler Test of Adult Reading (WTAR).** The Wechsler Test of Adult Reading (WTAR; Psychological Corporation, 2001) is a 50-item word recognition and pronunciation test that serves as means of estimating intellectual functioning. The WTAR takes approximately 5–10 minutes to administer. The WTAR has demonstrated sound psychometric properties with internal consistency coefficients for the US standardization sample ranging from .90–.97 in addition to a
high degree of temporal stability (test-retest coefficients ranging from .90–.94). The WTAR has also been found to be a valid tool, demonstrating good convergent validity ($r = .90$) with the American National Adult Reading Test (AMNART), a similar measure of reading recognition (Psychological Corporation, 2001). The WTAR has been identified as a valid tool for estimating premorbid intellectual ability in individuals with TBI, as it demonstrated stability in measurement at two- and five-months post-injury in a sample of severe TBI patients (Green et al., 2008).


The Wide Range Achievement Test-Fourth Edition (WRAT-4; Wilkinson & Robertson, 2006) Math Computation subtest measures computation skills. It is comprised of two parts, oral math (15-items) and math computation (40-items), which include problems that assess skills such as counting, identifying numbers, solving simple oral math problems, and calculating written mathematical problems. The WRAT-4 Math Computation subtest has two forms (blue and green; alternate form for retest) and takes 15 minutes to administer. If the examinee does not answer a minimum of five questions correctly on the oral math computation section, the 15 preliminary oral math problems must be administered. Raw scores are then calculated by adding the number of correct items and then converted to standard scores. The Math Computation subtest has demonstrated excellent reliability with median internal consistency reliabilities ranging from $\alpha = .87–.95$ and test-retest reliability ranging from $r = .82–.88$ for the 18–94+ age groups for both forms. The WRAT-4 Math Computation subtest has also been shown to be a valid tool, demonstrating good convergent validity with the Mathematics subtest on the WRAT-Expanded ($r = .74$) for the 19-94 age group and with the Arithmetic subtest of WAIS-III ($r = .72$; Wilkinson & Robertson, 2006).
National Institutes of Health (NIH) Dimensional Change Card Sort Test (DCCS). The National Institutes of Health (NIH) Dimensional Change Card Sort Test (DCCS) is a computerized measure of cognitive flexibility, switching, and set-shifting that examines one’s ability to match two, simultaneously presented test items that vary along two dimensions (e.g., color and shape) to a target item. The task demands shift, requiring participants to determine how to match the items (i.e., according to color or shape). Scoring is based upon accuracy and reaction of response. The test takes approximately four minutes to administer. The NIH DCCS has been found to have excellent reliability ($r = .85$) and adequate to good validity ($r = .55$ with D-KEFS Inhibition raw scores, and $r = .71$ with NIH Toolbox Flanker) in a normative sample. Research is currently underway to validate it’s use in individuals who have experienced neurological insult (Weintraub et al., 2013; Zelazo et al., 2014).

National Institutes of Health (NIH) Flanker Inhibitory Control and Attention Test. The National Institutes of Health (NIH) Flanker Inhibitory Control and Attention Test measures attention and inhibitory control by requiring a participant to focus on one, central stimulus (arrow), while inhibiting attention to the stimuli that are flanking the target arrow (e.g., target arrow may be surrounded by arrows that are congruent or incongruent). The participant is asked to press the button that corresponds to the direction in which the central arrow is pointing. Scoring is based upon accuracy and reaction time. The test takes approximately three minutes to administer. The NIH Flanker Inhibitory Control and Attention test been found to have excellent reliability ($r = .85$) and adequate to good validity ($r = .55$ with D-KEFS Inhibition raw scores, and $r = .71$ with NIH Toolbox DCCS) in a normative sample. Research is currently underway to validate it’s use in individuals who have experienced neurological insult (Weintraub et al., 2013; Zelazo et al., 2014).
**Patient Health Questionnaire-9 (PHQ-9).** The Patient Health Questionnaire-9 (PHQ-9; Spitzer, Williams, & Kroenke, 1999) is a self-report measure that assesses the frequency of 9 DSM-IV symptoms of major depression (MD), including depressed mood, loss of interest/anhedonia, feelings of worthlessness/guilt, reduced energy, poor concentration, appetite changes, psychomotor agitation/retardation, and suicidal ideation within the past two weeks. Participants are asked to rate how frequently they were bothered by the aforementioned symptoms, rating the frequency on a continuum from “Not at all” (0) to “Nearly Every Day” (3) over the past two weeks. Total scores on the PHQ-9 range from 0 to 27, with higher scores indicative of more severe depression. The PHQ-9 has been identified as a reliable (test retest $r = 0.76$) and valid tool (convergent validity $r = 0.78–0.90$ with other commonly used depression rating scales) for use with individuals with moderate to severe TBI. It has also demonstrated good sensitivity and specificity, which is maximized when a screening criterion of at least five symptoms present for several days over the last two weeks is used (i.e., sensitivity 0.93 and specificity 0.89; Fann et al., 2005; Seel et al., 2010).

**TBI Self-Efficacy for Symptom Management Questionnaire (TBI-SE).** The TBI Self-Efficacy Questionnaire (TBI-SE; Cicerone & Azulay, 2007) is an adaptation of a self-efficacy questionnaire that was developed by Lorig et al. (1996) for use with patients with chronic medical disability. The TBI-SE is a 13-item that asks patients to rate perceived confidence in their ability to obtain social support from community and friends to perform daily activities (items 1–4; SEsoc subscale), their ability to manage and compensate for cognitive symptoms (items 5–9; SEcog subscale), and their ability to manage and cope with the emotional symptoms associated with TBI (items 10–13; SEemot subscale). The rating scale was adapted from a 10- to 5-point Likert scale with labels for use (with permission) in the current study, so that response
APPLICATION OF LEARNED INDUSTRIOUSNESS THEORY

options are clear and distinct. Individuals were asked to rate their confidence on a scale from 1–5, with the lowest score representing “not at all confident” and the highest score signifying “extremely confident.” Item responses from each subscale were then summed to generate subscale scores, and the subscales were then summed to generate a SE Total Score. Higher scores suggest greater perceived self-efficacy (e.g., scores on the original scale show 13–59 low, 60–114 moderate, 115–130 high self-efficacy and adapted scale to reflect 13–29 low, 30–57 moderate, and 58–65 high self-efficacy). The TBI-SE has shown good internal reliability (α = .93) with subscale reliabilities of .77–.93. Construct validity was also shown, as the TBI-SE demonstrated a significant relationship with health rating questionnaires and satisfaction with cognitive functioning rating scale (Cicerone & Azulay, 2007; Cicerone, Mott, & Azulay, n.d.).

Quality of Life after Brain Injury. The Quality of Life after Brain Injury (QOLIBRI; von Steinbüchel et al., 2010) is a 37-item questionnaire that was designed to assess health-related quality of life after an individual has sustained a TBI. The QOLIBRI evaluates quality of life within six dimensions, including cognition, self perception, daily life and autonomy, social relationships, emotions, and physical problems. Items on the QOLIBRI are on a scale from “not at all [satisfied/bothered]” (1) to “very [satisfied/bothered]” (5) and total scores may range from 0 to 100 with higher scores representing better quality of life. The QOLIBRI takes approximately 7–10 minutes to complete. The QOLIBRI has also been found to be a psychometrically sound instrument with internal consistency ranging from .75–.89 and test retest reliability ranging from .78–.85 (von Steinbüchel et al., 2010). The QOLIBRI has also been shown to be a valid tool with symptom subscales showing expected correlations with other established measures. For example, high correlations were observed between the QOLIBRI physical problems and Short-Form Health Survey 36 Physical Component Scale (SF-36 PCS; r = .63), the QOLIBRI Emotions and
Hospital Anxiety and Depression Scale (HADS) anxiety scale ($r = -.64$), and QOLIBRI self perception and HADS depression ($r = -.62$; von Steinbüchel et al., 2010).

**Marlowe-Crowne Social Desirability Scale.** The Marlowe-Crowne Social Desirability Scale (MCSDS; Crowne & Marlowe, 1960) is a 33-item self-report measure that evaluates a participant’s tendency to respond in a socially and culturally desirable manner (e.g., degree to which they are “faking good”). Items on the MCSDS are in true/false format and are phrased in a manner to evaluate an individual’s endorsement of a range of socially and culturally appropriate or inappropriate behavior tendencies (e.g., “I never hesitate to go out of my way to help someone in trouble” or “I can remember ‘playing sick’ to get out of something”). Test items are designed to identify individuals that are aiming to portray themselves in an overly positive manner, such that they deny common, undesirable traits and exaggerate uncommon, desirable traits (Crowne & Marlowe, 1960; Tatman, Swogger, Love, & Cook, 2009). Scores on the MCSDS can range from 0 to 33, with higher scores reflective of higher social desirability. Psychometric properties of the original standardization sample showed that internal consistency was .88 with test-retest correlation of .89 (Crowne & Marlowe, 1960). Other research shows that internal consistency ranges from .71 to .72 in males and females (O’Grady, 1988) with test-retest reliability of .86 over a month period (Crino & Svoboda, 1983). The MCSDS has been shown to correlate with various MMPI scales that are associated with social desirability, including L (lie, $r = .54$), Pd (psychopathic deviate, $r = -.41$), Sc (schizophrenia, $r = -.40$), and K (test-taking attitude, $r = .40$; Crowne & Marlowe, 1960). A two-factor structure has been shown to underlie the MCSDS, including Attribution (18 items) and Denial (15 items), where higher scores on these respective scales are to represent exaggeration of status and self-deception, respectively (Tatman et al., 2009). Short forms of the MCSDS have been developed and have shown adequate factor
structure. However, no short-form has been consistently identified as being superior to the other, thus making the original form the preferred scale for evaluation (Barger, 2002).

**Effort training measures.** Three non-standardized tasks were used as part of the effort training intervention.

**Math problems.** A basic addition task comprised the first component of effort training. A previous study used math problems as part of the effort training intervention, and addition problems varied in degree of difficulty dependent upon group assignment (e.g., low- or high-effort training; Hickman et al., 1998). The current study used the same high-effort task that was used by Hickman et al. (1998), requiring participants to solve 5-digit addition problems. In contrast to the original task, however, participants were presented with addition worksheets that contained 12–18, 5-digit addition problems that varied in degree of difficulty. Addition worksheets included 5-digit numbers that did not require any digits to be carried, or included a different percentage of problems that required digits to be carried (e.g., Level 2 difficulty contained 25% of problems that required digits to be carried, Level 3 difficulty contained 50% of problems that required digits to be carried, and Level 4 difficulty contained 75% of the problems that required digits to be carried). See Appendix E for example of math worksheet.

**Perceptual “Find the Difference” task.** An adaptation of the perceptual “Find the difference” task used by Eisenberger and Masterson (1983) and later studies (Quinn, 1996) was used as the second component of the effort training intervention. The original task consisted of materials from the “Hocus Focus” cartoon and participants were asked to find a pre-determined number of differences between two otherwise identical images. The current study utilized different stimuli while preserving the integrity of the original task. Commercially available “spot the difference” materials, including stimuli from the “Life: The Ultimate Picture Puzzle: Can
You Spot the Differences?” and “Life: The Amazing Picture Puzzle: Can You Spot the Differences?” were used. These materials provided different degrees of difficulty, including novice, expert, and genius levels, in addition to providing suggested completion times. Please see Appendix F for listing of stimuli and order of administration. Participants were asked to find all the differences in each presented image.

**Problem-solving task.** A jigsaw puzzle task comprised the third component of the effort training intervention. Previous studies utilized an audio tone elimination task, which drew upon problem solving abilities (Boyagian & Nation, 1981; Quinn, 1996). Jigsaw puzzles that varied in degree of difficulty, such as those that included 36, 60, 80, and 100 pieces, were determined as an appropriate alternative to the tone elimination task used in the original study, as they would recruit similar ability and skill set. Additionally, jigsaw puzzles were purported to be perceived by participants as less frustrating and more enjoyable than the original tone elimination task, in addition to having greater ecological applicability (e.g., facilitate organization and planning skills). Please see Appendix G for a listing of puzzles and order of administration.

**Procedure**

**Screening phase.** Clinical staff members identified residential rehabilitation clients as potential study candidates based upon their apparent low-level participation in activities of daily living (e.g., hygiene, grooming, and dressing). Once participants were nominated to enter the screening phase of the study, the informed consent/assent process was initiated. Informed consent/assent procedures were completed with the appropriate individuals. The primary researcher explained the study to each participant and his or her legal guardian, verified understanding of the informed consent/assent document, and obtained signatures from all relevant parties. A copy of the consent/assent form was provided to the participant, as well as the
legal guardian. Potential participants were explicitly told that his or her participation in the study would be entirely voluntary and that they may withdraw at any time without negative consequences or loss of services to which they are otherwise entitled. This was also highlighted within the informed consent and assent forms for participants and legal guardians.

During the screening phase of the study, candidates then underwent evaluation by two clinical staff members (e.g., lead behavior analyst and the patient’s assigned behavior analyst). These respective staff members were trained on use of screening measures before ratings were gathered. Clinical staff jointly completed the Barthel Index and Overt Behaviour Scale for the nominated candidate. The participant was recruited into the study if he or she received ratings to suggest (a) ability to perform activities of daily living, as evidenced by a score of 14 on the Barthel Index, which has been shown as the mean score attained by brain injury patients at discharge (Liu et al., 2004) and (b) profile on the Overt Behaviour Scale that shows lack of initiation (as evidenced by a Severity score of at least 2 to indicate task prompting “approx. once/day”) and a low level of problem behaviors (as evidenced by low Total Level and Clinical Weighted Severity scores). Although no formal threshold has been defined to signify “challenging” behavior on the OBS, a sample of individuals with acquired brain injury identified as exhibiting challenging behaviors in community settings (N = 30) have shown profiles characterized by OBS Total Level scores of $M = 9.53, SD = 4.49$ (range 3–23) and OBS Total Clinical Weighted Severity scores of $M = 19.93, SD = 9.79$ (range 3–47; Kelly, Todd, Simpson, Kremer, et al., 2006). Those respective scores were used as a guideline for recruitment in the current study. Please see Participants for more detailed information regarding the OBS profiles for each respective participant. Generally, participants recruited into the study exhibited minimal to no verbal aggression, minimal to no physical aggression, minimal to no inappropriate sexual
behavior, no perseverative/repetitive behaviors, no wandering/absconding behavior, moderate levels of inappropriate social behaviors, and lack of initiation to a moderate to extreme degree.

Once participants were deemed eligible to enter the study, clinical and rehabilitation staff (e.g., primary behavior analyst and care staff working on each participant’s unit) received training on how to rate the participant’s behavior using the ILS. The “Hygiene & Grooming” and “Dressing” domains of the ILS were used to collect daily ratings. The ILS was used to monitor daily ADL engagement during a prolonged baseline period, which spanned from August until mid-November 2015. Data collection was closely monitored during this time and several training sessions were completed with the rehabilitation staff to address incorrect, incomplete, or inconsistent completion of daily rating forms. Education and training, which was formatted as presentations at daily shift report meetings and in-service trainings, were provided to staff on several occasions during the prolonged baseline phase to improve the accuracy and completeness of the daily ratings. Ratings identified as being incorrectly or inconsistently completed were used as examples during educational sessions to enhance awareness and understanding about appropriate completion of the rating form. Training exercises/scenarios were also developed to model appropriate completion of the ILS and enhance data collection. However, due to constraints within the institution, including an inability for rehabilitation staff to directly observe participants engaging in ADL activities, it was concluded that the ILS was not yielding data useful to answer the current research questions. Consequently, the ILS was adapted into a brief, user-friendly rating scale (Adapted ADL Rating Form and Extended ADL Rating Form) to more accurately reflect observations made by the rehabilitation staff. Staff gathered daily ADL ratings using the ADL Rating Form throughout the entirety of the study. Staff impression regarding the
participant’s ADL performance was gathered from two raters at baseline, post-intervention, and follow-up periods through use of the Extended ADL Rating Form.

**Baseline phase.** Rehabilitation staff monitored ADL engagement by completing daily ratings on “hygiene and grooming” and “dressing” sections of the ILS and, subsequently the Adapted ADL rating form (as noted above). The card-sorting task was completed during the initial session with each participant. The participants were approached and asked if they would be willing to “help out” by sorting cards. In accordance with the original procedure used by Eisenberger, Heerdt, et al. (1979), participants were informed that participation was optional. The participants received instruction on how to perform the task through demonstrations provided by the researcher. See Appendix H for the script. An instruction page that detailed instructions provided by the researcher was given to each participant as a reminder. The participants were given a maximum of 120 minutes to complete the sorting task, and performance was assessed at 15-minute intervals. The experimenter visited each participant at the location in which the were completing the sorting task, and if one or more packets had been sorted during the preceding period, socially reinforcing statements were provided (e.g., “Great, I really appreciate your help. Thanks, good work.”). If no cards were sorted during the preceding period, the participant was asked to complete some work in the remaining time.

Other baseline measures were then administered during 60-minute sessions in which each participant worked directly with the researcher in a private examination room. Measures administered during this time included: demographic questionnaire, WTAR, WRAT-4 Math Computation, NIH Flanker and Card Sort, TBI-SE, PHQ-9, QOLIBRI, and Social Desirability measure. These measures were administered to obtain an estimate of pre-morbid intellectual
ability and psychological functioning. Administration of baseline measures spanned 3–4 sessions depending on the participant.

**Effort training intervention.** The effort training intervention commenced after the baseline measures had been administered. Effort training was completed over nine, 45-minute training sessions that were completed two to three times per week over the course of four to five weeks. Participants were presented with one of the three respective training tasks (e.g., math problems, perceptual “find the difference,” or problem-solving task) for the duration of each session. Each task was presented three times such that tasks were presented in the order Task 1, Task 2, Task 3 and then the sequence repeated twice. Although each task was designed to train high effort, each task included different levels of difficulty to prevent ceiling effects from occurring during training sessions. Since tasks of “medium” difficulty have been identified as ideal for obtaining the learned industriousness effect, once participants achieved 90% or better accuracy on a respective level of math problems on three instances, they were administered the task at the next level of difficulty. Participants were presented with a pre-set order of FTD tasks, in which task difficulty was determined by the material publisher’s recommended task completion time. Stimuli were pulled from the “Novice” and “Master” sections of the FTD materials. Tasks were sequenced such that there were 19 sets of novice stimuli and 9 sets of master stimuli. If participants voiced that the task was too difficult at the master level, they were presented with a new task at the novice level. With regard to jigsaw puzzles, level of difficulty was determined by averaging jigsaw puzzle completion times from a group of graduate students. Thus, puzzles that were completed in less time were deemed as less difficult. Jigsaw puzzles were administered in a pre-set order, and if 75% completion was not achieved in a given session,
that same puzzle was presented at the start of the next session in which jigsaw puzzles were administered (i.e., every third session).

The participants were presented with task materials throughout the duration of the session, and therefore may have advanced in degree of task difficulty as the session progressed. The session was closely timed and the total items/pieces correct on the respective task was recorded. Positive reinforcement in the form of social praise (e.g., “Great job. You worked really hard on that. Keep up the Good work.”) was provided after a variable interval of time had passed, given that the participant had been appropriately engaged in the task during that window of time. Participants were deemed “appropriately engaged” in tasks if they were exhibiting behaviors commensurate with task instructions, such as writing down numerical digits to solve math problems, circling or otherwise marking differences during “Find the Difference” tasks, and arranging pieces in an effort to solve jigsaw puzzles. A MotivAider device was used to notify the researcher to provide social praise on a variable interval schedule, as the device was programmed to vibrate on a random-interval, 300-second schedule. Therefore, the first opportunity for reinforcement was 300 seconds into the session, and then the MotivAider vibrated at a random interval between 1 and 300 seconds. Generally, participants had the opportunity to receive 13–18 instances of reinforcement each session.

**Post-intervention.** Upon the conclusion of effort training, the participants were asked to participate in the card-sorting task. The baseline card-sorting procedure was used. The participants were also asked to complete self-ratings on the TBI-SE, PHQ-9, and QOLIBRI. Ongoing measures of ADL engagement were also gathered using the Adapted and Extended ADL Rating Forms.
6-week follow-up. At 6 weeks after the conclusion of the effort training intervention, participants were again asked to participate in the card-sorting task. They were also asked to complete self-ratings on the TBI-SE, PHQ-9, and QOLIBRI. Staff ratings of ADL engagement using the Adapted and Extended ADL Rating Forms concluded at this phase, which was 6-weeks after the end of effort training.

Data Analysis

Hypotheses 1 & 2. To investigate whether individuals who participated in high-effort training would subsequently exhibit increased persistence on a card-sorting task post-intervention that would be maintained at the 6-week follow-up, as measured by time engaged with task, the time the participant was engaged in the card-sorting task was recorded and graphed. Task persistence data gathered at baseline, post-intervention, and follow-up was visually examined to determine if increases in persistence were observed and maintained. Data related to the total number of packets completed and number of packets sorted correctly in sequential order were also obtained and visually examined for trends.

Hypotheses 3 & 4. To examine whether individuals who participated in high-effort training would subsequently exhibit generalization of effort as increased engagement in activities of daily living during the intervention period and maintained at follow-up, as measured by increased frequency of independent participation in ADLs in which performance was rated as “good” more frequently than “poor,” hygiene, grooming, and dressing ratings were examined by using a pivot table to observe trends. The data collected per the Adapted ADL Rating Form, which collected up to three shift ratings of the participant’s ADL behavior per day, were collapsed and analyzed within a pivot table. Frequency data yielded by the pivot table were converted into percentages. The percentage of ratings that corresponded to 0 (poor) to 3 (good)
for hygiene, grooming, and dressing, respectively, were examined at each time point during the study to determine whether improvement in hygiene was observed. Anchors were not provided for ratings of 1 or 2 to allow more flexibility of judgment while still requiring staff to make the poor/good distinction. To facilitate discussion of the findings, ratings of 1 and 2 will be discussed as substandard and mediocre, respectively. The level of prompting (e.g., prompted and refused, prompted and completed, or not prompted) that preceded each rating within the domain of hygiene, grooming, and dressing at each time point during the study was also converted to percentages and analyzed to determine the if the level of independence with ADLs improved during the course of the study. The quality of hygiene, grooming, and dressing behavior, respectively, was also observed in relation to the prompt level that preceded each rating at baseline, post-intervention, and follow-up in an effort to determine if the quality of ADL engagement and independence improved throughout the course of the study. Additionally, the data collected from the ADL Extended Rating Form at baseline, post-intervention, and follow-up were visually graphed and examined for trends among raters.

**Hypotheses 5.** In an effort to determine if self-reported ratings of self-efficacy, depression, and quality of life improved from baseline to post-intervention, scores on emotional functioning measures were examined for fluctuations in self-ratings over the course of the study and compared to normative data.
Chapter 6: Results

Participant 1

**Card-sorting & effort training.** At baseline, Participant 1 sorted cards for the full 120-minute period. During this time, he completed puzzles and sorted 23 packets of cards; however, no packets were sorted correctly in sequential order. Following the baseline card-sorting, Participant 1 completed nine effort training sessions. He engaged in each of these sessions for the entire 45-minute period, earning all reinforcement opportunities that were available at each session. It is notable that due to room scheduling constraints within the institution, the first session was conducted in Participant 1’s apartment. All other sessions throughout the study were conducted in a conference room on the campus of the residential facility. Post-intervention, Participant 1 sorted cards for the full 120-minute period allotted, completing the puzzles on each card and sorting a total of 24 packets of cards. Notably, 12 of these packets were correctly sorted in sequential order during the post-intervention period. At follow-up, Participant 1 sorted cards for 7 minutes, completing the puzzles and correctly sorting one packet of cards in sequential order.

**ADLs.** Hygiene-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 2–4. During the baseline period, Participant 1’s hygiene was overwhelmingly rated as “poor,” which was relatively stable throughout the study. Prompts attempting to improve the participant’s hygiene showed a markedly different pattern with a large decline in the frequency of prompting from baseline to intervention and follow-up. It is notable that when Participant 1 was prompted to engage in hygiene-related tasks at each phase in the study, he was substantially more likely to refuse than to complete, resulting in overwhelmingly “poor” ratings. Interestingly, hygiene ratings were similarly primarily “poor” when hygiene-related activities were not prompted, regardless of study time point.
Table 2

*Hygiene Ratings for Participant 1 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor 0</th>
<th>Poor 1</th>
<th>Poor 2</th>
<th>Good 3</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>87.85%</td>
<td>10.28%</td>
<td>1.87%</td>
<td>0%</td>
<td>107</td>
</tr>
<tr>
<td>Intervention</td>
<td>86.95%</td>
<td>6.52%</td>
<td>2.17%</td>
<td>4.35%</td>
<td>46</td>
</tr>
<tr>
<td>Follow-up</td>
<td>90.91%</td>
<td>2.27%</td>
<td>4.55%</td>
<td>2.27%</td>
<td>44</td>
</tr>
</tbody>
</table>

Table 3

*Hygiene Ratings for Participant 1 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
<td>Prompted &amp; Completed</td>
</tr>
<tr>
<td>Baseline</td>
<td>58.88%</td>
<td>1.87%</td>
</tr>
<tr>
<td>Intervention</td>
<td>15.22%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>11.36%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>
Table 4

Percentage of Hygiene Ratings for Participant 1 Conditioned on Prompt Level by Assessment Time Point

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor</th>
<th>1</th>
<th>2</th>
<th>Good</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>85.71%</td>
<td>12.69%</td>
<td>1.59%</td>
<td>0.00%</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>50.00%</td>
<td>50.00%</td>
<td>0.00%</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>95.24%</td>
<td>4.76%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>42</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>85.71%</td>
<td>14.29%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>87.18%</td>
<td>5.13%</td>
<td>2.56%</td>
<td>5.13%</td>
<td>39</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>89.74%</td>
<td>2.56%</td>
<td>5.13%</td>
<td>2.56%</td>
<td>39</td>
</tr>
</tbody>
</table>

Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted
No P/C data was reported for Participant 1 at intervention or follow-up, as denoted by dashes in the table.

Grooming-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 5–7. The quality of grooming behavior was similarly rated as “poor” more than half of the time during baseline, which remained relatively stable at intervention, with a trend toward poorer ratings at follow-up. Consistent with observations of hygiene ratings, there was a drastic shift in prompting frequency from baseline to intervention and follow-up. When prompting was provided at baseline, which was slightly more than half of the time, grooming was primarily rated as “poor.” Grooming was also rated as “poor” at intervention and follow-up
when prompts were rarely provided. Similar to observations within the hygiene domain, Participant 1 was markedly more likely to refuse prompts to engage in grooming-related tasks than to complete them. Interestingly, when prompting was not provided prior to grooming ratings, ratings were more likely to be distributed between “poor” and “substandard” at baseline and intervention, but were predominantly “poor” at follow-up.

Table 5

*Grooming Ratings for Participant 1 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th>Good Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td>65.71%</td>
<td>20.97%</td>
</tr>
<tr>
<td>Intervention</td>
<td>58.70%</td>
<td>30.43%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>90.91%</td>
<td>2.27%</td>
</tr>
</tbody>
</table>

Table 6

*Grooming Ratings for Participant 1 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
</tr>
<tr>
<td>Baseline</td>
<td>59.05%</td>
</tr>
<tr>
<td>Intervention</td>
<td>10.87%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>11.36%</td>
</tr>
</tbody>
</table>
Table 7

*Percentage of Grooming Ratings for Participant 1 Conditioned on Prompt Level by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor</th>
<th>Good</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>77.42%</td>
<td>20.97%</td>
<td>1.61%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>66.67%</td>
<td>0.00%</td>
<td>33.33%</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>47.50%</td>
<td>47.50%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>80.00%</td>
<td>20.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>56.10%</td>
<td>31.70%</td>
<td>9.76%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>89.74%</td>
<td>2.56%</td>
<td>5.13%</td>
</tr>
</tbody>
</table>

*Note:* P/R = prompted and refused; P/C = prompted and completed; NP = not prompted

No P/C data was reported for Participant 1 at intervention or follow-up, as denoted by dashes in the table.

Dressing-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 8–10. Dressing ratings were more distributed among qualitative rating categories at baseline than hygiene and grooming ratings, with most dressing ratings falling within the “mediocre” category. As the study progressed, there was a trend toward poorer ratings, with a greater frequency of ratings falling within the “substandard” and “poor” categories. In contrast to patterns of prompting for hygiene and grooming ratings, dressing behavior was less likely to be prompted. Dressing prompts were provided just over one-third of the time at baseline, and less than 10% and 5% of the time at intervention and follow-up,
respectively. When dressing was prompted, Participant 1 was less likely to refuse prompts, in contrast to prompts provided for hygiene and grooming. Interestingly, when prompts were provided during baseline and dressing-related behavior was executed, dressing was rated as “mediocre and “good” more often than “substandard” or “poor.” In contrast, when prompts were refused, dressing was more frequently rated as “poor” to “substandard.” When prompts were not provided, dressing was more frequently rated as “mediocre” during baseline, “substandard” during intervention, and “poor” during follow-up.

Table 8

*Dressing Ratings for Participant 1 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th>Good Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td>23.01%</td>
<td>26.92%</td>
</tr>
<tr>
<td>Intervention</td>
<td>36.96%</td>
<td>43.48%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>56.82%</td>
<td>34.09%</td>
</tr>
</tbody>
</table>

Table 9

*Dressing Ratings for Participant 1 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
<td>Prompted &amp; Completed</td>
</tr>
<tr>
<td>Baseline</td>
<td>25.96%</td>
<td>12.50%</td>
</tr>
<tr>
<td>Intervention</td>
<td>6.52%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>2.27%</td>
<td>2.27%</td>
</tr>
</tbody>
</table>
Table 10

Percentage of Dressing Ratings for Participant 1 Conditioned on Prompt Level by Assessment Time Point

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor</th>
<th>Good</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>62.96%</td>
<td>25.93%</td>
<td>11.11%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>15.38%</td>
<td>61.54%</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>10.94%</td>
<td>29.69%</td>
<td>48.44%</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>66.67%</td>
<td>33.33%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>34.88%</td>
<td>44.19%</td>
<td>13.95%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>54.76%</td>
<td>35.71%</td>
<td>7.14%</td>
</tr>
</tbody>
</table>

Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted
No P/C data was reported for Participant 1 at intervention, as denoted by dashes in the table.

More detailed impressions regarding ADL performance were gathered from four raters over the course of the study, as the two raters at baseline were no longer working on Participant 1’s unit post-intervention. Hygiene, grooming, and dressing ratings provided by each rater are depicted in Figures 1–3. Overall, hygiene and grooming were rated as poorer than dressing by all raters at each time point in the study. Raters 1 and 2 provided relatively higher hygiene ($M = 15.00$, $SD = 5.66$) and grooming ($M = 15.00$, $SD = 0.00$) ratings at baseline than Raters 3 and 4, who provided ratings post-intervention ($M = 8.85$, $SD = 0.71$ for both hygiene and grooming) and at follow-up ($M = 9.00$, $SD = 0.00$ and $M = 10.50$, $SD = 2.12$ for hygiene and grooming,)
respectively). Rater 3 noted no improvement in hygiene and grooming from post-intervention to follow-up, but slight improvement in dressing behavior. Rater 4 noted slight improvements in hygiene and grooming from post-intervention to follow-up, but a decline in quality of dressing behavior.
Figure 1. Hygiene ratings for Participant 1 by rater at post-intervention and follow-up

Figure 2. Grooming ratings for Participant 1 by rater at post-intervention and follow-up
Emotional functioning. Participant 1 did not endorse any symptoms consistent with depressive symptomology at any time point in the study (i.e., score of zero at baseline, post-intervention, and follow-up). He endorsed total scale scores of 95, 98, and 99 on the QOLIBRI at baseline, post-intervention, and follow-up, respectively, reflecting a relatively high degree of quality of life throughout the study compared to other individuals of his same age ($z = 1.81, 1.97,$ and 2.03, respectively). Specifically, measurable change was observed from baseline to follow-up on the Social Relationships subscale of the QOLIBRI, as he endorsed an 83, 92, and 100 at baseline, post-intervention, and follow-up, respectively. He also exhibited a high degree of self-efficacy in domains of daily functioning throughout the study, endorsing total scores of 62, 65, and 65 at baseline, post-intervention, and follow-up, in order.
**Participant 2**

**Card-sorting & effort training.** At baseline, Participant 2 sorted cards for the full 120 minute-period. She completed puzzles and sorted 23 packets of cards, sorting 19 packets of cards correctly in sequential order. She then participated in nine effort training sessions for the entire, 45-minutes, earning all reinforcement opportunities that were available. It is notable that effort training Sessions 1, 5, 7, and 8 were conducted in Participant 2’s apartment, in addition to several other sessions throughout the study due to Participant 2’s refusal to leave her apartment to complete the sessions. Post-intervention, she sorted for 92 minutes and announced that she had finished sorting all packets. She completed the puzzles and sorted 33 packets of cards; however, no cards were sorted correctly in sequential order. At follow-up, Participant 2 refused to attend the card-sorting session.

**ADLs.** Hygiene-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 11–13. It is notable that Participant 2 was moved from her apartment to a different unit on campus with one week left in the follow-up period. As such, a new team of rehabilitation staff was trained on how to complete the ADL Rating Form. Participant 2’s hygiene was rated in a relatively stable and consistent manner throughout the study, with the majority of ratings falling within the “substandard” category. Ratings were more widely distributed among rating categories at baseline and follow-up, with slightly more ratings shifted toward “substandard” and “mediocre” at intervention. Participant 2 was typically prompted to engage in hygiene-related tasks throughout the duration of the study, which resulted in refusals the majority of the time. Notably, Participant 2’s level of completions following prompts fluctuated across time points, as she exhibited a measurably lower frequency of prompt/completions at intervention than during baseline and follow-up. When prompts resulted
in completed action, hygiene was rated as “good” more than half of the time at baseline and more than three-quarters of the time during follow-up.

Table 11

*Hygiene Ratings for Participant 2 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th>Good Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td>19.12%</td>
<td>33.82%</td>
</tr>
<tr>
<td>Intervention</td>
<td>4.76%</td>
<td>66.67%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>26.53%</td>
<td>42.86%</td>
</tr>
</tbody>
</table>

Table 12

*Hygiene Ratings for Participant 2 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompted &amp; Refused</th>
<th>Prompted &amp; Completed</th>
<th>Not Prompted</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>58.82%</td>
<td>27.94%</td>
<td>13.24%</td>
<td>68</td>
</tr>
<tr>
<td>Intervention</td>
<td>85.71%</td>
<td>9.52%</td>
<td>4.76%</td>
<td>21</td>
</tr>
<tr>
<td>Follow-up</td>
<td>73.47%</td>
<td>16.33%</td>
<td>10.20%</td>
<td>49</td>
</tr>
</tbody>
</table>
Table 13

*Percentage of Hygiene Ratings for Participant 2 Conditioned on Prompt Level by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor 0</th>
<th>Poor 1</th>
<th>Poor 2</th>
<th>Poor 3</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>32.50%</td>
<td>47.50%</td>
<td>20.00%</td>
<td>0.00%</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>10.53%</td>
<td>26.32%</td>
<td>63.16%</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>0.00%</td>
<td>22.22%</td>
<td>33.33%</td>
<td>44.44%</td>
<td>9</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>5.56%</td>
<td>77.78%</td>
<td>16.67%</td>
<td>0.00%</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>100.00%</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>0.00%</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00%</td>
<td>1</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>30.56%</td>
<td>58.33%</td>
<td>11.11%</td>
<td>0.00%</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>75.00%</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>40.00%</td>
<td>0.00%</td>
<td>20.00%</td>
<td>40.00%</td>
<td>5</td>
</tr>
</tbody>
</table>

*Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted*

Grooming-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 14–16. Similar to patterns observed with hygiene ratings, grooming ratings remained relatively consistent over the course of the study, with the greatest frequency of ratings as “substandard” at each time point. It is notable that grooming ratings were also more widely distributed among rating categories at baseline and follow-up, with much less variability noted at intervention. Participant 2 was typically prompted and refused (more than half of the time) to complete grooming-related tasks throughout the study, with a higher frequency of prompt/refusal at intervention. Consistent with this observation, prompts that resulted in
completed action were more likely at baseline and follow-up than intervention, where ratings of “good” were provided more than half of the time or within the “mediocre” and “good” range the majority of the time. Interestingly, on occasions in which grooming was not prompted throughout the study, ratings fell within the “mediocre” to “good” range the majority of the time.

Table 14

*Grooming Ratings for Participant 2 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th>Good Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td>18.18%</td>
<td>40.91%</td>
</tr>
<tr>
<td>Intervention</td>
<td>4.76%</td>
<td>76.19%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>26.53%</td>
<td>42.86%</td>
</tr>
</tbody>
</table>

Table 15

*Grooming Ratings for Participant 2 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
<td>Prompted &amp; Completed</td>
</tr>
<tr>
<td>Baseline</td>
<td>60.61%</td>
<td>25.76%</td>
</tr>
<tr>
<td>Intervention</td>
<td>80.95%</td>
<td>9.52%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>65.31%</td>
<td>24.49%</td>
</tr>
</tbody>
</table>
Dressing-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 17–19. Consistent with ratings of hygiene and grooming behavior, dressing ratings most frequently fell within the “substandard” category at each time point in the study. It is noteworthy that ratings were widely distributed among rating categories at baseline and follow-up as opposed to intervention, suggesting that quality of dressing behavior fluctuated along the continuum from poor to good at these time points. Participant 2 was frequently prompted to engage in dressing-related tasks, in which she refused more than half of the time at baseline and intervention, and overwhelmingly refused at intervention. When Participant 2

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor</th>
<th>Good</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>30.00%</td>
<td>60.00%</td>
<td>7.50%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>11.76%</td>
<td>29.41%</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>0.00%</td>
<td>11.11%</td>
<td>44.44%</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>5.88%</td>
<td>94.12%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>0.00%</td>
<td>0.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>31.25%</td>
<td>62.50%</td>
<td>6.25%</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>8.33%</td>
<td>8.33%</td>
<td>41.67%</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>40.00%</td>
<td>0.00%</td>
<td>20.00%</td>
</tr>
</tbody>
</table>

*Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted*
completed dressing-related activity following prompts, dressing was far more frequently rated as “mediocre” to “good.” This pattern of more favorable ratings was also observed on occasions in which dressing was not prompted throughout the study, where ratings were more frequently “mediocre” to “good” than “substandard to “poor.”

Table 17

*Dressing Ratings for Participant 2 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th>Good Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td>19.12%</td>
<td>33.82%</td>
</tr>
<tr>
<td>Intervention</td>
<td>4.76%</td>
<td>66.67%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>22.45%</td>
<td>34.69%</td>
</tr>
</tbody>
</table>

Table 18

*Dressing Ratings for Participant 2 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
</tr>
<tr>
<td>Baseline</td>
<td>52.94%</td>
</tr>
<tr>
<td>Intervention</td>
<td>80.95%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>57.14%</td>
</tr>
</tbody>
</table>
Table 19

Percentage of Dressing Ratings for Participant 2 Conditioned on Prompt Level by Assessment Time Point

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor</th>
<th></th>
<th></th>
<th></th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>36.11%</td>
<td>52.78%</td>
<td>11.11%</td>
<td>0.00%</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>5.26%</td>
<td>31.58%</td>
<td>63.16%</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>0.00%</td>
<td>23.08%</td>
<td>7.69%</td>
<td>69.23%</td>
<td>13</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>5.88%</td>
<td>76.47%</td>
<td>11.76%</td>
<td>5.88%</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>33.33%</td>
<td>0.00%</td>
<td>66.67%</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>0.00%</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00%</td>
<td>1</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>28.57%</td>
<td>57.14%</td>
<td>14.29%</td>
<td>0.00%</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>6.25%</td>
<td>6.25%</td>
<td>50.00%</td>
<td>37.50%</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>40.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>60.00%</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted

More detailed impressions regarding ADL performance were also gathered from two raters throughout the duration of the study. Refer to Figures 4–6. Raters 1 and 2 generally rated dressing as better than hygiene and grooming. It is notable that Rater 1 typically rated Participant 2’s behavior as higher than Rater 2, indicating better performance across ADL domains at each time point in the study. Measurably higher ratings were especially noted within the dressing domain at baseline in addition to the hygiene at baseline and follow-up. However, ratings from both individuals generally show a slight decline or relative maintenance of behavior as the study progressed.
Figure 4. Hygiene ratings for Participant 2 by rater and assessment time point

Figure 5. Grooming ratings for Participant 2 by rater and assessment time point
Emotional functioning. Participant 2 endorsed symptoms consistent with depressive symptomology at each time point during the study. She endorsed scores of 15, 9, and 17 on the PHQ-9 at baseline, post-intervention, and follow-up, respectively, suggesting moderately severe depression at baseline and follow-up, and mild depression post-intervention. On the QOLIBRI Participant 2 endorsed a total score of 34, 24, and 26 at baseline, post-intervention, and follow-up, respectively, suggesting levels of quality of life that are well below average ($z = -1.54, -2.11$, and -2.00, respectively) compared to other individuals her age. See Figure 7 for complete QOLIBRI score profile. Interestingly, she demonstrated a “U-shaped” pattern on the Self-Perception, Daily Life and Autonomy, Social Relationships, and Physical subscales of the QOLIBRI, such that scores endorsed post-intervention were lower than scores at baseline and follow-up. The Cognition subscale remained the same at baseline and post-intervention, but a lower score was noted at follow-up. In contrast, the Emotions subscale increased post-
intervention as compared to levels endorsed at baseline and follow-up. On the TBI-SE measure, Participant endorsed total scores of 27, 29, and 28 at baseline, post-intervention, and follow-up, respectively, suggesting low levels of self-efficacy throughout the study.

![Quality of life ratings](image)

*Figure 7. Quality of life ratings for Participant 2 by assessment time point*

**Participant 3**

**Card-sorting & effort training.** At baseline, Participant 3 sorted cards for 30-minutes. He completed the puzzles and correctly sorted three packets of cards in sequential order. He then participated in nine effort training sessions, discontinuing Sessions 4 and 8 prior to the scheduled end time (i.e., discontinued 6 to 8-minutes early). He gained the majority of reinforcement opportunities available with the exception of two missed opportunities due to talking to the researcher and not actively completing math problems during Session 4. It is notable that Sessions 1 and 2 were unintentionally separated by 10 days, as Participant 3 was hospitalized for an amputated toe. Post-intervention, he sorted for 50-minutes before discontinuing the task. He sorted five packets of cards, correctly sorting four packets in sequential order. It is noteworthy
that Participant 3 did not write down the answers due to limitations related to his hemiparesis (i.e., stabilizing the card while writing the answers reportedly proved challenging for him at baseline), but rather he mentally solved the puzzles to put them in order. Participant 3 was unable to be tested at follow-up, as he underwent emergency surgery related to a ruptured esophagus. He was hospitalized 4 weeks into the follow-up period and was unable to complete the follow-up testing due to physical limitations and restrictions. He remained hospitalized for 5 weeks, and upon return to the residential rehabilitation facility, he moved from his independent apartment setting to a unit staffed with direct care providers.

**ADLs.** Hygiene-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 20–22. Hygiene ratings fluctuated over the course of the study, with most ratings as “poor” at baseline, “mediocre” at intervention, and widely distributed across rating categories, including “poor” and “good,” at follow-up. Primarily, Participant 3 was not prompted (more than half the time) to engage in hygiene tasks throughout the duration of the study, with the least amount of prompts occurring during the intervention phase. Just over half of the ratings were “poor” when he was not prompted at baseline and improved to primarily “mediocre” to “good” at intervention, which remained relatively stable at follow-up. When Participant 3 was prompted throughout the study, he was more likely to complete hygiene-related prompts than refuse them at each time point and hygiene was most frequently rated as “mediocre” to “good” at baseline and intervention, and “good” more than half of the time at follow-up.
Table 20

_Hygiene Ratings for Participant 3 by Assessment Time Point_

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th>Good Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td>44.05%</td>
<td>19.05%</td>
</tr>
<tr>
<td>Intervention</td>
<td>2.00%</td>
<td>18.00%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>32.65%</td>
<td>12.24%</td>
</tr>
</tbody>
</table>

Table 21

_Hygiene Ratings for Participant 3 Conditioned on Prompts by Assessment Time Point_

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th></th>
<th></th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp;</td>
<td>Prompted</td>
<td>Not Prompted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Refused</td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>16.67%</td>
<td>27.38%</td>
<td>55.95%</td>
<td>84</td>
</tr>
<tr>
<td>Intervention</td>
<td>10.00%</td>
<td>18.00%</td>
<td>72.00%</td>
<td>50</td>
</tr>
<tr>
<td>Follow-up</td>
<td>16.33%</td>
<td>18.37%</td>
<td>65.31%</td>
<td>49</td>
</tr>
</tbody>
</table>
Table 22

Percentage of Hygiene Ratings for Participant 3 Conditioned on Prompt Level by Assessment Time Point

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor</th>
<th></th>
<th>Good</th>
<th></th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>P/R</td>
<td>92.86%</td>
<td>7.14%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>13.04%</td>
<td>39.13%</td>
<td>47.83%</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>51.06%</td>
<td>25.53%</td>
<td>14.89%</td>
<td>8.51%</td>
<td>47</td>
</tr>
<tr>
<td>Intervention</td>
<td>P/R</td>
<td>0.00%</td>
<td>40.00%</td>
<td>60.00%</td>
<td>0.00%</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>0.00%</td>
<td>0.00%</td>
<td>77.78%</td>
<td>22.22%</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>2.78%</td>
<td>19.44%</td>
<td>33.33%</td>
<td>44.44%</td>
<td>36</td>
</tr>
<tr>
<td>Follow-up</td>
<td>P/R</td>
<td>87.50%</td>
<td>0.00%</td>
<td>12.50%</td>
<td>0.00%</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>P/C</td>
<td>11.11%</td>
<td>22.22%</td>
<td>0.00%</td>
<td>66.67%</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>NP</td>
<td>25.00%</td>
<td>12.50%</td>
<td>31.25%</td>
<td>31.25%</td>
<td>32</td>
</tr>
</tbody>
</table>

Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted

Grooming-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 23–25. Grooming ratings were similar to hygiene ratings at baseline and follow-up, but relatively better at intervention. As such, the highest frequency of ratings was “poor” at baseline, “good” at intervention (more than half of the time), and widely distributed among rating categories at follow-up, with just over one-third of the ratings as “good.” Similar to the level of prompting observed with hygiene, Participant was generally not prompted (over half of the time) to engage in grooming tasks throughout the study. It is notable that the least amount of prompting occurred during intervention. When Participant 3 was not prompted for grooming-
related tasks, just under half of the ratings were “poor” at baseline, over half of the ratings were “good” at intervention, and more than half of the time was rated as “mediocre” or “good.” On occasions in which Participant 3 was prompted, he was more likely to complete grooming-related activity at baseline and intervention and ratings were most frequently “good” and “mediocre” or “good,” respectively. Interestingly, he was slightly more likely to refuse at follow-up and ratings were overwhelmingly “poor.”

Table 23

*Grooming Ratings for Participant 3 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th></th>
<th></th>
<th>Good Rating</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Total Ratings</td>
</tr>
<tr>
<td>Baseline</td>
<td>39.29%</td>
<td>20.24%</td>
<td>15.48%</td>
<td>25.00%</td>
<td>84</td>
</tr>
<tr>
<td>Intervention</td>
<td>2.08%</td>
<td>8.33%</td>
<td>29.17%</td>
<td>54.17%</td>
<td>48</td>
</tr>
<tr>
<td>Follow-up</td>
<td>30.61%</td>
<td>8.16%</td>
<td>24.49%</td>
<td>36.73%</td>
<td>49</td>
</tr>
</tbody>
</table>

Table 24

*Grooming Ratings for Participant 3 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
<td>Prompted &amp; Completed</td>
<td>Not Prompted</td>
<td>Total Ratings</td>
</tr>
<tr>
<td>Baseline</td>
<td>14.29%</td>
<td>25.00%</td>
<td>60.71%</td>
<td>84</td>
</tr>
<tr>
<td>Intervention</td>
<td>2.08%</td>
<td>10.42%</td>
<td>87.50%</td>
<td>48</td>
</tr>
<tr>
<td>Follow-up</td>
<td>14.29%</td>
<td>10.20%</td>
<td>75.51%</td>
<td>49</td>
</tr>
</tbody>
</table>
Table 25

Percentage of Grooming Ratings for Participant 3 Conditioned on Prompt Level by Assessment Time Point

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th>Poor 0</th>
<th>Poor 1</th>
<th>Poor 2</th>
<th>Poor 3</th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline P/R</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>0.00%</td>
<td>14.29%</td>
<td>19.05%</td>
<td>66.67%</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>41.18%</td>
<td>27.45%</td>
<td>17.65%</td>
<td>13.73%</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Intervention P/R</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.00%</td>
<td>0.00%</td>
<td>60.00%</td>
<td>40.00%</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.38%</td>
<td>14.29%</td>
<td>26.19%</td>
<td>57.14%</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Follow-up P/R</td>
<td>100.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.00%</td>
<td>0.00%</td>
<td>20.00%</td>
<td>80.00%</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21.62%</td>
<td>10.81%</td>
<td>29.73%</td>
<td>37.84%</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

Note: P/R = prompted and refused; P/C = prompted and completed; NP = not prompted

Dressing-related ADL ratings during the baseline, intervention, and follow-up phase are summarized in Tables 26–28. Dressing ratings differed from hygiene and grooming ratings in that they were predominantly “good” at each time point in the study. However, it is notable that Participant 3 was prompted substantially less for dressing tasks than for the other two domains. Notably, under conditions in which prompts were not provided, ratings were improved from more than half of the ratings as “mediocre” to “good” at baseline to ratings of “good” nearly three-quarters of the time at intervention and remained to be “good” more than half of the time at
follow-up. When prompts were provided, Participant 3 was measurably more likely to complete dressing-related activity than to refuse and ratings were primarily “good.”

Table 26

*Dressing Ratings for Participant 3 by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Poor Rating</th>
<th></th>
<th></th>
<th>Good Rating</th>
<th></th>
<th></th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>15.29%</td>
<td>14.12%</td>
<td>29.41%</td>
<td>41.18%</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>1.96%</td>
<td>11.76%</td>
<td>19.61%</td>
<td>66.67%</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
<td>10.42%</td>
<td>8.33%</td>
<td>16.67%</td>
<td>64.58%</td>
<td>48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 27

*Dressing Ratings for Participant 3 Conditioned on Prompts by Assessment Time Point*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prompt Level</th>
<th></th>
<th></th>
<th></th>
<th>Total Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prompted &amp; Refused</td>
<td>Prompted &amp; Completed</td>
<td>Not Prompted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>1.18%</td>
<td>29.41%</td>
<td>69.41%</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>3.92%</td>
<td>13.73%</td>
<td>82.35%</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
<td>0.00%</td>
<td>10.42%</td>
<td>89.58%</td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>
More detailed impressions regarding ADL performance were also gathered from two raters throughout the duration of the study. Refer to Figures 8–10. It is remarkable that the follow-up time point ratings were gathered at 4-weeks into the follow-up period due to unforeseen circumstances noted above. Raters 1 and 2 were observed to differ with regard to changes in hygiene and grooming throughout the study. Rater 1 endorsed higher levels of performance at baseline in both domains and a slight decline or maintenance of functioning level post-intervention and at follow-up, whereas Rater 2 endorsed improvement post-intervention and at follow-up. Raters 1 and 2 endorsed similar profiles with regard to dressing, noting a decline in
performance post-intervention as compared to baseline and follow-up.

Figure 8. Hygiene ratings for Participant 3 by rater and assessment time point

Figure 9. Grooming ratings for Participant 3 by rater and assessment time point
Emotional functioning. Participant 3 reported minimal depressive symptomology at baseline and post-intervention, endorsing scores of 4 and 2, respectively. Quality of life was observed to remain relatively consistent overall from baseline to post-intervention, with QOLIBRI Total scores of 64 and 70, respectively, suggestive of average levels ($z = 0.16$ and 0.48, respectively) of quality as compared to other males of his age. It is notable that slight increases in scores were observed on the Cognition, and Daily Life and Autonomy subscales, and more marked increases on the Emotions and Physical subscales. Slight decreases in scores were observed on the Self Perception and Social Relationship subscales. See Figure 11 for complete QOLIBRI score profile. Self-efficacy was observed to increase slightly from baseline to post-intervention (i.e., 47 and 52, respectively), with scores remaining in the moderate range.
Figure 11. Quality of life ratings for Participant 2 by assessment time point
Chapter 7: Discussion

The main purpose of the current study was to replicate the learned industriousness effect in individuals who had sustained moderate to severe traumatic brain injuries and determine whether an effort training intervention would serve to enhance engagement in activities of daily living. Learned industriousness has been identified by Eisenberger (1992) as a phenomenon in which adaptive behavioral responses can be learned and perpetuated by establishing conditions in which contingent reinforcement is available for high-effort behavior. The phenomenon has not only been demonstrated in rats (Eisenberger, Carlson, et al., 1979; Eisenberger et al., 1989), but also in humans, such that behavior that requires greater effort produces a persistent and relatively stable pattern of behavior on a secondary task. Learned industriousness has specifically been observed in depressed, adult psychiatric patients (Eisenberger, Heerdt, et al., 1979), pre-adolescent children with learning disorders (Eisenberger, Heerdt, et al., 1979; Eisenberger et al., 1984), and non-clinical population of college students (Cameron et al., 2004; Drucker et al., 1998; Eisenberger et al., 1992, 1982; Eisenberger & Leonard, 1980; Eisenberger & Masterson, 1983; Gear, 2007; Hickman et al., 1998; Pierce et al., 2003). The learned industriousness effect has also been investigated, often with mixed results, as an intervention for smoking cessation (Brandon et al., 2003; Quinn et al., 1996; Quinn, 1996), ADHD (Miello, 2005), job seeking and unemployment (Plumly & Oliver, 1987), and to facilitate creativity and independence among the elderly dwelling in assisted care facilities (Polenick & Flora, 2012).

Given the strength of the literature demonstrating the learned industriousness phenomenon in humans and its potential for generating adaptive behavior, the current study sought to replicate the effect among individuals with acquired brain injuries who exhibited low levels of engagement in productive activities, including ADL behavior. The ability to independently engage in ADL behaviors has been identified as a primary rehabilitation goal that
serves to favorably affect subsequent rehabilitation outcomes, such as return to work among individuals who have sustained TBIs (Hofgren, Esbjornsson, & Sunnerhagen, 2010), and such was considered an important topic for study. The current study was the first investigation of learned industriousness completed over several months and with a brain injury population, as the previous literature observed this phenomenon emerge over the course of one to a few sessions.

Overall, the current study showed modest but variable evidence that individuals with moderate to severe TBI demonstrated the learned industriousness phenomenon. Participant’s 1 and 2 showed a similar performance profile at baseline, as they persisted on the card-sorting task for the full time allotted during the session. In contrast, Participant 3 sorted for a quarter of the time at baseline and completed fewer cards. Participant 1 exhibited the same level of persistence on the card-sorting task at baseline and post-intervention. It is notable that although Participant 1 sorted approximately the same number of packets at baseline and post-intervention, he sorted substantially more cards in sequential order during the post-intervention phase than at baseline (i.e., zero packets at baseline and 12 packets post-intervention). Contrary to Participant 1, the quality of Participant 2’s sorting behavior was observed to decline from baseline to post-intervention, as she sorted substantially fewer cards in sequential order; however, she expressed greater motivation to engage in the task until completion than in the initial session, stating “I’m going to finish all of these.” Participant 2 sorted all packets of cards and discontinued the session 28 minutes prior to the allotted time. Participant 3 also demonstrated greater persistence post-intervention, sorting 20 minutes longer and correctly sorting more packets of cards than at baseline.

Participant 1 was the only participant to complete the follow-up card-sorting task. He exhibited a noticeable decline in persistence during the follow-up card-sorting period, but
discontinued the follow-up card-sorting session to clean his apartment. It is possible that Participant 1 was merely disinterested in completing the task, since he had engaged in the task two times prior. However, upon the final follow-up session, Participant 1 indicated that he swept the floors and cleaned the bathroom and kitchen, which was later confirmed by rehabilitation staff. Participants 2 and 3 did not complete the follow-up card-sorting tasks due to unexpected events as previously noted in the Results section and will be further elaborated on throughout this section.

Participant 3 most clearly exhibited an increase in sorting behavior, with respect to both time and packets correctly completed; however, it is notable that a modification was made post-intervention that may have impacted his level of persistence. During the baseline session, Participant 3 was critical of his handwriting on the cards, explaining that it was difficult for him to stabilize the cards and write the solution to the puzzle due to his hemiparesis. Post-intervention, the task was modified such that he mentally solved the puzzles and placed the cards in order. It is possible that if this modification was put into practice sooner, better performance would have been noted at baseline and post-intervention due to feeling less critical and more confident about his ability to complete the task.

Nevertheless, improvement in card-sorting behavior was observed for Participant 3 following effort training, and effort imparted by each of the participants increased post-intervention. Participant 1’s increase in correct sorting behavior and Participant 2’s goal-oriented approach are both characterized by imparting greater effort into the task at hand. It is also noteworthy that during the post-intervention session, Participant 2 indicated that she would rather “be here and be productive” than at her apartment. She also expressed interest in getting back to her “old self,” who used to work. These observations are consistent with the learned
industriousness literature supporting the notion of different forms of effort and generalization of effortful behavior across performance domains post-intervention (Eisenberger et al., 1989; Eisenberger, 1992). The current findings are also consistent with those of the original study, as participants exposed to high-effort training exhibited an increase card-sorting behavior from pre- to post-test. It is noteworthy that the original study reported a relative decline in card-sorting persistence by all groups of participants over the course of four follow-up sorting sessions (Eisenberger, Heerdt, et al., 1979). These findings suggest that persistence on card-sorting are short-lived, likely due to the mundane and demanding nature of the task, even among those who underwent high-effort training. Thus, it is possible that even if participants completed the follow-up card sort, persistence would not have improved due to reasons that are not fully understood.

Transfer of persistence to ADL performance was not a strong across participants as improvements in card-sorting. Since the current study was the first to examine transfer of effort in relation to an unrelated, everyday task, it is possible that the routine nature of the task contributed to the lack of notable change across time points. For instance, generalization of effort in previous research was examined in relation to performance on mathematics tests and essay writing, which are measures that are academic in nature and not wholly unrelated to the tasks encountered at baseline and effort training. Therefore, performance of ADLs may have been too ingrained in each participant’s daily routine and personal preferences to be susceptible to significant change without any task-specific intervention. Daily ADL ratings were also gathered on an ongoing basis for several months, which drastically differs from previous investigations of learned industriousness that were completed over a few days.

Participant 1’s ratings were stable and remained within the “poor” category for hygiene and grooming, and he was prompted substantially less as the study progressed to complete ADLs
within these domains. Interestingly, Participant 1’s dressing ratings declined in quality from “mediocre” to “poor” as the study progressed, although the level of prompting remained consistent (i.e., generally not prompted to complete dressing tasks). It is possible that rehabilitation staff shifted their strategy following the baseline phase, prompting Participant 1 less to engage in ADL behaviors, since their efforts during baseline generally did not yield better engagement in ADL activities or better quality of hygiene, dressing, or grooming behavior. The decline in staff prompting throughout the course of the study may also be understood in the context of a medication change that occurred during the baseline phase of the study in which his dose of lamotrigine was reduced. Rehabilitation staff expressed feeling as though Participant 1 became more aggressive when prompted to engage in personal care ADLs, which may have consequently resulted in less prompting.

It is also noteworthy that Participant 1’s activity pattern was restricted during the follow-up phase due to ongoing observance of poor hygiene, grooming, and dressing. Due to guardian dissatisfaction and clinical team agreement, Participant 1 was restricted on social outings during the follow-up phase of the study. During this phase, social outings were contingent on adequate personal care, yet participation in supported employment placements was preserved. Given that employment opportunities were reportedly of greater importance and value to Participant 1, such that he reported a strong sense of satisfaction and enjoyment from employment experiences, perhaps hygiene may have improved during this phase if participation in a valued activity (i.e., employment) was contingent on adequate hygiene. It is possible that restriction of less valued activities served to frustrate the participant and perpetuate, or even worsen his poor personal care tendencies.
Extended ADL ratings for Participant 1 were generally consistent with the observed daily ADL rating profile. Hygiene and grooming were rated as poorer than dressing across raters. Nonetheless, it is important to note that raters changed from baseline to follow-up, which makes interpretation of this data challenging. The two raters at baseline appeared to hold more favorable perceptions regarding the quality of Participant 1’s ADL engagement and the effort required to facilitate engagement in hygiene, grooming, and dressing activities than Raters 3 and 4. Similarly, measurable differences were noted among Raters 3 and 4 at the last two time points in the study, demonstrating the impact of individual perception and opinion on the observed study findings. Consistent with this viewpoint, relatively stable ratings of “poor” across ADL domains may be explained by prevailing staff attitudes regarding Participant 1’s poor personal hygiene. Rehabilitation staff consistently reported the presence of body odor and Participant 1’s likelihood to wear dirty clothes for several days at a time throughout the course of the study, which may have biased ratings when hygiene, grooming, or dressing may have been adequate for the day. In fact, a recent investigation conducted within a residential drug rehabilitation facility found that clients who perceived discrimination were associated with higher rates of dropout from treatment (Brener, von Hippel, von Hippel, Resnick, & Treloar, 2010), which may explain how perceived bias may impact the noted lack of ADL improvement for Participant 1.

Alternatively, it is possible olfactory issues impeded his ability to optimally perform ADL activities, as TBI has been documented as the leading cause of posttraumatic anosmia and negatively impact adaptive functioning (Drummond, Douglas, & Olver, 2012).

Despite lack of reported improvement in ADL behavior, Participant 1 endorsed a profile to suggest he maintained or improved on his baseline level of psychological well-being throughout the study. He endorsed measurable improvement on the Social Relationship subscale
of the quality of life inventory and slight increase in self-efficacy post-intervention, where both improvements were maintained throughout the end of the study. These favorable changes in quality of life and self-efficacy may be attributed to the social nature of the intervention, such that several opportunities for social attention/praise was available from the researcher contingent on the participant’s engagement in moderately difficult tasks. Favorable changes in psychological status should also be considered within the context of Participant 1’s tendency to respond in a manner consistent with what he perceives as a socially desirable response. Given that the researcher read the questions and gathered responses to the emotional functioning questionnaires at each time point, perceived pressure to choose a desirable response may have impacted his responses. Nonetheless, Participant 1 denied any depressive symptomology and was actively engaged in valued employment positions throughout the course of the study; this profile suggests good psychological functioning and goal-oriented activity, failing to substantiate a strong argument for the influence of social desirability on the observed profile of psychological stability and well being.

Participant 2 was generally prompted to complete ADL tasks throughout the study and ratings primarily remained within the “substandard” category for all domains at each time point. It is notable that an increase in prompting was consistently observed across rating categories during the intervention phase, when prompt refusals were higher than at any other time in the study. An increase in prompts can likely be explained by the intervention schedule, such that rehabilitation staff were informed of the dates and times that the researcher would be meeting with the participant. In fact, rehabilitation staff members were phoned the morning of each scheduled session date in an effort to ensure attendance, since Participant 2 exhibited a tendency to remain in bed the majority of the day and emerge from bed during the evening hours. It is
likely that the scheduled sessions and phoned reminders influenced the frequency in which staff delivered prompts, which then negatively influenced the likelihood for Participant 2 to wake and prepare for the session. Indeed, the researcher often met the participant in her apartment at the scheduled session time, and prompted the participant to wake from sleep. On most occasions, these prompts resulted in Participant 2 waking and completing the session in her room, or dressing, applying perfume, and accompanying the researcher to the scheduled session room. Participant 2 refused on one occasion, indicating that she was tired because “they changed her meds,” and the session was rescheduled.

Participant 2 may have failed to demonstrate improvement in ADL ratings due to challenges with implementing the Adapted ADL Rating Form. Rehabilitation staff on Participant 2’s unit completed measurably fewer ratings than staff on Participant 1’s unit, who consistently completed the rating form throughout the study. Interestingly, the same number of ratings were gathered for Participant 2 during the 6-week follow-up phase as was completed for Participant 3 during the 4-week follow-up, further supporting that lack of evidence of improvement may have been limited by virtue of less data. However, extended ADL ratings were reasonably consistent with daily ADL ratings, as they showed a relative maintenance or even slight decline in behavior throughout the study. Although some variations were observed among raters, dressing was typically rated as better than hygiene or grooming, where more disparate views were noted with the former. It is likely that dressing was rated as better, since dressing was an activity that Participant 2 was reportedly more likely to complete. This observation is consistent with the researcher’s observations of Participant 2, such that she was more likely to put effort into selecting and changing her clothes to attend a session than to engage in a complete hygiene and grooming routine.
Considering Participant 2’s baseline level of functioning, including moderately severe depression and substantially low quality of life and self-efficacy, it is not surprising that considerable gains were not made following the relatively brief intervention phase. However, it is noteworthy that her depression subsided to mild depression post-intervention. Participant 2’s reported alleviation of depressive symptoms immediately following the intervention phase are consistent with the phenomenon of behavioral activation, such that active participation in activities consistent with her values resulted in mood improvement. In fact, Behavioral Activation Treatment for Depression-Revised is a treatment conducted over 10 or fewer sessions that helps individuals identify, connect, and engage with values-driven activities to alleviate symptoms of depression and improve quality of life (Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011; Lejuez, Hopko, & Hopko, 2001). The current intervention was similar, in that Participant 2 completed nine effort training sessions over a 3-week course, which reportedly provided several opportunities for her to engage in activities that facilitated a strong sense of productivity and accomplishment. Although a paucity of research examining the effectiveness of psychotherapeutic interventions for depression following brain injury still remains, a recent meta-analysis cited that dismantling designs show superiority for the behavior component of cognitive behavioral therapy (i.e., engaging in more reinforcing activities through behavioral activation), supporting the positive features and impact of the current intervention (Fann, Hart, & Schomer, 2009). Indeed, a telephone-based intervention that incorporated a strong behavioral activation component was found to ameliorate depressive symptoms among individuals following the first year of injury (Bombardier et al., 2009). More recently, a similar investigation of CBT with behavioral activation completed over eight or more in-person or phone sessions resulted in improvements in depression symptoms at 2-year follow-up (Fann et al., 2015). Future
investigations examining the effectiveness of psychotherapeutic interventions such as behavioral activation for depression following brain injury, however, are necessary to inform treatment recommendations. Patient heterogeneity, including nature and severity of injury and medical comorbidity, in addition to use of research designs with varying degrees of control have been cited as obstacles to synthesizing the literature to inform treatment guidelines (Fann et al., 2009).

It is plausible that Participant 2’s mood improvements were short-lived due to a significant change in living environment days prior to administration of follow-up measures, as she was abruptly moved from her established apartment to a new apartment in another building on campus. Consequently, environmental stressors, such as the loss of an established social support network and stability of living environment was introduced, where the sudden loss of these variables has a well-documented impact on the development of adjustment and depression-related concerns. Alternatively, it is possible that greater gains would have been realized if the intervention had been delivered over a longer time frame (i.e., one session per week over the course of 8–10 weeks), providing Participant 2 the opportunity to develop a stronger skillset that would more effectively generalize in the event of adversity.

Furthermore, quality of life ratings were found to decline following the intervention phase. Ratings decreased within the areas of self-perception, quality of life and autonomy, social relationships, and physical, but increased within the area of emotions. Interestingly, follow-up ratings were similar to baseline ratings. This relative decline in functioning after the intervention may suggest that the effort training provided an opportunity for Participant 2 to reconnect with valued activities and reflect on her values (i.e., productive engagement and employment), thus increasing her subjective ratings of her emotional state. It is possible that subsequent discontinuation of regular contact with the researcher and enjoyable activities led to a decline in
quality of life in circumscribed areas. It is also likely that no meaningful gains in psychological functioning or ADL behavior were observed at the conclusion of the study, since self-efficacy was noted to remain substantially low and stable throughout the study. Without confidence in one’s ability to function independently or recruit the support of others to assist with daily tasks, it is unlikely that actions to move toward valued, adaptive activities will be taken. Indeed, self-efficacy has been documented as one of the most influential psychosocial variables for predicting favorable, long-term outcomes within the areas of not only mood (e.g., anxiety and depression) but also community integration and satisfaction with life (Rutterford & Wood, 2006).

In contrast to Participants 1 and 2, Participant 3 exhibited the consistent improvement or maintenance of adaptive ratings throughout the intervention. It is noteworthy that Participant 3 was prompted less as the study advanced from baseline and exhibited improvement in ADL ratings as the study progressed. Improvements were observed for Participant 3 within the areas of hygiene and grooming ratings, which improved from “poor” to “mediocre” and “poor” to “good,” respectively, and these gains were generally maintained at follow-up. Dressing was consistently rated as “good” at each time point. Extended ADL ratings were similarly consistent with daily ADL ratings, especially as it pertains to differences noted between hygiene and grooming ratings (i.e., slightly lower hygiene ratings as compared to grooming), and relatively higher ratings in dressing compared to both hygiene and grooming ratings. It is likely that Participant 3 demonstrated maintenance or improvement in ADL performance given a combination of variables, including personal and institutional characteristics. Participant 3 was observed to be highly social, often found to be socializing with other clients and staff members in the common room of his residence. He was also reliable and consistently attended scheduled sessions, at times when medical problems were not a barrier. Given his social nature, coupled
with increased opportunities to meet one-on-one with a novel researcher, it is possible that greater attention to ADLs emerged as a result. Additionally, it is noteworthy that Participant 3’s ADLs were routinely monitored and consistently rated daily by rehabilitation staff without issue throughout the entirety of the study. Perhaps close, consistent monitoring, in addition to good relationships with staff provided opportunities to discern improvements in ADL behavior.

It is also plausible that improvements in ADL behavior emerged in relation to psychological status. Participant 3 endorsed minimal depressive symptomology, average quality of life, and moderate levels of self-efficacy at baseline with favorable fluctuations observed post-intervention. Since the learned industriousness and learned helplessness research shows that a positive cognitive style positively influences adaptive behavioral change, it is likely that Participant 3 embodied a positive attitude at the outset of the study that contributed to the opportunity for adaptive change to occur. Specifically, marked increases were noted within emotional and physical quality of life domains, suggesting that, following the intervention, Participant 3 experienced positive changes in thinking. Greater satisfaction with his physical and emotional state was associated with simultaneous improvement in ADL activities, providing evidence of a positive relationship between mood and activity level. In contrast to Participant 2, Participant 3 possessed greater confidence in his ability to complete daily activities. It is likely that this higher level of self-efficacy, coupled with minimal depression and normative levels of quality of life, provided the context for action oriented behavior to occur and manifestation of the learned industriousness behavior to be observed.

Since Participant 3 experienced a significant medical event that prevented his full completion of the study, it is unknown whether improvements in psychological status were maintained at 4-week follow-up when daily ratings concluded. Improvements in ADL ratings
observed post-intervention were not as strong during the follow-up phase; however, it is unknown whether this weakening of the observed learned industriousness effect was related to any change in psychological status, such as a decline in quality of life or self-efficacy at follow-up, which may or may not be related to deterioration in medical status. In fact, research shows a robust relationship among psychological functioning, physical status, and productive activity, such that depression and physical pain are highly correlated in a TBI sample. Physical pain has been shown to significantly impact whether return to productive activity, such as gainful employment or school is likely. Individuals who did not return to work following injury were found to report substantially more pain than individuals who returned with or without difficulty, highlighting the potential impact of medical-related pain on functioning (Dawson et al., 2007).

Limitations and Future Directions

Several factors, including institutional barriers, participant variables, and issues with research design limit the conclusions that can be drawn from the current investigation. Institutional barriers that were beyond the control of the researcher include insufficient medical records, inadequate staffing and high staff turnover, competing contingencies and effort discounting among staff, and the nature of the multifaceted rehabilitation environment. Insufficient medical records, including key markers of brain injury severity (e.g., GCS, PTA, and AOC) were unavailable to the researcher, which negatively impacts the strength of the conclusions that can be drawn regarding a “moderate to severe” TBI sample. Inadequate staffing impacted the ability to implement the original ADL rating scale (ILS), as staffing was not sufficient to complete direct observation of hygiene, grooming, and dressing behavior, resulting in the implementation of the Adapted ADL Rating Form. It was also not feasible to assess inter-rater reliability on the Adapted ADL Rating Form due to high staff turnover and irregular
staffing. Assessing inter-rater agreement on the Adapted ADL Rating Form would have strengthened the conclusions that could be drawn from the current findings.

Inconsistent staff cooperation with completing data collection forms, particularly across staff members of one participant’s unit, negatively impacted the study by limiting the number of ratings that were gathered. It is possible that vacillations in staff cooperation emerged as a byproduct of inadequate staffing on this particular unit. Alternatively, it is plausible that negative staff attitudes toward the intervention and research in general impeded cooperation with the study (P. W. Corrigan, McCracken, Edwards, Kommana, & Simpatico, 1997). It is noteworthy that measures were taken to ensure that rehabilitation staff were provided with appropriate education, training, and reinforcement to complete the daily rating forms, as noted previously. However, future studies may benefit from incorporating a more rigorous schedule of education, monitoring, feedback, and reinforcement as cited in Guercio et al., (2002). Future studies in this area would also benefit from conducting this research within a facility that comprises an organization structure that utilizes principles of organizational behavior management to motivate service staff. For instance, rehabilitation staff on units where Participants 2 and 3 resided often expressed that they felt their input about the respective participant’s treatment progress to clinicians and management were left unheard, noting that their efforts to relay clinical information were futile. Principles of organizational behavior management would prove helpful to increase staff motivation by clarifying objectives to enhance staff performance, in addition to reducing issues that may arise from disagreement among rehabilitation staff, clinicians, and management (Reid & Parsons, 2006b). An Outcome Management approach, in particular, would provide a framework for specifying and monitoring staff objectives to ensure that rehabilitation protocols are accurately and effectively implemented (Reid & Parsons, 2006a). Brown and Lewis
(2015) similarly tout that management should focus on “improving staff morale, self-care, peer support, team cohesion, and communication,” as this approach would help to limit burnout and enhance the psychosocial/psychiatric rehabilitation process (p. 365). Specifically, staff burnout has been identified as a salient issue among a large sample of psychiatric rehabilitation providers, where supervisor/management support, feedback, and involvement in decision-making have been associated with lower levels of staff burnout (Blau, Tatum, & Ward Goldberg, 2013; Scanlan & Still, 2013). By addressing potential inefficiencies with management style and providing clear objectives and support to staff, it would help to improve facility-wide communication and benefit the consumer and his or her progress on the road to recovery.

The current investigation also appeared to be limited by prevailing staff perception or bias of certain participants in the study. On the units where Participants 1 and 2 resided, rehabilitation staff routinely provided reports to the researcher in absolute terms (e.g., “always” or “never”), frequently reporting that the participant’s behavior across ADL domains was consistent with his or her longstanding history. It is also noteworthy that Participant 1’s behavior was consistently described as malicious, such that he was noted to cleverly evade prompts by rehabilitation staff to complete ADL activities. Given these prevailing impressions, it is likely that staff ratings were highly influenced by this bias, which may have also impacted the subsequent behavior of the participant. In fact, perceived discrimination has been associated with patient drop-out from treatment (Brener et al., 2010). It is plausible that staff perceptions or bias toward participants may have been mitigated if they had been provided basic education about brain injury prior to working with this population. Research shows that often times, rehabilitation care staff are not required to hold any specialized credentials or health background to obtain a job working with individuals with brain injury, although they are responsible for implementing
and carrying out highly detailed rehabilitation plans and handling the diverse behavioral and cognitive profiles characteristic of brain injury (Chapparo & Shepherd, 2010). Pizzacalla et al. (2015) recently found that staff members working on an orthopedic unit for patients with delirium and dementia felt much more confident and competent in handling challenging behaviors after participating in a one-day workshop teaching them techniques to support and respond to these behaviors in practice. As such, adequate education about the nature and characteristics of brain injury and principles of behavior analysis/modification would provide rehabilitation staff within this setting a foundational knowledge to more effectively interact with consumers and properly implement treatment plans.

The study was also limited by the multifaceted, dynamic nature of residential rehabilitation, such that participants are involved in several activities to support rehabilitation. All participants engaged in activities outside of the study, including supported employment, psychotherapy, and therapeutic massage. Not only did involvement in these other activities pose challenges for scheduling visits for the current study, but it also limited the conclusions that can be drawn from the current findings due to the unknown influence of work-related changes or impact of psychotherapy experiences on the results of the study. Additionally, given the continual flux of incoming consumers to the residential rehabilitation center, unanticipated relocations of consumers occasionally occur, as was the case in the current study. This unexpected barrier, encountered late in the investigation, is believed to have negatively impacted Participant 2’s full cooperation with the study.

The participants’ perceived absence of a collaborative rehabilitation atmosphere was another limitation of the current study. Participants 2 and 3 often reported that they perceived a lack of independence in the rehabilitation process, indicating that they disliked asking permission
to do basic leisure activities, and were irritated that they could only grocery shop on certain days and times. It is possible that if participants felt a greater sense of control in the rehabilitation process, the results of the current study may have been different. For instance, research has increasingly focused on enhancing community integration of individuals post-TBI by providing intervention to improve independent living skills, social and emotional functioning, and vocational abilities (Geurtsen, Martina, Van Heugten, & Geurts, 2008). Consistent with this focus, one study found that consumers of a residential rehabilitation program for acquired brain injury reported that the beneficial aspects of the program revolved around independence, identity, and sense of community among other variables (Gill, Wall, & Simpson, 2012). Consequently, these findings suggest that the absence of such variables may be detrimental to the rehabilitation process, and consumer involvement in the rehabilitation process should be a primary component and ongoing focus of treatment.

Other participant-specific issues that should be considered as limitations include unforeseen fluctuations in medical and psychological status. Unforeseen medical problems and long-term hospitalization negatively impacted Participant 3’s ability to fully complete the study. Additionally, since the one female participant (Participant 2) exhibited high levels of depressive symptomology during the study, it is important to consider the increasing prevalence of depression among women with TBI. Depression among females with comorbid TBI have been estimated to rise from 25% to 40%, with lack of hope considered as one of the most debilitating symptoms (Oyesanya & Ward, 2016). Future studies should make a concerted effort to control for gender differences that could affect treatment outcomes.

Another major limitation of the study was that outcome measures relied on rehabilitation staff and participant self-report. The disadvantages of self-report measures are well documented
within the literature (MacCann, Matthews, Zeidner, & Roberts, 2003; McDonald, 2008; Paulhus & Vazire, 2007), where the limitations of implementing these outcome measures in the current study were no exception. Participant self-reported emotional functioning provided valuable insight into perceived functioning, yet interpretation of this data posed challenges, especially given the documented impact of the degree of self-awareness on subjective well-being in this population. For instance, as compared to individuals on an inpatient TBI unit, outpatients reported less subjective well-being but better daily functioning. The literature shows that the trajectory of life satisfaction and quality of life has been noted to decline in individuals more than 2 years post-injury, which may be related to more realistic perceptions regarding limitations and goal attainment (Doering, Conrad, Rief, & Exner, 2011; S. Fischer, Gauggel, & Trexler, 2004). Future studies would benefit from not only examining the impact of social desirability on self-reported functioning, as was completed in the current study, but also instituting measures to more fully examine how a skewed self-perception may impact self ratings.

The overall nature of the single case design presented as barrier when such personal or institutional barriers presented. Although abundant and meaningful data was collected on a small group of participants, the differences inherent in these individuals, including nature of injury, age at injury, medical and psychological health history, and substance use history limit the conclusions that can be made. Future studies should be conducted in a facility that holds complete medical information on participants, where a larger sample of participants should be recruited who have similar injury characteristics and are age and demographically matched. Imposing greater rigor and control within the context of a single case experimental design will enhance the inferences that can be gleaned from the results. Alternatively, conducting this
investigation within the framework of a randomized controlled trial will provide the greatest level of rigor and control to determine the effectiveness of the effort training intervention.

Despite the aforementioned limitations, the results of this study provide information that may be used in the development of future learned industriousness investigations. The current study was the first to examine the learned industriousness phenomenon in a residential setting and with a brain injury population. As such, the results provide insight into the challenges of conducting research within a residential setting, where several variables, as noted previously, have the potential to impact the course of the study.

In conclusion, the findings of this study showed modest support for the learned industriousness phenomenon in a brain injury population. Given the staggering number of brain injuries that occur each year in the United States, interventions aimed at targeting the cognitive, behavioral, and emotional sequelae of physical insult to the brain are imperative. The results of the current study provide foundational support for future studies to continue to investigate the utility of an effort training intervention for increasing productive activity among individuals with low motivation and engagement post-injury.
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doi:10.1080/02699050210131957


APPLICATION OF LEARNED INDUSTRIOUSNESS THEORY  150


NIH Consensus Development Panel on Rehabilitation of Persons with Traumatic Brain Injury.


doi:10.1097/NOR.0000000000000127


Shores, E. A., Marosszeky, J. E., Sandanam, J., & Batchelor, J. (1986). Preliminary validation of


York: Cambridge University Press.


Organization.


Appendices
Appendix A

Human Subjects Review Committee Approval

RESEARCH @ EMU

UHSRC Determination: FULL BOARD INITIAL APPROVAL

DATE: April 27, 2015

TO: Aimee Moore, MS
    Eastern Michigan University

Re: UHSRC: # 736822-1
    Approval Date: April 27, 2015
    Expiration Date: April 26, 2016

Title: Application of Learned Industriousness Theory to Brain Injury Rehabilitation:
Examining the Effect of Effort Training on Task Engagement

Your research project, entitled Application of Learned Industriousness Theory to Brain Injury Rehabilitation: Examining the Effect of Effort Training on Task Engagement, has been approved in accordance with all applicable federal regulations.

This approval includes the following:

1. Enrollment of 5 subjects to participate in the approved protocol.
2. Use of the following study measures: Demographic Questionnaire; Card Sort; Jigsaw puzzles; Find the Difference task; Math: Solve the Problems; CLOX; use of the Vision Pocket Screener; Dimensional Change Card Sort (NIH Toolbox); NIH Flanker Inhibitory Control and Attention Test; WAIS-IV; WRAT-4; WTAR; Barthel Index; Independent Living Scale; ILS Daily Rating; Overt Behaviour Scale; PHQ-9; QOLIBRI; Social Desirability Scale; TBI-SE (SEx)
3. Use of the following stamped recruitment materials: N/A: Potential participants will be nominated by the clinical staff
4. Use of the stamped: Assent Form; Informed Consent Form; Authorization for Release of Health Information for Research

Renewals: This approval is valid for one year and expires on April 26, 2016. If you plan to continue your study beyond April 26, 2016, you must submit a Continuing Review Form by March 27, 2016 to ensure the approval does not lapse.

Modifications: All changes must be approved prior to implementation. If you plan to make any minor changes, you must submit a Minor Modification Form. For any changes that alter study design or any study instruments, you must submit a Human Subjects Approval Request Form. These forms are available through IRBNet on the UHSRC website. Please note that major modifications will require Full Board review and should be submitted at least 30 days in advance to allow for the UHSRC monthly meeting schedule.

Problems: All major deviations from the reviewed protocol, unanticipated problems, adverse events, subject complaints, or other problems that may increase the risk to human subjects or change the category of review must be reported to the UHSRC via an Event Report form, available through IRBNet on the UHSRC website

Follow-up: If your Expedited research project is not completed and closed after three years, the UHSRC office requires a new Human Subjects Approval Request Form prior to approving a continuation beyond three years.
Please use the UHSRC number listed above on any forms submitted that relate to this project, or on any correspondence with the UHSRC office.

Good luck in your research. If we can be of further assistance, please contact us at 734-487-3090 or via e-mail at human.subjects@ernich.edu. Thank you for your cooperation.

Sincerely,

Jennifer Kellman Fritz, PhD
Chair
University Human Subjects Review Committee
Appendix B

Example Stimulus Card for Card-Sorting Task

TWO FOUR EIGHT

_____ _____ _____

... ... ... ... ...

... ... ... ... ...

... ... ... ... ...
Appendix C

Daily ADL Rating Form

DATE: ________________

**C-Shift:** Before the end of your shift, please rate the QUALITY of the client’s hygiene, grooming, and dressing.

<table>
<thead>
<tr>
<th>Was the client in bed all shift?</th>
<th>HYGIENE</th>
<th>GROOMING</th>
<th>DRESSING</th>
<th>Did client have any out of apartment activities during shift?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Activities performed to establish cleanliness and maintain good health</td>
<td>Activities performed to maintain good physical appearance</td>
<td>Choosing and wearing clothes appropriate to situation</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>Poor</td>
<td>Good</td>
<td>No</td>
<td>Poor</td>
</tr>
<tr>
<td>If Yes, then</td>
<td></td>
<td></td>
<td>Poor</td>
<td>Good</td>
</tr>
</tbody>
</table>

**A-Shift:** Before the end of your shift, please rate the QUALITY of the client’s hygiene, grooming, and dressing.

<table>
<thead>
<tr>
<th>Was the client in bed all shift?</th>
<th>HYGIENE</th>
<th>GROOMING</th>
<th>DRESSING</th>
<th>Did client have any out of apartment activities during shift?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Activities performed to establish cleanliness and maintain good health</td>
<td>Activities performed to maintain good physical appearance</td>
<td>Choosing and wearing clothes appropriate to situation</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>Poor</td>
<td>Good</td>
<td>No</td>
<td>Poor</td>
</tr>
<tr>
<td>If Yes, then</td>
<td></td>
<td></td>
<td>Poor</td>
<td>Good</td>
</tr>
</tbody>
</table>

**B-Shift:** Before the end of your shift, please rate the QUALITY of the client’s hygiene, grooming, and dressing.

<table>
<thead>
<tr>
<th>Was the client in bed all shift?</th>
<th>HYGIENE</th>
<th>GROOMING</th>
<th>DRESSING</th>
<th>Did client have any out of apartment activities during shift?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Activities performed to establish cleanliness and maintain good health</td>
<td>Activities performed to maintain good physical appearance</td>
<td>Choosing and wearing clothes appropriate to situation</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>Poor</td>
<td>Good</td>
<td>No</td>
<td>Poor</td>
</tr>
<tr>
<td>If Yes, then</td>
<td></td>
<td></td>
<td>Poor</td>
<td>Good</td>
</tr>
</tbody>
</table>

**Poor:**
The client very clearly lacks an appropriate degree of cleanliness.

**Good:**
The client very clearly exhibits an appropriate degree of cleanliness.
Appendix D

Extended ADL Rating Form

Please rate the following items related to the client’s HYGIENE.

Circle the number/statement that best represents your impression of the client.

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongly</td>
<td>Disagree</td>
<td>2</td>
<td>Disagree</td>
<td>3</td>
<td>Somewhat</td>
</tr>
<tr>
<td>1</td>
<td>Never</td>
<td>Exhibits</td>
<td>2</td>
<td>Rarely</td>
<td>Exhibits</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Never</td>
<td>Prompt</td>
<td>2</td>
<td>Rarely</td>
<td>Prompt</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Never</td>
<td>Refuses</td>
<td>2</td>
<td>Rarely</td>
<td>Refuses</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Very Poor</td>
<td>2</td>
<td>Poor</td>
<td>3</td>
<td>Fair</td>
<td>4</td>
</tr>
</tbody>
</table>

6. Over the past month, the client has improved in his/her level of cooperation with activities necessary to maintain good hygiene.

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongly</td>
<td>Disagree</td>
<td>2</td>
<td>Disagree</td>
<td>3</td>
<td>Somewhat</td>
</tr>
</tbody>
</table>

7. The client is successful at completing activities to maintain good hygiene (i.e., no body odor).

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongly</td>
<td>Disagree</td>
<td>2</td>
<td>Disagree</td>
<td>3</td>
<td>Somewhat</td>
</tr>
</tbody>
</table>
Please rate the following items related to the client’s GROOMING activities.

Circle the number/statement that best represents your impression of the client.

1. The client is regularly well groomed.

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Somewhat Disagree</th>
<th>4 Neither agree nor disagree</th>
<th>5 Somewhat agree</th>
<th>6 Agree</th>
<th>7 Strongly agree</th>
</tr>
</thead>
</table>

2. How frequently does the client appear well groomed?

<table>
<thead>
<tr>
<th></th>
<th>1 Never Appears</th>
<th>2 Rarely Appears</th>
<th>3 Occasionally Appears</th>
<th>4 Sometimes Appears</th>
<th>5 Frequently Appears</th>
<th>6 Usually Appears</th>
<th>7 Always Appears</th>
</tr>
</thead>
</table>

3. How frequently do you have to prompt the client in order for he/she to complete grooming activities?

<table>
<thead>
<tr>
<th></th>
<th>1 Never Prompt</th>
<th>2 Rarely Prompt</th>
<th>3 Occasionally Prompt</th>
<th>4 Sometimes Prompt</th>
<th>5 Frequently Prompt</th>
<th>6 Usually Prompt</th>
<th>7 Prompt Every time</th>
</tr>
</thead>
</table>

4. When the client is prompted to complete activities related to grooming, what is the typical response?

<table>
<thead>
<tr>
<th></th>
<th>1 Never Refuses</th>
<th>2 Rarely Refuses</th>
<th>3 Occasionally Refuses</th>
<th>4 Sometimes Refuses</th>
<th>5 Frequently Refuses</th>
<th>6 Usually Refuses</th>
<th>7 Refuses Every time</th>
</tr>
</thead>
</table>

5. Over the past month, how would you describe the client’s level of cooperation with grooming activities?

<table>
<thead>
<tr>
<th></th>
<th>1 Very Poor</th>
<th>2 Poor</th>
<th>3 Fair</th>
<th>4 Good</th>
<th>5 Very Good</th>
<th>6 Excellent</th>
<th>7 Exceptional</th>
</tr>
</thead>
</table>

6. Over the past month, the client has improved in his/her level of cooperation with activities related to grooming?

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Somewhat Disagree</th>
<th>4 Neither agree nor disagree</th>
<th>5 Somewhat agree</th>
<th>6 Agree</th>
<th>7 Strongly agree</th>
</tr>
</thead>
</table>

7. The client is successful at completing activities, such that they appear well groomed (e.g., hair is combed).

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Somewhat Disagree</th>
<th>4 Neither agree nor disagree</th>
<th>5 Somewhat agree</th>
<th>6 Agree</th>
<th>7 Strongly agree</th>
</tr>
</thead>
</table>

Please rate the following items related to the client’s DRESSING activities.

Circle the number/statement that best represents your impression of the client.

1. The client is typically dressed appropriately.

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Somewhat Disagree</th>
<th>4 Neither agree nor disagree</th>
<th>5 Somewhat agree</th>
<th>6 Agree</th>
<th>7 Strongly agree</th>
</tr>
</thead>
</table>

2. How frequently is the client dressed appropriately?

|     | 1 Never Exhibits | 2 Rarely Exhibits | 3 Occasionally Exhibits | 4 Sometimes Exhibits | 5 Frequently Exhibits | 6 Usually Exhibits | 7 Every day |

3. How frequently do you have to prompt the client in order for he/she to dress appropriately?

|     | 1 Never Prompt | 2 Rarely Prompt | 3 Occasionally Prompt | 4 Sometimes Prompt | 5 Frequently Prompt | 6 Usually Prompt | 7 Every time |

4. When the client is prompted to complete dressing activities, what is the typical response?

|     | 1 Never Refuses | 2 Rarely Refuses | 3 Occasionally Refuses | 4 Sometimes Refuses | 5 Frequently Refuses | 6 Usually Refuses | 7 Every time |

5. Over the past month, how would you describe the client’s level of cooperation with dressing activities?

|     | 1 Very Poor | 2 Poor | 3 Fair | 4 Good | 5 Very Good | 6 Excellent | 7 Exceptional |

6. Over the past month, the client has improved in his/her level of cooperation with dressing activities.

|     | 1 Strongly Disagree | 2 Disagree | 3 Somewhat Disagree | 4 Neither agree nor disagree | 5 Somewhat agree | 6 Agree | 7 Strongly agree |

7. The client is successful at completing activities, such that they appear appropriately dressed (i.e., appropriate to situation).

|     | 1 Strongly Disagree | 2 Disagree | 3 Somewhat Disagree | 4 Neither agree nor disagree | 5 Somewhat agree | 6 Agree | 7 Strongly agree |
## Appendix E

### Example Math Worksheet

Solve the Problems.

<table>
<thead>
<tr>
<th>13211 +14210</th>
<th>24560 +31211</th>
</tr>
</thead>
<tbody>
<tr>
<td>62522 +22171</td>
<td>38019 +20980</td>
</tr>
<tr>
<td>70002 +51113</td>
<td>57318 +10081</td>
</tr>
<tr>
<td>24451 +70010</td>
<td>89001 +10998</td>
</tr>
<tr>
<td>14561 +75235</td>
<td>71184 +17215</td>
</tr>
</tbody>
</table>
## Find the Difference (FTD) Task Stimuli and Order of Administration

### Find the Difference (FTD) Task

<table>
<thead>
<tr>
<th>Task</th>
<th>Time</th>
<th>Possible differences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Novice</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is it Art?</td>
<td>2:05</td>
<td>11</td>
</tr>
<tr>
<td>The MP3 Shuffle</td>
<td>2:10</td>
<td>12</td>
</tr>
<tr>
<td>You Say It’s Your Birthday</td>
<td>2:30</td>
<td>15</td>
</tr>
<tr>
<td>Strange Fruit</td>
<td>2:40</td>
<td>12</td>
</tr>
<tr>
<td>Clean Sweep</td>
<td>2:45</td>
<td>13</td>
</tr>
<tr>
<td>Grease Monkey</td>
<td>3:10</td>
<td>10</td>
</tr>
<tr>
<td>Can You Hear Me Now?</td>
<td>3:25</td>
<td>10</td>
</tr>
<tr>
<td>High Score</td>
<td>5:05</td>
<td>17</td>
</tr>
<tr>
<td><strong>Master</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Castles in the Sand</td>
<td>3:25</td>
<td>11</td>
</tr>
<tr>
<td>Family Outing</td>
<td>3:50</td>
<td>10</td>
</tr>
<tr>
<td>Wheel Fun</td>
<td>4:20</td>
<td>11</td>
</tr>
<tr>
<td>This One’s a Gas</td>
<td>4:20</td>
<td>12</td>
</tr>
<tr>
<td>Bizarre Bazaar</td>
<td>4:20</td>
<td>12</td>
</tr>
<tr>
<td>Just Us Girls</td>
<td>4:20</td>
<td>14</td>
</tr>
<tr>
<td>A Moveable Feast</td>
<td>4:45</td>
<td>12</td>
</tr>
<tr>
<td>Puzzling Pagoda</td>
<td>5:20</td>
<td>14</td>
</tr>
<tr>
<td>Chillin’</td>
<td>6:05</td>
<td>14</td>
</tr>
<tr>
<td><strong>Novice</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It’s a Scorcher</td>
<td>2:10</td>
<td>9</td>
</tr>
<tr>
<td>Getting Crafty</td>
<td>2:30</td>
<td>9</td>
</tr>
<tr>
<td>What Up, Dawg?</td>
<td>2:40</td>
<td>11</td>
</tr>
<tr>
<td>Focus on the Present</td>
<td>2:55</td>
<td>10</td>
</tr>
<tr>
<td>It’s a Grand Old Flag</td>
<td>3:15</td>
<td>10</td>
</tr>
<tr>
<td>Farm Team</td>
<td>3:25</td>
<td>10</td>
</tr>
<tr>
<td>Hook, Line, and Sinker</td>
<td>3:30</td>
<td>9</td>
</tr>
<tr>
<td>Mug Shot</td>
<td>3:55</td>
<td>10</td>
</tr>
<tr>
<td>Petals Pushed</td>
<td>4:15</td>
<td>12</td>
</tr>
<tr>
<td>Of Mice and Man</td>
<td>6:20</td>
<td>20</td>
</tr>
</tbody>
</table>
### Jigsaw Puzzle Task

<table>
<thead>
<tr>
<th>Puzzle</th>
<th>Pieces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds of a Feather</td>
<td>36</td>
</tr>
<tr>
<td>Sewing Box</td>
<td>36</td>
</tr>
<tr>
<td>In the Galaxy</td>
<td>60</td>
</tr>
<tr>
<td>Everything’s Ducky</td>
<td>60</td>
</tr>
<tr>
<td>Best of Friends</td>
<td>63</td>
</tr>
<tr>
<td>At the Vets</td>
<td>100</td>
</tr>
<tr>
<td>Robots</td>
<td>80</td>
</tr>
<tr>
<td>Good Companions</td>
<td>100</td>
</tr>
<tr>
<td>No Dogs on the Beach</td>
<td>100</td>
</tr>
<tr>
<td>Down on the Farm</td>
<td>100</td>
</tr>
</tbody>
</table>
Appendix H

Card-Sorting Procedure Script

Card-Sorting Procedure

- Approach participant
- Ask, “Would you be willing to help out by sorting cards?”
- “Your participation is optional.”
- “Now I will show you some examples of the cards you will see.”
- Example A. Word cards
  - Two four eight, Two four nine, Two five zero
    - “Look at these cards. They have words printed on them in the top half, and fill in the blank lines in the bottom half. You will need to write the number in the blank that matches the word printed at the top. Look at the first word. It says two, so I write a 2 like this. Look at this word. It says four, so I write a 4 like this. Now look at this word. It says eight. So I write an 8 like this. You solved the puzzle and the answer is two-hundred forty eight.”
  - “Now, I would like you to try these two cards and do them the same way.” Give time to solve the problems. If incorrect, say “That’s not quite right” and provide teaching as above.
  - “Next, I would like you to take all 3 cards that have been solved and put them in order from lowest number to highest number.” Provide teaching if necessary. “Now the numbers are in order from lowest to highest- 248, 249, 250.”
- Example B. Counting cards
  - One dot, six dots, one dot- 161
  - One dot, six dots, two dots- 162
  - One dot, six dots, three dots- 163
    - “You are going to do the same thing with these cards, only this time you can see that they have shapes in the top part, and not words, but they also have fill-in the blank lines in the bottom part. You are going to count the shapes and write the number of shapes that you counted for each grouping on the line. Go ahead and try these. After you solve the puzzle on each card, put the cards in order from lowest to highest.” Provide teaching as above if necessary.
  - Now that you know how to do them, I need your help sorting as many of these cards as you can. You can see that this box says SORTED but is empty. This box says UNSORTED and is filled with packets of cards that need to be solved and sorted. You are to solve each packet of cards, put them in order, and then place the packet in the SORTED box.
  - “Here is a page that will remind you how to complete the problems in case you forget or have questions. I’ll come back and check in to see how you are doing.”

Check-in during Card Sort

- The participants will be given a maximum of 2 hours to complete the sorting task, and performance will be assessed at 15-minute intervals.
- If one or more packets have been sorted during the preceding period
  - Provide statement, such as “Great, I really appreciate your help. Thanks, good work.”
- If no cards were sorted during the preceding period
  - “Please try your best to sort some cards. You have time.”