TREATMENT COMPARISON FOR COLLEGE STUDENTS WITH TRAUMATIC BRAIN INJURY (TBI)

by

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As members of the Dissertation Committee, we certify that we have read the dissertation prepared by: Kristen Ackley, titled: Treatment Comparison For College Students With Traumatic Brain Injury (TBI), and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

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DEDICATION

To David Beukelman, in memoriam

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Abstract

Purpose: We compared an established cognitive-linguistic treatment protocol to a novel treatment protocol which incorporated injury-related education for college students with traumatic brain injury (TBI).

Method: Twelve college students with TBI received remote treatment per one of two protocols. Treatment targeted a distinct cognitive-linguistic domain per session in three, individual, one-hour sessions occurring between seven and fourteen days apart. Quality of life, TBI-related knowledge, likelihood of academic achievement, confidence, and treatment satisfaction outcome measures were used to characterize outcomes and were administered prior to and following treatment.

Results: Both treatment conditions produced significant improvement in participants' confidence, though confidence change did not differ across condition. Change in performance on predictive measures of academic achievement before and following treatment was statistically significantly more positive or less negative for participants treated in the established approach. Treatment satisfaction was statistically significantly higher for participants in the novel approach. Quality of life and TBI-related knowledge were not affected.

Conclusion: Both treatment protocols may benefit individuals with TBI, but the established approach may improve likelihood of academic achievement. In contrast, the novel approach may increase treatment satisfaction. Clinicians should personalize their approach for individual clients. Research further exploring treatment and educational components is warranted.

Introduction

Traumatic brain injury (TBI) is defined as a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or by a penetrating head injury (Centers for Disease Control, 2014). Approximately 2.8 million TBIs occur each year in the United States, and between 3.2 and 5.3 million Americans experience prolonged symptomatology following TBI, including cognitive deficits. For undergraduate college students with TBI, this symptomatology creates barriers to success within social, cognitive, and physical domains (Hux et al., 2010). For example, in a sample of 35 college students with history of TBI, 97% of respondents perceived a need to review academic material more than was required pre-injury, reported feeling that others do not understand their problems, felt nervous before tests, and forgot information heard in class, and 96% felt overwhelmed in class (Kennedy et al., 2008). In addition, the actual number of individuals who experience prolonged symptomatology attributable to TBI each year is likely much higher than available statistics imply as incidence and prevalence statistics often do not include persons who were treated and released from emergency departments, sought care in outpatient health-care settings, or did not seek treatment at all following injury (Taylor et al., 2017).

TBI Prevalence and Risk in Undergraduate College Students

Adolescents and young adults (i.e., 15–24 years old) sustain more TBIs than individuals within the general population (Popescu et al., 2015) and are at an increased risk for TBI. Hux and colleagues (2017) surveyed undergraduate students at one university and found that approximately 30% reported a history of potential brain injury. In another study, the incidence of newly acquired mild TBI (mTBI) among college students over one academic year was approximately 132.4 per 10,000 (Breck et al., 2019). Given that over 19 million students

attended colleges and universities in the fall of 2020 in the United States (National Center for Education Statistics, 2021), these findings indicate that up to 5.7 million college students may have experienced TBI, and that this number may increase by more than 25,000 individuals each academic year.

Management of post-TBI symptomatology for undergraduate college students necessitates the application of multidisciplinary, collaborative assessment and treatment. Speech-language pathologists (SLPs) receive specialized training that provides a unique, objective perspective in postinjury evaluation and treatment and may facilitate improved performance in areas of need for undergraduate college students. SLPs and researchers supporting individuals who have sustained TBI aim to facilitate client independence, capitalize on client strengths while addressing impairments, assist clients in skill acquisition and strategy use, and identify barriers to and enhancers of success (American Speech-Language-Hearing Association; ASHA, n.d.).

Addressing TBI Impact

Traditionally, many medical professionals have sought information relative to injury severity when considering the impact of TBI on individuals (e.g., Malec et al., 2007). Severity categorization (i.e., mild, moderate, or severe) allows for classification of an individual's level of consciousness and experienced impairments at the time of injury.

Mild TBI is characterized by no loss of consciousness or a loss of consciousness lasting for less than 30 minutes, the presence of posttraumatic amnesia for fewer than 24 hours, and/or a Glasgow Coma Scale rating of greater than 13 following the injury (Kay et al., 1993). Moderate TBI is characterized by a loss of consciousness lasting for at least 30 minutes and no more than 24 hours, the presence of posttraumatic amnesia and/or confusion for at least 24 hours but no more than 7 days, and/or a Glasgow Coma Scale rating of 9-13. Severe TBI is characterized by a

loss of consciousness and posttraumatic amnesia and/or confusion lasting for greater than 24 hours, and a Glasgow Coma Scale rating of 3-8 (American Congress of Rehabilitative Medicine, 1993) mTBI accounts for approximately 80% of reported TBI cases, whereas moderate and severe injuries each account for 10% (Popescu et al., 2015).

Severity classification may serve as an indication of typical or expected recovery patterns; however, there has been much debate surrounding the use of these categorical terms given that this classification may understate the deficits individuals report following injury, (particularly for individuals whose injuries are classified as less severe) and may not reflect real-world outcomes. Rather, considering impairment-related factors (e.g., symptomatology) that impact functional performance may be a more applicable approach to characterizing deficit impact on areas of interest (Dams-O'Connor et al., 2014).

TBI Impact on College Students

Hux and colleagues (2017) systematically identified a subset of undergraduate college students who were experiencing chronic symptomatology consistent with mTBI and reported a suspected mTBI history. These researchers examined relationships between latent symptomatology classes and academic outcome variables. The subset of participants with chronic symptomatology included 118 of 423 total undergraduate college students who self-reported possible mild brain injuries. The researchers utilized 24 cognitive, physiological, or socio-emotional sequelae to identify symptomatology profiles. Their findings indicated that 11% of participants experienced high symptomatology, 49% presented with moderate symptomatology, and 40% presented with negligible symptomatology. The symptoms that best separated high and moderate classes were impairments in memory, thinking speed, new learning, and attention. In addition, they did not find a significant difference in number of injury events

across symptomatology classes but noted that high symptomatology respondents were significantly more likely to have lower grade point averages and more likely to have failed courses than respondents with moderate or low symptomatology. From this, the authors concluded that presence of cognitive problems distinguishes college students with chronic high symptomatology following mTBI from those with moderate and negligible symptomatology. In addition, they concluded that mTBI results in negative functional, academic consequences (e.g., reduced grade point averages). Thus, consideration of severity categorization in isolation may not be sufficient; information about symptomatology should be considered alongside severity categorization to inform characterization of functioning and prognoses.

One widely addressed area in which college students experience deficits is *executive function*, which includes higher-order cognitive functions needed for goal-directed cognition and behavior (Diamond, 2013), such as memory, controlling attention, planning, and organizing. TBI prevents college students from full and successful participation in academic, social, and vocational activities (Ackley & Brown, 2020) as it negatively impacts performance in several areas of executive function, including memory, attention, planning, and organizing (Hux et al., 2017; Kennedy, 2017),

In addition to reliance on executive functions, college students also depend on skills relative to independence and autonomy (e.g., self-awareness, self-regulation, self-efficacy, and self-advocacy) to support their academic, social, and vocational participation (Ackley & Brown, 2020). These skills require *metacognition*, self-reflection on one's own strengths and limitations (Kennedy, 2017). Individuals with TBI demonstrate impaired metacognition, which mediates self-awareness, self-regulation, self-efficacy, and self-advocacy (e.g., Sohlberg et al., 2016).

The Role of the SLP

Many individuals who sustain TBI do not seek any form of post-injury follow-up care (e.g., initial physician evaluation; Brown & Knollman-Porter, 2020). For example, while mTBI accounts for 80-90% of all reported TBIs and many individuals who sustain injuries of this severity experience persistent and pervasive symptoms (Horneman & Emanuelson, 2009), as few as 30% of individuals who sustain mTBIs report seeking care. In addition, many individuals with mTBI who seek care report dissatisfaction stemming from a perceived lack of support from medical professionals and discrepancies between care expectations and receipt (Knollman-Porter & Brown, 2018).

Person-centered and personalized care approaches are supported means by which medical professionals may facilitate positive treatment outcomes and patient satisfaction (Brownie & Nancarrow, 2013; Poey et al., 2017; Van den Broek et al., 2013). SLPs may offer services to college students experiencing cognitive and communicative deficits post-TBI in the form of education (Knollman-Porter et al., 2019), assessment (Brown & Knollman-Porter, 2019), and/or therapy (e.g., Kennedy, 2017) at different timepoints across a patient's continuum of care. For example, for some individuals, service referral may occur immediately after diagnosis or injury occurrence; in other cases, referral may occur months or years post-injury (Brown et al., 2021).

Once a patient is referred for clinical service, the SLP should conduct a thorough, person-centered evaluation to obtain objective documentation of injury-related symptomatology via standardized assessment and a detailed medical history, provide education and counseling regarding injury mechanisms, outcomes, and deficit impact, set appropriate treatment goals, and initiate evidence-based treatment methods. The SLP should then repeat this cyclical process for

the duration of service provision with frequent assessment, goal revision, and treatment revision as needed based on patient outcomes and session data1 (Brown et al., 2021).

Current Treatment Recommendations for College Students with TBI

Few recommendations exist to guide treatment practices by SLPs treating college students with TBI. In a recent literature review, Ackley and Brown (2020) found one widely recommended model for treatment for college students with TBI. This approach is known as the *Dynamic Coaching Model* (Kennedy & Krause, 2011; Kennedy et al., 2012; 2017). The Dynamic Coaching Model is recommended for use for any college student with impaired executive functions. Within this section, we will first discuss the Dynamic Coaching Model as well as its goals and outcomes. Following this discussion, we will discuss the characterization of treatment outcomes for college students in general, recommendations for assessing treatment goals and outcomes, assessment and intervention within the Participation Model, and education recommendations within TBI treatment.

The Dynamic Coaching Model

Dynamic Coaching is highly personalized and occurs while students are enrolled in college. Kennedy states that any professionals with experience supporting older adolescents and adults with executive function deficits (e.g., educators, SLPs, occupational therapists) can serve as a "coach" in the Dynamic Coaching Model, although the ultimate aim of this treatment method is to encourage students to "coach" themselves. Kennedy states that coaches, in addition to possessing basic professional licensure and certification, should have the required knowledge and skills to work with college students specifically. Kennedy acknowledges that many professionals lack training relative to coaching, but cites evidence (e.g., Ehlhardt et al., 2008; Kennedy et al., 2008) suggesting that the use of components of Dynamic Coaching (e.g., direct

instruction and metacognitive strategy instruction) facilitates student "self-coaching" and provides optimal results.

The Dynamic Coaching Model integrates the use of several evidence-based components, such as metacognitive strategy training and the use of external aids to compensate for impaired memory (e.g., academic planner use) and is based on evidence from best learning and instructional practices. Specifically, Dynamic Coaching includes five sequential stages (Kennedy, 2017): precontemplation, contemplation, preparation, action, and change. Please see Figure 1 for a delineation of the actions that both the clinician and student take in each stage.

Figure 1

Dynamic Coaching Model Stages (adapted from Kennedy, 2017)

PRECONTEMPLATION	
Student	**SLP**
unaware of barriers	embraces student independence, offers options, and identifies strengths that may help compensate for deficits
CONTEMPLATION	
Student	**SLP**
acknowledges the problem, but not the cause; may generate pros and cons repeatedly of various potential solutions, but does not successfully generate solutions	provides information relative to abilities and disabilities, determines how long the student has been trying to problem solve, collaboratively generates an explicit list of pros and cons, affirms that change is possible
PREPARATION	
Student	**SLP**
ready for and committed to change	assesses the degree of the student's commitment to change, aims to increase the realistic nature and specificity of plans, provides solutions, and strategies, communicates that some ideas may generalize to other situations, cautions the student not to re-use previous plans that have failed, uses personal experiences
ACTION	
Student	**SLP**
puts plans into action, though goal may not be reached	affirms student success in putting the plan into action, suggests ideas for students to document plan or strategy use and success, discusses goal and/or plan modifications based on student and stakeholder feedback, relates actions to self-awareness
MAINTENANCE	
Student	**SLP**
maintains desired behaviors via plan use, but may relapse and recycle through the stages again	supports students who relapse into habits, routines, or coping mechanisms, discusses why people do not maintain new routines, and collaboratively creates a plan to either resume the formulated plan or create a different plan

SLP actively listens, personalizes information, provides the student with choices, collaborates with the student, acknowledges difficulty of change

Goals of Dynamic Coaching. Kennedy (2017) recommends that SLPs implementing Dynamic Coaching adhere to the practices delineated within each of the five stages of the model described above (e.g., relating student ideas to self-awareness). In addition to providing these suggestions, Kennedy also outlines goals for each stage. For example, one of the goals in the precontemplation stage, in which the student lacks deficit awareness, is to build student confidence. In fact, confidence is frequently cited as both a treatment goal and desired treatment outcome of the Dynamic Coaching Model (Kennedy, 2017).

Outcomes of Dynamic Coaching. To date, no large cohort studies have been conducted with college students who have sustained TBI following treatment under the Dynamic Coaching Model. Thus, consideration of relevant findings within related populations may be beneficial. In 2013, Field and colleagues conducted a randomized controlled trial to systematically compare the effectiveness of coaching 160 undergraduate students with ADHD from 10 colleges. Trained coaches provided treatment for six months to the experimental group. The authors then conducted qualitative analysis of post-treatment interviews, which indicated that coached students reported increased confidence relative to students in the comparison group.

Despite the documented importance of confidence as a contributor to outcomes such as quality of life (Kermode & Maclean, 2001) and self-efficacy (Al-Hebaish, 2012) as well as Kennedy's discussion of confidence as an objective of Dynamic Coaching (2017), no standardized, normed measures are available for use by SLPs to objectively quantify client confidence as a treatment outcome measure. One available measure is the College Survey for Students with Brain Injury (CSS-BI; Kennedy et al., 2014), although this tool is not norm-referenced or standardized. The CSS-BI is a self-report measure available for use with college students with TBI which queries students about their confidence in various areas (e.g., academic

task performance). Kennedy (2017) recommends the use of this measure to "capture student confidence in completing academic activities" (p. 99).

Ackley and Brown (2020) reviewed two articles examining the use of the CSS-BI with college students who have sustained TBI. Kennedy et al. (2014) first evaluated the use of this tool by asking college students with TBI to verbally verify survey responses and understanding of survey items relative to academic challenges via structured interview. From their analyses, the authors concluded that the CSS-BI's College Challenges subset accurately identifies obstacles that individuals with TBI face in college. O'Brien et al. (2018) later examined use of the CSS-BI via interview. Specifically, these researchers examined the academic challenges section of the CSS-BI across two time points by interviewing five college students with TBI. This subsection consists of academic statements (e.g., "I forget what has been said in class") where students rate their agreement on a 5-point scale. The researchers asked students to provide rationales for their selections and to identify strategies they used to help with the problem. From this, O'Brien and colleagues concluded that the use of the CSS-BI facilitated the reliable coding of self-regulation learning strategies, that this measure is a potential functional outcome measure, and that this modified coding schema may serve as an effective, valid measure of change in self-regulated learning strategies over time for college students with TBI.

While extant findings may have important implications for clinicians looking to collate data from multiple measure types (e.g., interview and self-report), these findings do not provide information relative to student confidence or the psychometric properties of the CSS-BI. It remains unclear whether the CSS-BI is an appropriate tool for clinicians hoping to characterize student confidence on academic tasks. Furthermore, this measure does not assess student confidence in non-academic areas (e.g., within personal or vocational realms), which may limit

its generalizability and contradict available guidelines from the World Health Organization (2003) highlighting the importance of holistic consideration of client participation.

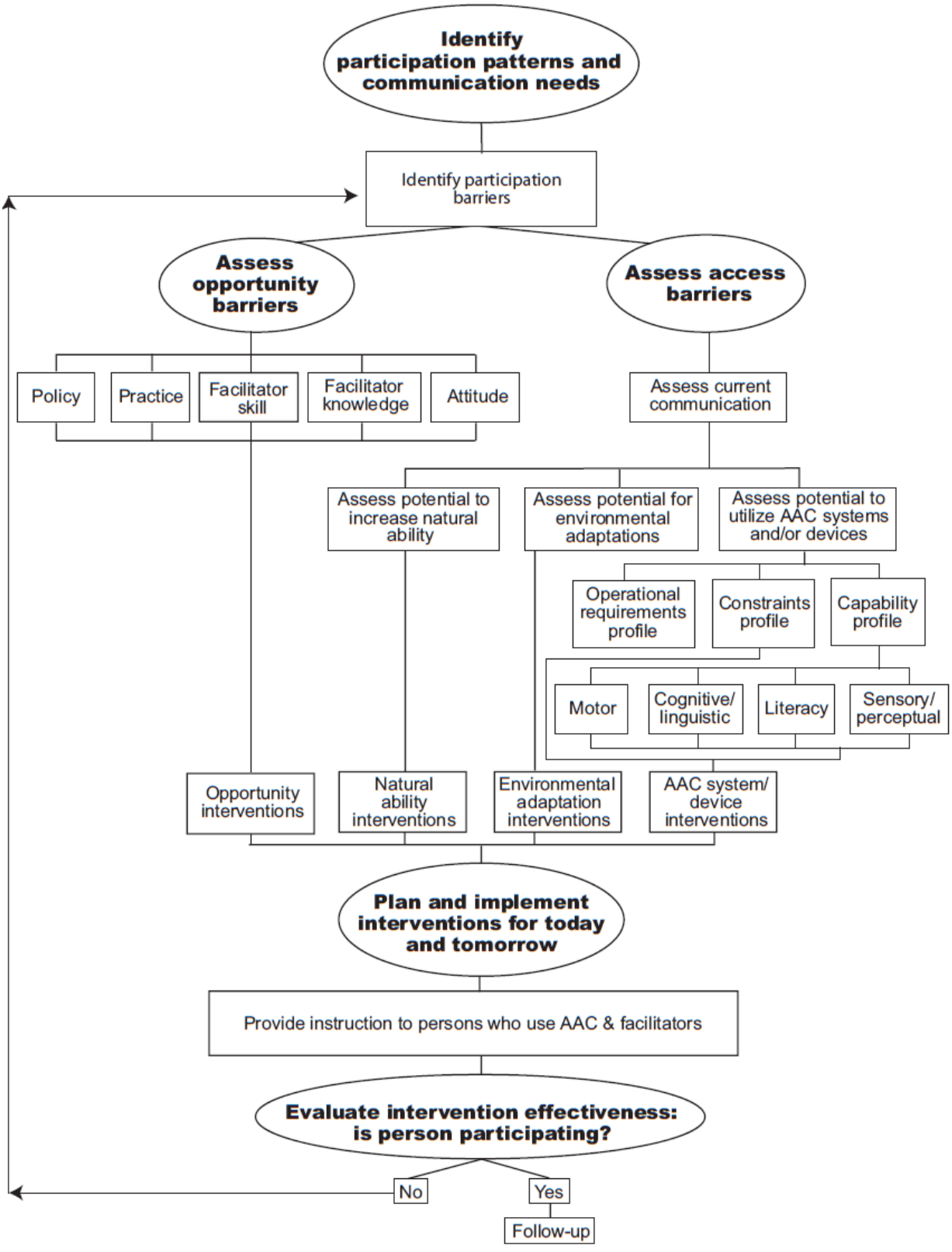
Characterizing Treatment Outcomes for College students with TBI

No current model or framework is available to characterize treatment outcomes for college students post-TBI; however, recommendations from related populations may be considered. In a recent literature review, Ackley & Brown (2020) reviewed recommended practices for college students with TBI by area of service delivery (i.e., general service delivery, assessment, treatment, and education) and found that such recommendations are consistent with the Participation Model proposed within the field of augmentative and alternative communication service provision (AAC; Beukelman & Mirenda, 1988).

Recommendations for Assessing Treatment Goals and Outcomes

The Participation Model (Beukelman & Mirenda, 1988; see Figure 2) is often used to guide service delivery efforts by SLPs supporting individuals who use augmentative and alternative communication (Beukelman & Light, 2020) and includes: (A) assessment of individuals' participation and communication needs; (B) assessment of environmental supports and opportunity barriers; (C) assessment of individuals' capabilities and access barriers; (D) planning and implementation of intervention with clients and relevant stakeholders, and; (E) assessment of intervention effectiveness and follow-up as needed. Of note, this figure is publicly available on the website of the American Speech-Language-Hearing Association (ASHA).

Figure 2
The Participation Model (Beukelman & Mirenda, 1988)



Assessment within the Participation Model

Within the Participation Model, the assessment process begins when clinicians identify barriers to client success relative to either opportunity or access. Opportunity barriers include obstacles stemming from policy, practice, facilitator skills and/or knowledge, and attitude. Conversely, access barriers stem from the individual's functioning. When identifying access barriers, clinicians and researchers assess individuals' potential to increase natural ability, potential for environmental adaptations, and potential to utilize external aids at the time of assessment. Identification of both opportunity and access barriers is essential for clinicians aiming to fully support adult clients as these individuals have unique (e.g., vocational or academic) roles and, as a result, unique task requirements.

Intervention within the Participation Model

Once the clinician or researcher has evaluated each barrier potentially impeding a client's participation, they select an intervention type accordingly. For example, after identifying opportunity barriers related to policy and practice, a clinician may choose to engage in an opportunity intervention by advocating on their client's behalf. In the case of a college student, this might entail writing a letter to the campus disability resource center, contacting an administrator to advocate for increased accessibility within a department, or collaborating with other healthcare professionals to ensure that the student has adequate access to necessary resources. Alternatively, a clinician supporting a client with a strong potential for environmental adaptations would implement an access-related intervention. This may entail the introduction of environmental modifications, such as reduced noise or changes in lighting. The division of barriers into those related to opportunity and those related to access enables researchers and clinicians to consider the multifaceted nature of college students' participation across contexts.

After identifying relevant barriers, the clinician plans and implements both short- and long-term interventions in accordance with barrier type (e.g., environmental adaptations to address access barriers) and provides relevant instruction to clients and relevant stakeholders. Finally, the clinician evaluates intervention outcomes by assessing whether the individual is participating in their academic, vocational, and/or personal roles (e.g., the role of college student). If the individual is not participating, they begin the assessment and intervention cycle again.

Extant literature overwhelmingly supports the use of individualized approaches (e.g., Kennedy et al., 2012, 2017; Sohlberg & Ledbetter, 2016). The protocol utilized within the Participation Model facilitates an individualized approach to both assessment and intervention as its success is measured by broader life participation by the client. In addition to emphasizing individualized intervention approaches, current findings support the use of metacognitive strategy training, assistive technology training, and external cognitive supports in treatment for college students experiencing attention, memory, executive function, and/or communication impairments following TBI (Brown et al., 2017; Brown & Wollersheim, 2018; Gilmore et al., 2019; Kennedy et al., 2017; 2012; Sohlberg & Ledbetter, 2016). Clinicians may easily individualize these intervention components to their clients via use of the Participation Model. For instance, when considering the use of an external aid or assistive technology with individuals post-TBI, a clinician should assess the individual's ability to utilize the aid or device in the same way they would assess an individual's use of an AAC device within the Participation Model.

Education Recommendations within TBI Treatment

SLPs and other healthcare providers may provide generalized and personalized education to college students who have sustained TBI about traumatic brain injury itself, its associated

symptomatology, and post-injury management within treatment, but no current educational guidelines are available to support clinicians in this endeavor. Ackley & Brown (2020) included findings relative to recommended and currently employed education practices for college students with TBI by SLPs in their review and found no articles that included college students with moderate or severe TBI in their search. The authors located only one experimental article conducted by SLP researchers regarding knowledge of and education practices for college students with mild TBI. In this study, Knollman-Porter et al. (2017) surveyed 306 college students with and without a history of potential TBI and found that these individuals lacked knowledge of mTBI definition, symptomatology, and professionals involved in postinjury management. In fact, less than 3% of respondents identified SLPs as professionals involved in TBI management. In addition, differences in self-perceived knowledge did not correlate to knowledge-based performance (i.e., accuracy of responses to questions about TBI). Knollman-Porter and colleagues identified a need for further research on mTBI education efficacy overall and a specific need to educate college students about SLPs' roles in postinjury management.

Relevant findings outside the field of speech-language pathology relative to TBI knowledge and education within this population are available. For example, O'Brien et al. (2019) surveyed 246 parents and students about TBI knowledge and collected subjective confidence rankings regarding response accuracy. One hundred forty-seven students participated in the study and their mean age was 14.4 years, with some students' ages falling within the range of traditional college students (i.e., 18-22 years). These researchers found that individuals who reported knowing someone with a TBI achieved higher scores, that student confidence in their TBI knowledge was weakly related to objective measures of TBI knowledge, and that parents demonstrated more accuracy than students on knowledge questions. From this, the authors

concluded that parents may have greater exposure to educational opportunities and that lower confidence in students suggests an openness to education.

Findings from related populations may inform recommendations for educating college students with TBI. Historically, consideration of the principles of adult learning have been proposed to guide education design (Brundage & MacKeracher, 1980). These principles state that learning should be practical, autonomous, and self-directed, based on learners' life experiences, knowledge-, goal-, and relevancy-oriented, and that learners should be shown respect. Despite the existence of these guidelines, Ackley and Brown (2020) did not locate any work conducted by researchers examining the effects of the application of these principles to SLP service delivery for adolescents or adults with TBI. Consideration of these principles in education material design for college students with TBI may be a feasible way for clinicians and researchers to incorporate a greater number of *Participation Model* components in education and treatment efforts. More recently, Brown et al. (2019) recommended that SLPs working with adolescent students post-TBI should actively educate their clients and families via the provision of both general (e.g., warning signs of a serious head injury, description of concussion, expected symptoms and recovery course) and individualized (e.g., instructions regarding return to activity) information.

Critical Gaps in Treatment Research for College Students with TBI

In addition to available general treatment recommendations for individuals with TBI (e.g., Togher et al., 2014), extant recommendations are available to support distinct treatment efforts by SLPs working with college students who have sustained TBI (e.g., Kennedy et al., 2011; 2012; Kennedy, 2017; Knollman-Porter et al., 2017; Brundage & MacKeracher, 1980). While these recommendations include many evidence-based components (e.g., the use of

personalized treatment approaches), two critical gaps in the literature exist: (a) a lack of holistic treatment outcome characterization for college students with history of TBI, and (b) a lack of systematic evidence to support the use of currently recommended intervention methods. Investigating these gaps may increase current understandings of holistic treatment outcomes for college students with TBI and provide clarity relative to the effectiveness of individual treatment components (e.g., client education).

Characterization of Treatment Outcomes Within the Context of the Participation Model

The absence of an available "gold standard" to characterize function for individuals with TBI increases the pertinence of SLP consideration of the Participation Model (Beukelman & Mirenda, 1988) in all areas of service delivery, including in the characterization of treatment outcomes. This model has been widely applied to assessment and intervention for populations with complex communication needs and may be easily applied to college students with cognitive-linguistic deficits stemming from TBI across the severity spectrum. Unfortunately, many available measurements are not comprehensive and/or sensitive enough to detect the subtle deficits that may persist in individuals following these injuries. To this end, Brown and Knollman-Porter (2019) recently evaluated the contributions of both self-report and standardized measures using a multiple case study design with adults who had sustained mTBI, including one participant who was a college student. The authors' findings indicated that concurrent use of self-report and standardized measures may effectively detect cognitive deficits in college students post-mTBI.

Opportunity Outcomes. Literature documenting the importance of college student knowledge relative to TBI is available. Carroll-Alfano (2017) recommended that to facilitate improved outcomes (e.g., increased healthcare utilization), medical professionals (e.g., SLPs)

should educate college students with a history of TBI about brain injury, care, and the professionals who may be involved in post-injury management. Despite this, current available recommendations relative to TBI treatment research fails to consider the potential impact of client knowledge of and educational efforts related to TBI on treatment outcomes for college students. SLPs are well suited to support college students who report cognitive challenges post-TBI in the form of treatment and education relative to cognitive and communicative deficits, changes in academic performance, and self-awareness or monitoring of symptom recovery (Brown et al., 2019).

Access Outcomes. Literature documenting the impact of cognitive-communicative deficits following TBI in college students is available (Carroll-Alfano, 2017; Hux et al., 2017; Kennedy, 2017; Knollman-Porter et al., 2020). Specifically, these students frequently experience disruptions to their academic studies (i.e., in the return-to-learn process) because of their injuries, as well as social difficulties and feelings of isolation. Individuals with high symptomatology following their injuries are more likely to have lower grade point averages and more likely to have failed courses. In addition, some evidence is available to document improvement on measures of cognitive-linguistic performance by college students following TBI, specifically via the use of environmental adaptations (e.g., Kennedy, 2017; O'Brien et al., 2018) and assistive systems/devices (Brown & Wollersheim, 2018).

To best characterize the cognitive-communicative performance of college students who have sustained TBI, it is important for researchers to consider the demands placed on these individuals within their roles as students. Although no current measures of performance characterize likelihood of academic achievement for college students with TBI, Raes and colleagues (2011), Chen and colleagues (2001), and Dweck (2006) have developed several

predictive measures of academic achievement (i.e., self-compassion, self-efficacy, and growth mindset scales) for general college student populations that may apply.

Self-efficacy is an "individuals' perception of their ability to perform across a variety of different situations" (Judge et al., 1998, p. 170). Individuals differ in their self-perceived ability to meet task demands across contexts. Self-efficacy is influenced by the amount of success an individual experiences, and, as such, develops over a life span as individuals accumulate successes and failures across different task domains. Self-efficacy, self-esteem, and other motivational traits, including a need for achievement, are highly correlated (Judge, et al., 1999; 2000). Moreover, extant findings indicate that self-efficacious students are more likely to achieve academically (e.g., as indicated by higher grade point averages) than their peers with lower self-efficacy (e.g., Komarraju & Nadler, 2002; Nasir & Iqbal, 2019)

Self-compassion refers to the degree to which an individual is gentle toward themself when faced with negative feelings, acts in an unprejudiced manner against self-perceived inadequacy and failure, and accepts that negative life experiences are an inevitable part of human life (Neff, 2003). Evidence indicates that self-compassion is positively related to a need for achievement and inversely related to avoidance of academic tasks. Moreover, students with higher self-compassion are more likely to achieve academically (e.g., as indicated by higher grade point averages) than their peers with lower self-compassion (Tang, 2019).

Growth mindset orientation refers to the degree to which an individual believes that intelligence can be developed over time. Growth mindset is associated with positive learning and achievement in students from elementary school through college, especially during challenging transitions or in difficult courses (Blackwell et al., 2007; Paunesku et al., 2015). Fostering growth mindset in students may improve students' likelihood of academic achievement (e.g., as

indicated by improved grade point averages and reduced racial, gender, and socioeconomic status disparities; Aronson et al., 2002; Good et al., 2003).

Current Study

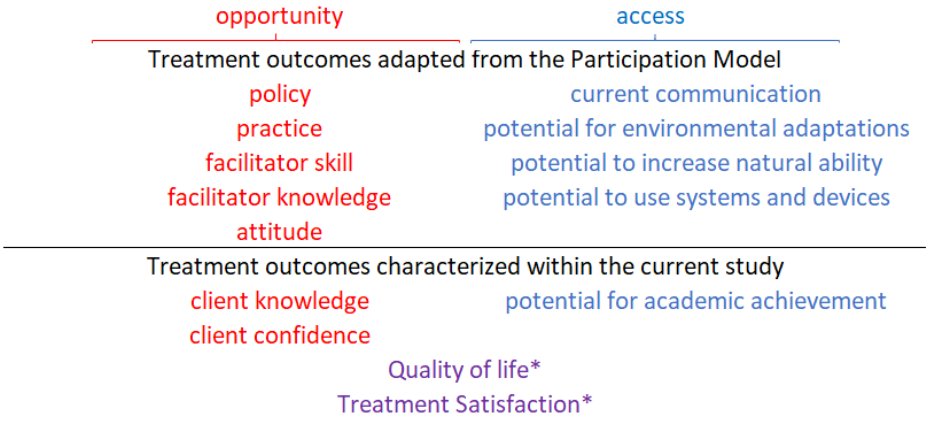
In the current study, we aimed to address the lack of available holistic treatment outcome measures for college students with history of TBI and the dearth of systematic evidence to support the use of currently recommended intervention methods by: (a) systematically evaluating the effects of incorporating education about TBI into the existing Dynamic Coaching Model for college students who have sustained TBI, and; (b) utilizing measures designed to characterize outcomes relative to all components of the Participation Model, as opposed to the sole inclusion of impairment-based measures. The Dynamic Coaching Model is a current, widely used treatment model for college students with TBI that incorporates multiple evidence-based components to help individuals restore or compensate for deficits; however, despite an overwhelming emphasis in the literature on the need for explicit instruction regarding injury factors and outcomes in this population, the Dynamic Coaching Model does not include explicit instruction.

The Apprenticeship Approach proposed in the current study is a novel treatment model that incorporates injury-related instruction into the existing Dynamic Coaching Model. Specifically, participants in the Apprenticeship condition independently completed two educational modules between treatment sessions. To address this issue, we systematically compared the use of the Dynamic Coaching Model to the novel Apprenticeship Approach in a remote treatment study with college students who had sustained TBI. The Apprenticeship Approach included the incorporation of explicit education about TBI into the existing Dynamic Coaching Model for college students with history of TBI. We characterized outcomes relative to

both access and opportunity barriers. See Figure 3 for a delineation of the outcomes characterized within this study and their applicability to the Participation Model.

Figure 3

Study Outcomes and their Applicability to the Participation Model



* denotes outcomes that relate to both opportunity and access

Specifically, we examined five research questions, including:

1. Does change on a measure of self-perceived quality of life differ based on treatment type?
2. Does knowledge change regarding TBI definition, symptomatology, and professionals involved in post-injury management differ based on treatment type?
3. Does change on predictors of academic achievement differ based on treatment type?
4. Does participant confidence on treatment and functional academic tasks change over time and as a function of treatment type?
5. Does self-perceived treatment satisfaction differ based on treatment type?

Before exploring these research questions, we formed the following hypotheses:

1. Quality of life would improve for participants assigned to both conditions, but more so for individuals receiving treatment under the Apprenticeship condition.

2. Knowledge would not change for participants assigned to the Dynamic Coaching condition, and knowledge for participants in the Apprenticeship condition would improve following treatment.
3. Participants assigned to the Dynamic Coaching Condition would demonstrate no change on measures of academic achievement, and participants assigned to the Apprenticeship condition would demonstrate improvement on these measures.
4. Participants in both conditions would improve on confidence measures, but participants assigned to the Apprenticeship condition would demonstrate more improvement.
5. Treatment satisfaction would be higher for participants assigned to the Apprenticeship condition.

For Research Questions 1-4, the null hypothesis was that participants in both conditions would demonstrate no change on measures. For Research Question 5, the null hypothesis was that treatment condition would not differ across treatment condition. See Table 1 for individual research questions and their associated component of the Participation Model.

Table 1

Research Questions and Participation Model Components

Research Question	**Participation Model Component**
Does change on a measure of self-perceived quality of life change differ by treatment type?	Opportunity barrier and access barrier
Does knowledge change regarding TBI definition, symptomatology, and professionals involved in post-injury management differ by treatment type?	Opportunity barrier
Does change on predictors of academic achievement (i.e., self-efficacy, self-compassion, and growth mindset) differ by treatment type?	Access barrier
Does participant confidence on treatment tasks and functional academic tasks change over time, and does this differ by treatment type?	Opportunity barrier
Does self-perceived treatment satisfaction differ by treatment type?	Opportunity barrier and access barrier

Methods

All procedures for this project occurred remotely, via HIPAA-compliant software (i.e., Zoom for Healthcare and Qualtrics). The research team included two licensed, certified SLPs; three trained graduate student clinicians; and eight undergraduate research assistants. The Human Subjects Protection Program and Institutional Review Board at the University of Arizona approved all experimental tasks and procedures prior to study initiation.

Participants

We recruited participants via repeated online postings to various social media platforms – Facebook, Instagram, and Reddit – and two online communities of Special Interest Groups within the American Speech-Language-Hearing Association (SIG 18 Telepractice and SIG 2 Neurogenic Communication Disorders). Interested individuals contacted the primary investigator (PI) directly. See Appendix A for a modified *Consolidated Standards of Reporting Trials* flowchart delineating the path from consent to data analysis. Inclusion criteria for this study required participants to:

- Have a documented history of mild, moderate, or severe TBI occurring no greater than 36 months prior to study initiation
- Be 18 years of age or older
- Speak English as a primary language
- Pass screenings indicative of ability to meet auditory, visual, and technological task requirements
- Be actively enrolled in at least one college-level class at the time of study initiation

Screening

Individuals who expressed interest in the study answered several questions to ensure that they met study inclusion criteria and consented to participate via completion of a two-part questionnaire. First, individuals completed the initial screening questionnaire via Qualtrics. This entailed responding to inclusion/exclusion questions, questions within the Brain Injury Screening Questionnaire (BISQ; Dams-O'Connor, 2014), and initial audiological, vision, and technology questions (see Appendix B). If participants met inclusion criteria, they were prompted to consent to study participation. Participant consent specified the inclusion of recordings to facilitate the capturing of participant verbal responses and behaviors during testing and treatment as well as for later transcription and analysis.

If participant responses to these questions indicated eligibility for the study, they underwent interactive screening procedures. These procedures included reading *The Rainbow Passage* (Fairbanks, 1960) which served to assess participants' abilities to meet technological, reading, visual, and auditory task requirements. Participants were included in the study if they were able to generally engage in the task and were judged by the primary researcher to have reading abilities commensurate with experimental task requirements. Finally, during each interactive assessment and treatment session, each participant answered repeated technology screening questions (see Appendix B).

Participant Information

Participants included six male college students, five female college students, and one college student who did not identify as male or female between the ages of 20 and 24 years (M = 21.83; SD = 1.59). At the time of study initiation, three participants (25%) were enrolled as part-time college students (i.e., taking fewer than 12 credit hours per semester); the remaining nine

students (75%) were enrolled in college full-time (i.e., taking at least 12 credit hours per semester). All participants had a documented history of between 1 and 4 TBIs (*M* = 2.17; *SD* = 1.76) across the lifespan and were between 2 and 25 (*M* = 11.70; *SD* = 7.04) months post-injury.

We defined TBI in accordance with the definition provided by the Centers for Disease Control and Prevention (2019; i.e., a disruption of the normal function of the brain that is caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth) and classified each participant's TBI severity in accordance with the *American Congress of Rehabilitative Medicine's Classification of Injury* (ACRM; 1993). See Table 2 for a delineation of the characteristics associated with injury severity classifications per ACRM standards.

Table 2
Symptomatology by Injury Severity

Severity	**Loss of Consciousness**		**Confusion/ Disorientation**		**Memory Loss**		**Imaging Results**
Mild	≤30 mins	**or**	<24 hrs	**or**	<24 hrs	**and**	Normal (if obtained)
Moderate	≥30 mins, <24 hrs	**or**	>24 hrs	**or**	>24 hrs, <7 days	**and**	May be normal or abnormal
or meets criteria for mild TBI, but with an abnormal CT scan							
Severe	>24 hrs	**or**	>24 hrs	**or**	>7 days	**and**	Usually abnormal

We asked participants to produce medical records documenting their injuries. If provided documentation did not include injury severity information (i.e., for P11), we obtained this information via participant self-report on the Brain Injury Screening Questionnaire (Dams O'Connor, 2014). See Table 3 for participant demographic information and injury characteristics.

Table 3

Participant Demographic Information and TBI Characteristics

	Age	Gender	Race and Ethnicity	Lifetime TBIs (*n*)	Severity; Months Post-Onset (Most Recent Injury)	Injury Mechanism (Most Recent Injury)	Assigned Treatment Condition[1]
P1	22	M	White; Non-Hispanic/Latino	1	Severe; 20	Motor vehicle accident	AA
P2	22	F	White; Non-Hispanic/Latino	4	Mild; 12	Sports	AA
P3	21	M	White; Non-Hispanic/Latino	3	Mild; 25	Sports	DCM
P4	20	F	White; Non-Hispanic/Latino	3	Mild; 2	Sports	DCM
P5	20	M	Asian; Non-Hispanic/Latino	1	Mild; 7	Struck by object	DCM
P6	21	M	White/Non-Hispanic/Latino	1	Mild; 4	Struck by vehicle	AA
P7	23	F	White/Non-Hispanic/Latino	1	Mild; 12	Sports	DCM
P8	21	F	White/Non-Hispanic/Latino	1	Severe; 12	Struck by vehicle	DCM
P9	24	M	White/Non-Hispanic/Latino	4	Mild; 15	Fall	AA
P10	24	M	White/Non-Hispanic/Latino	3	Mild; 12	Assault	AA
P11	21	Prefer not to identify	White/Non-Hispanic-Latino	1	Mild[2]; 8	Motor vehicle accident	DCM
P12	21	F	Black/Non-Hispanic/Latino	1	Mild; 12	Struck by object	AA

[1] DCM = Dynamic Coaching Model; AA= Apprenticeship Approach

[2] Injury severity information obtained from self-report.

Materials

Assessment stimuli included eight measures. Treatment stimuli included personalized cognitive treatment materials and metacognitive strategy worksheet materials suggested for use within Dynamic Coaching. Additional materials included a computer with Qualtrics and Zoom for Healthcare capabilities.

Assessment

Please see Table 4 for a list of assessment measures and their descriptions below.

Table 4
Assessment Measures

MEASURE	TIME REQUIRED	AREA(S) ADDRESSED	PSYCHOMETRIC PROPERTIES
Measures Administered in Pre- and Post-Test Part 1: Independent Completion (via Qualtrics)			
Quality of Life After Brain Injury	10 minutes	Quality of life (Research Question 1)	.91 test-retest reliability; .75 concurrent validity (Von Steinbuchel et al., 2010)
TBI Knowledge Questionnaire	10 minutes	TBI-related knowledge (Research Question 2)	Not available
Self-Compassion Scale Short Form	2 minutes	Academic achievement (Research Question 3)	.97 reliability; .90 validity (Raes et al., 2010)
Self-Efficacy Scale	2 minutes	Academic achievement (Research Question 3)	.86 reliability; .88 validity (Chen et al., 2001)
Growth Mindset Scale	2 minutes	Academic achievement (Research Question 3)	.87 reliability; .95 validity (Dweck, 2006)
Treatment Satisfaction Questionnaire (post-test only)	5 minutes	Treatment satisfaction (Research Question 5)	Not available
Measures Administered in Pre- and Post-Test Part 2: Interactive Completion (via Zoom for Healthcare)			
Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)	30 minutes	Cognitive-linguistic performance (descriptive)	.84 reliability; .82 validity (Roth et al., 1998)
Interview	30 minutes	Subjective information not characterized elsewhere	Not available
Measures Administered in Treatment Sessions: Interactive Completion (via Zoom for Healthcare)			
Confidence Rankings	5 minutes	Treatment satisfaction (Research Question 4)	Not available

Measures Completed Independently by Participants. Participants independently completed the Quality of Life After Brain Injury questionnaire (QOLIBRI; von Steinbüchel et al., 2010a, 2010b), three predictive measures of academic achievement, and a TBI knowledge questionnaire independently via Qualtrics software prior to the pre-treatment interactive assessment session. Following completion of treatment, participants again completed these measures and a treatment satisfaction questionnaire independently via Qualtrics software.

Quality of Life Measure. We utilized the QOLIBRI to characterize participants' quality of life before and after treatment. This questionnaire includes 37 items and assesses participant self-reported satisfaction in six health-related dimensions of quality of life following traumatic brain injury (i.e., cognition, self, daily life and autonomy, social relations, emotions, and physical problems). Participants respond to queries in these domains by indicating their level of satisfaction or feeling bothered via use of a 5-point Likert scale (i.e., "How satisfied are you . . ." and "How bothered are you . . ."). Scores range from not at all satisfied (1) to very satisfied (5) or from very bothered (1) to not at all bothered (5), accordingly. Each domain is scored discretely; the QOLIBRI also provides a composite score to characterize overall quality of life. Each domain as well as the composite score is scored out of 100 possible points. A score of zero indicates very poor quality of life; a score of 100 indicates a very high quality of life.

Knowledge Questionnaire. We adapted a knowledge questionnaire from Knollman-Porter et al. (2017). We utilized an online survey to adhere to the remote format of the study and to better serve the population of interest in this study, as collegiate students are generally well-versed in computer and Internet practices (Galanek et al., 2018). Knollman-Porter and colleagues (2017) developed a 60-item questionnaire which included open-ended and forced-choice questions relative to mTBI/concussion definition, its associated symptoms, and individuals involved in post-injury management. We adapted items from this questionnaire to address TBI definition, its associated symptoms, and individuals involved in post-injury management (see Appendix C).

Self-perception knowledge questions were based on a 4-point Likert-type scale and prompted respondents to rate their knowledge about TBI-related topics (e.g., signs and symptoms) on a scale ranging from *Excellent* to *Poor*. In Knollman-Porter and colleagues'

survey (2017), participants provided a free recall definition of concussion, listed symptoms using their own words, and listed professionals who may be involved in the care and recovery of individuals with a concussion. We again adapted these items and asked participants to provide a definition of TBI, list symptoms in their own words, and list individuals who may be involved in the care and recovery of individuals with TBI.

Following response to free recall questions, participants in Knollman-Porter et al.'s 2017 survey responded to forced choice questions relative to concussion symptomatology and injury impact. Similarly, participants in the current study responded to a true/false question, which asked whether symptoms following concussion can negatively impact academic and work performance. Participants selected symptoms associated with TBI from a closed list of 38 options. As in Knollman-Porter and colleague's questionnaire (2017), symptom options included physical (e.g., headache), socioemotional (e.g., depression), and cognitive symptoms (e.g., decreased concentration). Participants in Knollman-Porter's study were presented with a list of 20 professionals who may be involved in post-injury management (e.g., athletic trainers, SLPs) Participants in the current study responded to these same questions as well as questions relative to self-perception knowledge, but we replaced the term "concussion" with "traumatic brain injury." Finally, as in Knollman-Porter's study, participants were asked to identify which, if any, methods had been used to educate them about concussion (e.g., videos, formal presentations). Participant scores ranged from 0 to 30.

Predictive Measures of Academic Achievement. We used three standardized predictive measures of academic achievement (i.e., the Self-Efficacy Scale; Chen et al., 2001; The Self-Compassion Scale Short Form; Raes et al., 2010; and the Growth Mindset Scale; Dweck, 2006;

see Appendix D). Norms are available for these measures from college student populations without disabilities (Lockard et al., 2014; Chen et al., 2001; Raes et al., 2010).

The Self-Efficacy Scale (Chen, 2001) is a seven-item self-report measure on which participants rate their agreement on a 5-point Likert-type scale ranging from "strongly disagree" to "strongly agree." Items query participants relative to their perception of their ability to perform tasks across a variety of contexts (e.g., "I will be able to achieve most of the goals I have set out for myself"). Possible scores ranged from 0 to 30.

The Self-Compassion Scale (Neff, 2003) is a 26-item self-report inventory and consists of six sub-scales: self-kindness, self-judgment, awareness of common humanity, isolation, mindfulness, and over-identification. Each item is rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree). The Self-Compassion Short-Form (Raes et al., 2011) has .97 reliability with the full scale and includes 12 items. To reduce burden on participants, we utilized this form. Possible scores ranged from 0 to 50.

The Growth Mindset Orientation Scale (Dweck, 2006) contains four items. Using a 6-point scale (1 = strongly agree; 6 = strongly disagree), respondents rate their agreement with statements about whether their efforts can change their intelligence such as, "You can learn new things, but you can't really change your basic intelligence." Possible scores ranged from 0 to 12.

Treatment Satisfaction Measure. In 2010, Bergquist and colleagues examined cognitive treatment satisfaction among individuals with moderate to severe acquired brain injury for services delivered via the Internet. Specifically, this questionnaire included four separate statements relative to participant satisfaction. Questions probed participants relative to satisfaction with the therapist and therapy received as well as willingness to receive therapy again. In the current study, we assessed treatment satisfaction by adapting this questionnaire. We

asked participants seven forced-choice questions (see Appendix E; adapted from Bergquist et al., 2010). We added questions asking whether participants attributed perceived improvements to treatment or other factors, preferred approaches to task completion before or following treatment, and perceived helpfulness of the treatment program. All questions were presented in a multiple-choice format (e.g., including the options "yes," "no," and "unsure") so that responses could be easily categorized and compared. Possible scores ranged from 0 to 10.

Measures Completed via Interaction Between Participants and Clinicians.

Participants completed a standardized cognitive-linguistic assessment, subjective confidence measures, and two interviews (i.e., a motivational interview pre-treatment and a semi-structured interview post-treatment) with a clinician via Zoom for Health software. Participants spent between 33.5 and 64.5 minutes completing interactive pre- and post-treatment measures (M = 47.91; SD = 12.35).

Cognitive-Linguistic Measure. We descriptively characterized cognitive-linguistic performance via the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Roth, 1998). The RBANS is a standardized, behavioral assessment that provides scores in five domains (i.e., attention, visuospatial/constructional ability, immediate memory, delayed memory, and language). We utilized this measure because the goal-setting protocols used in both treatment models address participant performance in these cognitive-linguistic domains and, in comparison to other cognitive-linguistic assessments, this assessment is relatively quick to administer (i.e., an average of 30-minutes) and is widely used by SLPs assessing adolescents and adults with TBI (Duff, 2002).

Evidence regarding delivery of this assessment via telepractice indicates that remote delivery does not compromise or alter the psychometric properties of this assessment (e.g.,

American Psychological Association Services, 2020; Grosch et al., 2011; Inter Organizational Practice Committee, 2020; Stolwyk et al., 2020). Despite this, some adaptations to ensure that the test was administered in accordance with standardized protocols were necessary. The RBANS consists of 12 subtests, 10 of which required no adaptations for remote administration (as judged by two nationally certified, state licensed speech-language pathologists and three speech-language pathology graduate student clinicians). One subtest (i.e., coding) was less amenable to the remote format due to its reliance on a coding form, wherein participants indicate a number corresponding to a series of symbols utilizing a provided key. Administration of this component required participants to print the form prior to each interactive testing session (i.e., pre- and post-treatment). In addition, administration of this component requires clinicians to model response completion. In one case, this required some trial-and-error by the clinician. Specifically, the clinician attempted to utilize a PDF editor to enter numbers into blank spaces and was unsuccessful. They then had to write in the numbers on a physical copy, stop screenshare, and hold the physical copy up to the Zoom screen.

In two cases, assessors had to make real-time adaptations when administering the figure copy subtest to ensure that responses could be interpreted and/or scored as they would be if in-person protocols were used. In one case, a participant's screen was mirrored, which made the screenshot difficult to capture for the assessor. In another case, the drawing was unclear when held up to the screen, despite several attempts at changing the distance between the physical paper and camera to make it clearer. In both cases, participants successfully emailed images to the assessor during the interactive session to ensure receipt.

Subjective Confidence Measures. We characterized participant confidence via subjective rankings in five academic task areas (i.e., attending to lectures, notetaking, completing

homework on time, completing quizzes and exams, and knowing what to do if they have a question). Rankings were based on a 5-point Likert-type scale, with options ranging from *Not at all confident* to *Very confident*. Likert scales were utilized in this case so that data could be compared both on an individual participant basis across time and between participants.

Goal Setting

We assigned each participant to either the existing Dynamic Coaching Model of treatment or the novel Apprenticeship Approach to treatment. These two interventions differed in two distinct ways: (a) goal setting procedures and (b) inclusion of education about TBI. For participants assigned to the Dynamic Coaching Model, we set goals using questions suggested by Kennedy (2017) relative to coursework (e.g., number of classes in which the student is currently enrolled; see Appendix F). We added two questions to ascertain information about the modality and (a)synchronicity of course delivery for each class given the current, widespread use of videoconference platforms.

Brown and colleagues (2021) recently explored the effects of a person-centered, holistic goal setting approach for two adults who had sustained TBI. This protocol included the provision of generalized TBI-related education to participants, which served as the first of three educational modules in the current study. Specifically, participants assigned to this protocol received generalized education via an interactive session with the treating clinician. This included the use of a list of 18 cognitive (e.g., vigilance, cognitive flexibility) and five linguistic (e.g., written expression, reading) domains as well as lay term definitions (e.g., “vigilance is paying attention to something”). In the current study, we utilized this same list and protocol to set goals for participants assigned to the Apprenticeship Approach; see Appendix G. The second

two educational modules were completed by participants independently during the course of treatment. Information about these two modules is available below.

Treatment

Treatment included both interactive and independent components. Treatment components differed by treatment condition. See Table 5 for a delineation of the treatment components included in both the Dynamic Coaching and Apprenticeship Approach treatment conditions.

Table 5
Treatment Components

	Dynamic Coaching Model	Apprenticeship Approach
Personalized, goal-centered treatment	✓	✓
Course-related goal setting protocol	✓	
Interactive instructional module and holistic goal setting protocol session		✓
Metacognitive strategy training	✓	✓
Independent, TBI-related instructional modules		✓

Interactive treatment included two components: (a) personalized cognitive treatment and (b) generalized metacognitive strategy training. Participants also completed subjective confidence rankings in each treatment session. Consistent with current recommendations (e.g., Kennedy 2017), materials used in the personalized cognitive treatment components depended on goal areas and participant-specific contextual factors (e.g., daily task requirements).

Materials for personalized cognitive training were ecologically valid. For instance, for participants whose goals related to listening to recorded lectures, training materials included course-specific lectures available from online learning systems accessible to the participants. In instances where no materials were directly available due to timing or other constraints, the clinician and client worked to procure ecologically valid materials from freely available internet sources. For example, one student's goals related to their ability to sustain attention and recall

key points of read material. In this instance, the student cited difficulty in completing quizzes about assigned weekly readings relating to current events in marine biology. They did not have an assignment available to them for a treatment session as they had already completed the reading and quiz for that week. Therefore, the treating SLP and student collaborated to locate a relevant article that contained similar content and was similar in form (e.g., length, readability) to the articles they were regularly assigned. See Table 6 for a full list of personalized treatment materials by goal area and participant. Treatment materials also included metacognitive strategy training worksheets, suggested for use by Kennedy (2017; e.g., Interpreting Abilities and Disabilities; see Appendix H).

Table 6

Treatment Activity Examples by Participant and Goal Area

Participant	Goal Area(s)	Treatment Activity
P1	Alternating attention	Answering listening comprehension questions about a biology video for school with their pet dog present
P2	Sustained attention	Metacognitive strategy training to redirect attention when reading from a textbook
P3	Short-term recall and sustained attention	Rehearsal strategy and metacognitive strategy to ensure that the participant was attending fully during encoding
P4	Reading comprehension and information recall	Participant verbally summarized information from an article that contained similar content (i.e., about marine biology) and was similar in form (e.g., length, readability) to articles assigned in courses
P5	Organization	Clinician trained participant in the use of an electronic task management system and app (i.e., Trello) and arranging their personal tasks into their Trello board according to the organizational system they felt was most appropriate (i.e., by time of day and level of effort required for tasks)
P6	Planning	Clinician trained participant to create systematic plans for large tasks (e.g., studying for exams)
P7	Processing speed	Participant completed practice math problems found in their course textbook to improve their task-specific processing speed
P8	Written expression	Clinician trained client to access and utilize feedback from previous assignments available via D2L to improve writing. Clinician also trained client in the use of outlines to organize writing
P9	Prospective memory	Clinician trained client to use routines and to write down information in one centralized location (i.e., a planner)
P10	Time management	Clinician trained client to allot a certain amount of time (e.g., one hour) to specific tasks and force themself to stop those tasks at the end of the hour to complete all tasks requiring attention
P11	Listening comprehension	Clinician trained client to create outlines from existing course materials (e.g., study guides) for listening to academic lectures and fill in information as it was presented
P12	Daily task completion	Clinician trained client to use visual reminders (e.g., placing pill bottles next to bed) and routines (e.g., taking pills immediately when waking up) to remember to complete certain tasks

Education. Participants treated via the Apprenticeship Approach independently completed two generalized, 30-minute educational modules between treatment sessions (i.e., "TBI and its Symptoms" and "The Post-Injury Management Team"). Each module included a passive, 20-minute, narrated PowerPoint presentation recorded utilizing a standardized script. Each module also included an interactive activity prompting the participant to apply information. Specifically, the interactive component for "TBI and its Symptoms" entailed completion of a

Symptom Recognition Log (Brain Injury Network, 2018; see Appendix I), wherein participants identified their symptoms. The interactive component for "The Post-Injury Management Team" prompted participants to write a paragraph in which they identified individuals who may help them with post-injury management (e.g., friends, academic advisors) and provided rationale for selecting those individuals. We adapted these materials from the Brain Injury Network's program entitled "Achieving Healing through Education, Accountability, and Determination" (2018). These materials were at or under a reading level of 7.0 on the Flesch-Kincaid Reading Ease Scale to ensure that readability was not a barrier to engagement with the materials.

Development of Treatment Fidelity Materials

We developed materials to measure assessment, goal setting, and treatment fidelity in accordance with available recommendations (Bellg et al., 2004). This entailed the creation and use of three separate checklists (i.e., one checklist for interactive assessment sessions, a separate checklist for goal setting sessions, and a third checklist for treatment sessions). All fidelity assessment checklists included items relative to audio and visual components (i.e., asking whether the assessor was able to be seen and heard throughout the entire session).

To assess interactive assessment fidelity, we developed a checklist utilizing the test manual (Roth, 1998). Specifically, we included items listed in the testing protocol (e.g., timing participants on specific subtests) within the checklist and instructed individuals completing the checklist to indicate whether each instruction was adhered to. The interactive assessment fidelity checklist included items relative to assessor screenshare (i.e., asking whether shared test stimuli were visible), delivery of all test items within each subtest, clear pronunciation of all verbally delivered test items, delivery of all subtests, and adherence to test instructions (e.g., reading instructions exactly as specified in the testing protocol and delivering items in the correct order).

To assess goal setting fidelity, we developed a checklist for each goal setting protocol utilized under each condition. We developed these checklists utilizing available, published goal setting protocol descriptions (i.e., Kennedy, 2017 for participants assigned to the Dynamic Coaching Model and Brown et al., 2021 for participants assigned to the Apprenticeship Approach). The goal setting fidelity checklist included items relative to assessor screenshare (i.e., determining whether shared stimuli were visible), discussion of all components mentioned within each protocol, and adherence to other goal setting instructions (e.g., reading instructions as specified in the protocol and performing goal setting steps in the correct order).

For treatment fidelity, we developed a similar checklist. The treatment fidelity checklist included three components (i.e., personalized cognitive treatment, metacognitive strategy training, and subjective confidence rankings) with time allotment specifications (e.g., 15 minutes for metacognitive strategy training). In addition, this checklist addressed time spent on off-topic conversation (i.e., with redirection occurring within one minute of off-hand remarks being made as needed).

We also recorded clinical notes and stored this documentation via Box for Healthcare in Microsoft Word. Each note included subjective, objective, assessment, and performance (SOAP) informational components in accordance with current and historical guidelines for medical documentation (e.g., Baird, 2004; 2016; Hodges, 2011; 2014; Weed, 1964). Within the subjective portion, we included information relative to participants' subjective behavior during a treatment session and reported information (e.g., level of fatigue). The objective portion contained information relative to tasks performed during treatment to address participant goals. The assessment portion contained information about participant behaviors and the ways in which participants responded to treatment activities. Finally, the plan section contained a statement that,

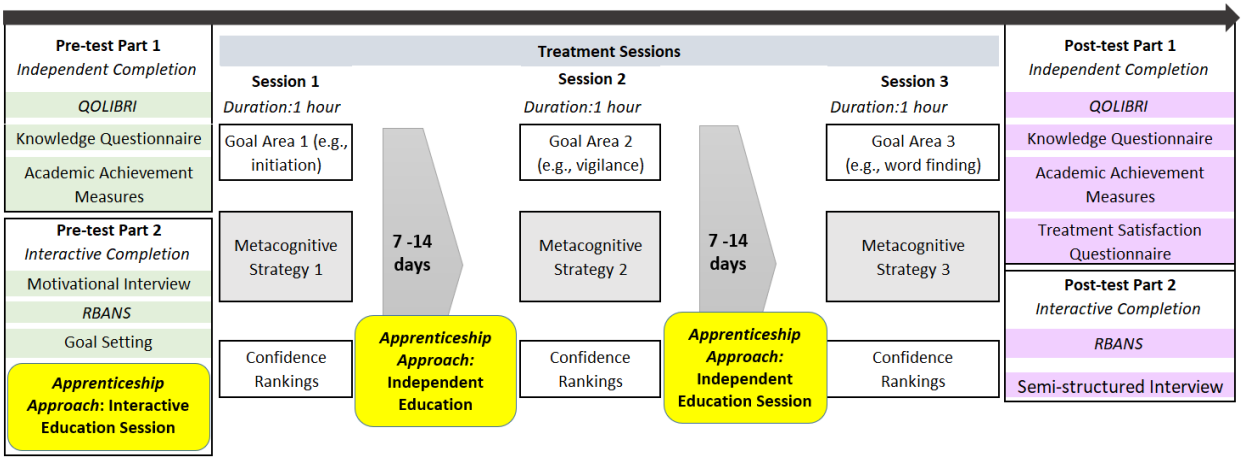
during the subsequent treatment session, the treating clinician would collaboratively revisit, or revise information addressed during treatment with the participant.

Procedures

One of three trained graduate student clinicians conducted 22 pre- and post-testing sessions via Qualtrics and Zoom for Healthcare. In two instances, graduate student clinicians were unavailable for data collection, and a trained, state-licensed, nationally certified SLP conducted assessment procedures. A single SLP (the project PI) who did not conduct either pre- or post-testing sessions facilitated all treatment sessions. Each participant completed five sessions (i.e., an interactive pre-test, three treatment sessions, and an interactive post-test) requiring a maximum total time commitment not exceeding seven hours. Pre- and post-test protocols included two parts. In Part 1, participants completed measures independently via Qualtrics software; in Part 2, a clinician administered measures via Zoom for Healthcare. See Figure 4 for procedures.

Figure 4

Procedural Components



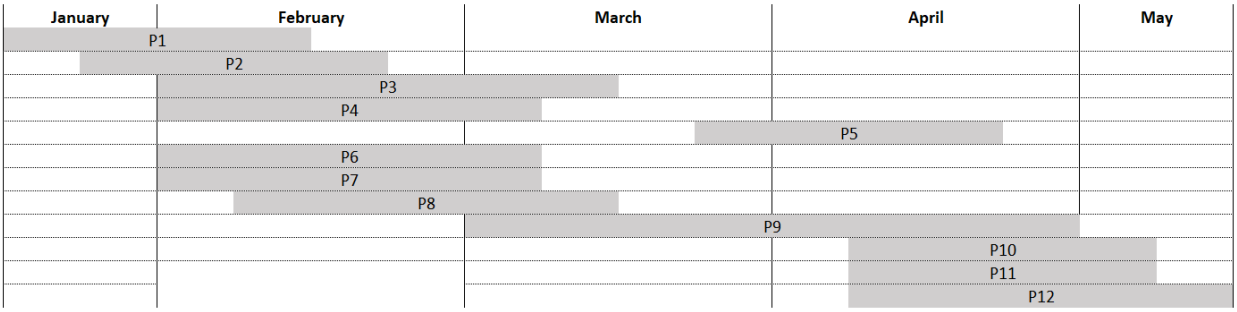
Assessment

Each participant underwent a two-part pre-test. We utilized a staggered entry approach to avoid the likelihood that noted changes were attributable to external temporal factors (e.g., point

in the semester). Specifically, participants entered the study at any time throughout the data collection period, which lasted from January 21, 2021, through May 17, 2021. Each participant began the study at a unique time zero and had a unique ending point corresponding to their individualized participation in the study (i.e., for the duration of all five sessions). See Figure 5 for participants' unique timelines.

Figure 5

Participant Study Participation Timelines



In Part 1 of the two-part assessment protocol, participants independently completed a TBI knowledge questionnaire, three standardized academic achievement measures (i.e., measures of self-efficacy, self-compassion, and growth mindset orientation), and the QOLIBRI via Qualtrics software. All measures were completed in unique, randomized orders. Participants completed Part 1 independently in a single, electronic session lasting from 8.45-68.33 minutes (M = 29.97; SD = 22.67). Participants were permitted to take breaks and return to sessions, which likely skewed timing statistics.

Following completion of Part 1, participants received a link to schedule Part 2 of the assessment session, which was administered via Zoom for Healthcare by a non-treating research assistant. This portion of the assessment was video- and audio-recorded via Zoom for Healthcare and included a motivational interview, a standardized cognitive assessment (i.e., the RBANS) and one of two goal setting procedures.

Motivational Interviewing

Following completion of independent testing and preceding any interactive testing activities, all individuals participated in a motivational interview. Motivational interviews were performed by one of three trained graduate student clinicians or by a non-treating, licensed, certified SLP and were digitally recorded via Zoom for Healthcare with both audio and video data for later transcription and analysis. Interviews lasted between 13 and 33 minutes (M = 20.18 min, SD = 7.12). During motivational interviews (Brown & Knollman-Porter, 2019; Hettema et al., 2005; Kennedy, 2017; Medley & Powell, 2010), clinicians employed supportive and empathic counseling techniques while asking questions in a conscious, directive manner to facilitate participant self-analysis. Interviews emphasized participant autonomy in the identification of participant needs via practitioner-participant collaboration. Specifically, clinicians began by asking one open-ended question relative to the participant's self-perceived cognitive changes following their most recent injury. The clinician then followed with open-ended, directive prompts, reflected on the participant's responses, and synthesized participant remarks. Follow-up questions included those relative to functional status changes, examples of how identified changes were affecting participants' daily functioning at the time of interview, level of participant independence and barriers to independent living, and prioritization of the three or four most changed or most problematic areas for the participant. Following completion of motivational interviews, participants underwent the RBANS. Completion of the RBANS took between 20 and 38 minutes (M = 27.73; SD = 5.32).

Goal Setting Procedures

Immediately following motivational interviews, participants underwent a standardized cognitive assessment (i.e., the RBANS) and goal setting procedures. Because goal-setting procedures differed based on treatment condition, we randomly assigned each participant to a

treatment condition immediately following pre-testing. We used covariate adaptive randomization (Suresh, 2011) to facilitate an equal assignment of individuals into treatment condition. Specifically, we considered participant gender and age as well as the severity and time post-onset for participants' most recent reported brain injury. We utilized this approach as opposed to block randomization because we were engaging in continuous enrollment. The treating clinician administered all goal setting protocols via Zoom for Healthcare immediately following administration of the RBANS in the pre-treatment assessment session or immediately prior to the first treatment session, dependent on participant availability and preference. Goal setting sessions lasted between 27 and 35 minutes (M = 30.25; SD = 2.91).

Dynamic Coaching. Goal setting protocols for participants in the Dynamic Coaching Model lasted between 27 and 35 minutes (M = 30.5; SD = 3.21). The Dynamic Coaching goal setting protocol included questions related to coursework (e.g., number of credit hours taken; see Appendix F). Following discussion of these questions, the clinician redirected the conversation toward anticipated needs and challenges relative to the individual's specific courses. Individuals then created three goals with clinician support. Specifically, the clinician first asked individuals to communicate their general objectives for treatment and provided individualized, unique feedback relative to goal specificity. This was done in accordance with recommendations from Kennedy (2017).

Consider the following example dialogue provided by Kennedy, 2017 (p. 111):

Student: *I want to keep up in class.*

Coach: *Tell me more about that. Describe for me what's happening.*

Student*: It should only take 2 hours to do the assigned readings, but I'm not really sure… so how can I plan? I'm worried about getting assignments done on time too.*

Coach: *OK, would you be willing to track how much time it's taking you compared to how long you think it will take?*

Student: *Sure.*

Coach: (instructs student in "goal-plan-do-review" and provides form)

From this dialogue, the coach and student generated two goal types: self-regulation and performance goals. Self-regulation goals required the student to self-regulate. For example, Kennedy provides the following suggested self-regulation goal relative to the dialogue above: student will accurately assess how long it takes to complete an assignment. In addition, Kennedy suggests the following performance goal related to behavior: student will turn in assignments on time this semester. Finally, Kennedy suggests a goal that is related to both self-regulation and performance: student will keep up with the readings this semester. Goals set for the purposes of this study were personalized to each individual participant, but adhered to the same format.

Apprenticeship Approach. The goal setting protocol for participants assigned to the Apprenticeship Approach (Brown et al., 2021; see Appendix G) lasted between 27 and 35 minutes (M = 30; SD = 2.97) and included both generalized and individualized educational components. In this protocol, the clinician provided individuals with a list of 18 cognitive (e.g., vigilance, cognitive flexibility) and five linguistic (e.g., written expression, reading) domains. The clinician defined each domain using pre-determined lay terms included in clinical training (e.g., "vigilance is paying attention to something"; i.e., generalized education). Following this, the clinician asked the individual to state whether they noted post-injury changes in this domain. This occurred immediately following definition provision. If self-perception of deficits or strengths differed from that of the clinician, the clinician provided assessment data exemplifying the strength or deficit. For each deficit identified in this process, the student then generated

relevant examples of daily tasks in which they rely on that skill (e.g., writing requires sustained attention). Finally, the clinician reviewed domains in which the individual identified a negative change post-injury and asked the individual to select the three they most wanted to target in therapy.

Treatment

Treatment procedures for both groups were identical with the exception of the independent TBI educational modules, which only participants assigned to the Apprenticeship Approach condition completed. All participants underwent three distinct, one-hour treatment sessions. Treatment Session 1 occurred between 4 and 13 days (M = 7.50; SD = 2.22) after the pre-test session, Treatment Session 2 occurred between 6 and 10 days after Session 1 (M = 7.40; SD = 1.17), and Treatment Session 3 occurred between 5 and 12 days following Treatment Session 2 (M = 7.63; SD = 2.13).

Treatment sessions lasted from 54 to 67 minutes in length (M = 58.92; SD = 3.96) and consisted of two main training components, metacognitive strategy training and personalized cognitive training. Treatment components were completed in unique, randomized orders. Confidence ranking probes were performed at the end of the session as they entailed asking participants about their confidence on therapeutic and academic tasks. Within treatment sessions, 30-40 minutes were allotted to personalized cognitive treatment activities; 15 minutes were allotted to metacognitive strategy training, and 5-10 minutes were allotted to rapport building and confidence ranking probes.

Personalized Cognitive Treatment. Personalized cognitive treatment activities for participants in both conditions included ecologically valid, performance-based tasks that were collaboratively generated by the clinician and participant. For example, P5 indicated a need to

organize tasks and a desire to do so utilizing an electronic application that could be accessed via phone or computer. Therefore, one treatment activity included training them in the use of such an application (i.e., Trello) and arranging their personal tasks into their Trello board according to the organizational system they deemed most appropriate (i.e., by time of day and level of effort required for tasks). See Figure 6 for a description of the personalized cognitive treatment protocol used in this study and Figure 7 for P5's example activity.

Figure 6

Personalized Cognitive-Linguistic Treatment Protocol for the Current Study

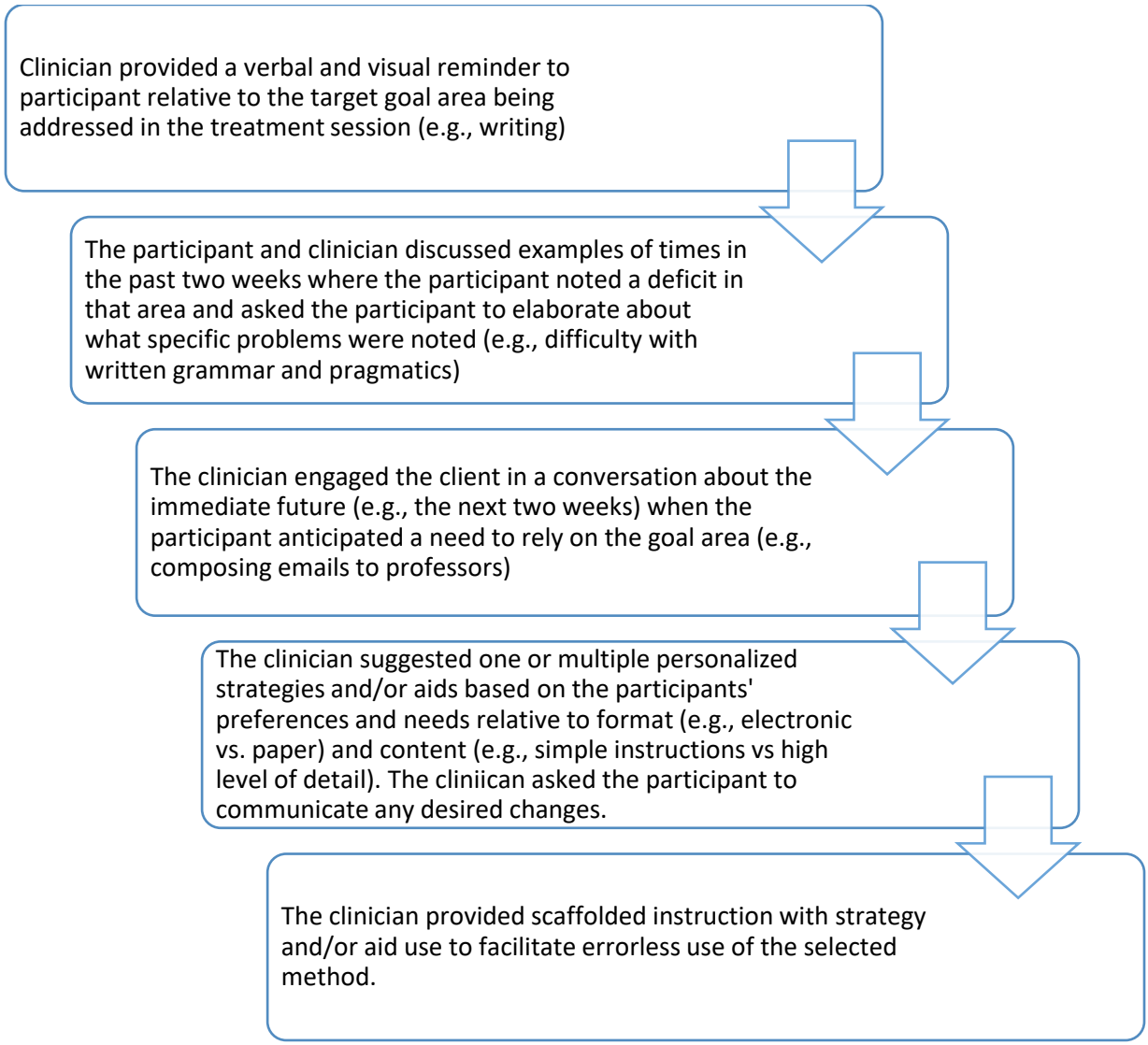
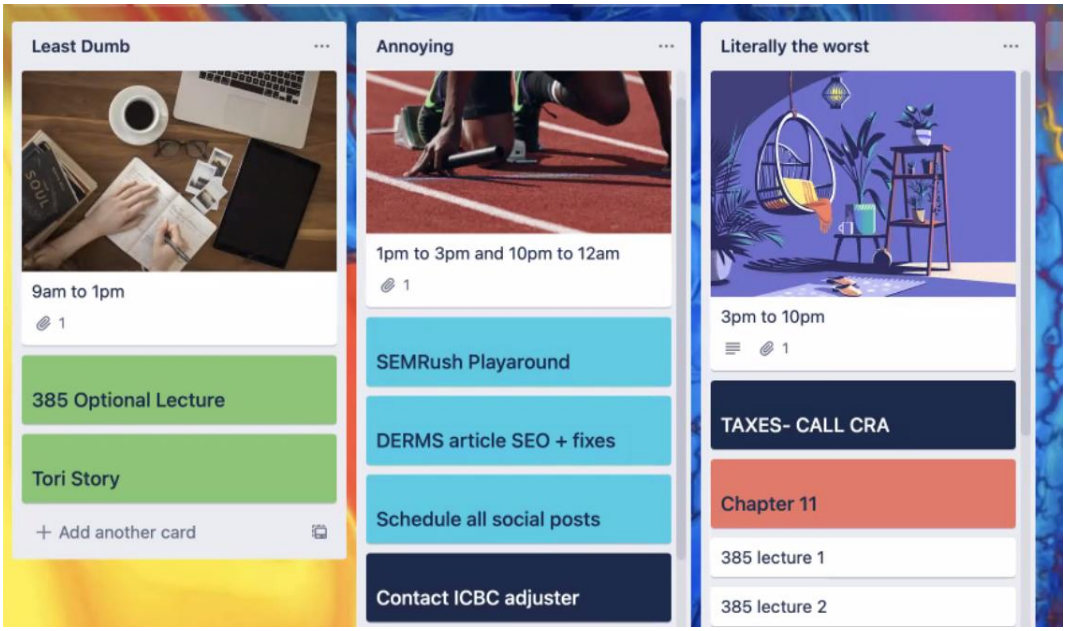


Figure 7

Example of a Treatment Activity Completed during Personalized Cognitive Treatment



Metacognitive Strategy Training. Metacognitive strategy training included three activities recommended for use within the Dynamic Coaching Model (Kennedy, 2017). Each activity took approximately 15-minutes to complete and entailed training participants in strategy use via explicit teaching and the provision of guided practice opportunities. Specifically, these activities required participants to assess their own strengths and limitations, to assess their own ability to set and manage performance-based goals (e.g., completing individual homework assignments), and to assess their own performance in various goal areas and/or in classes.

For example, participants completed goal attainment scaling (Kennedy, 2017), in which they quantified their performance towards a performance goal (e.g., completing assignments on time) on a scale. In accordance with Kennedy's recommended protocol, goal quantification was customized to the goal and based on individual preference. For example, goals could be measured in frequency (e.g., number of times per week), percentage (e.g., percentage of

assignments completed in each course), or subjective opinion (e.g., how well the student believed they were doing on a Likert-type scale).

Subjective Confidence Rankings. Participants verbally ranked their confidence level on treatment tasks and in five functional academic task areas (i.e., attending to lectures, notetaking, completing homework on time, completing quizzes and exams, and knowing what to do if they have a question) at the end of every treatment session using a five-point Likert scale. Functional academic task areas were verbally presented in unique, randomized orders in each session. For each probe, the treating SLP verbally reminded participants of the scale endpoints (i.e., "1 means not at all confident; 5 means very confident").

Educational Modules. Participants assigned to the Apprenticeship Approach independently completed two pre-recorded visual educational modules between treatment sessions. These participants received educational materials via two emails from the treating clinician. Participants emailed completed active educational activities (i.e., a symptom recognition log and a one-paragraph explanation of which individuals and resources they think might be helpful) to the treating clinician prior to their subsequent treatment session. These modules were designed to be completed in approximately 30 minutes.

Post-Testing

Following completion of the third and final treatment session, participants completed a post-testing session, which followed a similar procedure as the pre-testing session and again included two parts and occurred between 3 and 30 days following Treatment Session 3 (M = 7.58; SD = 8.04). In Part 1, participants again completed knowledge questions, academic achievement measures (i.e., self-compassion, self-efficacy, and growth mindset orientation scales), a quality-of-life measure (i.e., the QOLIBRI), and a treatment satisfaction questionnaire

via Qualtrics software. In Part 2 of the assessment, a research assistant administered the RBANS and completed a semi-structured interview in an interactive session that was video- and audio-recorded via Zoom for Healthcare. During the interview portion, the assistant adhered to the stylistic parameters of motivational interviewing (e.g., asking follow-up questions when appropriate), but asked some structured questions (e.g., whether participants thought their goals were appropriate and whether they noted improvements in their specific goal areas over the course of treatment).

Data Analysis

The research team performed all data analyses utilizing session recordings, exported data from Qualtrics questionnaires (stored via Box for Healthcare), and R software (R Core Team, 2021). We measured fidelity and the following five dependent variables across treatment group: (a) change in knowledge; (b) change in performance on predictors of academic achievement; (c) change in confidence rankings; (d) treatment satisfaction; and (e) change in quality of life.

Fidelity

We measured research fidelity in accordance with available recommendations for best research practice (Bellg et al., 2004). This included three components. First, undergraduate research assistants watched at least 20% of the recorded interactive assessment, goal setting, and treatment sessions and assessed them for adherence to the assessment protocol using checklists in accordance with protocols delineated in the standardized assessment manual (Roth, 1998) and within the Dynamic Coaching Model (Kennedy, 2017). This entailed the use of checklists for assessment, goal setting, and treatment sessions. Bellg and colleagues recommended checking 20% of sessions for fidelity. In accordance with this guideline, we rounded the number of sessions being checked for fidelity up to the nearest whole number above 20% (Bellg et al.,

2004). Therefore, we performed fidelity checks for 25% of assessment and goal setting sessions (i.e., three sessions) and in 22% of treatment sessions (i.e., eight sessions). We selected sessions to be checked for fidelity at random, by assigning each session a number and utilizing a random number generator. Second, we measured intervention engagement through participant completion of treatment and independent educational module activities. Third, the treating clinician documented treatment enactment via session recording and clinical notetaking via the SOAP note format.

Pre- and Post-Treatment Comparison of Dependent and Descriptive Variables

Performance on measures of quality of life and academic achievement was scored utilizing available guidelines. Performance on subjective confidence ratings was scored on a scale of 1-5 for each item. Performance on the TBI-related knowledge questionnaire required the use of a coding system. For free recall questions, participants received a score of 1 for indicating each of the following items: (a) a TBI is a disruption in the normal function of the brain; (b) TBI results from a bump, blow, or jolt to the head or by a penetrating injury; (c) TBI symptoms include any physical, socioemotional, or cognitive/linguistic symptoms that are documented in literature; (d) that post-injury management: involves any services/professionals that are documented in literature. For forced response questions, participants received a score of 1 for: (a) identifying that symptomatology following TBI negatively impact academic and work performance; (b) correctly selecting symptoms associated with TBI, and; (c) selecting post-injury professionals/ services from a list. For symptoms and services/professionals, scores were divided by a total number of possible items, resulting in a proportion ranging from 0 to 1 for each item. In combination with other response items (e.g., how confident participants felt about their responses), this resulted in a possible score ranging from 0-30. 20% of scored questionnaires

were randomly selected to be checked for fidelity by an additional trained member of the research team. A fidelity score of 100% was obtained.

We then measured change in TBI knowledge, academic achievement, and quality of life measures across two time points (i.e., prior to and following treatment), change in confidence across three time points (i.e., each treatment session), and treatment satisfaction by treatment condition at one time point (i.e., following completion of all 3 treatment sessions). We first created change score variables for each measure to quantify change over time. We obtained this value by subtracting participants' pre-treatment scores from post-treatment scores. For example, because there were five points on the Likert-type scale used in this measure, self-efficacy item change scores ranged from -5 to 5, and total self-efficacy change scores could range from -35 to 35 (i.e., all seven items on the scale multiplied by five Likert-type scale points). Item change scores for self-compassion could range from -12 to 12 and total change scores for self-compassion could range from -60 to 60; item change scores for growth mindset could range from -4 to 4; total growth mindset change scores could range from -24 to 24. Positive values indicate higher post-treatment scores whereas negative values indicate lower post-treatment scores in comparison to pre-treatment scores. We then used Wilcoxon Signed Rank tests to determine whether change score variance could be explained by treatment condition because we were working with integer data, our data were not normally distributed (see Appendix J) and/or we were statistically underpowered due to our relatively small *n*, and we wanted to examine the role of treatment condition in data variance. We used paired Wilcoxon Signed rank tests to assess differences between pre- and post-testing points because we were working across multiple time points and our change score data were not normally distributed. We used independent Wilcoxon

Signed Rank tests to assess differences in mean treatment satisfaction between groups because we were examining change at one time point and our data were not normally distributed.

Although the RBANS was utilized as a descriptive measure, we compared pre- and post-treatment changes in performance on this assessment by treatment condition via creation of change variables and use of Wilcoxon Signed Rank tests. Finally, we compared participants' subjective outcomes via quantification of interview responses. Prior to treatment, all participants identified three cognitive-linguistic domains to address during intervention. Following treatment, the interviewer asked participants whether they noticed changes in general cognition and whether they noticed changes in the three identified goal areas. We quantified participant interview data utilizing a binary coding system to characterize subjective differences noted by participants. Post-treatment participant interviews included information relative to whether participants noted change over the course of treatment in one of the three goal areas identified prior to treatment. When participants identified a post-injury change in a goal area, we assigned that individual a score of 1. If participants did not identify a change in an area, we assigned a score of 0. This resulted in post-treatment interview scores ranging from 0 to 3 for all participants.

Results

Results for the five research questions are described below and descriptive statistics are delineated in Table 7. In addition, results for descriptive measures are described below. An alpha level of 0.05 was used to determine statistical significance.

Table 7

Means, Standard Deviations, and (Range) Statistics for Dependent Variables

Dynamic Coaching Model			**Apprenticeship Approach**		
Research Question 1: Quality of life (scale of 0-100)					
Pre-test	**Post-test**	**Change**	**Pre-test**	**Post-test**	**Change**
M = 54.17	*M* = 56.56	*M* = 2.38	*M* = 41.19	*M* = 66.55	*M* = 25.36
SD = 10.12	*SD* = 18.16	*SD* = 26.08	*SD* = 12.54	*SD* = 16.80	*SD* = 19.71
(35.00-64.29)	(32.86-77.86)	(-24.29-42.86)	(22.86-53.57)	(67-110)	(4.29-57.86)
Research Question 2: TBI knowledge (scale of 0-30)					
Pre-test	**Post-test**	**Change**	**Pre-test**	**Post-test**	**Change**
M = 12	*M* = 13.83	*M* = 12.17	*M* = 13.18	*M* = 12.5	*M* = 0.83
SD = 5.48	*SD* = 2.40	*SD* = 13.99	*SD* = 2.40	*SD* = 5.36	*SD* = 6.97
(7-22)	(13-18))	(-5-11)	(13-18)	(6-19)	(-5-10)
Research Question 3: Self-efficacy (scale of 0-30)					
Pre-test	**Post-test**	**Change***	**Pre-test**	**Post-test**	**Change***
M = 7.30	*M* = 7.8	*M* = -5.00	*M* = 22.33	*M* = 6.20	*M* = -1.1
SD = 8.77	*SD* = 6.3	*SD* = 3.37	*SD* = 11.18	*SD* = 7.90	*SD* = 3.36
(1-30)	(-6-30)	(-12-10)	(1-30)	(1-30)	(-11-5)
Research Question 3: Self-compassion (scale of 0-50)					
Pre-test	**Post-test**	**Change***	**Pre-test**	**Post-test**	**Change***
M = 38.17	*M* = 34.00	*M* = 11.17	*M* = 41.00	*M* = 37.83	*M* = -3.17
SD = 3.87	*SD* = 16.54	*SD* = 11.02	*SD* = 3.52	*SD* = 2.56	*SD* = 5.04
(34-43)	(3-46)	(-4-24)	(36-45)	(33-40)	(-12-2)
Research Question 3: Growth mindset orientation (scale of 0-12)					
Pre-test	**Post-test**	**Change***	**Pre-test**	**Post-test**	**Change***
M = 7.73	*M* = 7.67	*M* = -0.07	*M* = 14.00	*M* = 11.33	*M* = -2.67
SD = 4.80	*SD* = 5.89	*SD* = 3.47	*SD* = 3.16	*SD* = 3.14	*SD* = 2.25
(3-17)	(2-18)	(-7-8)	(2-18)	(3-17)	(-6- -1)
Research Question 4: Self-perceived confidence (scale of 0-5)					
Session 1	**Session 2**		**Session 1**	**Session 2**	
M = 3.44	*M* = 3.94		*M* = 3.44	*M* = 3.73	
SD = 0.88	*SD* = 0.90		*SD* = 0.94	*SD* = 0.86	
(2-5)	(2-5)		(2-5)	(2-5)	
Session 3	**Change**		**Session 3**	**Change**	
M = 4.28	*M* = 5.59		*M* = 4.23	*M* = 6.13	
SD = 0.69	*SD* = 3.15		*SD* = 0.68	*SD* = 4.70	
(2.5-5)	(1-30)		(3-17)	(4-32)	
Research Question 5: Treatment satisfaction (scale of 0-10)					
Post-test†			**Post-test†**		
M = 5.57			*M* = 4.43		
SD = 5.32			*SD* = 4.58		
(6-10)			(0-10)		

* Scores for participants assigned to the Dynamic Coaching Model were statistically significantly greater

† Scores for participants assigned to the Apprenticeship Approach were statistically significantly greater

Quality of Life

We calculated QOLIBRI results in R software via creation of change scores (i.e., post-treatment minus pre-treatment) and use of paired and independent Wilcoxon Signed Rank tests to examine change overall and to compare pre-treatment score differences, post-treatment score differences, and pre-post treatment score changes by assigned treatment condition. Power calculations revealed that we had adequate power (0.95) to detect statistically significant results.

Computation of paired Wilcoxon Signed Rank tests indicated that participants assigned to treatment under the Dynamic Coaching Model did not demonstrate statistically significant change on QOLIBRI scores ($Z = 1.64$; $p = 1$), whereas participants treated within the Apprenticeship Approach demonstrated statistically significant improvement on QOLIBRI scores ($Z = -1.88$; $p = .03$). Three participants assigned to treatment under the Dynamic Coaching Model demonstrated decreased quality of life following treatment; three demonstrated increased quality of life following treatment. No participants assigned treated via the Apprenticeship Approach demonstrated decreased quality of life following treatment; six demonstrated increased quality of life following treatment. Computation of an independent Wilcoxon Signed Rank test indicated that pre-test QOLIBRI scores did not statistically significantly differ by treatment condition ($Z = 0.61$; $p = .542$), that post-treatment QOLIBRI scores did not differ by treatment condition ($Z = 1.17$; $p = .240$), and that change scores on the QOLIBRI did not differ by treatment condition ($Z = 1.17$; $p = .180$).

Knowledge Relative to TBI

Computation of independent Wilcoxon Signed Rank Tests indicated that pre-test knowledge scores did not differ by treatment condition ($Z = 1.13$; $p = .258$), that post-treatment knowledge scores did not differ by treatment condition ($Z = 0.48$; $p = .628$), and that knowledge

did not statistically significantly improve between pre- and post-testing dates (Z = 1.64; $p = 1$ for participants assigned to the Dynamic Coaching condition; $Z = 0.21$; $p = .83$ for participants assigned to the Apprenticeship Approach). Three participants assigned to treatment within the Dynamic Coaching Model demonstrated decreased TBI-related knowledge following treatment; three demonstrated increased TBI-related knowledge. Similarly, three participants assigned to treatment within the Apprenticeship Approach demonstrated decreased TBI-related knowledge following treatment; three demonstrated improved TBI-related knowledge. Change on the knowledge questionnaire did not differ between groups ($Z = 0.40$; $p = .686$). Power calculations revealed that we had adequate power to detect statistically significant change over time (0.81) and between groups (0.95).

Predictive Measures of Academic Achievement

Self-Efficacy

Computation of paired Wilcoxon Signed Rank Tests indicated that participants treated via the Dynamic Coaching Model did not demonstrate statistically significant change on self-efficacy scores following treatment ($Z = 0.52$; $p = .60$), whereas participants treated under the Apprenticeship Approach demonstrated change that approached significance ($Z = 1.55$; $p = .06$). Three participants assigned to Dynamic Coaching demonstrated decreased self-efficacy following treatment; three demonstrated increased self-efficacy following treatment. Five participants treated within the Apprenticeship Approach demonstrated decreased self-efficacy following treatment; one demonstrated improved self-efficacy. Computation of Wilcoxon Signed Rank tests revealed that the two treatment groups did not differ on pre-treatment self-efficacy scores ($Z = 0.47$; $p = .636$). Differences between the two treatment groups on post-treatment self-efficacy scores approached significance ($Z = 1.88$; $p = .057$); self-efficacy change scores were

statistically significantly lower for participants assigned to treatment under the Apprenticeship Approach ($Z = 3.09$; $p = .002$).

Self-Compassion

Computation of paired Wilcoxon Signed Rank tests revealed that participants in each condition did not statistically significantly improve on measures of self-compassion following treatment ($Z = 1.37$; $p = .170$ for participants assigned to the Apprenticeship Approach; $Z = 0.20$; $p = .84$ for participants treated via the Dynamic Coaching Model). Computation of independent Wilcoxon Signed Rank tests revealed that two groups did not statistically significantly differ on pre-treatment self-compassion scores ($Z = 0.98$; $p = 0.327$) or post-treatment self-compassion scores ($Z = 0.10$; $p = 0.920$) but indicated that self-compassion change scores were significantly higher for participants assigned to treatment under the Dynamic Coaching Model than for participants treated under the Apprenticeship Approach ($Z = 3.29$; $p < .001$). Three participants assigned to the Dynamic Coaching condition demonstrated decreased self-compassion following treatment; three demonstrated improved self-compassion following treatment. Four participants treated within the Apprenticeship Approach demonstrated decreased self-compassion following treatment; two demonstrated increased self-compassion following treatment.

Growth Mindset Orientation

Computation of paired Wilcoxon Signed Rank tests indicated that participants assigned to the Dynamic Coaching Model did not demonstrate statistically significant change on growth mindset scores following treatment ($Z = 0.41$; $p = .68$); participants treated under the Apprenticeship Approach demonstrated statistically significantly lower scores following treatment ($Z = 2.17$; $p = .03$). Three participants treated via Dynamic Coaching demonstrated increased growth mindset orientation following treatment. One participant assigned to the

Dynamic Coaching condition demonstrated no change; two demonstrated decreased growth mindset orientation following treatment. All participants assigned to treatment under the Apprenticeship Approach demonstrated decreased growth mindset orientation following treatment. Computation of independent Wilcoxon Signed Rank tests revealed that the two groups did not statistically significantly differ on pre-treatment growth mindset orientation scores (Z = 0.67; p = .506) or post-treatment growth mindset orientation scores (Z = 1.27; p = .205) and that growth mindset orientation change was significantly higher for participants treated via Dynamic Coaching (Z = 3.09; p = .002).

Subjective Confidence Ratings

Computation of paired Wilcoxon Signed Rank tests indicated that participants treated within both conditions demonstrated statistically significant change on subjective confidence rankings over the course of treatment (Z = 2.05; p = .040 for participants treated via the Dynamic Coaching Model; Z = 2.17; p = .030 for participants treated via the Apprenticeship Approach). All participants, regardless of treatment condition, demonstrated improved confidence following treatment. Computation of an independent Wilcoxon Signed Rank test indicated that overall change in confidence scores between treatment sessions did not differ by treatment condition (Z = 0.84; p = .402). Additional computation of independent Wilcoxon Signed Rank tests revealed that confidence change on treatment (Z = 1.08; p = .279), or academic-related activities did not statistically significantly differ by treatment condition (Z = 0.49; p = .622).

Treatment Satisfaction

We utilized an independent Wilcoxon Signed Rank test to assess differences in treatment satisfaction by treatment condition. Our findings indicated that participants assigned to the Apprenticeship Approach condition demonstrated statistically significantly greater treatment

satisfaction than participants receiving treatment within the Dynamic Coaching Model ($Z = 2.58$; $p = .010$).

Descriptive Measures

In addition to assessing participant change on the five dependent variables, we also assessed change on several descriptive variables. These included performance on the RBANS standardized assessment and changes noted during participant interviews before and following treatment. Participant performance on these measures is described below and is compared across treatment condition. Overall, results on descriptive measures indicated no difference between treatment groups. Results are described below.

RBANS Scores

Computation of a paired Wilcoxon Signed-Rank Test indicated that participants assigned to the Dynamic Coaching Model did not demonstrate statistically significant improvement on overall RBANS scores ($Z = 1.88$; $p = .06$); participants treated within the Apprenticeship Approach statistically significantly improved performance on the RBANS overall ($Z = 2.17$; $p = .03$). Treatment condition did not statistically significantly affect RBANS change scores ($Z = 0.11$; $p = .91$).

Self-Perceived Differences Revealed via Interview

Prior to treatment, participants assigned to both treatment conditions collaboratively set three goals to address during therapy with the treating clinician. Following therapy, these individuals were asked by a non-treating clinician whether they noticed changes in their cognition in general and within the three identified goal areas. The number of goal areas in which participants noted change following treatment was identical across condition (i.e., 13 out of a potential 18 across all participants in each condition).

Discussion

Researchers have emphasized the importance of considering individuals' unique needs based on injury-related characteristics (e.g., injury severity), level of desired and/or pre-injury participation in personal, vocational, and/or academic roles (e.g., continuation of status as a full-time student), and tasks required by participation in these roles (e.g., homework completion for college students). The Dynamic Coaching Model (Kennedy, 2017) is widely recommended for college students with TBI. Although this approach integrates several evidence-based components (e.g., external aid use, metacognitive strategy training, goal attainment scaling, and motivational interviewing; Ackley & Brown, 2020), it does not currently integrate the use of outcome measures specifically related to college students' academic roles (e.g., predictive measures of academic achievement) or education related to TBI.

In the current study, we sought to holistically characterize participant outcomes following treatment under one of two conditions – the established Dynamic Coaching Model and the novel Apprenticeship Approach. To do this, we sought to balance specific injury characteristics (i.e., time post-onset, symptomatology, and injury severity) across treatment conditions. Our findings indicated that participant pre-treatment scores did not statistically significantly vary between groups for the assessment tools used, which suggests that the injury characteristics we used to assign participants to a treatment condition were adequate.

We examined the effects of integrating impairment- and injury-related education into current recommended goal setting and treatment protocols for college students following TBI. Use of assessment measures related to participants' quality of life, knowledge of TBI, likelihood of academic achievement, self-reported confidence on academic and treatment tasks, and treatment satisfaction allowed for examination of the potential effects of injury-related education

across a variety of contexts. In addition, we examined two descriptive variables: participant performance on the RBANS (a cognitive-linguistic measure) and participant responses to interview questions.

Kennedy et al. (2011) have historically characterized outcomes of Dynamic Coaching via use of standardized assessment scores, student-reported academic challenges on a researcher-generated questionnaire, student-reported strategy use, student grades on assignments, the number of assignments students attempted versus the number they completed, and changes in academic status and campus life (e.g., enrollment changes). Their findings indicated that students improved on graded assignments after receiving strategy instruction, reported increased strategy use by the end of the year, earned the majority of credits they attempted, made positive academic decisions (as judged by the researchers), and were in good academic standing at the end of treatment. Additionally, students in Kennedy's previous work demonstrated variable performance on standardized cognitive-linguistic measures both prior to and following treatment. This finding is consistent with the current study – participants assigned to both treatment conditions demonstrated variable performance on the RBANS that was not explained by time post-onset or symptomatology.

Kennedy (2017) states that college students who underwent treatment via Dynamic Coaching subjectively reported increased confidence, increased self-determination, self-awareness, and self-acceptance, as indicated via interview. Our findings also indicated that participants demonstrated an increase in self-perceived confidence, although our findings also indicated that participants demonstrated decreased self-efficacy (i.e., self-determination). In addition, three participants (50%) assigned to the Dynamic Coaching Model demonstrated decreased self-compassion (i.e., self-acceptance) following treatment. These findings indicate

that future work carefully examining the use of various measure types in relationship to this model may be warranted.

More recently, Hoepner et al. (2019) compared the effects of Dynamic Coaching via a case study comparison of two college students with acquired brain injury over the course of two semesters. These researchers found that both students improved on metacognitive strategy use and that the coached student completed most of the credits they attempted. The authors then concluded that the personalized treatment activities included within Dynamic Coaching are feasible and replicable.

Within the current study, delivery of personalized cognitive-linguistic activities was feasible. In fact, the feasibility of these activities was enhanced and the burden of material provision on both the participant and clinician was reduced by the remote nature of this study. For example, participants were able to share their screen when accessing course materials in order to engage in personalized treatment activities. If participants were seen in a clinic, they would have needed to bring course materials with them to treatment and/or have accessed their materials on a cell phone or computer to fully engage in treatment.

In addition to demonstrating consistency with Kennedy's previous findings that Dynamic Coaching is feasible, we sought to examine the impact of Dynamic Coaching utilizing outcome measures that have not previously been used to evaluate this treatment approach. These included participant knowledge of TBI, self-reported quality of life, self-perceived likelihood of academic achievement, subjective confidence rankings, and self-perceived treatment satisfaction.

Goal Setting

In accordance with the Participation Model, clinicians or researchers select an intervention type that matches the types of barriers faced by their clients. For example, after

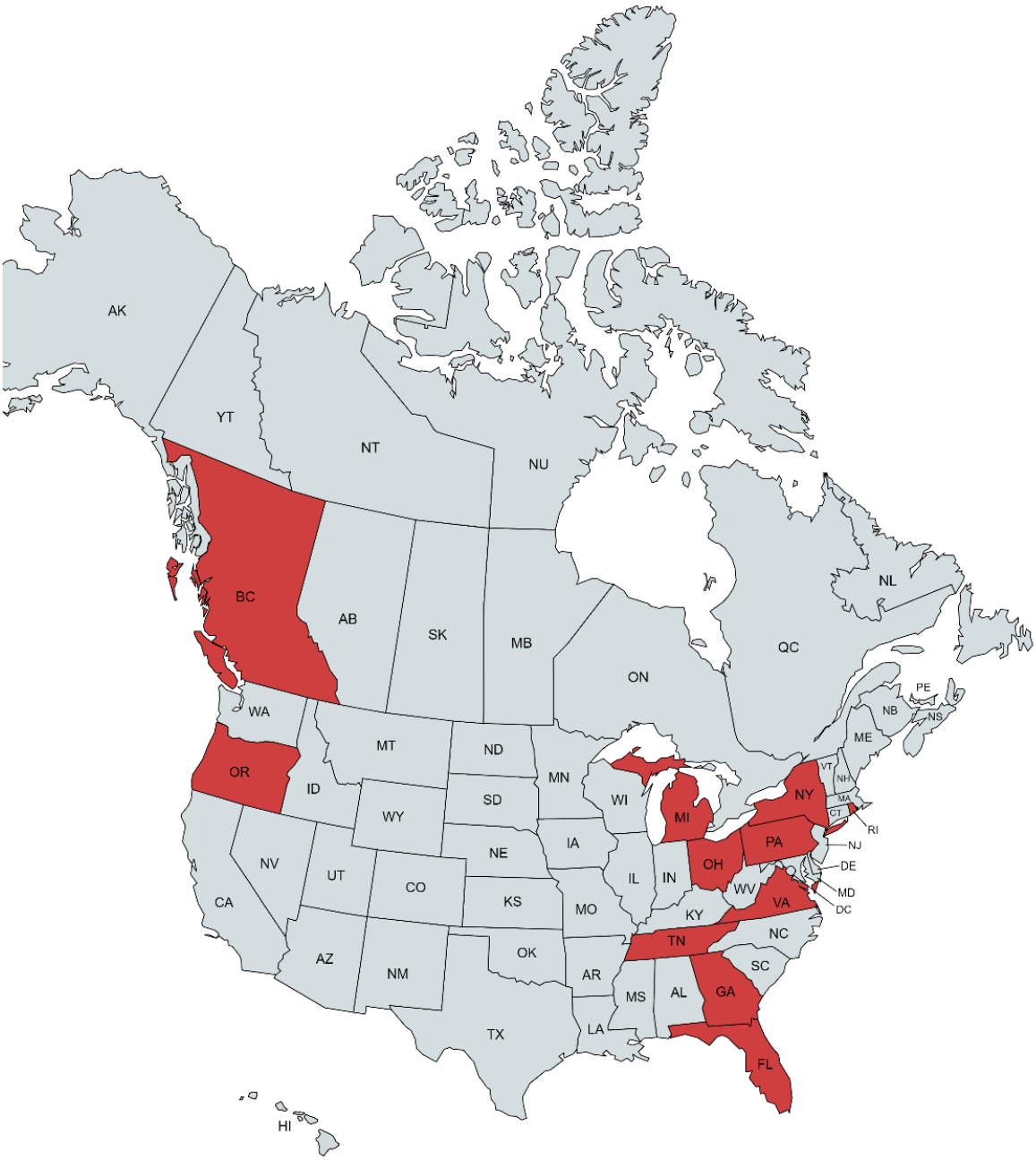
identifying opportunity barriers (i.e., those related to policy and practice), a clinician might engage in an opportunity intervention by advocating on their client's behalf. Conversely, for a client facing access barriers, the clinician might introduce environmental modifications to improve client participation. During goal setting sessions, all participants within the current study primarily identified one or more access barriers (e.g., cognitive-linguistic deficits) during interview, although two participants identified opportunity-related barriers.

Remote Nature of the Current Study

The use of remote methods for data collection (e.g., via *Zoom for Health*) served as a strength in the current study in that it resulted in increased access to study participation. We recruited participants from 12 different university settings and 11 different states or provinces. Please see Figure 8 for a representation of participant location. In addition, participants experienced greater flexibility in scheduling due to increased access to assessment materials, a lack of need to reserve data collection space, and increased flexibility on the part of the treating clinician. This increased access to care may have reduced attrition as compared to in person activities. This work has implications for future increased access to services for individuals who otherwise would not receive care due to the presence of financial, geographic, or other barriers (e.g., for individuals with mobility restrictions). For instance, many individuals who have sustained TBI also experience physical symptomatology, which may impact their ability to participate in in-person activities (e.g., medical appointments). Other individuals live in rural locations (e.g., in Alaska), and, as a result, have decreased access to services. This does not preclude those individuals from experiencing TBI or its associated symptoms. The availability of remote services for these individuals, therefore, may address a significant need, may help to decrease health disparities, and may increase the portion of individuals living with TBI

represented in research. Additionally, we had no attrition for individuals who participated in at least one session. This lack of attrition indicates that clients may be more likely to attend appointments if they are available via remote delivery.

Figure 8
Participant Geographic Location



Treatment

Two important components of treatment within the current study included personalized cognitive-linguistic treatment and metacognitive strategy training. Personalized cognitive-linguistic treatment allows students to address access barriers and, potentially, self-advocate to address opportunity barriers. For example, if a student demonstrates difficulty with written communication and treatment focuses on improving skills in that area, that student may experience reduced barriers to completion of written assignments for classes (i.e., a component of participation as a college student) and may be able to advocate for accommodations via email communication with relevant university faculty and/or staff. Metacognitive strategy training supports individuals' self-awareness of their abilities and progress towards overcoming or compensating for access barriers within the Participation model (e.g., barriers stemming from cognitive-linguistic deficits).

Outcome Measures

One strength of the current study is the use of functional outcome measures. Within the Participation Model, Beukelman and Mirenda (1988) recommend that SLPs consider how treatment affects individuals' participation in life activities (e.g., in college). Therefore, use of multiple measures that characterize contextual factors such as quality of life and treatment satisfaction, ecologically valid factors such as likelihood of academic achievement and confidence for completion of academic and treatment-related tasks, and objective factors such as TBI-related knowledge is a more holistic and functional means for assessing treatment efficacy and effectiveness than what has been used historically. We hypothesized that the integration of education into the existing Dynamic Coaching Model would improve performance on these outcome measures. Many of our findings were inconsistent with our hypotheses. We explore our

findings and implications relative to Research Questions 1-5 and descriptive variables below and discuss potential limitations and relevant future research directions. Findings relative to each outcome variable are described in greater detail below.

Quality of Life

There were no differences in pre- and post-test QOLIBRI scores for participants in the Dynamic Coaching Model, but post-test scores were significantly higher than pre-scores for participants in the Apprenticeship Approach, indicating an increased quality of life for participants assigned to this treatment condition. The lack of differences on QOLIBRI change scores was inconsistent with our hypothesis that improvement on the QOLIBRI would be greater for participants treated under the Apprenticeship Approach than for participants assigned to the Dynamic Coaching Model. There are several possible explanations for this. First, the treatment duration in this study was relatively short, lasting only for three one-hour sessions to reduce time burden on participants. Therefore, it is possible that significant differences would emerge between groups if participants had undergone more treatment sessions. Alternatively, variance between participants may have been more susceptible to injury characteristics (e.g., time post-onset and symptomatology) than treatment condition. For example, participants within the Apprenticeship Approach sustained their injuries an average of 12.5 months prior to the onset of treatment, whereas participants who had undergone treatment within the Dynamic Coaching Model were, on average, 5.5 months post-injury at the time of study initiation. It is possible that this variable explained more variance on QOLIBRI performance than treatment condition.

Alternatively, symptomatology may explain variance on student QOLIBRI performance in the current study. Hux et al. (2017) examined relationships between latent symptomatology classes and academic outcome variables in college students with suspected histories of mTBI.

Their findings indicated that individuals with high symptomatology following TBI were more likely than their peers with moderate or negligible symptomatology to have lower grade point averages, and more likely to have failed courses than respondents with moderate or low symptomatology. Hux and colleagues concluded that mTBI results in functional, academic consequences (e.g., reduced grade point averages). Students who experience negative academic consequences, such as reduced grade point averages, may be more likely to seek academic assistance and self-select to participate in the current study. In addition, individuals who exhibit poorer academic performance than their peers also exhibit higher rates of depression and/or other socioemotional symptoms (e.g., stress; Bryan et al., 2014), which may have disproportionally affected QOLIBRI scores for participants in our study.

Knowledge Relative to TBI

On average, participants assigned to both treatment conditions demonstrated lower-than-chance accuracy on the knowledge questionnaire before and following treatment, indicating low knowledge of TBI, its symptoms, and post-injury management recommendations. These findings are consistent with a documented lack of TBI-related knowledge in college students (Knollman-Porter et al., 2017); however, to date, few guidelines exist to help clinicians determine the type and format of educational materials or what content should be provided when educating college students who have sustained TBI (Ackley & Brown, 2020) in the attempt to improve injury-related knowledge.

Participants assigned to both treatment approaches within the current study demonstrated improved accuracy on the knowledge questionnaire following treatment, indicating increased knowledge relative to TBI, though these scores were still low on average. This finding is consistent with our hypothesis that participants in the Apprenticeship condition would

demonstrate improved knowledge following treatment; however, the amount of improvement was not statistically significant and knowledge change did not significantly differ between groups, which is inconsistent with our hypothesis that participants assigned to the Dynamic Coaching Model would not demonstrate knowledge improvement. Several possible explanations exist.

One possible explanation for our results relative to injury-related knowledge is that college students may demonstrate improved accuracy on knowledge-based questionnaires following treatment simply as a result of participating in treatment, though further exploration of this variable is needed to determine which components of educational materials impact knowledge change for college students with TBI. Additionally, participants were not explicitly instructed not to educate themselves during treatment. Therefore, it is possible that participants sought opportunities to learn more about their injuries (e.g., via freely available internet resources), and were perhaps even primed by in-treatment discussions of symptoms and target areas. Alternatively, the clinician may have mistakenly provided education to participants during interactive treatment sessions, although 20% of sessions were checked by a research assistant to ensure a lack of explicit education. New learning is difficult for individuals who have sustained TBI (e.g., Hux et al., 2010). Therefore, an additional explanation for the lack of improvement demonstrated by participants in this study on TBI-related knowledge is that retainment of learned information from the educational modules may have been impaired. Alternatively, the presentations could have prohibited the retention of information due to a lack of interesting formatting and/or content. Finally, further evaluation of the format of TBI-related educational materials may result in increased learning by college students with TBI.

Performance on Predictors of Academic Achievement

Pre-treatment scores on any individual measure of academic achievement (i.e., self-efficacy, growth mindset, or self-compassion) did not statistically significantly vary by treatment condition. Participants assigned to the Apprenticeship Approach demonstrated reduced self-efficacy, self-compassion, and growth mindset orientation following treatment. This change was more negative than the change demonstrated by individuals treated under the Dynamic Coaching Model, suggesting that participation in the Apprenticeship Approach may negatively impact performance on these three predictive measures of academic achievement. This finding is inconsistent with our hypotheses for all three variables, which posited that participants treated via the Apprenticeship Approach would demonstrate more positive change on measures of academic achievement than those treated via the Dynamic Coaching Model. Several possible explanations exist for this inconsistency. For example, it is possible that the addition of treatment sessions directly targeting performance in these three areas may be indicated for college students. Scores in all three areas are discussed below.

Self-Efficacy. Participants assigned to both treatment conditions demonstrated decreased self-efficacy following treatment. Change on self-efficacy scores over time was statistically significantly lower for participants assigned to the Apprenticeship Approach, indicating that their self-efficacy decreased significantly more than participants treated under the Dynamic Coaching Model. This finding is inconsistent with our hypothesis. One possible explanation for this finding is that participants who received explicit education about their injury and its related symptoms (i.e., participants assigned to the Apprenticeship Approach) became more aware of their symptomatology and barriers to success than participants who did not receive this education (i.e., participants assigned to the Dynamic Coaching Model*)*. In particular, the goal-setting approach that was used for participants assigned to the Apprenticeship Approach asks participants to

identify, from a list of 18 cognitive-linguistic domains, areas in which they have experienced difficulty post-injury. For participants with a large number of symptoms, this can become very overwhelming. In addition, individuals who have undergone a change in academic participation (e.g., individuals who are transitioning from high school to college or individuals who are taking increasingly technical or specialized coursework in comparison to prior semesters) post-injury may be more likely to notice more symptoms due to increased task demands. Again, the goal-setting protocol utilized within the Apprenticeship Approach may have provided an opportunity for these individuals to identify more barriers to participation in academic activities than the goal-setting approach utilized in the Dynamic Coaching Model, in which the clinician probes the student specifically about their coursework requirements instead of difficulties across broader domains.

Self-Compassion. Participants treated via the Dynamic Coaching Model demonstrated increased self-compassion following treatment, whereas participants in the Apprenticeship Approach demonstrated lower self-compassion scores post-treatment. This finding is inconsistent with our hypothesis and suggests that use of Dynamic Coaching may positively impact self-compassion, whereas use of the Apprenticeship Approach may negatively impact self-compassion. One possible explanation for this difference is that the goal-setting procedure utilized within the Dynamic Coaching Model, which focuses heavily on the student's academic activities, may have addressed specific activities with which the student expressed difficulty and may have facilitated the student's connection of academic task difficulty to their injury. In addition, some of the generalized education materials provided to participants in the Apprenticeship Approach may have increased participant perceptions of missed opportunities immediately following injury. Specifically, the education modules covered material about

recommended actions immediately post-injury (e.g., seeking assistance from various medical professionals). Since study participants were at least 4 months post-onset, this may have caused participants to feel as though they had missed an opportunity to seek assistance, and, in turn, led to reduced self-compassion.

Growth Mindset Orientation. Participants assigned to both treatment conditions demonstrated reduced growth mindset scores following treatment. One possible explanation for this is that metacognitive strategy training may negatively impact growth mindset as clinicians engaging in this type of training explicitly attempt to increase individuals' awareness of their deficits. Growth mindset orientation scores were statistically significantly higher for participants assigned to treatment under the Dynamic Coaching Model. Again, this finding is inconsistent with our hypothesis. One possible explanation for the difference in growth mindset scores may again be the educational focus on symptomatology in the Apprenticeship Approach, which potentially increases participant awareness of potential barriers to success.

Subjective Confidence Ratings

We hypothesized that participants in both conditions would improve on confidence measures, but that participants assigned to treatment within the Apprenticeship Approach would demonstrate more improvement. Overall, participants assigned to both treatment conditions demonstrated statistically significant improvement on confidence measures over time. Change in confidence scores over time did not differ by treatment condition. This finding was inconsistent with our hypothesis, suggesting that education does not impact participant confidence. One possible explanation for this is that the small number of completed educational modules may not have impacted confidence, but that additional education may have affected participant

confidence rankings. We asked participants to complete only two educational modules to reduce the burden of time on them.

In addition, this finding is inconsistent with previous literature, which suggests that confidence may contribute to quality of life (Kermode et al., 2001) and self-efficacy (Al-Hebaish, 2012). In the current study, confidence increased, but self-efficacy scores decreased, which does not suggest that self-efficacy is related to confidence. Additionally, quality of life did not significantly improve. These findings indicate that this relationship may be measure-dependent or may differ for individuals who have sustained TBI.

Treatment Satisfaction

Our findings relative to treatment satisfaction were consistent with our hypothesis that treatment satisfaction means would be higher for participants assigned to the Apprenticeship treatment condition; participants assigned to the Apprenticeship Approach condition demonstrated statistically significantly greater treatment satisfaction than participants treated via the Dynamic Coaching Model. There are several possible reasons for these noted differences across treatment condition. First, participants may have been satisfied with the goal-setting protocol used in the Apprenticeship Approach and felt that it was more holistic and/or personalized in nature than the protocol used in the Dynamic Coaching Model, which would be consistent with previous reports from participants in a case-series design study (Brown et al., 2021). Second, participants may have responded positively to generalized education modules, although it was outside the scope of this study to examine which components of education modules were more preferred than others.

Participants who underwent treatment in the Apprenticeship Approach demonstrated more negative change on predictive measures of academic achievement (i.e., self-efficacy, self-

compassion, and growth mindset orientation) in comparison to participants treated via the Dynamic Coaching Model but demonstrated increased treatment satisfaction following treatment relative to their peers. Clinical SLPs treating college students with TBI may need to consider which outcomes (e.g., subjective outcomes such as treatment satisfaction or objective outcomes such as performance on standardized assessments) may impact their client the most and individualize treatment based on this.

Personalizing the amount of time dedicated to treatment activities may help improve outcomes and aligns with the Participation Model (Beukelman & Mirenda, 1988). Because few studies have examined the impact of extant treatment approaches for college students following TBI (Ackley & Brown, 2020), future studies examining the impact of various treatment activities on specific outcome measures may be beneficial.

RBANS Scores

Treatment condition did not impact performance on the RBANS or on its subtests, with the exception of the visuospatial subtest, on which participants assigned to treatment under the Dynamic Coaching Model demonstrated statistically significantly more change (i.e., in a negative direction). These results are partially consistent with our hypothesis that overall RBANS scores would not change for participants assigned to either condition following treatment. Interestingly, visuospatial skills worsened for participants assigned to Dynamic Coaching but improved for participants in the Apprenticeship Approach. One potential explanation for this change is that P12, who was an outlier assigned to the Apprenticeship condition in the positive direction, may have explained the variance between groups.

Interview

Prior to treatment, participants assigned to both treatment conditions collaboratively set three goals to address during therapy. Following treatment, the number of goal areas in which participants noted change following treatment was identical across condition (i.e., 13 out of a potential 18 across all participants in each condition). It is possible that metacognitive abilities impact participants' noted changes in each goal area more than treatment condition. It is also possible that the reduced number of treatment sessions impacted the number of changes noted by participants in both conditions.

Limitations

Several limitations to the current study exist. First, it was essential to reduce the burden of time and energy on participants. Our data were collected during the COVID-19 pandemic via Zoom. This historical event impacted college students, who reported increased mental fatigue as a result (Heilferty et al., 2021). Within the current study, participants subjectively reported experiencing Zoom fatigue and otherwise feeling "burnt out." In anticipation of this, we limited treatment to three one-hour sessions. This limited number of sessions may have reduced change for all participants or may have resulted in practice effects for study measures (e.g., the knowledge questionnaire). In addition, participants may have experienced increased socioemotional symptomatology due to COVID-19. Findings from the *Healthy Minds Study* indicated that, because of the pandemic, over 60% of college students experienced greater financial stress, 30% reported a change in their living situation, depression increased, access to mental health care declined, and academic performance suffered (American College Health Association, 2020). Interestingly, some students reported higher levels of resilience. To avoid coinciding with the start or end of the semester and reducing the impact of time on our data, we staggered study entry (see Figure 5). Despite this, our data may have been affected by the

COVID-19 historical pandemic, and, as a result, our findings may not generalize to future students in different educational climates.

Secondly, some participants were unable to complete treatment and/or assessment sessions at the planned time intervals due to unexpected events (e.g., illnesses), which affected timelines for completion. For example, P9 experienced two unexpected events and completed independent post-treatment measures 22 days following their final therapy session and interactive assessment and interview 30 days following their third treatment session. This may have affected their responses to interview questions and performance on assessment measures.

Thirdly, our subjective confidence rankings were possibly skewed by a reporting bias, as participants were completing them with the treating clinician, who participants may have presumed was motivated by participant improvement and noted confidence on about treatment tasks. In addition, although participants did not complete post-treatment interviews with the treating clinician, there was a potential reporting bias, as participants may have presumed that the study goals were improvement on assessment measures.

Fourthly, we did not ask participants whether they noted changes in metacognition following treatment, despite targeting this in all treatment sessions. Although no gold standard measure of metacognition exists, researchers conducting replications of the current study should seek to characterize metacognition in order to compare change in this area to other variables.

Fifthly, there is a possibility of sampling bias based on our recruitment methods. For example, many participants enrolled in this study after reading an advertisement on Reddit. This recruitment method required potential participants to self-enroll, which may not be feasible for individuals with moderate to severe symptomatology, and therefore may over-sample participants with mild symptoms. In addition, we recruited through advertisements to caregiver

support groups and clinicians who serve adults with TBI, (i.e., clinician or caregiver referral), which may have yielded participants for the current study with more severe TBI. Historically, Kennedy and colleagues (e.g., Kennedy et al., 2011) have recruited participants in studies examining use of the Dynamic Coaching Model through referrals from campus disability service centers. This method may result in a similar sampling bias as our recruitment through Reddit, as college students are required to seek out disability services.

Finally, there is a documented mismatch between performance-based and report-based tasks relative to executive function. For example, Ten Eycke and Dewey (2016) compared the use of a commonly used report-based measure (i.e., the Behavioral Rating Inventory of Executive Function; Gioia et al., 2000) to performance-based measures of executive function and concluded that these tasks assess different constructs. Similarly, Krivitzky et al. (2019) identified negative correlations between self-report index scores and performance-based results. Therefore, these two measurement types appear to capture different constructs or aspects of executive functioning (Ackley & Kapa, *under review*). Importantly, several authors have recommended the use of both self-report and performance-based tasks for measuring executive function with individuals who have sustained TBI (Brown & Knollman-Porter, 2018; Brown et al., 2021). We did not include self-report of executive function in order to reduce the time burden placed on our participants. In future replications of this study, self-report measures should be used to ensure that participants' executive function abilities are holistically characterized. Of note, the lack of correlation between performance on self-report and performance-based measures of executive function does not apply to predictive measures of academic achievement, as there is a strong correlation between performance on objective measures of academic achievement (e.g., grade

point average) and performance on these measures (i.e., self-efficacy, Ismail et al., 2017; self-compassion, Neff et al., 2005; and growth mindset orientation, McCabe et al., 2020).

Future Directions

The following treatment components were efficient, effective, and feasible for completion of the current study: (a) the training protocol utilized with the graduate student clinicians who completed the assessment protocols; (b) both the independent and interactive pre- and post-treatment assessment sessions; (c) both goal-setting protocols; (d) completion of treatment activities, including metacognitive strategy training and activities targeting cognitive-linguistic domains; (e) completion of education modules; (f) general communication between clinicians and clients (e.g., for scheduling purposes) outside of scheduled interactive sessions, and; (g) the remote nature of the study. Therefore, replications of the current study are likely feasible. Several potential future directions for data collection protocols, materials, and data analysis methods used within the current study are suggested below.

Modifications to the data collection protocols utilized within this study may help to mitigate the limitations noted above. First, increasing the number of treatment sessions offered to participants may help shed light on whether the limited number of treatment sessions provided to participants within the current study affected the lack of group differences on dependent variables (e.g., knowledge of TBI). Second, the recruitment of additional clinicians to perform assessment and/or treatment sessions may help reduce differences in time intervals between sessions across participants as sessions were only offered during times when clinicians were available. In addition, obtaining funding to remunerate clinicians for their time spent on this work may help increase the number of clinicians who are able to participate in training and data

collection. Finally, use of the computerized version of the RBANS may have increased the efficiency of data analysis.

Several future directions exist relative to the educational materials utilized within the current study. First, we relied on the use of software that was freely available to us for data collection purposes (i.e., Microsoft Office software). Therefore, we did not have a way of verifying that participants completed educational modules, only that they completed the interactive activity components. In future studies, use of software to verify participant completion of passive education components is warranted. Second, education about resources for individuals who are greater than one-year post-injury may be warranted, as 75% of the participants in the current study fell into this category. Third, participants were provided with information about symptomatology, but including information about overcoming symptoms and inclusion of case examples about individuals who overcame barriers to success stemming from symptomatology may help increase participant self-efficacy and/or growth-mindset orientation. Fourth, obtaining participant feedback about the content and format of the educational materials may provide insight into the degree of engagement participants felt with these materials.

Conclusion

In the current study, we completed several tasks for the first time. First, we systematically evaluated the use of Dynamic Coaching beyond the level of a case series design. Second, we examined the feasibility of the remote use of this protocol. Third, we applied the use of this treatment protocol across a variety of university settings and with individuals who had sustained injuries across the severity spectrum. Fourth, we systematically examined outcomes in five areas that had not previously been considered in the literature (e.g., predictive measurements of academic achievement). Finally, we compared the relative effects of the Dynamic Coaching

model versus a novel Apprenticeship Approach to TBI treatment that included TBI education and a modified goal setting procedure.

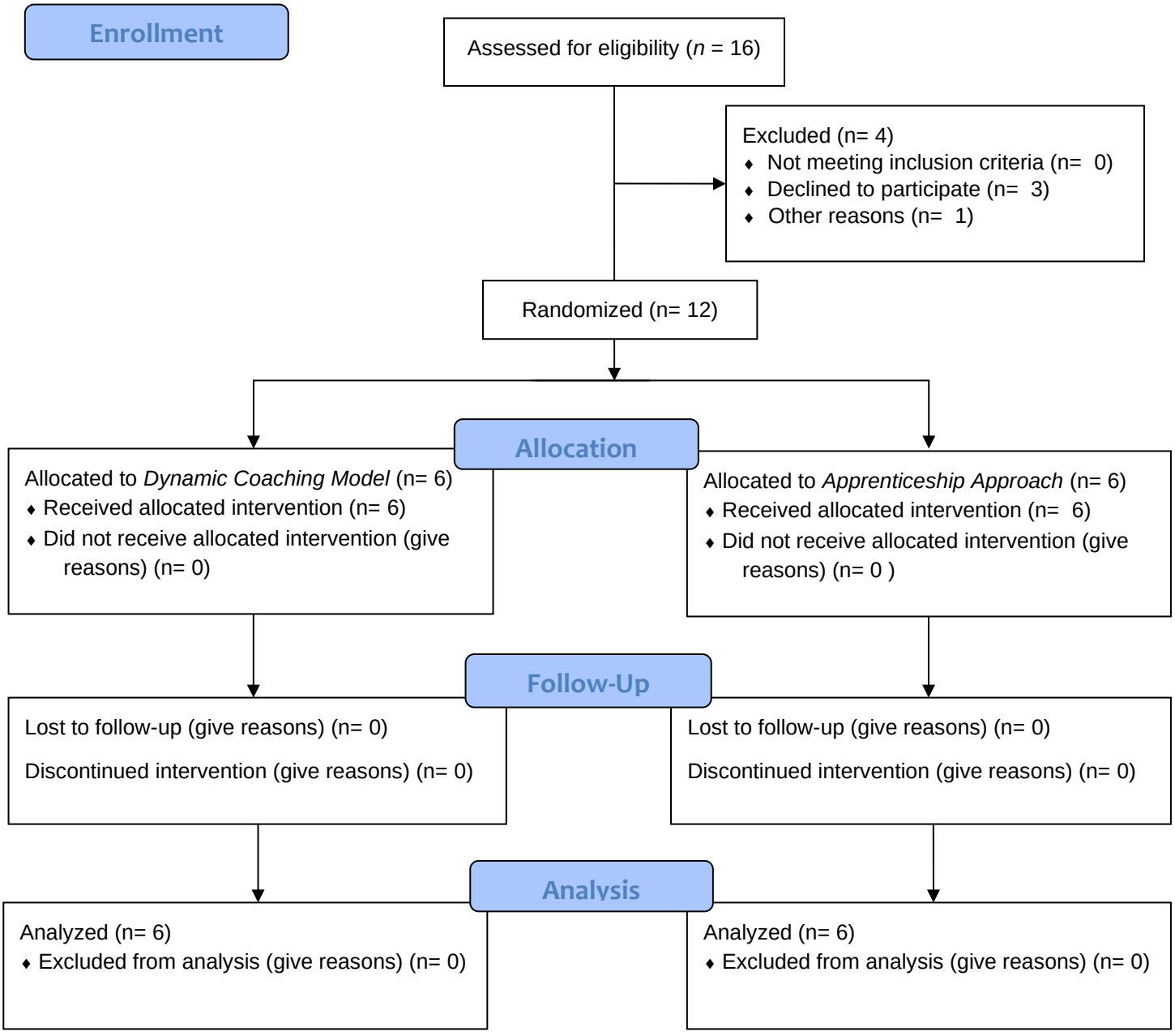
No significant differences were found between treatment groups relative to change on quality of life, TBI-related knowledge, or subjective confidence measures; however, both Dynamic Coaching and the Apprenticeship Approach offer unique pros and cons. SLPs can expect both approaches to be beneficial for clients, but the Dynamic Coaching Model may have the additional benefit of increased self-perceived academic achievement. In contrast, the Apprenticeship Approach is associated with higher treatment satisfaction. Because there is overwhelming support in the literature for person-centered and personalized treatment approaches (e.g., Brownie & Nancarrow, 2013; Poey et al., 2017; Van den Broek et al., 2013), clinicians should determine which approach may be more effective for their individual client.

In addition to facilitating the selection of appropriate goal-setting approaches and treatment activities, personalized care may be beneficial in helping the clinician educate clients. Because SLPs are not permitted to bill insurance companies for client education, clinicians often provide clients with written or electronic sources of information. Therefore, clients must access educational materials independently, meaning educational materials should be highly motivating for the individual. It is essential, therefore, that these materials be tailored to individual client needs. For example, P1 verbally expressed an appreciation of a mindfulness strategy provided in the first education module. For an SLP treating this client, further provision of mindfulness-focused educational materials may have facilitated increased improvement on outcomes. This type of responsiveness is recommended within the Participation Model and is a feasible means by which clinicians may educate clients.

Findings from the present study demonstrate support for personalized cognitive-linguistic treatment for college students with TBI. Further research on the type and modality of educational modules, the content of these modules, and the use of current recommended treatment approaches (i.e., metacognitive strategy training) is warranted to best understand the effects of TBI-related education and metacognitive strategy training on measures of quality of life, TBI-related knowledge, academic achievement, and confidence within the treatment of college students with TBI.

Appendix A

Modified CONSORT Flow Diagram of Dynamic Coaching and Apprenticeship Approach Participants



Appendix B

Initial Audiological, Visual, and Technological-Related Barrier Questions

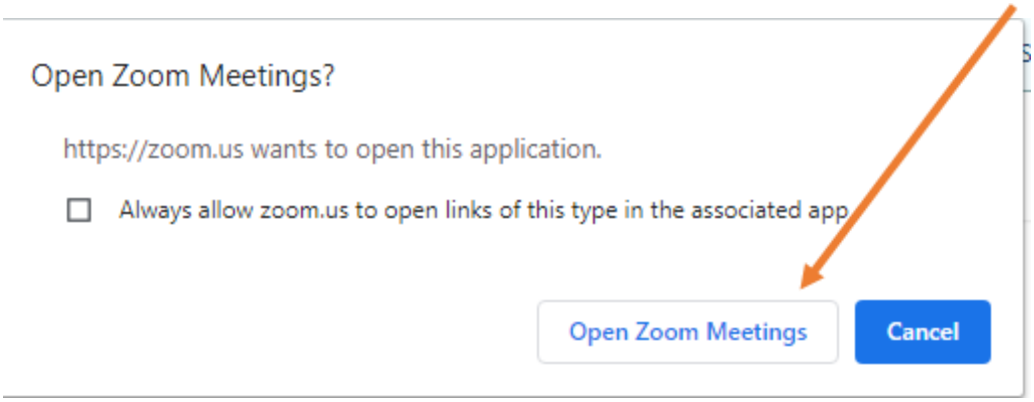
If you own headphones, you are encouraged to use them for all study activities. You are encouraged to alter volume to your preferred listening level and to adjust the brightness of your screen to your preferred viewing level as needed throughout study activities. If at any time you are unable to hear the clinician, please ask them to repeat what was said.

Please click on the following link to be taken to the screening session at ASSIGNED DAY AND TIME:
Follow the link by pressing "Ctrl" at the same time that you click below:

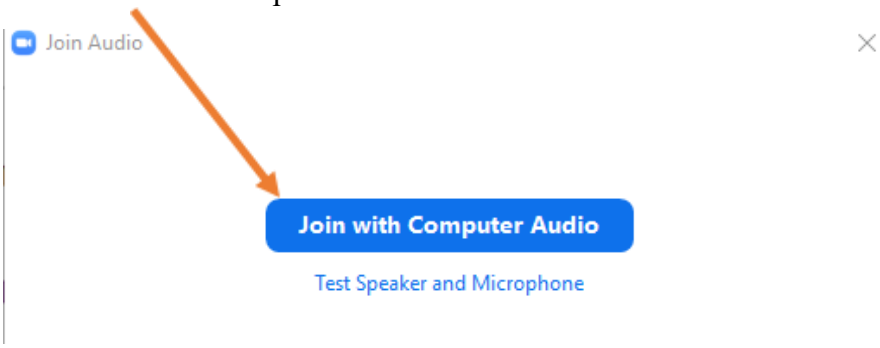
LINK HERE

Click the "Join" button.

You may see a prompt to open Zoom Meetings. It will look like this, and you should click "Open Zoom Meetings."



Click "Join with Computer Audio."



If at any point throughout this process, you experience difficulty with Zoom, press "Ctrl" and click the link below:

https://support.zoom.us/hc/en-us/sections/200305593-Troubleshooting

QUESTIONS FOR CLINCIANS TO ASK PARTICIPANTS:

1) Do you wear corrective lenses, such as contact lenses or glasses?
   If yes:
   - Are you wearing them now?
   - Do they work?
2) Do you have a history of hearing impairment?
3) Do you experience ringing in the ears (tinnitus) that lasts for at least 5 minutes?
4) Do you have a problem tolerating sounds because they often seem too loud or bother you for other reasons?
5) Do you have any difficulties understanding speech or other sounds?
6) Do you feel like you have more difficulties hearing in noise compared with others?
7) Do you wear hearing aids?
   If yes:
   - How many hours do you wear them per day?
   - Are you wearing them now?
   - Do they work?
8) Do you have a reliable internet connection?
9) Do you have regular access to a computer, phone, or tablet that you can use to participate in the study?
10) Do you have headphones that you can use? (This is not necessary but is encouraged)
11) Are you able to control the brightness and the volume of your computer?
12) Please read the passage you are about to see- open the Rainbow Passage

PARTICIPANT QUESTIONNAIRE (INDEPENDENT COMPLETION)

By checking each item below, you are indicating that the statement is true.

1. I have a reliable internet connection – broadband wired or wireless (3G or 4G/LTE) - that I can use for the purposes of this research study. ☐
2. I have regular access to a computer, phone, or tablet that I can use to participate in this study. ☐
3. I joined the first meeting successfully. ☐
4. I heard the clinician (even if we had to troubleshoot). ☐
5. I could see the clinician on the screen (even if we had to troubleshoot). ☐

In-Treatment Participant Questionnaire

By checking each item below, you are indicating that the statement is true.

1) I had no difficulty with my internet connection throughout the session. ☐
2) I could see the clinician on the screen for the whole session (even if we had to troubleshoot). ☐
3) I could hear the clinician for the whole session (even if we had to troubleshoot). ☐

Please email this questionnaire to ackleykl@email.arizona.edu when you have completed it.
Thank you

Appendix C

Knowledge Questionnaire

How would you rate your current knowledge on the following topics?

	Excellent	Good	Fair	Poor
Definition of a TBI				
Signs and symptoms of a TBI				
Support services available for individuals with traumatic brain injuries				
"I prefer not to answer this question."				

In your own words, define a TBI.

_____

Provide as many symptoms as you can think of that could result from a TBI.

_____

Provide a list of professionals who may be involved in the care and recovery of individuals with traumatic brain injuries.

_____

Symptoms following concussion can negatively impact academic and work performance

TRUE
FALSE
Unsure/ I don't know

Select all of the symptoms you think a person with a TBI might experience:

- Decreased memory for events immediately before the injury
- Decreased memory for events immediately after the injury
- Planning/organization problems
- Slow thinking
- Difficulty learning new information
- Confusion to your situation
- Problems paying attention at school or work
- Concentration problem
- Difficulty multitasking
- Problems starting or finishing tasks
- Problems thinking clearly
- Difficulty solving problems
- Difficulty speaking

(adapted from Knollman Porter et al., 2017)

- ☐ Difficulty reading
- ☐ Difficulty writing
- ☐ Trouble sleeping
- ☐ Sleeping more than usual
- ☐ Dizziness
- ☐ Headaches
- ☐ Sensitivity to light or sound
- ☐ Vision loss
- ☐ Problems focusing your eyes
- ☐ Hearing loss
- ☐ Tinnitus (ringing in the ears)
- ☐ Balance/coordination problems
- ☐ Reduced mobility
- ☐ Decreased endurance
- ☐ Excessive fatigue
- ☐ Unusual hunger
- ☐ Loss of appetite
- ☐ Pain
- ☐ Depression
- ☐ Irritability
- ☐ Mood swings
- ☐ Anger or aggression
- ☐ Difficulty with relationships
- ☐ Decreased self-awareness
- ☐ Loss of interest in previously enjoyed activities
- ☐ Panic attacks
- ☐ None of the above

Select all of the service providers/medical professionals that you would expect to be involved in the treatment and recovery of a person with a TBI:

- ☐ Emergency room doctor
- Primary care/family medicine doctor
- Psychologist or neuropsychologist
- Psychiatrist
- Nurse
- Athletic trainer
- Teacher
- Occupational therapist
- Speech-language pathologist
- Audiologist
- Physical therapist
- Chiropractor

- Social worker
- Optometrist/ophthalmologist
- Coach
- Academic advisor
- Vocational rehabilitation specialist
- Recreational therapist
- Dietician
- Radiologist
- Neurologist

The following questions ask about your educational background and thoughts regarding TBI.

Before today, have you been educated on TBI?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

If you have previously been educated, what methods were used to educate you on concussion or mild head injury?

- Handouts/pamphlets
- Videos
- Formal presentations
- Self-education through books or online
- Parents
- Coaches
- Nurses, doctors, or other medical professionals
- Other: _____

(adapted from Knollman Porter et al., 2017)

Appendix D

Predictive Scales of Academic Achievement

Scale of Self-Efficacy

	Strongly disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Strongly agree
I will be able to achieve most of the goals I have set out for myself.	O	O	O	O	O
When facing difficult tasks, I am certain that I will accomplish them.	O	O	O	O	O
In general, I think I can obtain outcomes that are important for me.	O	O	O	O	O
I believe I can succeed at most any endeavor to which I set my mind.	O	O	O	O	O
I am confident that I can perform effectively on many different tasks.	O	O	O	O	O
Compared to other people, I cannot do most tasks very well.	O	O	O	O	O
Even when things are tough, I can perform quite well.	O	O	O	O	O

Self-Compassion Scale

	Strongly disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Strongly agree
When I fail at something important to me I become consumed by feelings of inadequacy.	O	O	O	O	O
I try to be understanding and patient towards those aspects of my personality I don't like.	O	O	O	O	O
When something painful happens I try to take a balanced view of the situation.	O	O	O	O	O
When I'm feeling down, I tend to feel like most other people are probably happier than I am.	O	O	O	O	O
I try to see my failings as part of the human condition.	O	O	O	O	O
When I'm going through a very hard time, I give myself the caring and tenderness I need.	O	O	O	O	O
When something upsets me I try to keep my emotions in balance.	O	O	O	O	O
When I fail at something that's important to me, I tend to feel alone in my failure	O	O	O	O	O
When I'm feeling down I tend to obsess and fixate on everything that's wrong.	O	O	O	O	O
When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people	O	O	O	O	O
I'm disapproving and judgmental about my own flaws and inadequacies.	O	O	O	O	O
I'm intolerant and impatient towards those aspects of my personality I don't like.	O	O	O	O	O

Growth Mindset Scale

	Strongly agree	Agree	Mostly agree	Mostly disagree	Disagree	Strongly disagree
You have a certain amount of intelligence, and you can't really do much to change it.	O	O	O	O	O	O
I try to be understanding and patient towards those aspects of my personality I don't like.	O	O	O	O	O	O
When something painful happens I try to take a balanced view of the situation.	O	O	O	O	O	O
When I'm feeling down, I tend to feel like most other people are probably happier than I am.	O	O	O	O	O	O

Appendix E

Treatment Satisfaction Questionnaire (adapted from Bergquist et al., 2010)

In terms of helping me with the above skills, this treatment program was:

Very helpful

Moderately helpful

Slightly helpful

Unhelpful

I prefer the way I did things before treatment to using the skills I learned:

No

Sometimes

Yes

I am satisfied with this program:

No

Yes

Unsure

The therapist who provided therapy seemed to genuinely care about me:

No

Yes

Unsure

I attribute my improvement to:

Treatment

Factors other than treatment

I don't feel I improved

If given the opportunity, I would want to complete this program again:

No

Yes

Maybe

I would recommend this program to a friend:

No

Yes

Unsure

Appendix F

Dynamic Coaching Model Goal Setting Protocol

- What classes are you taking?
- How many hours of credit are given for each class?
- How often do classes meet?
- How long are your classes?
- What are the course requirements?
- How many exams are given?
- What is the format (multiple choice, essay, etc.)?
- Are there papers or presentations?
- What are the reading expectations?
- Is there any group work?
- Is the class delivered online, in-person, or both?*
- Is the class synchronous or asynchronous?*

Student Goal	Coaching follow-up	Self-regulation goal	Performance Goal

* Question added due to current widespread use of videoconferencing for course delivery

Appendix G

Apprenticeship Approach Goal Setting Protocol

Patient ID: _____ DOB: _____ Gender: _____ Date: _____

Comments:

Cognitive Domains & Subdomains

_____ Attention
- □ Orientation
- □ Vigilance
- □ Selective Attention
- □ Alternating Attention
- □ Sustained Attention

_____ Memory
- □ Working Memory
- □ Immediate Memory (little to no delay)
- □ Delayed Recall (short-term)
- □ Prospective Memory
- □ Long-Term Memory

_____ Executive Functioning (adapted from Sohlberg & Mateer)
- □ Initiation
- □ Inhibition
- □ Processing Speed
- □ Planning
- □ Organization/Sequencing
- □ Problem Solving
- □ Cognitive Flexibility
- □ Self-Awareness

_____ Language & Communication
- □ Comprehension of Spoken Language
- □ Comprehension of Written Language
- □ Oral Expression
- □ Written Expression
- □ Pragmatics (e.g., social skills, extralinguistics, paralinguistics)

Appendix H

Interpreting Abilities and Disabilities (Kennedy, 2017)

I am able to:	**Examples of this are:**
1. _____	1.
2. _____	2.
3. _____	3.
4. _____	4.

I have difficulty with:	**Examples of this are:**
1. _____	1.
2. _____	2.
3. _____	3.
4. _____	4.

Appendix I

Symptom Recognition Log

A helpful strategy is to create your own Daily Symptom Recognition Log. Each day, you should fill out the symptom log. Tracking the times and ways that you experience your symptoms will help you to better understand them, and that understanding can lead to better symptom management. Taking note of how you felt when you went through each symptom will help you to plan how you are going to react next time. Please answer the following questions:

1. WHAT SYMPTOMS DID I EXPERIENCE TODAY? (List the name of the symptom if you know what it is called; describe the symptom if you do not know what to call it)

_____

_____

2. I EXPERIENCED THESE SYMPTOMS WHEN I WAS: (where you were/what you were doing)

_____

_____

3. I HAVE FELT THIS SYMPTOM BEFORE WHEN I WAS…

_____

_____

4. MY REACTION TO FEELING THIS SYMPTOM WAS…

_____

_____

5. THE WAY I REACTED MADE ME FEEL…

_____

_____

(adapted from *The Brain Injury Network*, 2018)

6. NEXT TIME WHEN I EXPERIENCE THIS SYMPTOM, I WANT TO…

_____

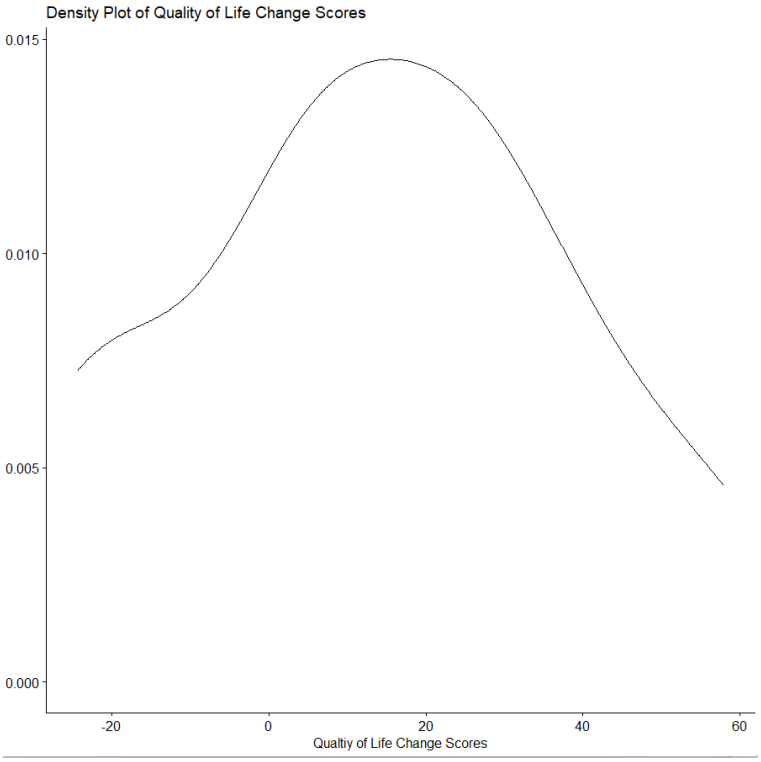
_____

(adapted from *The Brain Injury Network*, 2018)

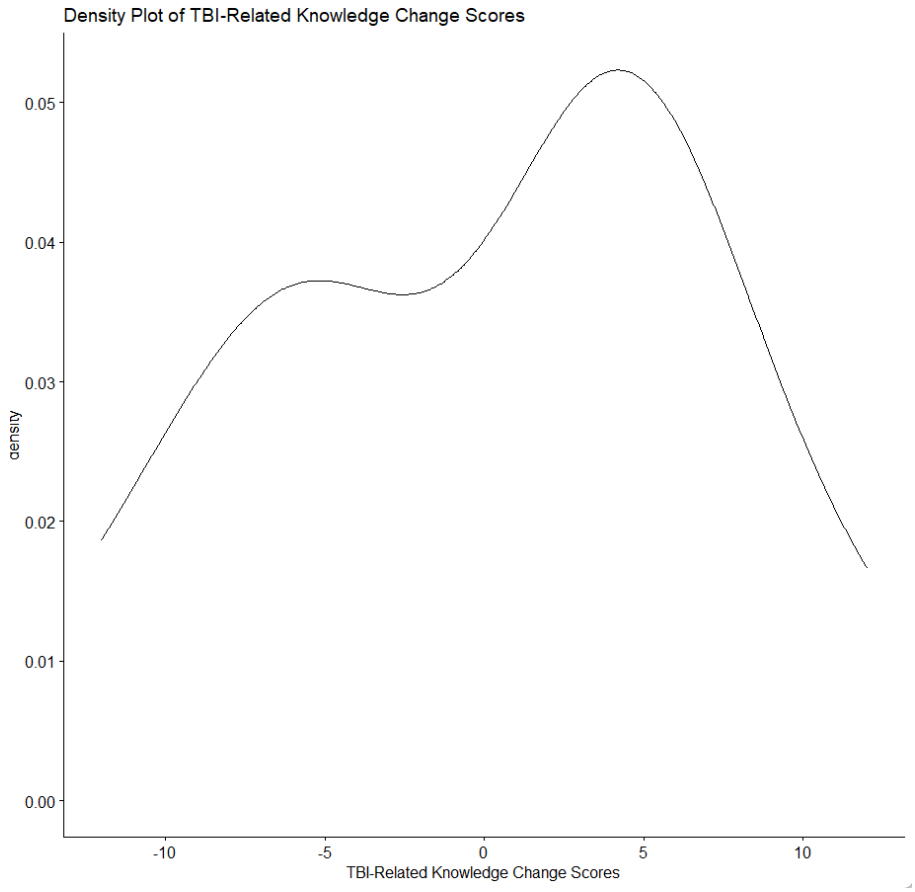
Appendix J

Normality Data for Statistical Analyses

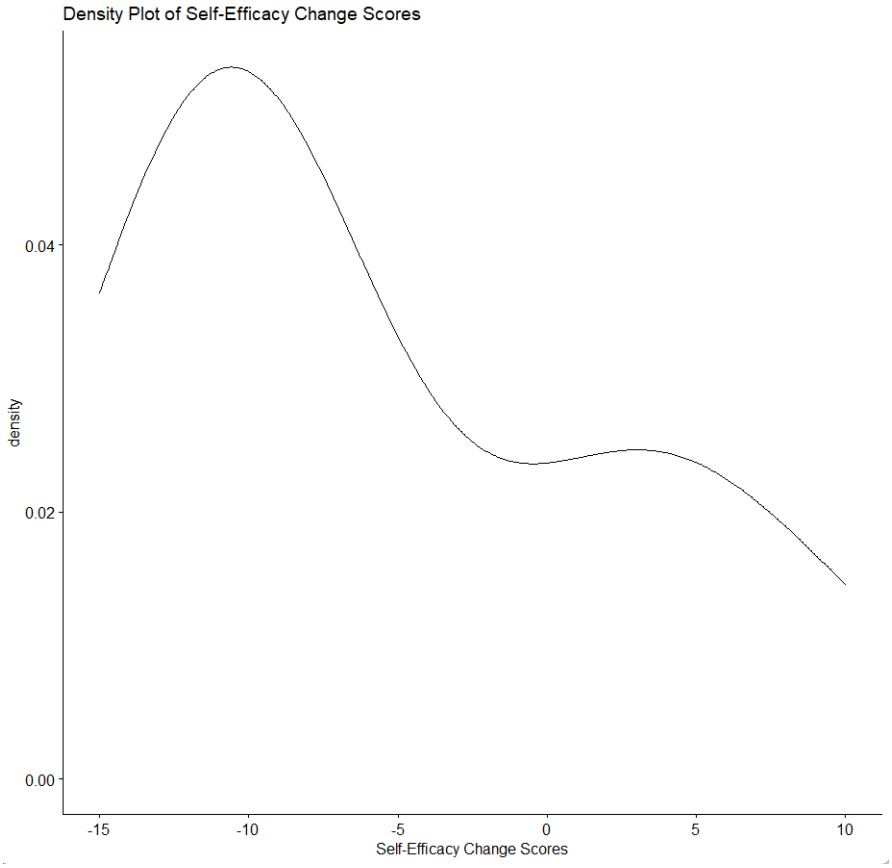
Quality of Life



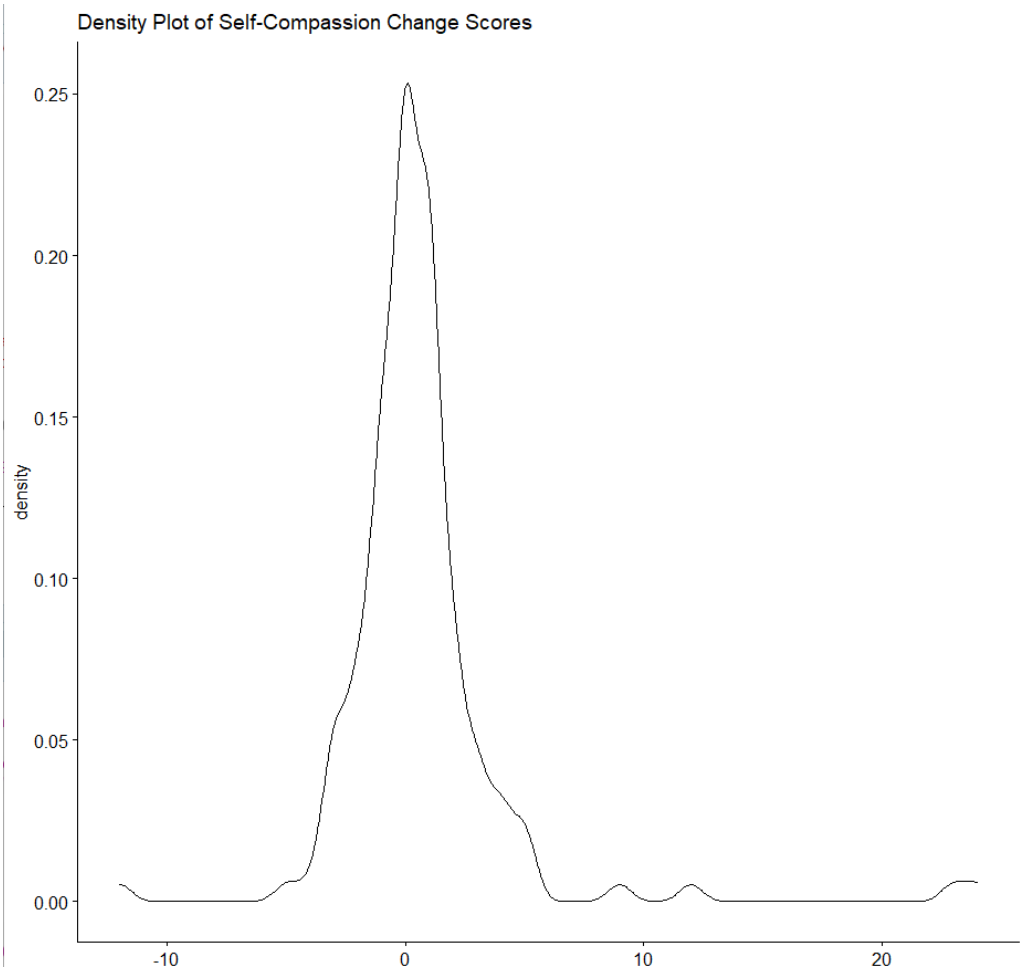
TBI-Related Knowledge



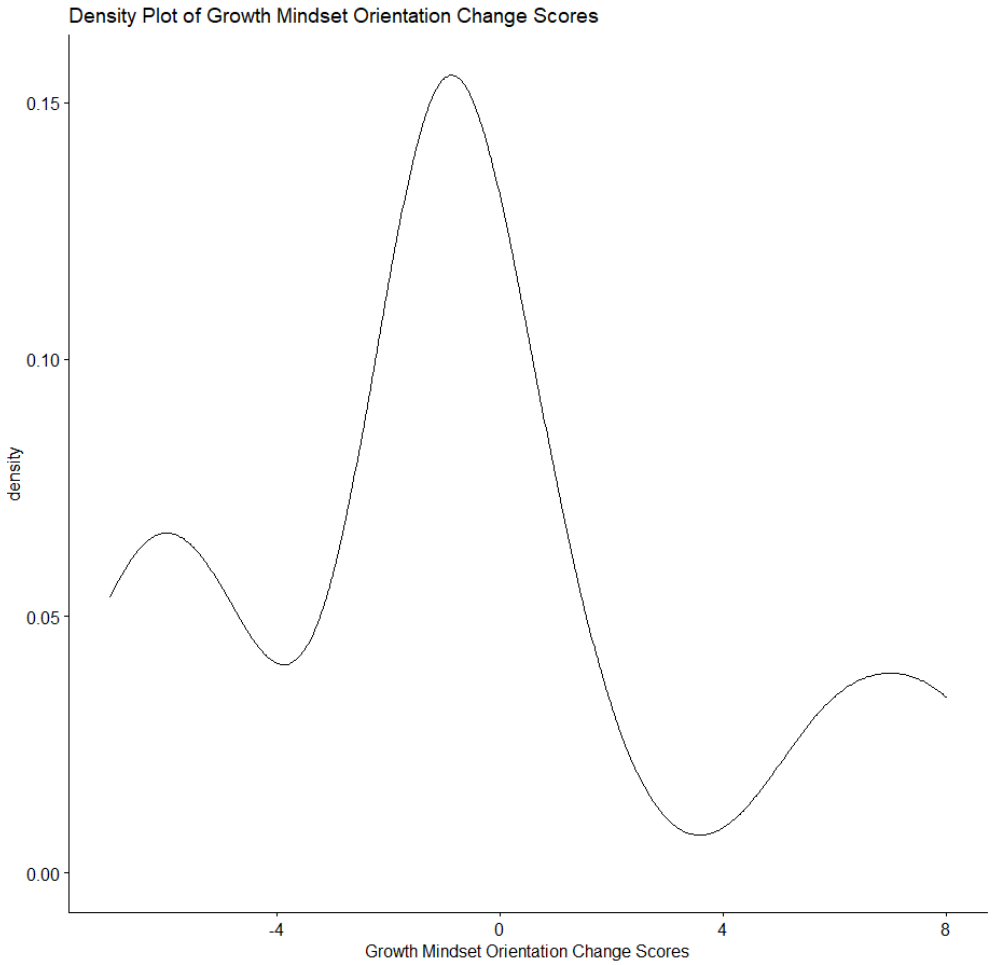
Self-Efficacy



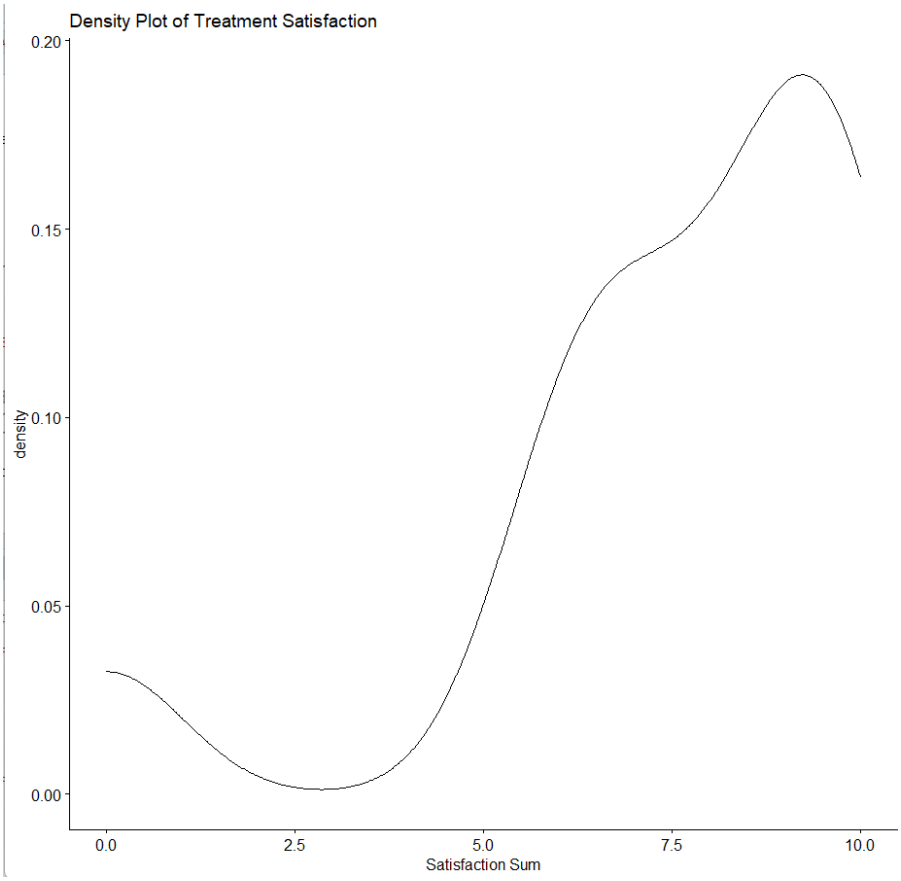
Self-Compassion



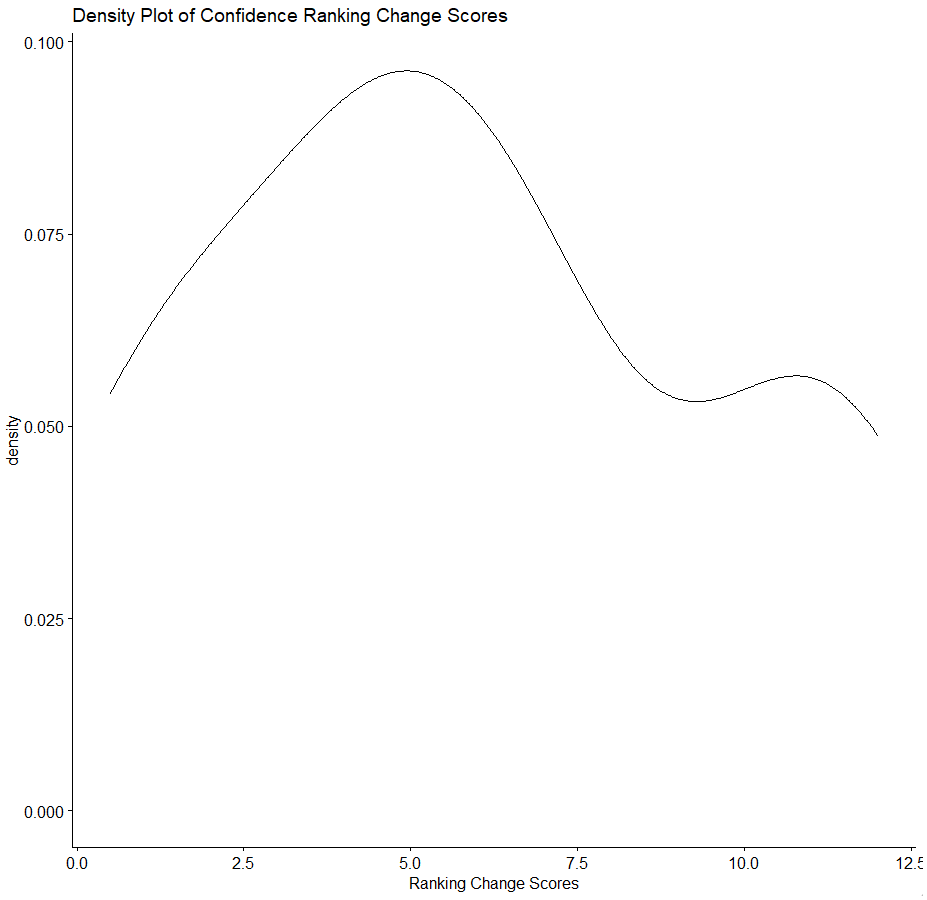
Growth Mindset Orientation



Treatment Satisfaction



Confidence


Density Plot of Confidence Ranking Change Scores
0.100
0.075
0.050
0.025
0.000
density
0.0
2.5
5.0
7.5
10.0
Ranking Change Scores

References

Ackley, K. & Brown, J. (2020). Speech-language pathologists' practices for addressing cognitive deficits in college students with traumatic brain injury. *American Journal of Speech-Language Pathology, 29*(4). https://doi.org/https://doi.org/10.1044/2020_AJSLP-20-00079

Ackley, K. & Kapa, L. (*under review*). Using executive function measures to predict word-learning in at-risk youth.

Al-Hebaish, S. (2012). The correlation between general self-confidence and academic achievement in the oral presentation course. *Theory and Practice in Language Studies, 2*. https://doi.org/10.4304/tpls.2.1.60-65

American Congress of Rehabilitative Medicine. (1993). *Definition of mild traumatic brain injury.* https://www.acrm.org/wp-content/uploads/pdf/TBIDef_English_10-10.pdf

American Psychological Association Services. (2020). *Guidance on psychological teleassessment during the COVID-19 crisis*. https://www.apaservices.org/practice/reimbursement/health-codes/testing/teleassessmentcovid9?fbclid=IwAR1d_YNXYS2Yc5mdIz_ZIYSkrrJ_6A9BQeKuIHxEEjjRh1XDR6fOYncM3b4

American Speech-Language-Hearing Association. (n.d.). *Traumatic brain injury in adults* (Practice portal). http://www.asha.org/Practice-Portal/Clinical-Topics/Traumatic-Brain-Injury-in-Adults/

Aronson, J., Fried, C., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology, 38,* 113-125. https://doi.org/10.1006/jesp.2001.1491

Bellg, A.J., Borrelli, B., Resnick, B., Hecht, J., Minicucci, D.S., Ory, M., Ogedegbe, G., Orwig, D., & Ernst, D., Czajkowski, S. (2004). Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. *Health Psychology*, *23*(5), 443-451. https://doi.org/10.1037/0278-6133.23.5.443

Beukelman, D. R., & Light, J. (2020). *Augmentative and alternative communication: Supporting children and adults with complex communication needs* (5th ed.). Brookes.

Beukelman, D.R. & Mirenda, P. (1988). *Communication options for persons who cannot speak: Assessment and evaluation*. Association for Advancement of Rehabilitation Technology.

Blackwell, L., Trzesniewski, K., & Dweck, C.S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: a longitudinal study and an intervention. *Child Development, 78*, 246-263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Brain Injury Network. (2018). *Achieving Healing through Education, Accountability, and Determination.* https://mindsourcecolorado.org/ahead/

Breck, A., Bohr, J., & Poddar, S. (2019). Characteristics and incidence of concussion among a US collegiate undergraduate population. *JAMA Network Open, 2*(12), 1–7. https://doi.org/10.1001/jamanetworkopen.2019.17626

Brown, J., Ackley, K., & Knollman-Porter, K. (2021). Collaborative goal setting: A clinical approach for adults with mild traumatic brain injury. *American Journal of Speech-Language Pathology*, 1-20. https://doi.org/10.1044/2021_AJSLP-21-00078

Brown, J., Hux, K., Hey, M., & Murphy, M. (2017). Exploring cognitive support use and preference by college students with TBI: A mixed-methods study. *NeuroRehabilitation,* 41(2), 483–499. https://doi.org/10.3233/NRE-162065

Brown, J., & Knollman-Porter, K. (2019). Evaluating cognitive-linguistic deficits post-concussion in adults: Contributions of self-report and standardized measures. *Topics in Language Disorders, 39*, 239-256. https://doi.org/10.1097/TLD.0000000000000186

Brown, J., & Knollman-Porter, K. (2020). Continuum of care following sports-related concussion. *American Journal of Speech-Language Pathology*, *29*(3), 1389–1403. https://doi.org/10.1044/2020_AJSLP-19-00131

Brown, J., O'Brien, K., Knollman-Porter, K., & Wallace, T. (2019). The speech-language pathologist's role in mild traumatic brain injury for middle and high school-age children: Viewpoints on guidelines from the Centers for Disease Control and Prevention. *American Journal of Speech-Language Pathology*, *28*(3), 1363–1370. https://doi.org/10.1044/2019_AJSLP-18-0296

Brown, J., & Wollersheim, M. (2018). Exploring assistive technology use to support cognition in college students with histories of mild traumatic brain injury. *Disability and Rehabilitation: Assistive Technology*, *14*(3), 255–266. https://doi.org/10.1080/17483107.2018.1428371

Brownie, S. & Nancarrow, S. (2013). Effects of person-centered care on residents and staff in aged-care facilities: a systematic review. *Clinical Interventions in Aging*, *8*, 1–10. https://doi.org/10.2147/CIA.S38589

Brundage, D.H. & MacKeracher, D. (1980). *Adult learning principles and their applicability to program planning.* Ontario Dept. of Education.

Bryan, C. J., Bryan, A. O., Hinkson, K., Jr, Bichrest, M., & Ahern, D. A. (2014). Depression, posttraumatic stress disorder, and grade point average among student servicemembers

and veterans. *Journal of rehabilitation research and development, 51*(7), 1035–1046. https://doi.org/10.1682/JRRD.2014.01.0012

Carroll-Alfano M. (2017). Mandated high school concussion education and collegiate athletes' understanding of concussion. *Journal of Athletic Training, 52*(7), 689–697. https://doi.org/10.4085/1062-6050-52.3.08

Centers for Disease Control and Prevention. (2014). *Report to Congress on traumatic brain injury in the United States: Epidemiology and rehabilitation*. https://www.cdc.gov/traumaticbraininjury/pdf/tbi_report_to_congress_epi_and_rehab-a.pdf

Chen, G., Gully, S.M., & Eden, D. (2001). Validation of a new self-efficacy scale. *Organizational Research Methods, 4*(1), 62-83. https://doi.org/10.1177%2F109442810141004

Dams O'Connor, K., Cantor, J. B., Brown, M., Dijkers, M. P., Spielman, L. A., & Gordon, W. A. (2014). Screening for traumatic brain injury: Findings and public health implications. *The Journal of Head Trauma Rehabilitation*, 29(6), 479–489. https://doi.org/10.1097/htr.0000000000000099

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168. https://dx.doi.org/10.1146%2Fannurev-psych-113011-143750

Duff, M., Proctor, A., & Haley, K. (2002). Mild traumatic brain injury (MTBI): Assessment and treatment procedures used by speech-language pathologists (SLPs). Brain Injury, 16(9), 773-787. https://dx.doi.org/10.1080/02699050210128870

Dweck, C. S. (2006). *Mindset: The new psychology of success.* Random House.

Ehlhardt, L., Sohlberg, M. M., Kennedy, M., Coelho, C., Ylvisaker, M., & Turkstra, L. (2008). Evidence-based practice guidelines for instructing individuals with neurogenic memory

impairments: What have we learned in the past 20 years? *Neuropsychological Rehabilitation, 18*(3), 300–342. https://doi.org/10.1080/09602010701733190

Fairbanks, G. (1960). *Voice and articulation drillbook,* 2nd ed. Harper & Row. pp124-139.

Field, S., Parker, D. R., Sawilowsky, S., & Rolands, L. (2013). Assessing the impact of ADHD coaching services on university students' learning skills, self-regulation, and well-being. *Journal of Postsecondary Education and Disability, 26*, 67-81.

Galanek, J.D., Gierdowski, D.C., & Brooks, D. C. (2018, October). ECAR study of undergraduate students and information technology, 2018. *ERIC Institute of Education Sciences*. https://eric.ed.gov/?id=ED614399

Gilmore, N., Ross, K., & Kiran, S. (2019). The Intensive Cognitive-Communication Rehabilitation Program for young adults with acquired brain injury. *American Journal of Speech Language Pathology, 28*(1S), 341–358. https://doi.org/10.1044/2018_AJSLP-17-0153

Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). BRIEF: Behavior Rating Inventory of Executive Function. Psychological Assessment Resources.

Good, C. Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An Intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology, 24*, 645-662. https://doi-org.ezproxy3.library.arizona.edu/10.1016/j.appdev.2003.09.002

Grosch, M. C., Gottlieb, M. C., & Cullum, C. M. (2011). Initial practice recommendations for teleneuropsychology. *The Clinical Neuropsychologist, 25*, 1119–1133. https://doi.org/10.1080/13854046.2011.609840

Heilferty, Phillips, L. J., & Mathios, R. (2021). Letters from the pandemic: Nursing student narratives of change, challenges and thriving at the outset of COVID-19. *Journal of Advanced Nursing, 77*(8), 3436–3445. https://doi.org/10.1111/jan.14862

Hoepner, J.K., Salo, M., & Weich, H. (2019). Replication of a dynamic coaching program for college students with acquired brain injury. *Clinical Archives of Communication Disorders, 4*(2), 98-112. https://doi.org/10.21849/cacd.2019.00101

Horneman, G. & Emanuelson, I. (2009). Cognitive outcome in children and young adults who sustained severe and moderate traumatic brain injury 10 years earlier. *Brain Injury, 23*(11), 907-914. https://doi.org/10.1080/02699050903283239

Hux, K., Bush, E., Zickefoose, S., Holmberg, M., Henderson, A., & Simanek, G. (2010). Exploring the study skills and accommodations used by college student survivors of traumatic brain injury. *Brain Injury*, *24*(1), 13–26. https://doi.org/10.3109/02699050903446823

Hux, K., Brown, J., & Lambert, M. (2017). Latent class analysis of brain injury symptomatology among college students. *Concussion*, *4*(1), e14–e22. https://doi.org/10.1055/s-0037-1606578

Inter Organizational Practice Committee. (2020). Recommendations/guidance for teleneuropsychology (TeleNP) in response to the COVID-19 pandemic. https://static1.squarespace.com/static/50a3e393e4b07025e1a4f0d0/t/5e8260be9a64587cfd3a9832/1585602750557/Recommendations-Guidance+for+TeleneuropsychologyCOVID-19-4.pdf

Ismail, M., Aziz, F.H., Fajil, M., Ismail, M.F., & Shah, A. (2017). The relationship between self-efficacy and GPA grade scores of students. (2017). *International Journal of Applied Psychology, 7*(2), 44-47. https://doi.org/10.5923/j.ijap.20170702.03

Judge, T. A., Bono, J. A., & Locke, E. A. (2000). Personality and job satisfaction: The mediating role of job characteristics. *Journal of Applied Psychology, 85*, 237-249. https://doi.org/10.1037//0021-9010.85.2.237

Judge, T. A., Erez, A., & Bono, J. A. (1998). The power of being positive: The relation between positive self-concept and job performance. *Human Performance, 11*, 167-187. https://doi.org/10.1080/08959285.1998.9668030

Judge, T. A., Thoresen, C. J., Pucik, V., & Welbourne, T. M. (1999). Managerial coping with organizational change: A dispositional perspective. *Journal of Applied Psychology, 84*, 107-122. https://psycnet.apa.org/doi/10.1037/0021-9010.84.1.107

Kay, T., Harrington, D., Adams, R., Anderson, T., Berrol, S., Cicerone, K., Dahlberg, C., Gerber, D., Goka, R., Harley, P., Hilt, J., Horn, L., Lehmkuhl, D., & Malec, J. (1993). *Definition of mild traumatic brain injury*. Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine. https://acrm.org/wp-content/uploads/pdf/acrm%20mtbi%20def%20jhtr93.pdf

Kennedy, M. R. T. (2017). *Coaching college students with executive function problems*. Guilford.

Kennedy, M. R. T., & Krause, M. O. (2011). Self-regulated learning in a dynamic coaching model for supporting college students with traumatic brain injury. *Journal of Head Trauma Rehabilitation, 26*(3), 212-223. https://doi.org/10.1097/HTR.0b013e318218dd0e

Kennedy, M. R. T., Krause, M. O., & O'Brien, K. (2014). Psychometric properties of the college survey for students with brain injury: Individuals with and without traumatic brain injury. *Brain Injury, 28*(13–14), 1748–1757. https://doi.org/10.3109/02699052.2014.955883

Kennedy, M. R. T., Krause, M. O., & Turkstra, L. S. (2008). An electronic survey about college experiences after traumatic brain injury. *NeuroRehabilitation, 23*(6), 511–520. https://doi.org/10.3233/NRE-2008-23607

Kennedy, M. R. T., O'Brien, K. H., & Krause, M. O. (2012). Bridging person-centered outcomes and therapeutic processes for college students with traumatic brain injury. *SIG 2 Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders, 22*(4), 143–151. https://doi.org/10.1044/nnsld22.4.143

Kermode, S., & Maclean, D. (2001). A study of the relationship between quality of life, self-esteem and health. *Australian Journal of Advanced Nursing, 19,* 33-40.

Knollman-Porter, K., & Brown, J. (2018). Concussion reporting and medical care: An in-depth interview with young adults. *Archives of Physical Medicine and Rehabilitation. 99*. E3-e4. https://doi.org/10.1016/j.apmr.2018.07.011

Knollman-Porter, K., Brown, J., & Flynn, M. (2017). A preliminary examination of concussion knowledge by college athletes and non-athletes. *American Journal of Speech-Language Pathology, 27*(2), 778–795. https://doi.org/10.1044/2018_AJSLP-17-0108

Knollman-Porter, K., Constantinidou, F., Beardslee, J., & Dailey, S. (2019). Multidisciplinary management of collegiate sports-related concussions. *Seminars in Speech and Language, 40*(1), 3–12. https://doi.org/10.1055/s-0038-1676363

Komarraju, M. & Nadler, D. (2013). Self-efficacy and academic achievement: Why do implicit beliefs, goals, and effort regulation matter? *Learning and Individual Differences, 25,* 67-72. https://doi.org/10.1016/j.lindif.2013.01.005

Krivitzky, L., Bosenbark, D. D., Ichord, R., Jastrzab, L., & Billinghurst, L. (2019). Brief report: Relationship between performance testing and parent report of attention and executive functioning profiles in children following perinatal arterial ischemic stroke. *Child Neuropsychology, 25,* https://doi.org/10.1080/09297049.2109.1588957

Lockard, A.J., Hayes, J.A., Neff, K., & Locke, B.D., (2014). Self-compassion among college counseling center clients: an examination of clinical norms and group differences. *Journal of College Counseling, 17*(3), 249-259. https://doi.org/10.1002/j.2161-1882.2014.00061.x

Malec, J.F., Brown, A.W., Leibson, C.L., Flaada, J.T., Mandrekar, J.N., Diehl, N.N., & Perkins, P.K. (2007). The Mayo Classification System for Traumatic Brain Injury Severity. *Journal of Neurotrauma, 24*(9), 1417-1424. http://doi.org/10.1089/neu.2006.0245

McCabe, J. A., Kane-Gerard, S., & Friedman-Wheeler, D. G. (2020). Examining the utility of growth-mindset interventions in undergraduates: A longitudinal study of retention and academic success in a first-year cohort. *Translational Issues in Psychological Science, 6*(2), 132–146. https://doi.org/10.1037/tps0000228

National Center for Education Statistics. (n.d.) *Fast facts: Back-to-school statistics*. https://nces.ed.gov/fastfacts/display.asp?id=372

Nasir, M. & Iqbal, S. (2019). Academic self-efficacy as a predictor of academic achievement of students in pre-service teacher training programs. *Bulletin of Education and Research, 41*(1), 33-42.

Neff, K. (2003). The development and validation of a scale to measure self-compassion. *Self and Identity, 2*(3), 223-250, https://doi.org/10.1080/15298860309027

Neff, K., Ya-Ping, H., & Dejitterat, K. (2005). Self-compassion, achievement goals, and coping with academic failure. *Self and Identity, 4*(3), 263-287. https://doi.org/10.1080/13576500444000317

O'Brien, K., Schellinger, S., Hwang, B., & LaPlaca, M. (2019). A comparison of student and parent knowledge and perceived confidence about brain injury and concussion. *Topics in Language Disorders, 39*(3), 313–334. https://doi.org/10.1097/TLD.0000000000000190

O'Brien, K. H., Schellinger, S. K., & Kennedy, M. (2018). Self-regulation strategies used by students with brain injury while transitioning to college. *NeuroRehabilitation, 42*(3), 365–375. https://doi.org/10.3233/NRE-172413

Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science, 26*(6), 784–793. https://doi.org/10.1177/0956797615571017

Poey, J. L., Hermer, L., Cornelison, L., Kaup, M. L., Drake, P., Stone, R. I., & Doll, G. (2017). Does person-centered care improve residents' satisfaction with nursing home quality? *Journal of the American Medical Directors Association, 18*(11), 974–979. https://doi.org/10.1016/j.jamda.2017.06.007

Popescu, C., Anghelescu, A., Daia, C., & Onose, G. (2015). Actual data on epidemiological evolution and prevention endeavours regarding traumatic brain injury. *Journal of Medicine and Life, 8*(3), 272–277.

Raes, F., Pommier, E., Neff, K. D., & Gucht, D. V. (2010). Construction and factorial validation of a short form of the self-compassion scale. *Clinical Psychology and Psychotherapy, 18*, 250-255. https://doi.org/10.1002/cpp.702

Randolph, C. (1998). Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). Psychological Corporation.

R Core Team. (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing. https://www.R-project.org/

Sohlberg, M. & Ledbetter, A. (2016). Management of persistent cognitive symptoms after sport-related concussion. *American Journal of Speech-Language Pathology, 25*(1). https://doi.org/10.1044/2015_AJSLP-14-0128

Stolwyk, R., Hammers, D. B., Harder, L., & Cullum, C. M. (2020). Teleneuropsychology (TeleNP) in response to COVID-19. https://event.webinarjam.com/replay/13/pyl2nayhvspsp0

Suresh K. (2011). An overview of randomization techniques: An unbiased assessment of outcome in clinical research. *Journal of Human Reproductive Sciences, 4*(1), 8–11. https://doi.org/10.4103/0974-1208.82352

Tang, W.K. (2019). Resilience and self-compassion related with achievement emotions, test anxiety, intolerance of uncertainty, and academic achievement. *Psychological Studies, 64*, 92–102. https://doi.org/10.1007/s12646-019-00482-6

Taylor, C.A., Bell J.M., Breiding M.J., & Xu L. (2017). Traumatic brain injury–related Emergency Department visits, hospitalizations, and deaths — United States, 2007 and 2013. *Morbidity and Mortality Weekly Report Surveillance Summary 2017, 66*(SS-9), 1–16. http://dx.doi.org/10.15585/mmwr.ss6609a1

Ten Eycke, K. D., & Dewey, D. (2015). Parent-report and performance-based measures of executive function assess different constructs. *Child Neuropsychology, 22,* 889-906. https://doi.org/10.1080/09297049.2015.1065961

Togher, L., Wiseman-Hakes, C., Douglas, J., Stergiou-Kita, M., Ponsford, J., Teasell, R., Bayley, M., & Turkstra, L., (2014). INCOG recommendations for management of cognition following traumatic brain injury, part IV. *Journal of Head Trauma Rehabilitation, 29*(4), 353-368. https://doi.org/10.1097/HTR.0000000000000007

Van den Broeck, A., Lens, W., De Witte, H., & Van Collie, H. (2013). Unraveling the importance of the quantity and the quality of workers' motivation for well-being: A person-centered perspective. *Journal of Vocational Behavior, 82*(1), 69-78. https://doi.org/10.1016/j.jvb.2012.11.005

von Steinbuchel, N., Wilson, L., Gibbons, H., Hawthorne, G., Hofer, S., Schmidt, S., et al. (2010b). Quality of Life after Brain Injury (QOLIBRI): Scale development and metric properties. *Journal of Neurotrauma, 27*(7), 1167–1185. https://doi.org/10.1089/neu.2009.1076

von Steinbuchel, N., Wilson, L., Gibbons, H., Hawthorne, G., Hofer, S., Schmidt, S., et al. (2010b). Quality of Life after Brain Injury (QOLIBRI): Scale development and metric properties. *Journal of Neurotrauma, 27*(7), 1167–1185.

Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics Bulletin, 1*(6), 80–83. https://doi.org/10.2307/3001968

World Health Organization. (2003). *ICF Checklist* [Clinician Form]. https://nces.ed.gov/fastfacts/display.asp?id=372