WHAT IS THE EFFECT OF PERSONALIZED COGNITIVE STRATEGY INSTRUCTION ON FACILITATING RETURN-TO-LEARN FOR INDIVIDUALS EXPERIENCING PROLONGED CONCUSSION SYMPTOMS?

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Title: What is the Effect of Personalized Cognitive Strategy Instruction on Facilitating Return-to-Learn for Individuals Experiencing Prolonged Concussion Symptoms?

Experimental and retrospective research has suggested the treatment components of psychoeducation and cognitive strategy instruction show promise to treating individuals with cognitive deficits following mild to severe traumatic brain injury; however, there is lacking experimental evidence to support these interventions for the treatment of adolescents with prolonged concussion symptoms (PCS). The purpose of this study aimed to address the knowledge gap of adolescent PCS treatment by evaluating the degree to which the implementation of personalized cognitive strategy instruction assisted students to achieve functional and academic-related goals.

This study utilized a single case experimental design (SCED) to investigate the effect of personalized cognitive strategy instruction on facilitating the achievement of functional goals. A noncurrent, multiple-baseline design was used across three female, adolescent participants ages 13-16. The primary measurement analyzed to determine the existence of a functional relation between the addition of personalized cognitive strategy instruction to psychoeducation and the achievement of participant outcome was the weekly status tracking measurement of participant performance corresponding to their treatment goal. Three pre/post outcome measurements were additionally administered at

three separate time points. Selected responses to the first administration assisted in the treatment selection process, and these selected responses were compared across the three collection points to determine if positive change was achieved with the implementation of personalized cognitive strategy instruction.

Visual analysis of the plotted status tracking data did not support the existence of a functional relation as there was not a demonstration of an effect across three points in time. Further, a *Tau-U* analysis obtained a small treatment effect size, while the obtained multilevel modeling (MLM) effect size was not significant. However, it is noteworthy that two participants did demonstrate a treatment response, and all three participants achieved their treatment goal suggesting the potential viability of the intervention. I discuss the results in terms of the emergence of three response profiles as well as the benefits and challenges to the types of measurements collected. I provide further discussion on contextual and methodological limitations to the study and provide future steps to improve design methodology.

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CHAPTER I

INTRODUCTION

In the United States, 70-90% of the 1.7 million annual traumatic brain injuries are classified as concussion (Arbabi et al., 2020). The primary cause of concussion results from the application of biomechanical force to the head and/or neck, which instigates a cascade of pathophysiological changes and alterations in cerebral blood flow, glucose metabolism, and axonal functioning, leading to observable changes in cognitive, somatic, and neurobehavioral functioning (Barkhoudarian et al., 2011; Churchill et al., 2017; Giza & Hovda, 2014; Signoretti et al., 2011).

The expected recovery time to experience symptom resolution post-concussion varies across the literature. The most recent consensus statement on concussion in sports, published in 2017, promotes an expected recovery of 10-14 days for adults and four weeks for children and adolescents (McCrory et al., 2017). Other recent literature suggests the typical recovery period for a concussion may last up to three months (Lumba-Brown et al., 2018). The majority of individuals recovering from a concussion resolve their symptoms within this two week to three month window; however, 10-20% of concussions result in the development of prolonged concussion symptoms (PCS), defined as the presence of at least three concussion symptoms three months post-injury (Babcock et al., 2013; Zemek et al., 2013). Common PCS complaints include: (a) somatic symptoms (e.g., headache, light sensitivity, and noise sensitivity); (b) cognitive concerns (e.g., alterations in attention, concentration, and memory); (c) psychological symptoms (e.g., irritability, depression, and anxiety); (d) ocular-motor symptoms (e.g., visual problems); (e) vestibular symptoms (e.g., dizziness and balance problems); and (f) sleep

difficulties (e.g., fatigue, trouble falling asleep, and drowsiness) (Emery et al., 2016; Kerr et al., 2017; Towns et al., 2015).

The Need to Address PCS in Adolescents and Young Adults

The treatment and prevention of PCS has become a public health priority due to the considerable toll on healthcare, educational and vocational resources (Gioia, 2016; Gioia et al., 2016). The prevention and treatment of PCS in the adolescent and young adult populations is of particular importance as these populations are: (a) the most susceptible to developing PCS, and (b) represent the populations with the highest incident rate of PCS (Cancelliere et al., 2014).

The development of PCS in adolescent and young adult populations is particularly concerning due to the impact on the individual's ability to maintain academic success (Glang et al., 2019; Halstead et al., 2013; McAvoy et al., 2018). Common academic challenges in students with PCS that result in a referral for services from a speech-language pathologist (SLP) include an overall decrease in grades, reduced assignment completion, poor school attendance, decreased reading comprehension, and difficulty learning and processing new information (Gioia, 2016). Due to the complexity of managing PCS in adolescents and young adults, it is imperative that SLPs working with these populations have the access and knowledge to implement evidence-based treatments to manage the ongoing cognitive challenges in individuals experiencing PCS. Furthermore, there is a lack of experimental studies investigating pediatric cognitive rehabilitation for PCS leaving clinicians to extrapolate findings from studies evaluating treatment on the moderate to severe TBI populations.

Statement of Purpose

This study aims to address the knowledge gap in the PCS literature on the treatment components that most effectively and efficiently return students to their pre-injury academic level. Given the national trend of an increased concussion incidence in the adolescent population (Zhang et al., 2016), it is necessary to identify essential treatment components delivered by SLPs in order to both elevate the role of the SLP in the return-to-learn (RTL) process and reduce the number of adolescents experiencing PCS.

CHAPTER II

REVIEW OF THE LITERATURE

PCS Development

The PCS literature has identified a variety of factors that are associated with or predict the likelihood of an individual developing PCS following a concussion. Predictive factors of PCS fall into three categories: (a) pre-injury factors, (b), injury-related factors, and (c) post-injury factors (Emery et al., 2016; Ponsford et al., 2012). Each category will be discussed further, and Table 1 summarizes the contributing factors to predicting PCS as presented in the literature.

Table 1

Contributing Factors to PCS Development

Time	Factor
Pre-injury	Older age
	Female sex
	Pre-injury low cognitive ability
	Previous history of concussion
	Pre-injury history of anxiety and/or depression
Injury-related	Feeling mentally foggy
	Drowsiness
	Fatigue
	Difficulty concentrating
	Headache
	Sensitivity to light and/or noise
Post-injury	Anxiety and/or depression
	PTSD
	Chronic pain
	Insomnia
	Chronic vestibular difficulties

Pre-Injury Factors

There is general consensus in the literature identifying the following pre-injury factors as contributors to PCS development: (a) older age, (b) female sex, (c) pre-injury low cognitive ability, (d) previous history of concussion, and (e) pre-injury history of depression and/or anxiety (Dean et al., 2012; Emery et al., 2016; Foy, 2009; Oldenburg et al., 2016; Ponsford et al., 2012; Root et al., 2016; Ryan & Warden, 2003; Yang et al., 2015). The literature support for pre-injury factors is robust, demonstrating that knowledge of them is critical for clinicians working with the adolescent and young adult populations to most successfully identify students at risk for developing PCS and to manage their symptoms. Subsequently, the literature has produced a number of theories for the rationale of female sex and a history of depression and/or anxiety as likely PCS predictors.

Sex differences as a predictor of PCS. Although males sustain more concussions than females, no definitive explanation exists for why females are more likely to develop PCS. Two theories that aim to address this disparity include differences between males and females in both behavioral symptom reporting and physiology. In a prospective cohort study, Root et al. (2016) identified that females who reported high somatization scores on the Children's Somatization Inventory immediately after sustaining a concussion were significantly more likely to report symptoms at 2- and 4-weeks post-injury compared to males. Further, a retrospective case study involving 147 participants ages 13-19 identified that female participants were more likely to both report a greater number of symptoms at the initial intake following a concussion and take longer to achieve full symptom recovery compared to male counterparts (Baker et al., 2016).

The results of these studies suggest females are more consistently identified with PCS because they are more likely to report symptoms compared to their male counterparts.

Although females may be more likely to report symptoms, Gallagher et al. (2018) reviewed sex differences in outcome following concussion for 40 collegiate athletes and determined there was no significant difference in total symptom severity between males and females when measured by the Sport Concussion Assessment Tool. Interestingly, Gallagher et al. (2018) identified that symptom severity was strongly related to overall length of recovery in males but not in females and that females, on average, experienced a significantly longer length of recovery compared to males, consistent with the findings of Root et al. (2016) and Baker et al. (2016).

Physiological differences between males and females that may explain differences in PCS development include differences in both biomechanics and neurophysiology. As previously stated, concussion occurs following the application of force to the head and/or neck region. The force applied is the product of the mass of the individual by the acceleration they experience in the collision (Broglio et al., 2012). Because the head possesses the ability to move independently from the trunk, its low mass is susceptible to concussion given a fixed level of force and high levels of acceleration. The principle of effective mass, which is the ability to couple the head to the trunk through the stiffening of the omohyoid muscle, allows humans to increase their overall mass and reduce the force applied when colliding at a fixed acceleration (Baker et al., 2016; Broglio et al., 2012). On average, males possess a greater mass than females, so this biomechanical difference leaves females more prone to sustaining a concussion (Baker et al., 2016). Although females are biomechanically more vulnerable to sustaining a concussion, a

retrospective review of 40 adolescent concussion cases determined body mass index to not be a predictor of PCS development when controlling for sex; however, the small sample size of this study suggests more research on this topic is necessary (Morgan et al., 2015).

Neurophysiological differences between males and females, specifically the role of the hormone estrogen, may additionally provide insight to the PCS disparity (Bazarian et al., 2010; Emerson et al., 1993; Gallagher et al., 2018). Estrogen has been observed to provide both protective and damaging properties in relation to cell death, and it is believed its most damaging property is that it increases the likelihood of neurons to respond to excitatory neurotransmitters (Emerson et al., 1993). This damaging capability of estrogen is particularly important following a concussion, where the mass release of the excitatory neurotransmitter glutamate is the hallmark physiological event of the early stages of the neurometabolic cascade (Giza & Hovda, 2014). To compare the effects of estrogen following brain injury, Emerson et al. (1993) induced traumatic brain injury in rats and treated the subjects with estrogen. Of note, estrogen treatment was observed to be beneficial to male rates resulting in significant improvements of magnesium concentration and slight improvements of cytosolic phosphorylation compared to non-treated male rats. Conversely, estrogen treatment was found to exacerbate female rat brain injury resulting in a significantly higher mortality rate compared to treated males and significantly lower cytosolic phosphorylation compared to non-treated female controls, which Emerson et al. (1993) concluded was mediated by estrogen receptor binding, which is more likely to occur in females due to a higher estrogen binding capacity than males.

Estrogen's damaging capability at the molecular level, specifically in females, has been explored as a potential explanation for the PCS disparity between males and females. In a retrospective review of 1,425 concussion cases, Bazarian et al. (2010) compared recovery outcomes between males and females and identified that at three months post-injury, length of recovery was similar between males and females, but overall symptom severity was significantly worse for females. The authors concluded estrogen may strongly contribute to PCS severity in females as the peak age difference for reported symptom severity between males and females was identified during the female child-bearing years (Bazarian et al., 2010).

In the aforementioned review of concussion in college athletes, Gallagher et al. (2018) additionally explored the role of hormonal contraception (HC) in moderating outcomes in females. The review consisted of 24 females identified as HC users and 25 females identified as non-HC users. The authors identified no difference on overall length of recovery between the HC and non-HC groups but observed that females in the HC group tended to report lower symptom severity than females in the non-HC group (Gallagher et al., 2018). Although a very small sample size, the results of this study, along with Bazarian et al. (2010), highlight the need for more research on this topic to gain further insight on neurophysiological differences between the sexes that may explain variability in PCS development and overall outcome.

Why psychological history is critical to predicting PCS. Pre-injury history of psychological distress, such as depression and/or anxiety, has been consistently linked to PCS development and has been identified to exacerbate the presence of PCS months following a concussion (Ryan & Warden, 2003; Segev et al., 2016; Silverberg et al.,

2018; Silverberg & Iverson, 2011; Walker et al., 2017; Yang et al., 2015). A definitive explanation as to why pre-injury depression and/or anxiety predict PCS development remains unresolved, but there is relative consensus that its existence negatively affects the individual's ability to cope with concussion symptoms, thus creating an interaction of psychological and concussion symptoms that fuels PCS development (Broshek et al., 2015; Nelson et al., 2016; Silverberg & Iverson, 2011; Yang et al., 2015).

Injury-Related Factors

The traditional factors at the immediate time of injury believed to yield the greatest impact on concussion symptom duration and resolution were loss of consciousness (LOC) following the injury and duration of post-traumatic amnesia (PTA) (Ponsford et al., 2012). More recent literature considers these useful factors to charactering the nature of the injury, but the identification of the type, number, and severity of symptoms at the time of injury are the injury-related factors with the most growing support for predicting PCS (Babcock et al., 2013; Heyer et al., 2016). Heyer et al. (2016) developed six symptom clusters at time of injury and clinical evaluation to best predict PCS: (a) cognitive-fatigue, (b) emotional, (c) cephalagic, (d) arousal-stimulation, and (e) vomiting. Results identified the greatest predictors of PCS to come from the cognitive-fatigue and cephalagic clusters, with such symptoms as feeling mentally foggy, drowsiness, fatigue, difficulty concentrating, headache, and sensitivity to light and noise (Heyer et al., 2016).

Contrary to the shift away from presence of LOC or duration of PTA, Tator et al. (2016), in a retrospective cohort study of 221 cases of PCS, identified that the most significant injury-related factors in predicting duration of PCS were presence of LOC,

PTA, and/or extracranial injuries. Tator et al. (2016) concluded these factors increased the probability participants would report more overall symptoms at 1-month follow-up, therefore allowing the number of reported symptoms to be the most significant predictor of PCS following the injury. A meta-analysis conducted by Zemek et al. (2013) additionally provides support for the presence of LOC at time of injury for predicting PCS; however, the results additionally suggested the presence of headache, nausea/vomiting, and dizziness may be the best predictors of PCS when considering the number, type, and severity of symptoms. Overall, the literature presents a general consensus in the shift away from the presence of LOC and/or PTA as significant predictors of PCS and stresses the type and severity of symptoms as more likely PCS predictors.

Post-Injury Factors

There is broad agreement in the literature that the most likely post-injury factors that mediate PCS development are a combination of psychological symptoms (e.g., depression or anxiety), psychological conditions (e.g., PTSD), insomnia, or chronic vestibular symptoms (Combs et al., 2015; Ponsford et al., 2012; Schmidt et al., 2016; Silverberg & Iverson, 2011; Towns et al., 2015; Walker et al., 2015; Wares et al., 2015).

How post-injury psychological distress contributes to PCS. The experience of post-injury depression and anxiety have been consistently linked to mediate PCS in the civilian population. In a longitudinal cohort study, Ponsford et al. (2012) identified clinically elevated symptoms of depression and anxiety, as measured by the Hospital Anxiety and Depression Scale (HADS), one week post-injury was the strongest predictor of patient reporting of prolonged symptoms. It has further been suggested that

psychological distress such as depression and/or anxiety arise following a concussion because the individual is removed from activities for prolonged periods of time during the recovery phase. Therefore, it is hypothesized the prolonged periods of inactivity lead to depression and/or anxiety, and thus, contribute to PCS development, which suggests the need to encourage early exposure to typical activities following a concussion at a level the individual can tolerate to prevent the onset of PCS (Grool et al., 2016).

The majority of literature supporting the role of psychological conditions in mediating PCS comes from studies investigating the comorbid effects of post-traumatic stress disorder (PTSD) and concussion in the military population, where there has been an abundance of studies since the beginning of the wars in Iraq and Afghanistan. Blast exposure in combat has resulted in a large number of concussions in military personnel causing some to refer to concussion as the hallmark injury of the recent Middle East wars (Combs et al., 2015). PTSD itself is associated with impairments in memory, attention, and executive functioning, so there is significant interest in determining whether PTSD or concussion alone causes the most deficits and prolonged symptoms or rather a combination of both (Combs et al., 2015).

Wares et al. (2015) investigated the covariance of concussion and PTSD in veterans of Iraq and Afghanistan by organizing participants into groups of concussion with comorbid PTSD and concussion without comorbid PTSD. Results of this study concluded the combination of concussion and PTSD resulted in worse severity of prolonged symptoms compared to concussion without PTSD (Wares et al., 2015). In a similar study design, Combs et al. (2015) investigated cognitive and psychological outcomes in veterans with comorbid concussion and PTSD compared to concussion only,

PTSD only, and healthy veteran controls. Results of this study concluded that comorbid concussion and PTSD have the greatest impact on cognitive and psychological outcomes compared to the other three groups (Combs et al., 2015). Overall, research in both civilian and military populations highlight the role of post-injury psychological conditions in mediating PCS development.

How sleep disturbance post-concussion contributes to PCS. Individuals experiencing PCS have been identified to exhibit poorer overall sleep quality, longer sleep latency (duration of time to fall asleep), and more difficulties completing daytime activities due to fatigue (Schmidt et al., 2016). When compared to non-concussion injuries and healthy controls, individuals recovering from concussion have been identified to report the most significant sleep disturbance as measured by the Pittsburgh Sleep Quality Index (PSQI), and it has been suggested the presence of sleep challenges post-concussion result from the influence of comorbid psychological symptoms of depression and/or anxiety (Schmidt et al., 2016; Towns et al., 2015).

The Biopsychosocial Conceptualization as a Model for PCS Development

Pre-injury, injury-related, and post-injury factors do not influence PCS development in isolation. Rather, it is the interaction of these factors that mediate PCS, which has been defined as the biopsychosocial conceptualization of PCS (Broshek et al., 2015; Iverson et al., 2017; Kenzie et al., 2017; Silverberg & Iverson, 2011). Figure 1 displays the biopsychosocial conceptualization of PCS developed by Silverberg & Iverson (2011), which defines the etiology of PCS as the result of the interaction of pre-injury, injury-related, and post-injury factors (Broshek et al., 2015; Silverberg & Iverson, 2011). Applying this model, the neurophysiological changes that transpire at the time of

the event and ensuing days, specifically decreased cerebral blood flow and glucose metabolism and altered axonal transmission, generate physical symptoms the individual experiences. As symptoms develop, how the individual responds to, and copes with symptoms, will impact their recovery time (Kenzie et al., 2017). Although a singular physiological explanation of PCS etiology dependent upon prolonged impairments to either global brain metabolism or neurological sub-system dysfunction (e.g. vestibulo-ocular and/or cervicogenic functioning) has been presented (Ellis et al., 2015), the biopsychosocial conceptualization of PCS has experienced the most broad support. It is widely agreed upon that the neuropathophysiology of concussion is the critical, initial event; however, the individual response to the injury will likely be a significant factor to developing PCS and is influenced by such experiences as psychological distress, misattribution of concussion symptoms, the nocebo effect, and physical deconditioning (Broshek et al., 2015; DiFazio et al., 2016; Kenzie et al., 2017; Polich et al., 2020; Silverberg et al., 2018; Silverberg & Iverson, 2011). The application of this model highlights both the complexity of PCS and need for effective interventions to successfully manage it.

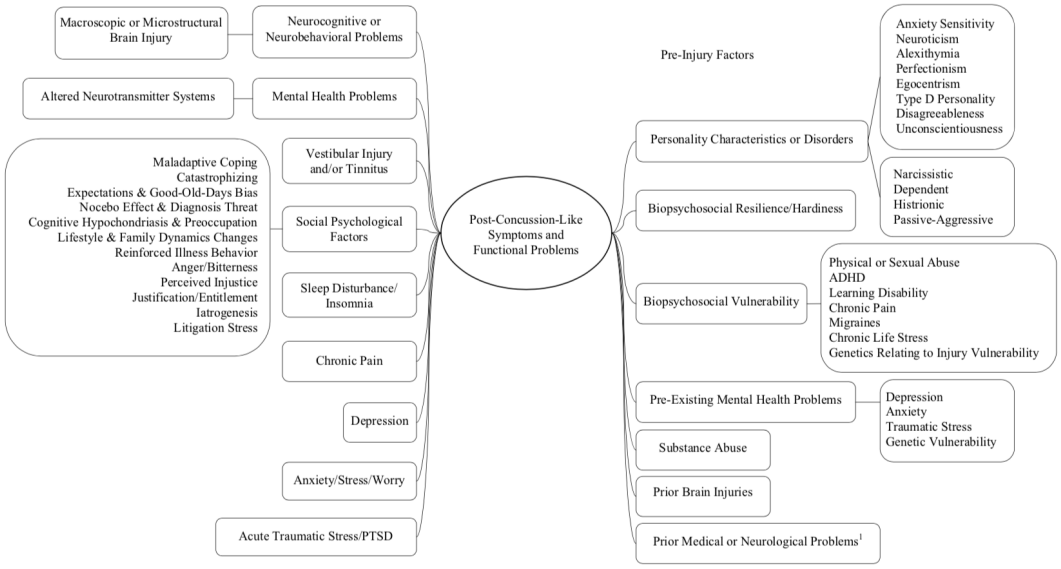

Figure 1. The biopsychosocial conceptualization of PCS as presented by Silverberg & Iverson (2011).

Current Practices for SLP Treatment of PCS

In general, there is a lack of literature from the field of speech-language pathology specific to the treatment of PCS in adolescents and young adults. To address the needs of this population, the most influential literature sources include theoretical position statements on school concussion management, the neuropsychology treatment literature, and the cognitive rehabilitation literature on treatment of acquired brain injury by SLPs.

Concussion Management in Schools

Concussion management in the K-12 educational setting originally focused on the development of return-to-play (RTP) protocols to safely return athletes to the field to avoid the risk of re-injury. Laws exist in a majority of U.S. states that encourage step-wise RTP protocols driven by evidence-based guidelines to achieve this goal (Murata et

al., 2019; Tamura et al., 2020). More recently, stakeholders and researchers of school-based concussion management have called for the development of evidence-based return-to-learn (RTL) guidelines to successfully return students to their baseline academic performance and have argued that RTL should be completed prior to the student entering a RTP protocol (Gioia, 2016; Gioia et al., 2016; Tamura et al., 2020).

Presently, the evidence base for RTL guidelines is limited, but in general, theoretical RTL guidelines center around the provision of academic accommodations (e.g. less homework, reduced class schedule, rest breaks) to gradually return the student to their baseline academic performance (Dachtyl & Morales, 2017; Gioia, 2016; Gioia et al., 2016; Halstead et al., 2013; McAvoy et al., 2018). Such guidelines promote consistent symptom monitoring and collaboration of multidisciplinary partners in both the school and medical settings to ensure the student successfully makes a full return to their baseline academic performance in an efficient manner (Dachtyl & Morales, 2017; Gioia, 2016). RTL Guidelines such as *Get Schooled on Concussion* and *In the Classroom after Concussion* provide educators, parents, and adolescents with resources on concussion recovery that emphasize classroom accommodations, education and self-management of symptoms (Glang et al., 2019). Although the development of RTL guidelines has been pivotal to providing school staff and families with guidelines for the active monitoring of students recovering from concussion, there is little research evaluating direct interventions to manage or prevent prolonged symptoms.

Current Treatment Approaches

Literature on the direct treatment of cognitive symptoms post-concussion predominately comes from two primary sources, the neuropsychology treatment literature

and the cognitive rehabilitation literature. Specific interventions identified in these adult-focused literature sources include the delivery of psychoeducation and cognitive strategy instruction.

Psychoeducation. The neuropsychology treatment literature promotes the early implementation of psychoeducation to treat individuals experiencing PCS. Effective delivery of psychoeducation pairs information that addresses the individual's most pressing concerns and symptoms and will often include a combination of the following targets: (a) validation of patient symptoms, (b) patient education, (c) reassurance of recovery, and (d) the promotion of behavioral health (e.g. sleep hygiene, increase activity level) (McNally et al., 2018; Ponsford et al., 2001; Scheenen et al., 2017; Vanderploeg et al., 2019). A number of different types of psychoeducation techniques have been utilized to support these targets ranging from broad, general education on the physiological nature of concussion and typical symptom trajectories post-injury (Ponsford et al., 2001; Williams-Butler & Cantu, 2019) to more targeted psychoeducation on the management of psychological, somatic, ocular-motor, and/or vestibular symptoms. Such examples include the delivery of cognitive behavioral therapy (CBT) through the teaching of cognitive restructuring techniques and relaxation techniques to manage psychological symptoms and the delivery of sleep hygiene and education on increasing activity level to manage somatic, ocular-motor, and/or vestibular symptoms (McNally et al., 2018; Scheenen et al., 2017; Vanderploeg et al., 2019). Through the implementation of a 4-session cognitive behavioral intervention, McNally et al. (2018) identified positive outcomes on both the Sports Concussion Assessment Tool – 3rd Edition and the Pediatric Quality of Life Inventory (PedsQL) for 31 participants ages 10-18 years old. Although

lacking a control group, the participants were observed to make the most significant improvements on the emotional and school domains of the PedsQL following the 4-session treatment regimen that focused on psychoeducation, activity and sleep scheduling, relaxation training, and cognitive restructuring (McNally et al., 2018). In a more rigorous design, Ponsford et al. (2001) identified that children provided with early education on symptom management and coping strategies at one week post-concussion reported overall quicker symptom resolution compared to children who were not provided this information, highlighting the importance of providing patients with education early during the recovery process.

Cognitive rehabilitation. Experimental studies from the cognitive rehabilitation literature have identified cognitive strategy instruction embedded with psychoeducation delivered by SLPs implementing manualized treatment programs as an effective therapy model for facilitating positive outcomes in the cognitive domains of attention, working memory, and executive functioning (Huckans et al., 2010; Storzbach et al., 2017; Twamley et al., 2014). The evaluation of three manualized programs has been especially influential on the development of effective PCS treatment. *Cognitive Strategy Training* (CST), piloted by Huckans et al. (2010), provided participants recovering from TBI with a 6-8 week training program where the participants were provided with psychoeducation and instructed on organization, attention, and memory strategies. After completion of CST, participants reported significantly lower levels of memory and cognitive impairment as measured by the Multiple Sclerosis Neuropsychological Screening Questionnaire (MSNQ) – Patient and the Prospective-Retrospective Memory

Questionnaire (PRMQ). Weaknesses of this study included a small sample size ($N = 21$) and a lack of a control group.

A similar 12-week compensatory training program, *Cognitive Symptom Management and Rehabilitation Therapy* (CogSMART), was evaluated in a RCT with 50 veteran participants. CogSMART consisted of education on concussion symptoms as well as strategy training and education on the following domains: prospective memory, attention and vigilance, learning and memory, and executive functioning (Twamley et al., 2014). Following completion of the CogSMART program, participants were observed to experience significant improvements in prospective memory as measured by the Memory for Intentions Screening Test (MIST) (Twamley et al., 2014). Although participants improved prospective memory scores on the MIST post-treatment, the MIST was the only outcome measurement out of a total of 13 measurements to demonstrate a treatment effect. Such a discrepancy in outcome measurements limits the true effect of the treatment.

Lastly, Storzbach et al. (2017) observed that the 10-week program *Compensatory Cognitive Training* (CCT) assisted participants to report fewer cognitive and memory challenges and report greater use of cognitive strategies as measured by the MSNQ, PRMQ, and the Portland Cognitive Strategies Scale. The CCT program consisted of psychoeducation on managing concussion symptoms and provided strategy training related to organization and prospective memory, attention and concentration, learning and memory, and problem-solving (Storzbach et al., 2017). Similar to CST and CogSMART, CCT was evaluated on the military veteran population consisting of a predominately male sample, which limits the generalizability of results to the general, more heterogeneous

population. Nonetheless, the results of CST, CogSMART, and CCT have encouraged the development of procedural guidelines for implementation, such as *The Clinician's Guide to Cognitive Rehabilitation in Mild Traumatic Brain Injury* and *Cognitive Rehabilitation for Service Members and Veterans Following Mild to Moderate Traumatic Brain Injury*.

Combining traditional CR with neuropsychology principles. There is evidence suggesting a combination of traditional CR and neuropsychology principles, such as cognitive behavioral therapy (CBT), is an effective treatment method for PCS. Utilizing a waitlist-control, randomized control trial (RCT), Tiersky et al. (2005) implemented a treatment program consisting of 11 weeks of both CBT and CR sessions compared to a waitlist control group. CBT sessions targeted the development of better coping strategies and CR sessions targeted the domains of attention and memory using cognitive drilling tasks and the teaching of compensatory strategies. Results of the study identified reduced symptoms depression and anxiety as measured by the Symptom Checklist-90-Revised and improved cognitive functioning as measured by the Paced Auditory Serial Addition Test (PASAT) (Tiersky et al., 2005). Although the results of this study yielded positive results, the small sample size for an RCT ($N = 20$) with an unequal number of participants in the treatment and control groups limits the generalizability of the results to the greater mTBI population.

In a more rigorous RCT, Cooper et al. (2016) randomized 126 participants into four different treatment arms to determine the best treatment practices for military service members diagnosed with mTBI. The clinician-directed interventions included traditional CR interventions, such as attention drills, the training of external aids and cognitive strategies, and psychoeducation. Arm 1 included the delivery of psychoeducation only;

Arm 2 included computer-delivered CR in the form of attention drills without clinician feedback; Arm 3 included clinician-delivered CR that consisted of psychoeducation, attention drills, and the training of external aids and cognitive strategies; and Arm 4 integrated the treatment intervention of Arm 3 with CBT and psychotherapy. Participants randomized to Arm 4 received 10 hours per week of clinical services, where cognitive rehabilitation sessions (both individual and group) targeted restorative cognitive functioning and the teaching of compensatory cognitive strategies, and CBT sessions targeted mindfulness-based stress reduction. The authors found that participants in all four treatment arms improved over time on the three primary outcome measurements, which included the PASAT, the Symptom Checklist – 90 Revised (SCL-90-R), and the Key Behaviors Change Inventory (KBCI); however, the two clinician-directed CR treatment groups, Arms 3 and 4, demonstrated better outcomes on the KBCI compared to Arms 1 and 2 (Cooper et al., 2016). Similar to the aforementioned CR treatment studies, the primary weakness of Cooper et al. (2016) is that it was conducted on the military veteran population, limiting the generalizability of findings. Nevertheless, the use of integrated interventions combining CR and neuropsychology treatment principles such as CBT represent a shift in the literature on PCS treatment to address the cognitive challenges by first acknowledging and targeting the underlying psychological symptoms and/or conditions that so often mediate PCS (Vanderploeg et al., 2019).

Pediatric and adolescent CR influence on PCS treatment. There is a lack of experimental research on the pediatric and adolescent PCS populations; therefore, evidentiary support comes from studies evaluating treatment on the moderate to severe TBI populations. Although evaluated in pilot studies with small sample sizes ($N < 15$),

direct attention training and cognitive strategy instruction are two interventions both identified to improve attention and executive functioning in the moderate to severe TBI populations as measured by standardized assessments and questionnaires like the Test of Everyday Attention for Children, the Kelis-Kaplan Executive Function System, and the Behavior Rating Index of Executive Functioning (Sohlberg et al., 2014; Treble-Barna et al., 2016).

Retrospective case series reviewing SLP-delivered CR in the adolescent and young adult populations provide a primary source of evidence to treat PCS in the target population of the proposed study. Although retrospective case series lack control groups and experimental design, they provide encouragement for the treatment of PCS in adolescents and young adults through the implementation of an embedded model of psychoeducation and cognitive strategy instruction (Sohlberg & Ledbetter, 2016; Wright et al., 2020). Integral components of both case series included: (a) the use of motivational interviewing for the development of collaboratively developed goals between the clinician and participant; (b) the use of goal attainment scaling (GAS) to measure progress on individualized goals (Grant & Ponsford, 2014); and (c), the implementation of a dynamic clinical model that encourages weekly sessions to be driven by participant progress rather than a pre-determined manualized program (Sohlberg & Ledbetter, 2016; Wright et al., 2020).

Treatment measurement discrepancies. The aforementioned PCS treatment literature has utilized a variety of measurements, including standardized assessments, questionnaires, and checklists, to evaluate and identify participant response to psychoeducation and cognitive strategy instruction. Vanderploeg et al. (2019) expressed

concern for the interpretation of total scores from measurements like standardized assessments and questionnaires to evaluate the effect of treatment as they may not precisely capture change in target behavior following intervention. Therefore, it is essential for the PCS treatment literature to become more explicit in associating the anticipated change in behavior with what aspect of the measurement is expected to change following treatment, such as a specified composite score on a standardized assessment or a response to a questionnaire. Additionally, it is essential to utilize measurements that assist the clinician in the treatment selection process to best place the client on the path to achieving functional change.

Current Practices Summary

The PCS treatment literature provides preliminary evidence to support the treatment components of psychoeducation and cognitive strategy instruction as feasible and effective ingredients to managing PCS. The neuropsychology literature supports the early implementation of psychoeducation to manage the interaction of somatic, ocular-motor, vestibular, psychological, and cognitive symptoms (McNally et al., 2018; Mittenberg et al., 2001; Ponsford et al., 2001). Although weaknesses exist in the generalizability of results, namely discrepancies in measurement and often a homogeneous, small sample of military veterans, the cognitive rehabilitation literature additionally promotes psychoeducation but does so embedded in a treatment model consisting of cognitive strategy instruction, often delivered as part of a manualized treatment program (Huckans et al., 2010; Storzbach et al., 2017; Twamley et al., 2014).

Manualized treatments continue to be promoted and evaluated because they provide a districting roadmap for treating PCS. However, they leave little flexibility in

the identification and development of personally meaningful, functional goals, the selection of treatment ingredients that best matches the individual's needs, and the ongoing measurement of progress. Experimentation of dynamic and personalized treatment models can be found in the clinical psychology literature, where positive findings for evidence-based treatment of psychological disorders provide direction for experimentation of such a model on the PCS population (Clark, 2013; Katzman et al., 2014; Roy-Byrne et al., 2010). Nevertheless, recent retrospective case series on PCS treatment have demonstrated the successful implementation of a dynamic and personalized treatment to meet the individual needs of the client where weekly treatment is determined by client progress instead of adhering to the timeline of a program (Sohlberg & Ledbetter, 2016; Wright et al., 2020). The personalization of psychoeducation occurs through the delivery of education that accounts for the interaction of physical and underlying psychological symptoms reported by the client that may mediate cognitive symptoms related to PCS (Vanderploeg et al., 2019). Conversely, personalization of cognitive strategy instruction occurs via a collaborative process between the clinician and client to identify and implement strategies that address the client's most pressing cognitive challenges and concerns and also take into consideration the client's skill level at implementing a specific strategy (American Speech-Language Hearing Association, 2017). A personalized and dynamic treatment approach may be more suitable to managing PCS, demonstrating the need for experimental research evaluating the implementation of psychoeducation and cognitive strategy instruction to address the client's primary concerns where the interpretation of standardized measurements is strategically utilized to aid in the treatment selection process.

The evaluation of the treatment components of psychoeducation and cognitive strategy instruction has primarily occurred in military populations; therefore, there continues to be a lack of research evaluating their effectiveness on the adolescent and young adult populations. School guidelines on concussion management (Dachtyl & Morales, 2017; Gioia, 2016; Halstead et al., 2013; McAvoy et al., 2018) provide school staff with protocols to gradually return students to their pre-injury level, but there is little knowledge on direct interventions, specifically cognitive strategy instruction, to support students during the RTL process. Due to this knowledge gap, it is imperative to evaluate the implementation of personalized cognitive strategy instruction on adolescents and young adults to determine if it aids in the facilitation of RTL.

Rationale for the Present Study

The objective of the present study was to evaluate the impact of the two treatment components that have shown the most promise for PCS, namely psychoeducation and cognitive strategy instruction, on individualized rehabilitation targets important for RTL, which are academic behaviors such as increased assignment completion, increased lecture comprehension, or increased school attendance. The PCS treatment literature has demonstrated the potential positive benefit of implementing cognitive strategy instruction to address cognitive deficits related to attention, working memory, and executive functioning (Huckans et al., 2010; Storzbach et al., 2017; Twamley et al., 2014). Deficits in these cognitive domains directly impact academic performance, which highlights the need for successful interventions to mitigate cognitive dysfunction post-concussion. Further, there is a need to understand the benefit and effect of personalizing the selection of cognitive strategies when tailoring the intervention to meet the needs and concerns of

the individual. Gaining further knowledge on the treatment of PCS in the adolescent and young adult populations through the present study has the potential to impact the RTL process on a wide scale across the K-12 educational setting.

Research Questions

There are two research questions for the present study:

1. Is there a functional relation between the addition of personalized cognitive strategy instruction to psychoeducation and the achievement of student RTL targets?
2. Do selected scores on the pre/post outcome measures that aid in the treatment selection process yield positive change following the delivery of personalized cognitive strategy instruction?

First, it was hypothesized that participant outcome on collaboratively identified areas of concern corresponding to their RTL target (e.g. school attendance, lecture retention, assignment completion, reading comprehension, or sleep quality) would improve with the introduction of the personalized cognitive strategy instruction. Second, it was hypothesized that selected scores on the pre/post outcome measurements that aid in the treatment selection process, specifically the Behavior Rating Inventory of Executive Function, the Concussion Learning Assessment and School Survey, and the Post-Concussion Symptom Scale, would improve following the delivery of personalized cognitive strategy instruction.

CHAPTER III

METHODS

Chapter III provides a detailed description of the participants, research design, and experimental protocol used in the study. The first section describes the clinical setting and participant characteristics. The second section describes the single-case design. The third section describes the research procedures, and the fourth section describes the measurements collected. The University of Oregon IRB approved the study. Due to the COVID-19 pandemic, data collection occurred remotely via Zoom video telehealth sessions, which was encouraged and approved by the University of Oregon IRB.

Setting and Participant Characteristics

This study was conducted in a university outpatient clinic that serves as a training facility for students pursing their Master's degrees in speech-language pathology. The university clinic contains a sub-clinic, the HEDCO Brain Injury and Concussion Clinic (BrICC) that provides cognitive rehabilitation services to individuals experiencing cognitive deficits following acquired brain injury, which includes adolescents experiencing PCS. Through collaboration with a local, multidisciplinary concussion management team coordinated by a pediatric neuropsychologist, the university clinic is referred approximately 15-20 clients a year for PCS treatment. The treatment of clients experiencing PCS through the concussion management team has provided insight to the treatment components that support this population to achieve progress on functional goals (Wright et al., 2020).

Participants

Participants eligible to enroll in the study were adolescents ages 13-17 who had sustained a concussion, were experiencing PCS, and were referred to the BrICC to treat ongoing cognitive challenges that were negatively impacting academic and functional performance. Enrollment eligibility further required the duration of time from the date of concussion to the date of the first session to be at least three months. These criteria were confirmed by a pediatric neuropsychological evaluation. Hence, participation in the study was an indirect result of the referral from the pediatric neuropsychologist to the university clinic. Three participants were recruited to complete the study and were all treated by the same two graduate student clinicians. Table 2 displays participant demographic information.

Table 2

Participant Demographic Information

Participant	Sex	Age	Etiology	Number of previous concussions	History of depression or anxiety	Time post onset (months)
Participant 1	Female	16	MVA	0	No	3.5
Participant 2	Female	15	SRC	1	Yes	7.5
Participant 3	Female	13	Fall	3	Yes	9

Note. History of depression or anxiety determined by clinical interview with the pediatric neuropsychologist; SRC = sport-related concussion; MVA = motor vehicle accident

Experimental Design

The study implemented a single case experimental design (SCED) in the form of a non-concurrent multiple-baseline (MBL) design. Although the implementation of a randomized control trial (RCT) is considered the "gold standard" of experimental research, SCEDs are an ideal design for establishing the viability of treatments in real-life settings before attempting them at the large scale needed for RCTs (Byiers et al., 2012; Horner et al., 2005). Further, both the development of standards to improve SCED methodological quality (Horner et al., 2005; Kratochwill et al., 2013) and the development of statistical analyses suitable for single case research have led to a revival in the use of SCEDs across a variety of fields evaluating psychological and behavioral interventions (Evans et al., 2014).

The use of MBL designs across at least three participants is considered an effective research methodology to demonstrate experimental control of the independent variable (Byiers et al., 2012; Horner et al., 2005). A MBL was the appropriate SCED for the present study as it allowed for the evaluation of the independent variable across multiple participants with different treatment targets and eliminated the need for a withdrawal condition (Byiers et al., 2012). Concurrent MBL designs are adept in limiting potential threats to internal validity; however, a non-concurrent MBL design was implemented in the present study because simultaneous data collection from all participants was not feasible as participants were referred for services and enrolled in the study at different times. Although less rigorous than concurrent designs, the flexibility of non-concurrent MBL designs allow for the evaluation of interventions in complex situations like the outpatient clinic where participant enrollment was contingent on the

time of referral for treatment (Harvey et al., 2004; Watson & Workman, 1981). Therefore, to ensure sufficient experimental control and to strengthen the internal validity of the non-concurrent MBL design utilized for the study, the following steps were taken. First, implementation of the independent variable was staggered across participants to determine if the desired change in the primary repeated measure occurred repeatedly and selectively with the successive implementations (Kratochwill & Levin, 2010). Second, the order in which the staggered implementation of the independent variable occurred across participants was randomized, which strengthened both internal validity and statistical conclusion validity (Kratochwill & Levin, 2010).

Procedures

The design for the study consisted of two phases, baseline and experimental. Both the baseline and experimental phases involved the delivery of typical treatment components (psychoeducation and personalized cognitive strategy instruction) in the university clinic where the three participants were treated. Traditionally, psychoeducation and cognitive strategy instruction are delivered in tandem to meet the needs of the individual. However, it was the intention of this study to separate the treatment components and deliver them individually to address the research questions. All three participants participated in the same total number of sessions across both phases, but the implementation of the independent variable and transition to the experimental phase was staggered across participants, and the collection of at least three data points in the baseline phase was required to transition to the experimental phase. As stated, the order of implementation of the independent variable of personalized cognitive strategy instruction was randomized across the three participants to occur in either the fourth,

seventh, or ninth treatment session. Table 3 displays the randomized order of personalized cognitive strategy instruction implementation.

Table 3

Implementation Order of Personalized Cognitive Strategy Instruction

Participant	Implementation session
Participant 1	7
Participant 2	4
Participant 3	9

Baseline Phase

The baseline phase consisted of three components. The first two components, the clinical interview and goal formation, occurred during the 90-120-minute initial consultation during the first session. The third baseline component, psychoeducation, was introduced during the initial consultation and delivered to the participants for the remainder of the baseline phase.

Clinical interview. The purpose of the clinical interview was to identify participant concerns and to develop treatment goals. The clinical interview included open-ended questions as well as the validation, affirmation, and self-reflection of the participants' statements to ensure they felt understood (American Speech-Language Hearing Association, 2017; Medley & Powell, 2010; Miller & Rollnick, 2004; Wright et al., 2020). The following broad, open-ended questions were presented to the participants

and their parent (if present). First, the participants were prompted to describe their primary concerns following their concussion with particular emphasis on the perception of perceived cognitive challenges on academic performance. While the participants describe their concerns, the trained graduate student clinicians presented them with questions to determine treatment priorities such as, “If we were able to make progress on one or two areas, what would you pick?”. The participants were then prompted to describe what has changed or not changed since their concussion. For example, the graduate student clinicians asked the participants to compare their grades prior to and after their concussion to explore what may be responsible for changes in performance. While continuing to discuss what has changed since their concussion, the graduate student clinicians asked the participants questions to determine their attributions for symptoms and knowledge about concussion and concussion recovery. Questions like “What have you been told about concussion?”, “What are you most worried about in terms of recovery?”, and “What actions have you tried that have helped or not helped?” were explored with the participants. The ultimate goal of the clinical interview was to present the participants with questions that addressed their primary concerns and perceptions of changes in function following their concussion in order to identify functional goals and priorities.

Goal formation. The results of the clinical interview influenced the formation of the participants’ treatment goals (American Speech-Language Hearing Association, 2017; Wright et al., 2020). Treatment goals were developed to reflect both the cognitive domain to be targeted as well as the academic behavior impacted by cognitive challenges.

Imperative to goal development was that the goal was specific, relevant, measurable, and attainable in a specified duration of time (Playford et al., 2009; Prescott et al., 2015).

Psychoeducation. The delivery of psychoeducation was the only treatment component delivered during the duration of the baseline phase. It was introduced during the initial consultation and was delivered during the participants' weekly sessions. In session, the clinicians and the participants discussed topics presented in *Recovering from Mild Traumatic Brain Injury/Concussion: A Guide for Patients and Their Families* (Mittenberg et al., 1992). This handbook provides information on three specific topics of concussion recovery:

- *What symptoms can I expect following a concussion?*
- *How long will my symptoms last?*
- *What can I do about my symptoms?*

During the baseline phase, the clinicians delivered psychoeducation on these three topics in the order listed above. Depending upon the number of sessions the participant completed during the baseline phase, topics were either discussed one per session (Participant 2) or discussed across multiple sessions to extend the duration of the baseline phase (Participants 1 and 3). The *symptom expectation* topic provided the participants with education on the types of symptoms commonly experienced following a concussion; the *symptom duration* topic provided information on typical concussion recovery patterns; and the *symptom management* topic detailed ways to manage concussion symptoms, specifically the importance of maintaining a typical routine and activity level (Mittenberg et al., 1992). The content of all three topics aligned with psychoeducation delivered in more recent treatment studies (Arbabi et al., 2020; McNally et al., 2018).

Each session, the clinicians would provide psychoeducation from one of the topics via didactic instruction with teach-back and then engage the participants in a collaborative discussion on how the information related to their concussion recovery.

Experimental Phase

In the experimental phase, participants were introduced to the independent variable, personalized cognitive strategy instruction. Similar to psychoeducation, cognitive strategy instruction refers to a broad set of strategies that can be implemented to compensate for cognitive deficits following brain injury (Cooper et al., 2016; Huckans et al., 2010; Storzbach et al., 2017; Twamley et al., 2014; Vanderploeg et al., 2019). To implement personalized cognitive strategy instruction, the trained graduate student clinicians providing treatment worked with the participants to select a strategy that addressed their primary concerns identified during the clinical interview and that would support the participants' progress on their functional goals. The identification and selection of strategies that align with participant concerns represented the personalization of cognitive strategy instruction. Initial experimental phase sessions focused on educating the participants on the purpose of strategies and demonstrating how to use them. Eventually, sessions transitioned to a weekly measurement of the participants' use of their strategies and perceived helpfulness of their implementation. The measurement of participant use and helpfulness of their cognitive strategy is outlined in the *Measurements* section below. Figure 2 outlines the procedure of the study.

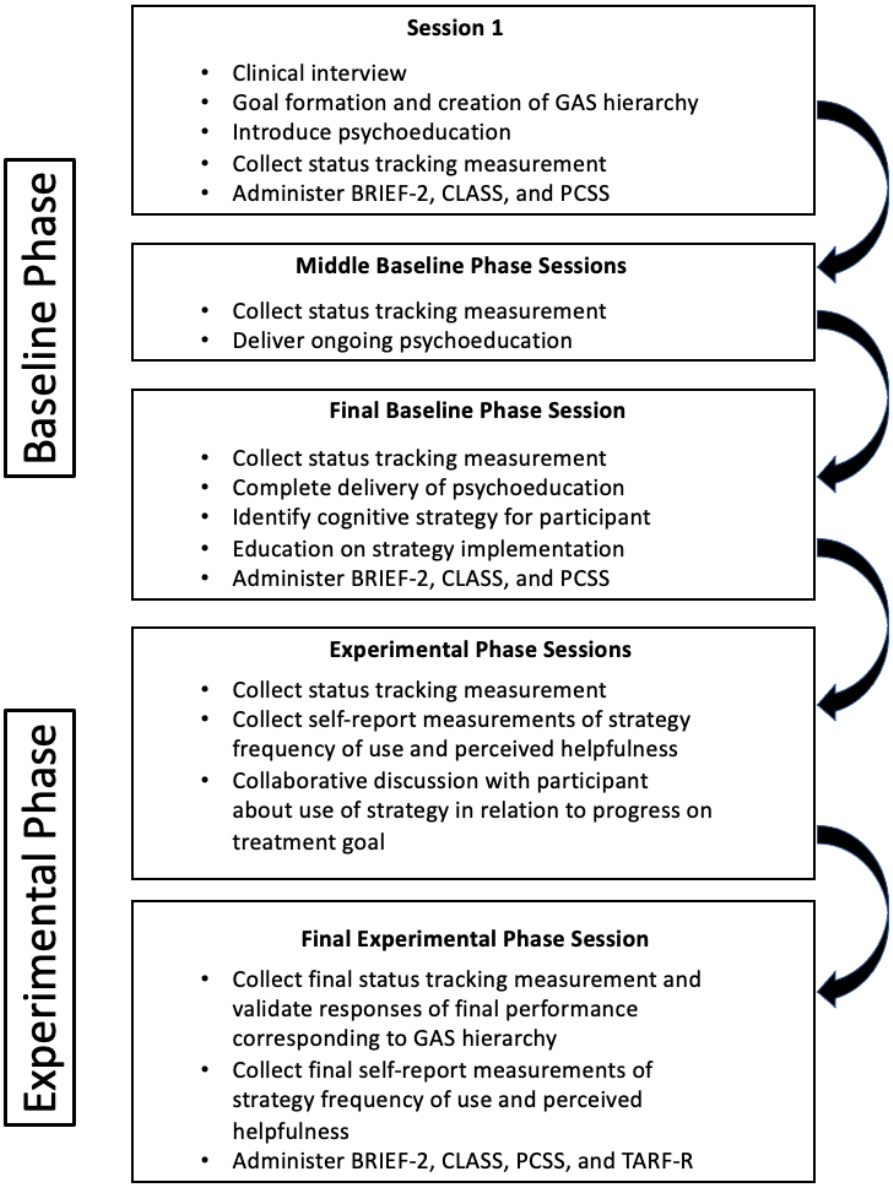

Figure 2. Study procedure.

Measurements

The measurements were organized into three categories: repeated measurements, pre/post outcome measurements, and measurements of treatment implementation.

Repeated Measurements

Status tracking. The status tracking measurement directly corresponded to the participants' individual goal attainment scale (described below) and represented weekly performance on the functional goal across both phases. It served as the primary indicator of responsivity to treatment and provided clinicians the weekly opportunity to assess participant performance on their treatment goal. The tracking and collaborative reflection on performance has also been identified to have therapeutic effects in brain injury rehabilitation for participants with moderate to severe injuries (Ownsworth et al., 2000; J. Toglia & Kirk, 2000). In the present study, weekly collection of the status tracking measurement facilitated collaborative discussion between the clinicians and participant on either the obstacles preventing progress or the catalysts to facilitating positive change on the treatment goal. It was hypothesized that participants would demonstrate improvements on their status tracking measurement with the introduction of personalized cognitive strategy instruction.

Frequency of strategy use. During the experimental phase, the participants reported the frequency of use of their cognitive strategy. The measurement of the frequency of strategy use has been successfully implemented in previous studies on the mTBI population. Huckans et al. (2010) developed the Frequency of Cognitive Strategy Use Scale to measure participant perception of the use of compensatory strategies and identified that participants significantly improved strategy use following the intervention.

In a similar study, Storzbach et al. (2017) developed the Portland Cognitive Strategies Scale 2.0 to measure participant perception of the use of cognitive strategies and additionally concluded that perceived strategy usage increased following intervention. It was hypothesized that elevated and sustained frequency of strategy use would occur parallel to increased and sustained participant status tracking measurements.

Perceived strategy helpfulness. Participants rated the perceived helpfulness of their cognitive strategy on a 1 – 5 scale, where 1 indicated *not helpful at all*, 2 indicated *not helpful*, 3 indicated *somewhat helpful*, 4 indicated *helpful*, and 5 indicated *very helpful*. The measurement of perceived strategy helpfulness is additionally grounded in the mTBI literature. Storzbach et al. (2017) utilized the aforementioned PCSS-2.0 to measure the perception of strategy helpfulness and usefulness and identified that usefulness of strategies was perceived to be highest in individuals with higher levels of frequency of strategy use. In a similar study, Huckans et al. (2010) designed the Usefulness of Cognitive Strategies Scale to measure participant perception of strategy helpfulness and concluded that participants reported high levels of strategy helpfulness on everyday tasks following the completion of the intervention. For the present study, it was hypothesized that elevated and sustained measurements of strategy helpfulness would correspond with sustained improvements on the status tracking measurement.

Pre/Post Outcome Measurements

Four pre/post outcome measurements were collected for all participants, including the participants' Goal Attainment Scale (GAS), the Behavior Rating Index of Executive Functioning (BRIEF), the Concussion Learning Assessment and School Survey (CLASS), and the Post-Concussion Symptom Scale (PCSS). The participants completed

all four pre/post outcome measures, and the parents of the participants completed the BRIEF and CLASS to compare to their child's responses. Collection of the BRIEF, CLASS, and PCSS occurred at three time points during the study: (a) prior to the first baseline phase session, (b) prior to the first session of the experimental phase, and (c) the conclusion of the study.

Goal Attainment Scale (GAS). GAS hierarchies were developed for each participant during the first session and aligned with their treatment goal. Further, participant GAS hierarchies directly corresponded to the repeated status tracking measurement, which represented the participant's weekly progress on their developed GAS. The primary advantage of GAS is the ability to scale and measure progress on personalized goals that are important and meaningful to the participant by delineating possible levels of progress towards selected goals (Grant & Ponsford, 2014; Malec, 2001). Typical goal hierarchies are generated with five equidistant, discrete levels (-2, -1, 0, +1, and +2) where -1 represents baseline performance**,** and 0 represents expected improvement. +1 and +2 correspond to better than expected improvement and best possible improvement. -1 corresponds to less than expected improvement since the person would remain at baseline, and -2 corresponds to much less than expected improvement. The benefit of GAS is that it enables the assessment of a treatment's efficacy in terms of goals set by patients themselves (Krasny-Pacini et al., 2017). Although the development of GAS goals allows for the ability for different goals to be compared, the true validity of a GAS goal will depend upon the way it is written and the individual's objectivity and ability to anticipate the range of possible outcomes (Krasny-Pacini et al., 2016). It was hypothesized that participants would obtain and sustain

expected levels of performance or greater on their GAS hierarchies with the introduction of personalized cognitive strategy instruction.

Behavior Rating Index of Executive Function (BRIEF). The BRIEF is a standardized questionnaire designed to measure executive functioning and behavioral regulation skills that consists of a self-report and informant/parent-report (Gioia et al., 2000). The BRIEF-2 was administered to the participants of the present study as it is adapted for 13-17 year-olds. The BRIEF-2 is divided into indices and scales, where any obtained *T*-score of 65 or greater indicates clinical significance and corresponds with perceived deficit on that specific index or scale. The BRIEF-2 has been found to maintain moderate to strong internal structural validity across all indices and scales when rated by parents, teachers, and self-report (Gioia et al., 2015). The BRIEF-2 contains four indices: the *Global Composite Index* designating the overall score, the *Behavioral Regulation Index*, *Emotional Regulation Index*, and the *Cognitive Regulation Index*. On the self-report version of the BRIEF-2, the *behavioral regulation index* is composed of the *Inhibit* and *Self-Monitor Scales*, the *Emotional Regulation Index* is composed of the *Shift* and *Emotional Control Scales*, and the *Cognitive Regulation Index* is composed of the *Task Completion*, *Working Memory*, and *Plan/Organize Scales*. On the parent-report version of the BRIEF-2, the *Behavior Regulation Index* is composed of the *Inhibit* and *Self-Monitor Scales*, the *Emotional Regulation Index* is composed of the *Shift* and *Emotional Control Scales,* and the *Cognitive Regulation Index* is composed of the *Initiate, Working Memory, Plan/Organize, Task-Monitor,* and *Organization of Materials Scales.*

The rationale to administer the BRIEF-2 during the same session as the clinical interview was to identify clinically elevated scores corresponding to challenges in

specific executive functioning behaviors. These scores, in comparison to the concerns identified during the clinical interview, would assist in goal formation and eventual treatment selection. It was unrealistic to anticipate positive change to all index and scale scores at the completion of the study; therefore, it was hypothesized that the index/scale scores that influenced treatment selection at the time of the first administration would obtain the most positive change after the delivery of personalized cognitive strategy instruction.

Concussion Learning Assessment and School Survey (CLASS). The CLASS is 20-item, formal questionnaire that assesses: (a) concern for the injury's effect on school learning and performance (response options: none, mild, moderate, high); (b) new or exacerbated post-concussion academic problems; and (c) perceived impact on academic performance (e.g., decline in grades, ability to learn) (Ransom et al., 2015). The CLASS has been found to help in the identification of students who have not yet recovered from concussion by showing higher levels of concern, more self-reported post-injury academic problems, and greater difficulty in classes than their recovered peers (Ransom et al., 2016). The first 14 items of the CLASS prompt respondents to rate how worse academic behaviors have become following a concussion. Possible responses include: (a) *Not worse/not a problem*, (b) *A little worse*, (c) *Somewhat worse*, or (d) *A lot worse*. The final six items of the CLASS prompt respondents to rate their stress level to specific behaviors following their concussion. Possible responses include: (a) *Not stressful*, (b) *A little stressful,* (c) *Moderately stressful*, or (d) *Very stressful.*

The rationale to administer the CLASS during the same session as the clinical interview was to identify academic behaviors that the participants perceived as more

challenging or stressful. The responses to the first administration of the CLASS provided clinicians with direct input on what behavior to target for a treatment goal. Similar to the BRIEF-2, it was unrealistic to anticipate positive change across all CLASS items at the conclusion of the study; therefore, it was hypothesized the responses that influenced treatment selection at the time of the first administration would yield the most positive change after the delivery of personalized cognitive strategy instruction.

Post-Concussion Symptom Scale (PCSS). The PCSS is a 22-item, formal questionnaire designed to quantify the severity of post-concussion symptoms from all six concussion symptom clusters as defined by Harmon et al. (2019) and Lumba-Brown et al. (2019): (a) headache-migraine symptoms, (b) cognitive symptoms, (c) anxiety-mood symptoms, (d) ocular-motor symptoms, (e) vestibular symptoms, and (f) sleep symptoms. Symptoms are rated 0 (*no symptoms*) to 6 (*severe symptoms*), and a total symptom severity score slightly below and above 30 on the PCSS correlates with high symptom burden (Lovell et al., 2006). The PCSS has been identified to be a valid and reliable measurement for measuring the severity of concussion symptoms post-injury compared to baseline pre-injury with symptoms related to fatigue, cognition, and headache consistently rated the most severe (Kontos et al., 2012).

The rationale to administer the PCSS was to specifically observe responses to items 18-21, which represents symptoms from the *cognitive symptom cluster*. The symptoms include: (a) feeling "slow", (b) feeling "foggy", (c) difficulty concentrating, and (d) difficulty remembering. Like the BRIEF-2 and CLASS, the *total symptom severity* rating was not likely to be significantly impacted by the delivered intervention; however, it was hypothesized *cognitive symptom cluster* severity ratings would decrease

following the delivery of personalized cognitive strategy instruction. Table 4 provides a brief summary of each measurement and outlines when it was collected.

Table 4

Measurements

Measurement	Completion time	Description
Status tracking repeated measurement	Every session during baseline and experimental phases	Weekly measurement of participant status on goal behavior
Frequency of strategy use repeated measurement	Every session during experimental phase	Measurement of participant reported frequency of their cognitive strategy use
Perceived strategy helpfulness repeated measurement	Every session during experimental phase	Measurement of participant perception of strategy helpfulness
GAS	Initial consult during baseline phase, final session of baseline phase, and final session of experimental phase	Goal hierarchy representing levels of progress corresponding to treatment goal
BRIEF	Initial consult during baseline phase, final session of baseline phase, and final session of experimental phase	Standardized questionnaire measuring executive functioning skills as rated by the participant and parent
CLASS	Initial consult during baseline phase, final session of baseline phase, and final session of experimental phase	Questionnaire measuring post-concussion academic challenges as rated by the participant and parent
PCSS	Initial consult during baseline phase, final session of baseline phase, and final session of experimental phase	Symptom checklist measuring symptom severity level of 22 concussion symptoms as rated by the participant

Measurements of Treatment Implementation and Outcome

Three measurements of treatment implementation and outcome were utilized in the present study including a measurement of treatment fidelity, a measurement of social validity and treatment appropriateness, and a measurement of treatment attendance (Lewis et al. 2017).

Measurement of Treatment Fidelity. All participants in the present study were assessed and treated in the university clinic by two trained graduate student clinicians. Treatment fidelity of both the baseline (psychoeducation) sessions and experimental (cognitive strategy instruction) sessions was examined by calculating the percentage of treatment components that were present in sessions observed across two observers (Toglia et al., 2020). I served as the first observer, and I trained an independent, second observer on the study's purpose and how to score treatment components. I rated the delivery of treatment components for all treatment sessions, and the trained observer rated treatment components for 18/39 sessions across all three participants.

I developed five separate fidelity checklists to correspond to different session objectives for both baseline and experimental sessions. The first fidelity checklist corresponded to the first session of the study; the second fidelity checklist corresponded to remaining baseline phase sessions; the third fidelity checklist corresponded to the session in which cognitive strategy instruction was introduced; the fourth fidelity checklist corresponded to remaining experimental phase sessions; and the fifth fidelity checklist corresponded to the final session of the study. Adapted from Toglia et al. (2020), session objectives were rated on an ordinal scale ranging from 0-2, where 0 corresponded to *objective was not introduced or covered by the clinicians;* 1

corresponded to *objective was partially achieved*; and 2 corresponded to *objective was fully achieved*.

Acceptable treatment fidelity was defined as the rating of delivered treatment components at a level of 75% or greater (Borrelli, 2011). Further, inter-rater reliability of the fidelity measurement was established by comparing the fidelity ratings to the 18 sessions observed by both raters with weighted Cohen's *Kappa* (Cohen, 1968) using SPSS statistical package version 27 (SPSS Inc, Chicago IL). Acceptable level of agreement was considered if there was weighted Cohen's *Kappa* of .60 or greater on identified treatment components between the trained observer and myself. (Cohen, 1968; Fleiss, 1973).

Measurement of Social Validity and Treatment Appropriateness. Objective measurements of appropriateness and social validity through the collection of feedback from treatment consumers provide information on the perceived fit and relevance of an intervention as well as evaluate the acceptability of the intervention (Lewis et al., 2017; Schwartz & Baer, 1991). To measure social validity and treatment appropriateness, participants completed a modified version of the Treatment Acceptability Rating Form-Revised (TARF-R) (Reimers et al., 1992) at the completion of the study. The modified TARF-R consisted of seven items focused on evaluating different aspects of treatment appropriateness, and a copy is provided in the Appendix. Constructs measured by the modified TARF-R included perceived effectiveness, side-effects, disruption/time costs, willingness, understanding of the treatment, and compliance with treatment variables. Items were rated on a 5-point Likert scale where ratings of 1 corresponded to *Strongly*

disagree, 2 corresponded to *Disagree,* 3 corresponded to *Neutral,* 4 corresponded to *Agree,* and 5 corresponded to *Strongly agree*.

Measurement of Treatment Attendance. Treatment attendance is one indicator of participant engagement and treatment acceptability. It was measured as the number of sessions per participant that required rescheduling as a result of participant request or participant failure to attend scheduled sessions. Participant 1 rescheduled two sessions, while both Participants 2 and 3 rescheduled zero sessions; however, Participant 3's 13th and final session occurred three weeks after session 12 due to the winter break holidays.

Analyses

Research Question 1

The status tracking measurement was the primary measurement analyzed to address the first research question through a combination of visual and quantitative analyses. The results of the repeated status tracking measurement were graphed to allow for the comparison of data through the traditional single-case research approach of visual analysis (Horner et al., 2005). I made observations regarding changes in level, trend, immediacy of effect, and consistency within, and across phases for each participant.

To augment visual analysis, two quantitative analyses were utilized to determine the statistical difference in status tracking measurements between the baseline and experimental phases. First, the *Tau-U* statistic was calculated to generate an effect size of the intervention between phases. *Tau-U* is a reliable estimate of effect size because it integrates nonoverlap between the baseline and experimental phases and controls for monotonic trend within the data (Parker et al., 2011). The *Tau-U* analysis was completed using a publicly available online calculator accessible at www.singlecaseresearch.org. I

interpreted *Tau-U* scores using the following benchmarks: (a) .65 or lower: *weak or small effect*; .66 to .92: *medium to high effect*; and .93 to 1: *large or strong effect* (Parker et al., 2011). The first and second participants required a baseline correction.

Statistical analysis was additionally performed utilizing multilevel modeling (MLM) via the use of Rstudio version 1.4 (Manolov & Moeyaert, 2017) to identify potential variation of the treatment effect across cases and whether this potential variation can be explained by characteristics of the cases (Moeyaert et al., 2014; Shadish et al., 2008). MLM is a versatile statistical tool in that it allows for the calculation of an effect size for a single case as its change over time as well as the calculation of an average effect size of all cases and that average effect size's change over time (Moeyaert et al., 2014). I interpreted the MLM effect size by first evaluating the obtained *p*-value, and an effect size where the *p* value was greater than .05 was not considered to represent a treatment effect.

Research Question 2

As discussed in Chapter 1, measurement discrepancies exist throughout the PCS literature, highlighting the need for more valid and reliable measurements to assist in the treatment selection process and to demonstrate the effectiveness of an intervention. The BRIEF-2, CLASS, and PCSS were administered as selected scores and responses of each measurement can be isolated to compare to information shared by the participants in the clinical interview to assist in treatment selection. To address the second research question, a descriptive analysis was utilized to demonstrate the nature to which selected scores yield positive change following the intervention. The selected scores and responses from the first administration that contributed to treatment selection were

compared to the collected scores and responses prior to the experimental phase and at the conclusion of the study to determine if positive change was obtained with the delivery of personalized cognitive strategy instruction.

To further analyze change in responses to the BRIEF-2, a reliable change index (RCI) was calculated to evaluate whether obtained scale and index scores across different time points were significantly different (Hawley, 1995; Jacobson et al., 1999; Jacobson & Truax, 1991; Maassen, 2004). The calculation of reliable change indices has previously been implemented in the concussion literature (Hinton-Bayre et al., 1999) and is sensitive to measuring change over time. An RCI was calculated to determine the difference between BRIEF-2 scores at two time points. The first RCI calculated the difference in BRIEF-2 scores obtained prior to the first session and prior to the experimental phase, and the second RCI calculated the difference between the BRIEF-2 scores obtained prior to the experimental phase and at the conclusion of the study. An absolute RCI value exceeding 1.96 was regarded as corresponding to meaningful change between measurements (Hinton-Bayre et al., 1999; Jacobson et al., 1999; Jacobson & Truax, 1991).

CHAPTER IV

RESULTS

This chapter presents (a) information on the treatment goals collaboratively developed and cognitive strategies implemented for each participant, (b) the analyses conducted to answer the two research questions, (c) GAS outcome results, (d) the obtained measurements of frequency of strategy use and perceived strategy helpfulness, (e) treatment fidelity results, and (f) post-experimental social validity results.

Treatment Goals

The clinicians and participants collaboratively developed treatment goals during the clinical interview, which occurred during the first session of the baseline phase. Table 5 displays the treatment goals for each participant, and Table 6 displays corresponding GAS hierarchies.

Table 5

Participant Treatment Goals

Participant	Goal
Participant 1	Increase the number of minutes per class engaged in online Literature class
Participant 2	Increase the number of minutes per week spent studying for Spanish class
Participant 3	Increase weekly assignment completion

Table 6

Participant GAS Hierarchies

Level	Participant		
	Participant 1	Participant 2	Participant 3
Much more than expected	36 to 45 minutes engaged in online lecture	36 to 45 minutes per week studying Spanish	Complete 80 to 100% of weekly assignments
More than expected	26 to 45 minutes engaged in online lecture	26 to 45 minutes per week studying Spanish	Complete 60 to 79% of weekly assignments
Expected	16 to 25 minutes engaged in online lecture	16 to 25 minutes per week studying Spanish	Complete 40 to 59% of weekly assignments
Baseline	6 to 15 minutes engaged in online lecture	6 to 15 minutes per week studying Spanish	Complete 20 to 39% of weekly assignments
Decline	0 to 5 minutes engaged in online lecture	0 to 5 minutes per week studying Spanish	Complete 0 to 19% of weekly assignments

Cognitive Strategies

The clinicians and participants collaboratively identified and discussed the implementation of cognitive strategies to address their treatment goals. Participants 1 and 2 implemented two strategies, and participant 3 implemented one strategy. Table 7 displays participant cognitive strategies.

Table 7

Participant Cognitive Strategies

Participant	Cognitive strategies implemented
Participant 1	Take a 5-minute break after listening to 15 minutes of online lecture
	Set reminders in phone to remember to take a break during lecture
Participant 2	Set two reminders to specific times per week to dedicate studying for Spanish class
	Use a "study buddy" for Spanish class to study with at least once per week
Participant 3	Use academic planner to track weekly assignments

Research Question 1: Is there a functional relation between the addition of personalized cognitive strategy instruction to psychoeducation and the achievement of student RTL targets?

For the first research question, I hypothesized that participant outcome on collaboratively identified areas of concern would improve with the introduction of personalized cognitive strategy instruction. Figure 3 displays the plotted status tracking data that was visually analyzed for the three participants. It was hypothesized that visually analyzing changes in level and immediacy of effect would be more sensitive than changes in trend to the identification of a functional relation because I anticipated that

participants were likely to demonstrate positive improvements on their status tracking measurements from the delivery of psychoeducation during the baseline phase.

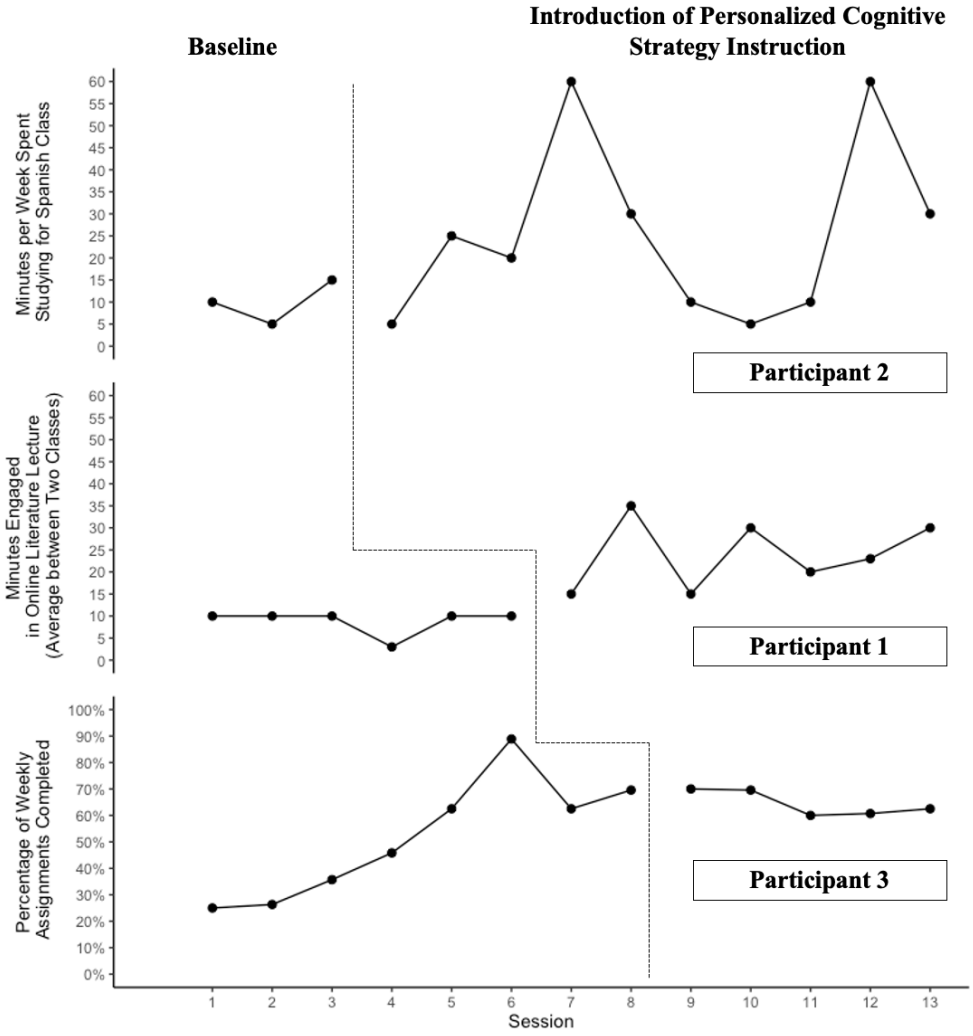

Figure 3. Status tracking measurement corresponding to the participants' individual area of concern.

Visual analysis of the plotted status tracking data did not support the existence of a functional relation between the addition of personalized cognitive strategy instruction to psychoeducation and the achievement of participant RTL targets. Although baseline stability was not anticipated for all participants, Participant 1 was the only participant who demonstrated stability on her status tracking measurement during the baseline phase, whereas Participant 3 demonstrated a gradual rise on her status tracking measurement reaching her peak performance for the entire study at session 6 before the implementation of cognitive strategy instruction occurred at session 9. As previously stated, changes in trend were not anticipated to be as sensitive to identifying a functional relation due to potential volatility on status tracking performance during the baseline phase. Of note, however, is the volatility in trend obtained for Participant 2 during the experimental phase. Participant 2 participated in the most experimental phase sessions obtaining two separate peaks of positive trend during this phase with a significant negative trend between the two peaks.

Change in level was the most apparent for Participant 1 with no overlapping data between the two phases. Participant 2's two instances of peak performance during the experimental phase suggest a significant change in level between the two phases; however, the negative trend she experienced in the experimental phase negated the significant level change. Participant 3 demonstrated an observable change in level between the first four data points of the baseline phase and the entire experimental phase; however, overlapping data points between the final four baseline phase sessions and the entire experimental phase negates a significant level change.

Lastly, immediacy of effect was the most apparent for Participant 1 and was not identified for Participant 3. Participant 2 demonstrated an immediate decrease on her status tracking measure upon the implementation of cognitive strategy instruction followed by substantial increase to her first peak performance, suggesting slight immediacy of effect. Taken together, the standards of visual analysis did not support the existence of a functional relation as a treatment effect was not apparent at three separate points in time across participants; however, it is noteworthy that visual analysis of individual participant data did support a treatment response for both Participants 1 and 2 (Horner et al., 2005).

In addition to visual analysis, two analyses were calculated to determine the statistical difference in status tracking measurements between the two phases of the study. Table 8 displays the results of the *Tau-U* analysis, which yielded a weighted score of .605 suggesting a small treatment effect (Parker et al., 2011). Table 9 displays the results of the MLM analysis, which generated an effect size of 10.17, $p = .177$. Since the obtained *p*-value was greater than .05, the obtained effect size was not considered significant. Although effect sizes do not imply causation and are independent of experimenter control (Carter, 2013), both the obtained results of the *Tau-U* and MLM analyses reinforce the visual analysis interpretation to not support the existence of a functional relation across three separate points in time. However, it should be noted the small treatment effect obtained by the *Tau-U* analysis likely corresponds to the observed treatment effect in Participants 1 and 2.

Table 8

Tau-U Results

Value	Score
Tau-U	.605
z-Score	2.93
p-value	.0034

Note. The Single Case Research free calculator (http://www.singlecaseresearch.org/) was utilized to calculate the Tau-U effect size value. Participants 1 and 2 required a baseline trend correction.

Table 9

Multilevel Model Results

Value	Score	*p*-value
Autocorrelation	.494	
Level	10.17	.177
Slope	1.84	.337

Note. MLM results were calculated using Rstudio version 1.4.

GAS Outcome

Although the comparison of GAS performance between the baseline and experimental phases did not factor into the determination of a functional relation, participant GAS directly corresponded to the status tracking measurement. It was hypothesized that participants would obtain and sustain the expected level of performance on their GAS with the introduction of cognitive strategy instruction. All three participants achieved the expected level of performance on their GAS by the conclusion of the experimental phase. Participants 1 and 2 achieved the expected level of performance on their GAS hierarchies after the introduction of cognitive strategy instruction. By the conclusion of the experimental phase, both participants achieved performance corresponding to *more than expected* on their GAS. Participant 3 achieved the expected level of performance on her GAS during the baseline phase. She then achieved performance corresponding to *more than expected* during the experimental phase and sustained that performance until the conclusion of the study.

Frequency of Strategy Use and Perceived Strategy Helpfulness

The two additional repeated measurements collected during the experimental phase measured participant perception of the frequency of their strategy use and perceived helpfulness of their strategies. These measurements did not contribute to the determination of a functional relation, but it was hypothesized that participant responses to these measurements would directly correspond to their status tracking measurements. Moreover, the collection of these measurements facilitated collaborative discussion between the clinicians and participants on how perceived strategy use and helpfulness impacted the status tracking measurement.

Participant 1. To target her goal of increasing the number of minutes per week engaged in her online Literature lecture class, Participant 1 implemented two cognitive strategies during the experimental phase. The first strategy, implemented at the beginning of the experimental phase, was to engage in her online lecture for 15 minutes followed by a 5-minute break before rejoining the class for at least 15 more minutes. Frequency of use and perceived helpfulness measurements for this strategy are displayed in Figure 4. Frequency of the first strategy was measured as the number of lectures per week Participant 1 implemented the strategy. She initially reported inconsistent use of the strategy sessions 7-10, so during session 10, the clinicians and Participant 1 collaboratively discussed the addition of a second strategy aimed to increase her use of the first strategy. Participant 1 reported she consistently forgot to use her first strategy of taking a break, so the second strategy targeted the use of phone reminders to alert her prior to, and during class, to remind her to take a break and re-engage in class. She set six reminders per class for a total of 12 reminders per week, and frequency was measured as the number of reminders adhered to, either to take a break or to re-engage in class after her break. Figure 5 displays frequency of use and perceived helpfulness of the second strategy. Participant 1 concluded the study reporting increased strategy use and helpfulness across both strategies, which corresponded to a rising trend in her status tracking measurement, the number of minutes per week she engaged in her online Literature course.

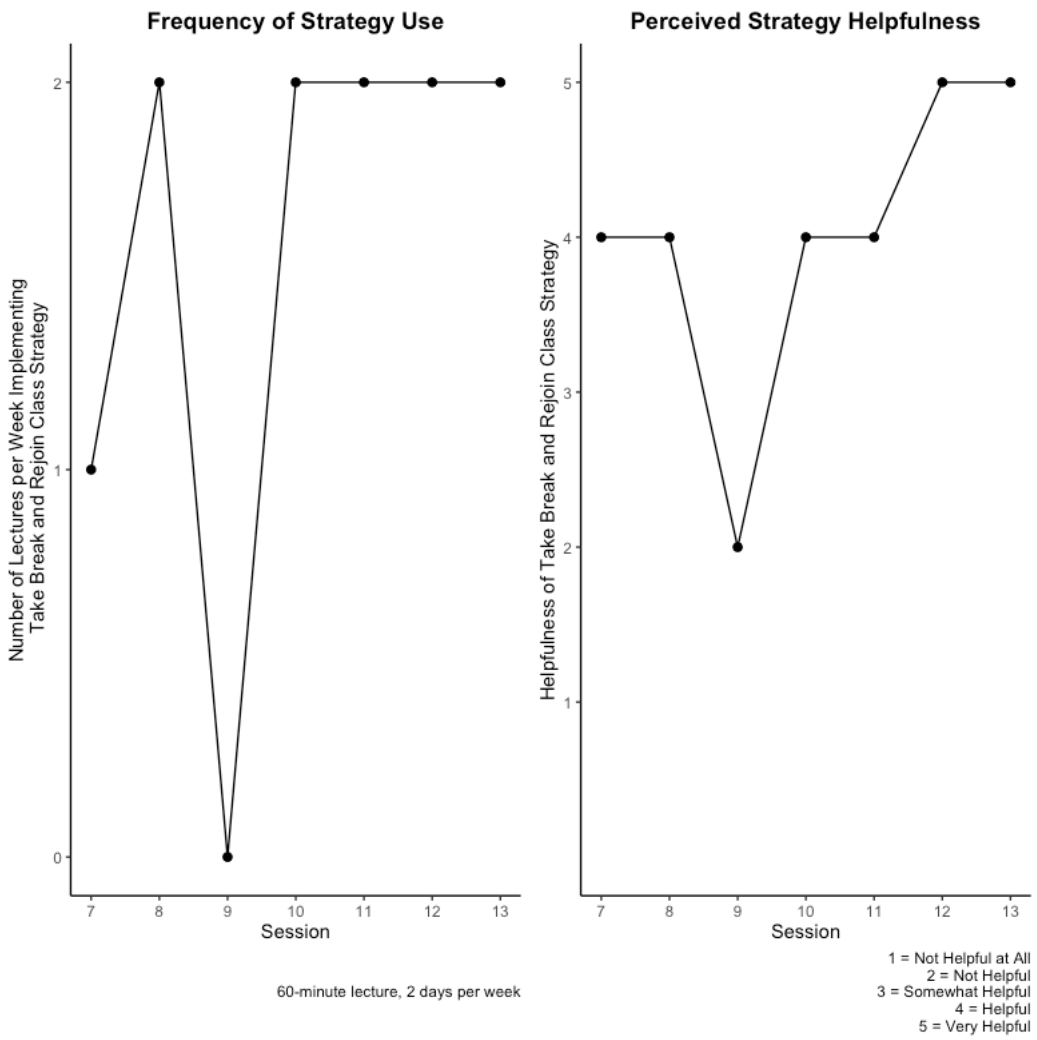

Figure 4. Participant 1 frequency of strategy use and perceived helpfulness of the "take break and rejoin class" strategy.

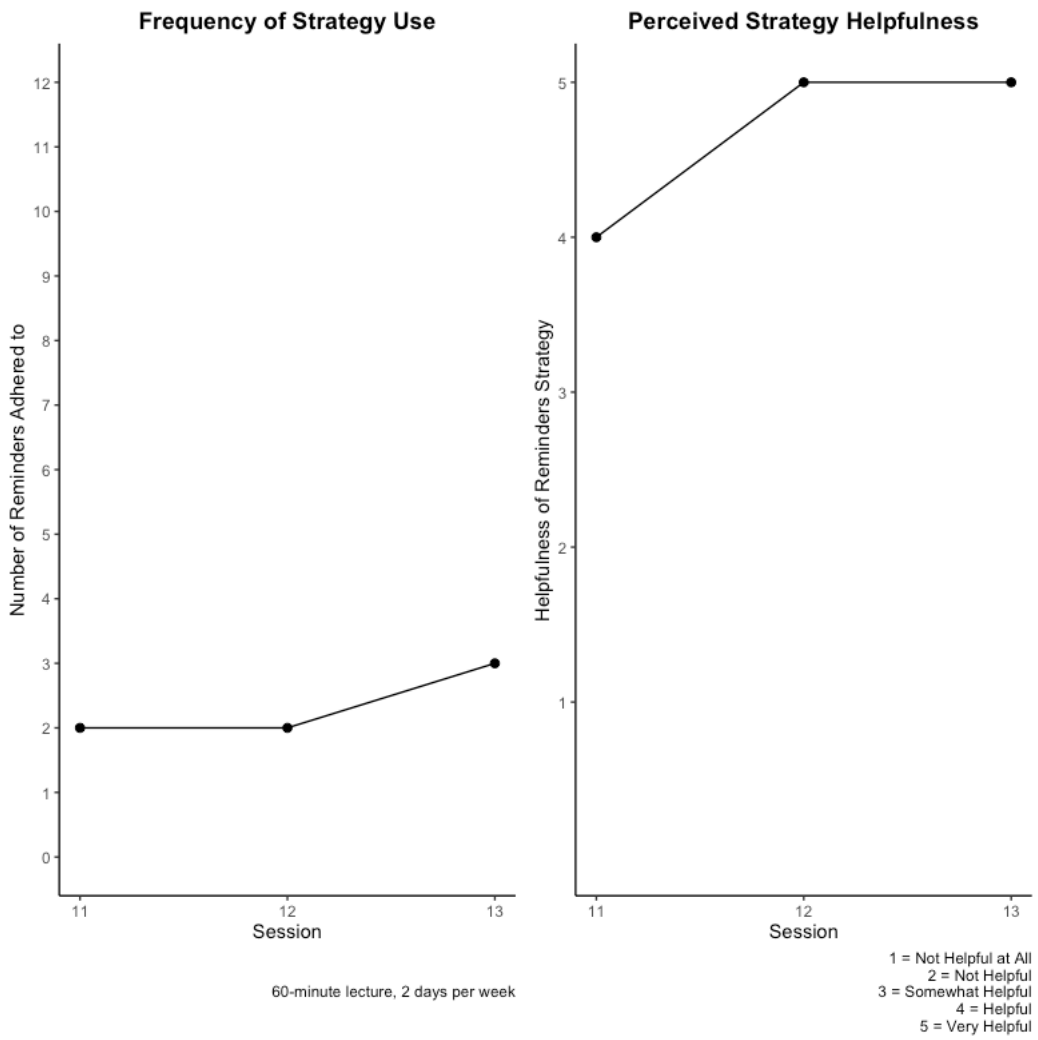

Figure 5. Participant 1 frequency of strategy use and perceived helpfulness of the reminders strategy.

Participant 2. To target her goal of increasing the number of minutes per week spent studying for Spanish class, Participant 2 also implemented two cognitive strategies. At the beginning of the experimental phase, Participant 2 first implemented the strategy of setting two reminders in her phone per week at a dedicated time to alert her to study for Spanish. Figure 6 displays frequency of use and perceived helpfulness of the first

strategy, where frequency was measured as the number of reminders adhered to by studying for Spanish when the reminder went off. Sessions 4-11, she reported inconsistent use of the reminders strategy and never rated it greater than *Somewhat Helpful*. Therefore, during session 11, Participant 2 and the clinicians identified that studying with a partner would be a helpful strategy to increase the duration of time spent studying per week, where the number of partner study sessions per week was measured to represent frequency of strategy use. Figure 7 displays the frequency of strategy use and helpfulness of the study partner strategy across her final two sessions. Although she only participated in one study session with a partner per week across the final two sessions, Participant 2 rated this strategy as very helpful, which corresponded to increased reported frequency of use and perceived helpfulness of her first strategy. The addition of the second strategy directly corresponded with the second peak of her status tracking measurement, the number of minutes per week spent studying for Spanish class, during the experimental phase of the study.

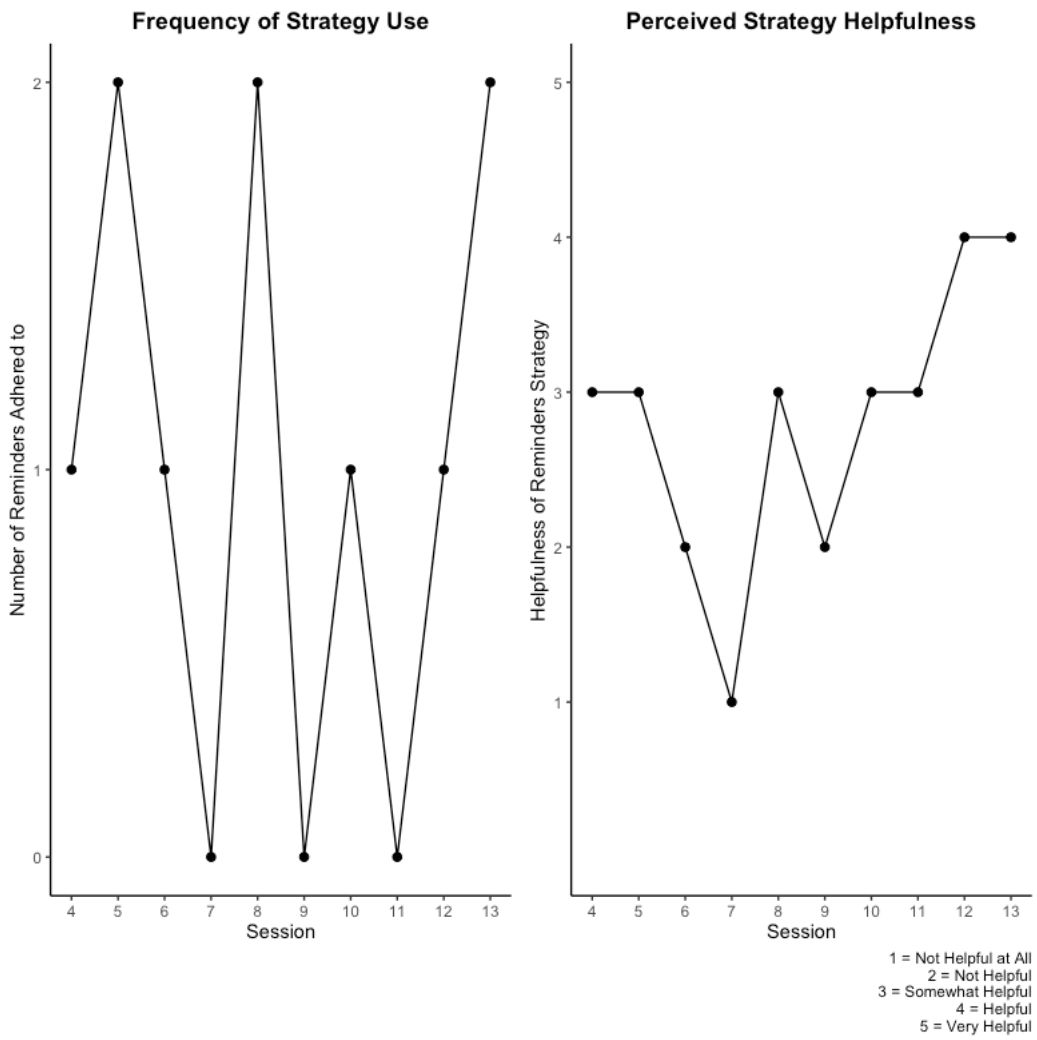

Figure 6. Participant 2 frequency of strategy use and perceived helpfulness of the reminders strategy.

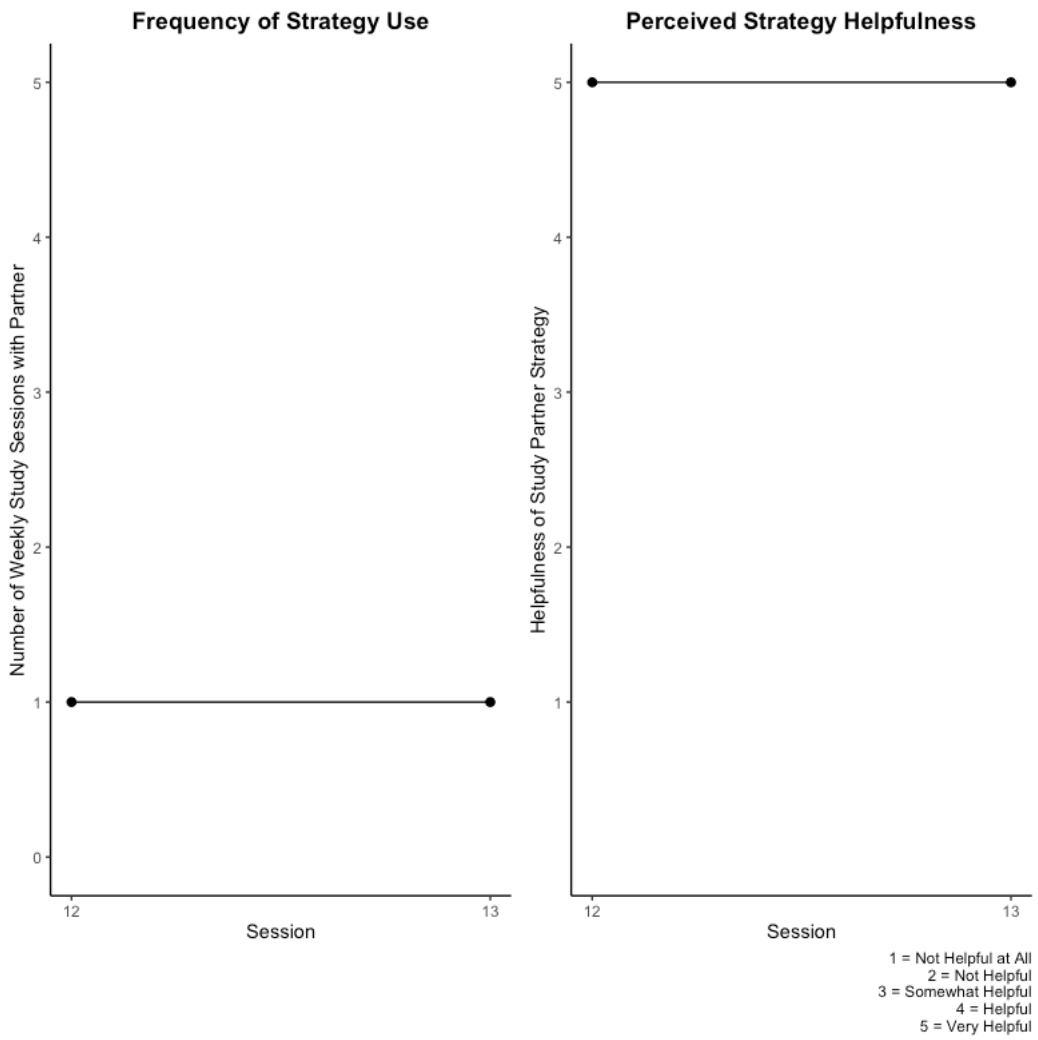

Figure 7. Participant 2 frequency of strategy use and perceived helpfulness of the study partner strategy.

Participant 3. To target the goal of increased weekly assignment completion, Participant 3 implemented the cognitive strategy of an academic planner to track and organize all assignments. Figure 8 displays the frequency of use of the planner, which was measured as both the percentage of weekly assignments entered into the planner as well as the number of days per week she used her planner to track assignments. Figure 9

displays her perceived helpfulness of using an academic planner to track assignments, and Figure 11 displays the perceived helpfulness of the planner. Although perceived helpfulness of using an academic planner was never rated lower than *Helpful*, frequency of use of the academic planner remained relatively stable to the conclusion of the study. This stability in the use of the planner to track approximately 70% of assignments 3-4 days per week directly corresponded with stability in Participant 3's status tracking measurement, completing 60-70% of assignments across the last five sessions of the study.

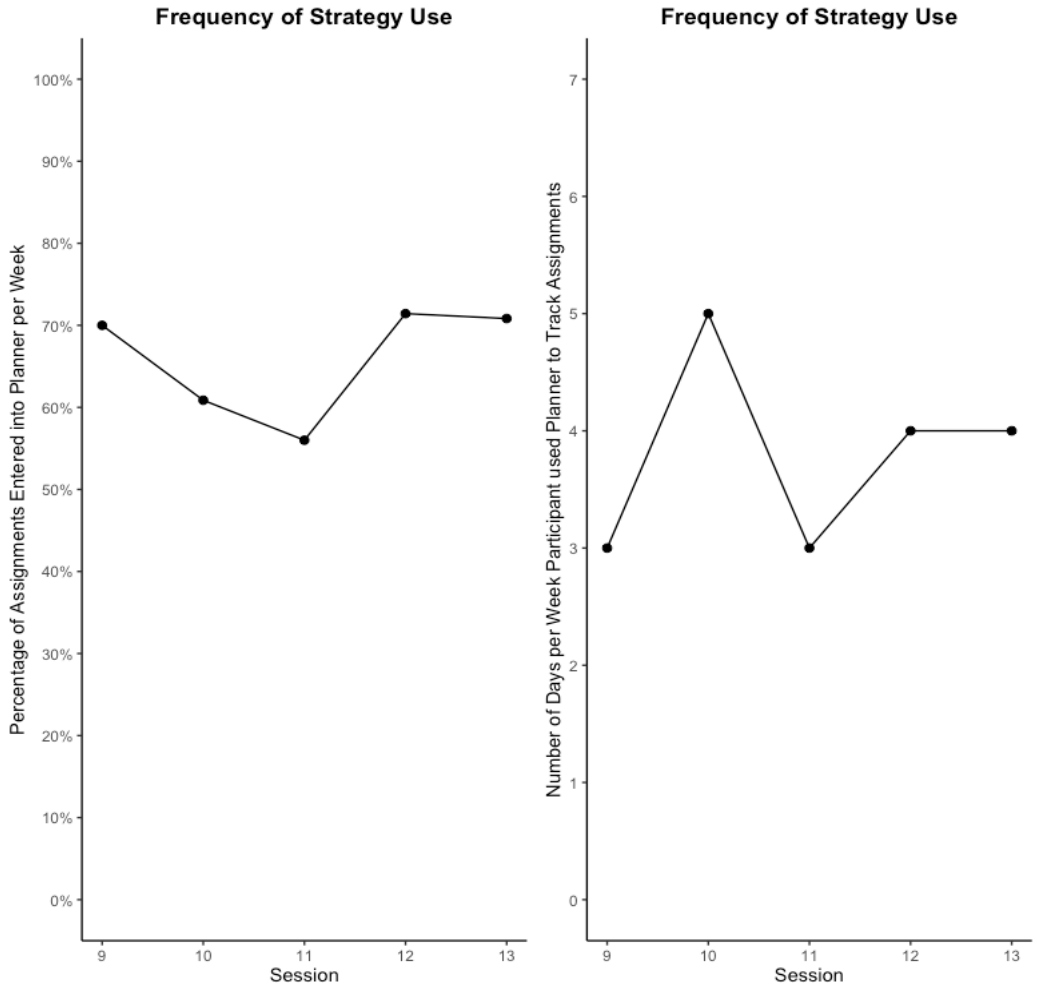

Figure 8. Participant 3 frequency of academic planner use.

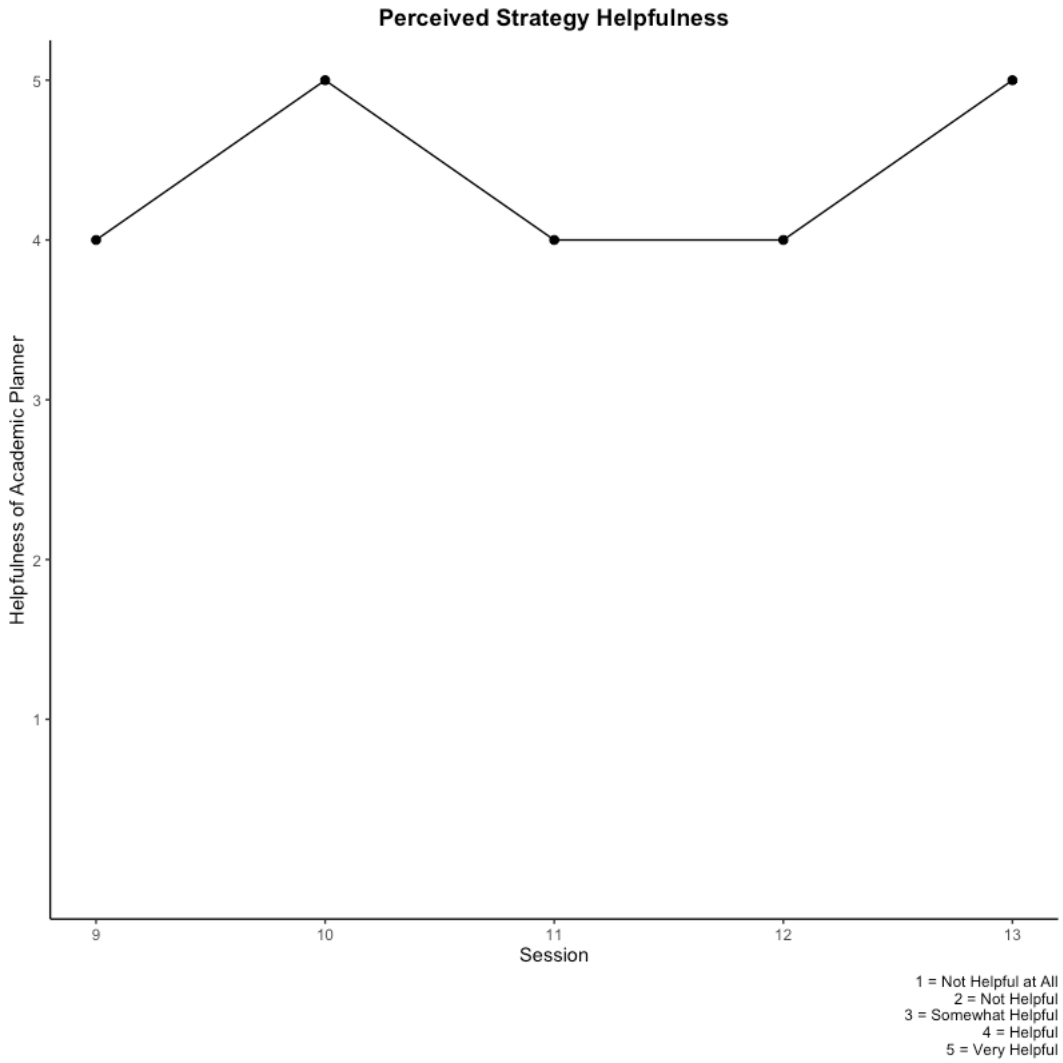

Figure 9. Participant 3 perceived helpfulness of academic planner.

Research Question 2: Do selected scores on the pre/post outcome measures that aid in the treatment selection process yield positive change following the delivery of personalized cognitive strategy instruction?

It was hypothesized that selected scores and responses on the BRIEF-2, CLASS, and PCSS that contributed to the treatment selection process would improve the most following the delivery of personalized cognitive strategy instruction.

BRIEF-2

Selected BRIEF-2 *T*-score values to compare across the three administrations of the study were primarily dictated by the self-report responses that assisted with treatment selection obtained prior to the baseline phase. Selected *T*-score values prior to the baseline phase from the parent-report either corresponded to the same scales and indices selected from the self-report or represented a clinically significant score that contributed to treatment selection.

Participant 1. Self-report responses to the BRIEF-2 that guided treatment selection at the beginning of the baseline phase included the *Task Completion Scale* (*T*-score = 69), *Working Memory Scale* (*T*-score = 78), and the *Cognitive Regulation Index* (*T*-score = 70). All three *T*-score values were greater than 65, indicating clinical significance. Prior to the experimental phase, Participant 1 obtained increased *T*-score values on two out of three selected scores. The *Task Completion Scale* increased to a *T*-score of 75 (RCI = 0.99), and the *Cognitive Regulation Index* increased to a *T*-score of 74 (RCI = 0.97). The *Working Memory Scale* maintained a *T*-score of 78 (RCI = 0). At the conclusion of the study, she obtained increased *T*-score values across all three selected scores. The *Task Completion Scale* increased to a *T*-score of 86 (RCI = 1.81); the *Working Memory Scale* increased to a *T*-score of 82 (RCI = 0.80); and the *Cognitive Regulation Index* increased to a *T*-score of 78 (RCI = 0.97). No RCI calculations between the selected scores for both comparisons were significant. Table 10 displays all BRIEF-2 *T*-score and RCI values obtained for Participant 1.

Participant 1's mother completed the BRIEF-2 at all three collection points. At the beginning of the baseline phase, parent responses to selected scores included the

following: (a) *Working Memory Scale* (*T*-score = 62), (b) *Task-Monitor Scale* (*T*-score = 49), and (c) *Cognitive Regulation Index* (*T*-score = 53). Prior to the experimental phase, the *Working Memory Scale* decreased to a *T*-score of 56 (RCI = -2.41); The *Task-Monitor Scale* did not change (RCI = 0); and the *Cognitive Regulation Index* decreased to a *T*-score of 50 (RCI = -1.05). At the conclusion of the study, *T*-score values increased for both the *Working Memory Scale* (*T*-score = 67, RCI = 4.42) and the *Cognitive Regulation Index* (*T*-score = 58, RCI = 2.81). The *Task-Monitor Scale* decreased to a *T*-score value of 44 (RCI = -1.00). Obtained RCI values for the *Working Memory Scale* were significant for both calculations. The obtained RCI value comparing the *Cognitive Regulation Index* prior to the experimental phase and at the conclusion of the study was additionally significant. Table 11 displays all BRIEF-2 *T*-score and RCI values obtained for Participant 1's mother.

Table 10

Participant 1 Self-Report BRIEF-2 T-Score and RCI Values

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Inhibit scale	64	64	67*	0	0.61
Self-monitor scale	55	55	46	0	-1.34
Behavior regulation index	62	62	59	0	-0.57
Shift scale	52	58	71*	0.80	1.73
Emotional control scale	79*	82*	79*	0.49	-0.49
Emotional regulation index	66*	71*	77*	0.86	1.03
Task completion scale[a]	69*	75*	86*	0.99	1.81
Working memory scale[a]	78*	78*	82*	0	0.80
Plan/organize scale[a]	60	66*	63	1.25	-0.63
Cognitive regulation index[a]	70*	74*	78*	0.97	0.97
Global executive composite	68*	72*	75*	1.03	0.77

Note. *T*-score values greater than 65 are considered clinically significant and RCI values with an absolute value exceeding 1.96 are considered significant.

*Denotes clinically significant *T*-score value.

[a] Denotes scale or index guided treatment selection at pre-baseline phase.

Table 11

Participant 1 Parent-Report BRIEF-2 T-Score and RCI Values

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Inhibit scale	47	51	44	0.83	-1.45
Self-monitor scale	55	55	45	0	-1.72
Behavior regulation index	50	52	44	0.44	-1.78
Shift scale	58	54	44	-0.83	-2.08**
Emotional control scale	56	54	60	-0.35	1.05

Table 11 continued

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Emotional regulation index	57	54	52	-0.65	-0.43
Initiate scale	44	53	49	1.95	-0.87
Working memory scale[a]	62	56	67*	-2.41**	4.42**
Plan/organize scale[a]	48	51	53	0.74	0.49
Task-monitor scale[a]	49	49	44	0	-1.00
Organization of materials scale	57	43	67*	-3.45**	5.91**
Cognitive regulation index[a]	53	50	58	-1.05	2.81**
Global executive composite	54	52	54	-0.68	0.68

Note. T-score values greater than 65 are considered clinically significant and RCI values with an absolute value exceeding 1.96 are considered significant.

*Denotes clinically significant *T*-score value; **denotes significant RCI value.

[a] Denotes scale or index guided treatment selection at pre-baseline phase.

Participant 2. Self-report responses to the BRIEF-2 that assisted in treatment selection at the beginning of the baseline phase included the *Task Completion Scale* (*T*-score = 86), *Working Memory Scale* (*T*-score = 82), *Plan/Organize Scale* (*T*-score = 71), and the *Cognitive Regulation Index* (*T*-score = 81). All four *T*-score values exceeded the clinical significance threshold of 65. Prior to the experimental phase, Participant 2 obtained decreased *T*-score values across all four selected scores; however, three of the four scales remained clinically significant. The *Task Completion Scale* decreased to a *T*-score value of 82 (RCI = -0.66); the *Working Memory Scale* decreased to a *T*-score value of 82 (RCI = -0.80); the *Plan/Organize Scale* decreased to a *T*=score value of 63 (RCI = -1.67); and the *Cognitive Regulation Index* decreased to a *T*-score value of 75 (RCI = -1.46). There were no significant RCI calculations comparing obtained *T*-scores prior to the baseline phase and prior to the experimental phase. At the conclusion of the study, Participant 2 obtained decreased *T*-score values across all four selected scores with only the *Task Completion* and *Working Memory* scales remaining clinically significant. The *Task Completion Scale* decreased to a *T*-score value of 72 (RCI = -1.64); the *Working Memory Scale* decreased to a *T*-score value of 65 (RCI = -2.61); the *Plan/Organize Scale* decreased to a *T*-score value of 50 (RCI = -2.72); and the *Cognitive Regulation Index* decreased to a *T*-score value of 62 (RCI = -3.16). The obtained RCI values comparing responses prior to the experimental phase and at the conclusion of the study were significant for the *Working Memory Scale, Plan/Organize Scale*, and the *Cognitive Regulation Index.* Table 12 displays all BRIEF-2 *T*-score and RCI values obtained for Participant 2.

Participant 2's mother provided responses to the parent-version of the BRIEF-2 at all three collection points. At the beginning of the baseline phase, parent responses to selected scores included the following: (a) *Working Memory Scale* (*T*-score = 59), (b) *Plan/Organize Scale* (*T*-score = 58), (c) *Task-Monitor Scale* (*T*-score = 57), and (d) *Cognitive Regulation Index* (*T*-score = 60). Prior to the experimental phase, increased *T*-score values were only observed on the *Working Memory Scale* (*T*-score = 62, RCI = 1.21). The *Plan/Organize Scale* decreased to a *T*-score value of 53 (RCI = -1.23), the *T*-score value of the *Task Monitor Scale* remained 57 (RCI = 0), and the *Cognitive Regulation Index* decreased to a *T*-score value of 60 (RCI = -1.40). No RCI calculations comparing *T*-score values prior to the baseline phase and prior to the experimental phase were significant. At the conclusion of the study, the *T*-score value for the *Plan/Organize Scale* remained the same (*T*-score = 53, RCI = 0), while *T*-score values were observed to decrease for the *Working Memory Scale* (*T*-score = 53, RCI = -3.62); *Task-Monitor Scale* (*T*-score = 49, RCI = -1.60); and the *Cognitive Regulation Index* (*T*-score = 51, RCI = -1.76). Only the RCI calculation comparing the *T*-score values to the *Working Memory Scale* prior to and following the experimental phase represented significant change. Table 13 displays all BRIEF-2 *T*-score and RCI values obtained for Participant 2's mother.

Table 12

Participant 2 Self-Report BRIEF-2 T-Score and RCI Values

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Inhibit scale	64	55	45	-1.82	-2.03**
Self-monitor scale	51	51	46	0	-0.74
Behavior regulation index	59	53	45	-1.14	-1.52
Shift scale	67*	71*	64	0.53	-0.93
Emotional control scale	79*	75*	79*	-0.65	0.65
Emotional regulation index	75*	75*	73*	0	-0.34
Task completion scale[a]	86*	82*	72*	-0.66	-1.64
Working memory scale[a]	82*	78*	65*	-0.80	-2.61**
Plan/organize scale[a]	71*	63	50	-1.67	-2.72**
Cognitive regulation index[a]	81*	75*	62	-1.46	-3.16**
Global executive composite	76*	71*	62	-1.29	-2.31**

Note. *T*-score values greater than 65 are considered clinically significant and RCI values with an absolute value exceeding 1.96 are considered significant.

*Denotes clinically significant *T*-score value; **denotes significant RCI value.

[a] Denotes scale or index guided treatment selection at pre-baseline phase.

Table 13

Participant 2 Parent-Report BRIEF-2 T-Score and RCI Values

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Inhibit scale	57	51	54	-1.24	0.62
Self-monitor scale	55	60	60	0.86	0
Behavior regulation index	57	55	57	-0.44	0.44
Shift scale	65*	65*	58	0	-1.45
Emotional control scale	68*	56	56	-2.11**	0

Table 13 continued

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Emotional regulation index	68*	61	57	-1.52	-0.87
Initiate scale	57	53	49	-0.87	-0.87
Working memory scale[a]	59	62	53	1.21	-3.62**
Plan/organize scale[a]	58	53	53	-1.23	0
Task-monitor scale[a]	57	57	49	0	-1.60
Organization of materials scale	64	53	50	-2.71**	-0.74
Cognitive regulation index[a]	60	56	51	-1.40	-1.76
Global executive composite	62	57	54	-1.71	-1.03

Note. T-score values greater than 65 are considered clinically significant and RCI values with an absolute value exceeding 1.96 are considered significant.

*Denotes clinically significant *T*-score value; **denotes significant RCI value.

[a] Denotes scale or index guided treatment selection at pre-baseline phase.

Participant 3. Self-report responses to the BRIEF-2 that assisted in treatment selection at the beginning of the baseline phase included the *Task Completion Scale* (*T*-score = 78), *Working Memory Scale* (*T*-score = 72), and the *Cognitive Regulation Index* (*T*-score = 71). All three *T*-score values exceeded the clinical significance threshold of 65. Prior to the experimental phase, *T*-score values for all three selected scores were observed to increase: (a) *Task Completion Scale* (*T*-score = 82, RCI = 0.66); (b) *Working Memory Scale* (*T*-score = 84, RCI = 2.41); and (c) *Cognitive Regulation Index* (*T*-score = 82, RCI = 2.67). The obtained RCI values comparing pre-baseline and pre-experimental phase *T*-score values for the *Working Memory Scale* and *Cognitive Regulation Index* were significant. At the conclusion of the study, Participant 3 obtained decreased *T*-score values across all three selected scores that all fell below the clinical significance threshold of 65. The *Task Completion Scale* decreased to a *T*-score value of 64 (RCI = -2.96), the *Working Memory Scale* decreased to a *T*-score value of 63 (RCI = -4.22), and the *Cognitive Regulation Index* decreased to a *T*-score value of 63 (RCI = -4.61). All three RCI values comparing obtained *T*-score values for the *Task Completion Scale, Working Memory Scale*, and the *Cognitive Regulation Index* prior to the experimental phase and the conclusion of the study were significant. Table 14 displays all BRIEF-2 *T*-score and RCI values obtained for Participant 3.

Participant 3's mother provided responses to the parent-version of the BRIEF-2 at all three collection points. At the beginning of the baseline phase, parent responses to selected scores included the following: (a) *Working Memory Scale* (*T*-score = 72), (b) *Plan/Organize Scale* (*T*-score = 71), (c) *Task-Monitor Scale* (*T*-score = 47), and (d) *Cognitive Regulation Index* (*T*-score = 66). The obtained *T*-score values for the *Working*

Memory Scale, Plan/Organize Scale, and the *Cognitive Regulation Index* were clinically significant. Prior to the experimental phase, increased *T*-score values were only observed on the *Task-Monitor Scale* (*T*-score = 61, RCI = 2.81). The *Working Memory Scale* decreased to a *T*-score value of 70 (RCI = -0.80), the *Plan/Organize Scale* decreased to a T-score of 58 (RCI = -3.19), and the *Cognitive Regulation Index* decreased to a *T*-score value of 54 (RCI = -0.70). The RCI calculations comparing the *T*-score values of the *Task-Monitor* and *Plan/Organize Scales* prior to the baseline phase and prior to the experimental phase were significant. At the conclusion of the study, *T*-score values were observed to decrease across all four selected scores, and all scores fell below the clinical significance threshold of 65: (a) *Working Memory Scale* (*T*-score = 59, RCI = -4.42); (b) *Plan/Organize Scale* (*T*-score = 53, RCI = -1.23); (c) *Task-Monitor Scale* (*T*-score = 47, RCI = -2.81); and (d) *Cognitive Regulation Index* (*T*-score = 54, RCI = -3.51). The RCI calculations comparing *T*-score values prior to and following the experimental phase for the *Working Memory Scale, Task-Monitor Scale,* and the *Cognitive Regulation Index* represented significant change. Table 15 displays all BRIEF-2 *T*-score and RCI values obtained for Participant 3's mother.

Table 14

Participant 3 Self-Report BRIEF-2 T-Score and RCI Values

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Inhibit scale	64	79*	64	3.04**	-3.04**
Self-monitor scale	76	72*	67*	-0.59	-0.74
Behavior regulation index	71*	79*	67*	1.52	-2.28**
Shift scale	64	71*	54	0.93	-2.26**
Emotional control scale	71*	64	57	-1.13	-1.13
Emotional regulation index	69*	69*	56	0	-2.23
Task completion scale[a]	78*	82*	64	0.66	-2.96**
Working memory scale[a]	72*	84*	63	2.41**	-4.22**
Plan/organize scale[a]	60	73*	60	2.72**	-2.72**
Cognitive regulation index[a]	71*	82*	63	2.67**	-4.61**
Global executive composite	72*	80*	63	2.06**	-4.37**

Note. *T*-score values greater than 65 are considered clinically significant and RCI values with an absolute value exceeding 1.96 are considered significant.

*Denotes clinically significant *T*-score value; **denotes significant RCI value.

[a] Denotes scale or index guided treatment selection at pre-baseline phase.

Table 15

Participant 3 Parent-Report BRIEF-2 T-Score and RCI Values

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Inhibit scale	68*	62	45	-1.24	-3.51**
Self-monitor scale	70*	65*	49	-0.86	-2.75**
Behavior regulation index	71*	64	46	-1.56	-4.00**
Shift scale	72*	68*	65*	-0.83	-0.62
Emotional control scale	83*	62	48	-3.69**	-2.46**

Table 15 continued

Scale/index	*T*-score value			RCI value	
	Pre-baseline phase	Pre-experimental phase	Post-experimental phase	Pre-baseline/pre-experimental	Pre-experimental/post-experimental
Emotional regulation index	82*	66*	56	-3.46**	-2.16**
Initiate scale	70*	70*	61	0	-1.95
Working memory scale[a]	72*	70*	59	-0.80	-4.42**
Plan/organize scale[a]	71*	58	53	-3.19**	-1.23
Task-monitor scale[a]	47	61*	47	2.81**	-2.81**
Organization of materials scale	53	49	46	-0.98	-0.74
Cognitive regulation index[a]	66*	64	54	-0.70	-3.51**
Global executive composite	72*	65*	53	-2.40**	-4.11**

Note. T-score values greater than 65 are considered clinically significant and RCI values with an absolute value exceeding 1.96 are considered significant.

*Denotes clinically significant *T*-score value; **denotes significant RCI value.

[a] Denotes scale or index guided treatment selection at pre-baseline phase.

CLASS

Selected CLASS responses to compare across the three administrations were determined by identifying the self-report and parent-report responses that guided treatment selection prior to the baseline phase.

Participant 1. The self-report ratings of three items as *A lot worse* (*Trouble remembering what was studied, Headaches interfering with classwork,* and *Tiring easily during the school day*) plus the rating of *Stressed out about your grades dropping* as *Very stressful* were selected to contribute to treatment selection prior to the baseline phase. At the transition to the experimental phase, the ratings of *Trouble remembering what was studied* and *Tiring easily during the school day* remained at the level *A lot worse*, the rating for *Stressed about your grades dropping* remained at the level *Very stressful*, and the rating for *Headaches interfering with classwork* improved to the level *Somewhat worse.* At the conclusion of the study, the rating of *Trouble remembering what was studied* remained at the level *A lot worse,* the rating for *Headaches interfering with classwork* decreased to the level of *A lot worse*, the rating for *Tiring easily during the school day* improved to the level *Somewhat worse*, and the rating for *Stressed about your grades dropping* remained at the level *Very stressful.*

The parent-report ratings of two items as *A lot worse* (*Trouble remembering what was studied* and *Headaches interfering with classwork*) were selected to contribute to treatment selection. Prior to the experimental phase, the parent-report ratings for both behaviors improved to the level *Somewhat worse*. At the conclusion of the study, the ratings for both behaviors returned to the level *A lot worse.* Table 16 displays all Participant 1 self- and parent-report CLASS responses.

Table 16

Participant 1 Self-Report and Parent-Report CLASS Responses

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Difficulty taking notes	A little worse	Somewhat worse	Somewhat worse	Somewhat worse	A little worse	A little worse
Difficulty understanding new material	Somewhat worse	Somewhat worse	A lot worse	Somewhat worse	Somewhat worse	Somewhat worse
In class, work taking longer	Somewhat worse	A lot worse	A lot worse	Somewhat worse	Somewhat worse	Somewhat worse
Homework taking longer	Somewhat worse	A lot worse	A lot worse	Somewhat worse	Somewhat worse	Somewhat worse
Difficulty studying for tests or quizzes	Somewhat worse	A lot worse	A lot worse	Somewhat worse	Somewhat worse	Somewhat worse
Trouble remembering what was studied[ab]	A lot worse*	A lot worse	A lot worse	A lot worse	Somewhat worse	A lot worse
Trouble reading	Somewhat worse	Somewhat worse	A lot worse	Somewhat worse	Somewhat worse	A lot worse

Table 16 continued

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Easily distracted during classwork	Somewhat worse	A little worse	Somewhat worse	Somewhat worse	Somewhat worse	Somewhat worse
Easily distracted during homework	A little worse	A little worse	Somewhat worse	Somewhat worse	Somewhat worse	A little worse
Headaches interfering with classwork[ab]	A lot worse*	Somewhat worse	A lot worse*	A lot worse*	Somewhat worse	A lot worse*
Headaches interfering with homework	A little worse	Somewhat worse	A lot worse*	Somewhat worse	Somewhat worse	A lot worse*
Tiring easily during the school day[a]	A lot worse*	A lot worse*	Somewhat worse	Somewhat worse	Somewhat worse	A lot worse*
Tiring easily during homework	Somewhat worse	A lot worse*	A little worse	Somewhat worse	Somewhat worse	Somewhat worse
Easily bothered by lights/screens or noise	A little worse	A lot worse*	A lot worse*	A lot worse*	Somewhat worse	A lot worse*
Missing time with friends and/or social activities	A little stressful	Moderately stressful	Not stressful	Moderately stressful	A little stressful	Not stressful

Table 16 continued

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Not being allowed to play sports/recreation	Very stressful*	A little stressful	Very stressful*	Very stressful*	A little stressful	Moderately stressful
Not having enough support from teachers	Moderately stressful	A little stressful	Moderately stressful	A little stressful	Moderately stressful	A little stressful
Not having enough support at home from parents/siblings	Very stressful*	A little stressful	A little stressful	Not stressful	Not stressful	A little stressful
More stressed out/overwhelmed with the schoolwork piling up	Very stressful*	Very stressful*	Very stressful*	Moderately stressful	Moderately stressful	Moderately stressful
Stressed out about your grades dropping[a]	Very stressful*	Very stressful*	Very stressful*	Moderately stressful	Moderately stressful	Moderately stressful

[a] Denotes item from self-report responses that contributed to treatment selection at pre-baseline phase; [b] denotes item from parent-report responses that contributed to treatment selection at pre-baseline phase.

*Denotes clinically significant response that corresponded to participant and/or parent concern for academic behavior.

Participant 2. The self-report ratings of three CLASS items as *A lot worse* (*Difficulty understanding new material, Difficulty studying for tests or quizzes,* and *Trouble remembering what was studied*) were identified to directly influence treatment selection prior to the baseline phase. Prior to the experimental phase, ratings for *Difficulty understanding new material* and *Difficulty studying for tests or quizzes* improved to the level of *Somewhat worse*, while the rating of *Trouble remembering what was studied* remained at the level *A lot worse.* At the conclusion of the study, the ratings for all three items improved to the level of *A little worse*.

No specific CLASS item from the parent-response was observed to contribute to treatment selection; therefore, the same items selected from the self-report were selected from the parent-report to observe if change in response occurred across the three administrations. Prior to the baseline phase, Participant 2's mother rated the items *Difficulty understanding new material* and *Difficulty studying for tests or quizzes* as *A little worse* and rated *Trouble remembering what was studied* as *Somewhat worse*. Prior to the experimental phase, the ratings of all three items improved to the level of *Not worse* and remained at this level after the completion of the study. Table 17 displays all Participant 2 self- and parent-report CLASS responses.

Table 17

Participant 2 Self-Report and Parent-Report CLASS Responses

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Difficulty taking notes	A lot worse*	A little worse	Not worse	Somewhat worse	Not worse	Not worse
Difficulty understanding new material[a]	A lot worse*	Somewhat worse	A little worse	A little worse	Not worse	Not worse
In class, work taking longer	Somewhat worse	A little worse	A little worse	A little worse	Not worse	Not worse
Homework taking longer	Somewhat worse	A little worse	Not worse	A little worse	Not worse	Not worse
Difficulty studying for tests or quizzes[a]	A lot worse*	Somewhat worse	A little worse	A little worse	Not worse	Not worse
Trouble remembering what was studied[a]	A lot worse*	A lot worse	A little worse	Somewhat worse	Not worse	Not worse
Trouble reading	A lot worse*	Not worse	Not worse	A little worse	A little worse	Not worse

Table 17 continued

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Easily distracted during classwork	Somewhat worse	Somewhat worse	Somewhat worse	A little worse	Not worse	Not worse
Easily distracted during homework	Somewhat worse	Somewhat worse	Somewhat worse	A little worse	Not worse	Not worse
Headaches interfering with classwork	A little worse	Not worse	Not worse	Not worse	Not worse	Not worse
Headaches interfering with homework	A little worse	Not worse	Not worse	Not worse	Not worse	Not worse
Tiring easily during the school day	A lot worse*	A lot worse*	A little worse	Not worse	A little worse	Not worse
Tiring easily during homework	Somewhat worse	A little worse	A little worse	Not worse	Not worse	Not worse
Easily bothered by lights/screens or noise	A little worse	Not worse	Not worse	Not worse	Not worse	Not worse
Missing time with friends and/or social activities	A little stressful	A little stressful	A little stressful	A little stressful	A little stressful	A little stressful

Table 17 continued

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Not being allowed to play sports/recreation	Very stressful*	Moderately stressful	Moderately stressful	A little stressful	A little stressful	A little stressful
Not having enough support from teachers	A little stressful	A little stressful	Moderately stressful	Not stressful	Moderately stressful	Moderately stressful
Not having enough support at home from parents/siblings	A little stressful	Not stressful	Not stressful	A little stressful	A little stressful	Moderately stressful
More stressed out/overwhelmed with the schoolwork piling up	Moderately stressful	A little stressful	A little stressful	A little stressful	A little stressful	Moderately stressful
Stressed out about your grades dropping[a]	Very stressful*	Very stressful*	Moderately stressful	A little stressful	Moderately stressful	Moderately stressful

[a] Denotes item from self-report responses that contributed to treatment selection at pre-baseline phase.

*Denotes clinically significant response that corresponded to participant concern for academic behavior.

Participant 3. The self-report ratings of three CLASS items as *A lot worse* (*Easily distracted during classwork, Headaches interfering with classwork,* and *Headaches interfering with homework*) and three items as *Somewhat worse* (*In class, work taking longer; Homework taking longer*; and *Easily distracted during homework*) were identified to guide treatment selection prior to the baseline phase. Prior to the experimental phase, the rating for *Easily distracted during classwork* remained at the level *A lot worse*, while the ratings for *Headaches interfering with classwork* and *Headaches interfering with homework* improved to the level *Somewhat worse.* The ratings for *In class, work taking longer; Homework taking longer;* and *Easily distracted during homework* all remained at the level *Somewhat worse.* At the conclusion of the study, self-report ratings improved to the level *A little worse* for the following items: *Easily distracted during homework, Headaches interfering with classwork, and Headaches interfering with homework*. The rating for *Easily distracted during classwork* improved to the level *Somewhat worse*. The rating for *In class, work taking longer* remained at the level *Somewhat worse*, while the rating for *Homework taking longer* worsened to the level *A lot worse.*

The parent-report ratings of three items as *A lot worse* (*Homework taking longer, Difficulty studying for tests or quizzes,* and *Trouble remembering what was studied*) as well as the rating of *In class, work taking longer* as *Somewhat worse* were selected to contribute to treatment selection. Prior to the experimental phase, the rating of *Trouble remembering what was studied* remained at the level *A lot worse*, while ratings improved to the level *A little worse* for the items *In class, work taking longer; Difficulty studying for tests or quizzes;* and *Difficulty studying for tests or quizzes*. At the conclusion of the

study, the rating of *Difficulty studying for tests or quizzes* remained at the level *A little worse*, while ratings improved to the level of *Not worse* for the other three items: *In class work taking longer; Homework taking longer,* and *Trouble remembering what was studied.* Table 18 displays all Participant 3 self- and parent-report CLASS responses.

Table 18

Participant 3 Self-Report and Parent-Report CLASS Responses

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Difficulty taking notes	A little worse	A little worse	A little worse	Not worse	Not worse	Not worse
Difficulty understanding new material	Somewhat worse	Somewhat worse	A little worse	Somewhat worse	A little worse	Not worse
In class, work taking longer[ab]	Somewhat worse	Somewhat worse	Somewhat worse	Somewhat worse	A little worse	Not worse
Homework taking longer[ab]	Somewhat worse	Somewhat worse	A lot worse*	A lot worse*	A little worse	Not worse
Difficulty studying for tests or quizzes[b]	Somewhat worse	A lot worse*	A little worse	A lot worse*	A little worse	A little worse
Trouble remembering what was studied[b]	A little worse	A little worse	A little worse	A lot worse*	A lot worse*	Not worse
Trouble reading	A little worse	Not worse	Somewhat worse	A little worse	Not worse	Not worse

Table 18 continued

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Easily distracted during classwork[a]	A lot worse*	A lot worse*	Somewhat worse	A little worse	Somewhat worse	Not worse
Easily distracted during homework[a]	Somewhat worse	Somewhat worse	A little worse	A little worse	Somewhat worse	A little worse
Headaches interfering with classwork[a]	A lot worse*	Somewhat worse	A little worse	Somewhat worse	A little worse	Not worse
Headaches interfering with homework[a]	A lot worse*	Somewhat worse	A little worse	Somewhat worse	A little worse	Not worse
Tiring easily during the school day	Somewhat worse	Somewhat worse	A little worse	A little worse	Not worse	Not worse
Tiring easily during homework	Somewhat worse	Somewhat worse	A little worse	A little worse	Not worse	Not worse
Easily bothered by lights/screens or noise	A lot worse*	A little worse	A lot worse*	A lot worse*	A lot worse*	Not worse
Missing time with friends and/or social activities	Not stressful	A little stressful	Moderately stressful	Not stressful	Not stressful	A little stressful

Table 18 continued

Item	Self-report responses			Parent-report responses		
	Pre- baseline phase	Pre-experimental phase	Post-experimental phase	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Not being allowed to play sports/recreation	Not stressful	A little stressful	Moderately stressful	Not stressful	Moderately stressful	A little stressful
Not having enough support from teachers	Moderately stressful	Not stressful	Not stressful	Not stressful	A little stressful	Not stressful
Not having enough support at home from parents/siblings	Not stressful	Not stressful	Not stressful	Not stressful	Not stressful	Not stressful
More stressed out/overwhelmed with the schoolwork piling up	Moderately stressful	Moderately stressful	Moderately stressful	Moderately stressful	A little stressful	A little stressful
Stressed out about your grades dropping[a]	Moderately stressful	Moderately stressful	A little stressful	Not stressful	A little stressful	Not stressful

[a] Denotes item from self-report responses that contributed to treatment selection at pre-baseline phase; [b] denotes item from parent-report responses that contributed to treatment selection at pre-baseline phase.

*Denotes clinically significant response that corresponded to participant and/or parent concern for academic behavior.

PCSS

Responses to PCSS items 18-21 were selected to compare across all three administrations for the three participants as these items represent concussion symptoms from the *cognitive symptom cluster* (Harmon et al., 2019; Lumba-Brown et al., 2019), and they were the most influential to guiding treatment selection. The sum of the four symptom ratings was calculated to determine the *cognitive symptom cluster* score where the total possible cluster severity score was 24. The *total symptom severity* score represented the sum of all 22 items on the PCSS where the total possible severity score was 132.

Participant 1. Prior to the baseline phase, Participant 1 rated two cognitive symptoms with elevated severity. The *Feeling "slow"* symptom was observed to be rated a severity level of 6, and the *Difficulty remembering* symptom was observed to be rated a severity level of 5. The *Feeling "slow"* and *Difficulty concentrating* symptoms were rated less severe with symptom ratings of 3 and 2, respectively. The *cognitive symptom cluster* score was observed to be 16 and the *total symptom severity* score was observed to be 71. Prior to the experimental phase, symptom severity was observed to increase for three symptoms. The *Feeling "foggy"* and *Difficulty remembering* symptoms increased to severity level 6, and the *difficulty concentrating* symptom increased to severity level 4. The *Feeling "slow"* symptom was observed to decrease in severity to level 3. The increased severity ratings of three symptoms increased the *cognitive symptom cluster* score to 19, while the *total symptom severity* score additionally increased to 76. Following the conclusion of the study, the *Feeling "foggy"* and *Difficulty concentrating* symptoms decreased in severity to levels 5 and 3, respectively. The *Feeling "slow"*

symptom was observed to increase in severity to level 5, and the *Difficulty remembering* symptom remained at severity level 6. Both the *cognitive symptom cluster* and *total symptom severity* scores were observed to increase with obtained scores of 20 and 77, respectively. All symptom severity ratings, *cognitive symptom cluster* scores, and *total symptom severity* scores are displayed in Table 19.

Table 19

Participant 1 PCSS Symptom Severity Ratings

Item	Pre- baseline phase	Pre- experimental phase	Post- experimental phase
Headache	2	2	4
Nausea	4	4	4
Vomiting	0	3[a]	2
Balance problems	4	4	5
Dizziness	1	2	3
Fatigue	4	5	4
Trouble falling asleep	6	3[a]	2
Excessive sleep	4	4	4
Loss of sleep	1	1	2
Drowsiness	3	3	2
Light sensitivity	6	5	5
Noise sensitivity	4	3	3
Irritability	3	4	3

Table 19 continued

Item	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Sadness	5	5	3
Nervousness	0	1	2
More emotional	5	3	2
Numbness	3	3	5
Feeling “slow”*	6	3[a]	6[a]
Feeling “foggy”*	3	6[a]	5
Difficulty concentrating*	2	4	3
Difficulty remembering*	5	6	6
Visual problems	0	2	2
Cognitive symptom cluster score	16	19	20
Total symptom severity score	71	76	77

*Denotes item representing the *cognitive symptom cluster.*

[a] Denotes change in symptom severity rating three or greater compared to preceding administration.

Participant 2. Prior to the baseline phase, Participant 2 rated two cognitive symptoms with moderate severity. The *Difficulty concentrating* and *Difficulty remembering* symptoms were observed to be rated severity levels 3 and 4, respectively. The *Feeling "slow"* and *Feeling "foggy"* symptoms were rated with less severity, both observed to be rated level 1. The *cognitive symptom cluster* score was observed to be 9, and the *total symptom severity* score was observed to be 27. Prior to the experimental phase, symptom severity ratings were observed to increase for three symptoms. The *Feeling "slow"* symptom increased to level 2, and both the *Difficulty concentrating and Difficulty remembering* symptoms increased to level 5. The *Feeling "foggy"* symptom was observed to decrease to level 0. Both the *cognitive symptom cluster* score and *total symptom severity* score were observed to increase to totals of 12 and 41, respectively. At the conclusion of the study, the *Feeling "foggy"* symptom rating remained at level 0, while the other three cognitive symptoms were observed to decrease in severity. The *Feeling "slow"* symptom decreased to level 0, the *Difficulty concentrating* symptom decreased to level 2, and the *Difficulty remembering* symptom decreased to level 3. The *cognitive symptom cluster* score and *total symptom severity* score additionally decreased to obtained scores of 5 and 15, respectively. Table 20 displays all symptom severity ratings, *cognitive symptom cluster* scores, and *total symptom severity* scores obtained for Participant 2.

Table 20

Participant 2 PCSS Symptom Severity Ratings

Item	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Headache	0	0	0
Nausea	0	3[a]	0[a]
Vomiting	0	0	0
Balance problems	1	1	1
Dizziness	0	0	1
Fatigue	0	2	1
Trouble falling asleep	2	0	0
Excessive sleep	2	2	0
Loss of sleep	2	0	0
Drowsiness	0	3[a]	0[a]
Light sensitivity	0	0	0
Noise sensitivity	0	0	0
Irritability	1	4[a]	2
Sadness	3	5	2[a]
Nervousness	2	4	0[a]
More emotional	3	4	1[a]
Numbness	0	0	0
Feeling “slow”*	1	2	0
Feeling “foggy”*	1	0	0
Difficulty concentrating*	3	5	2[a]

Table 20 continued

Item	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Difficulty remembering*	4	5	3
Visual problems	2	1	2
Cognitive symptom cluster score	9	12	5[b]
Total symptom severity score	27	41[c]	15[c]

*Denotes item representing the *cognitive symptom cluster.*

[a] Denotes change in symptom severity rating three or greater compared to preceding administration; [b] denotes change in *cognitive symptom cluster* rating five or greater compared to preceding administration; [c] denotes change in *total symptom severity* score 10 or greater compared to preceding administration.

Participant 3. Prior to the baseline phase, Participant 3 rated all four cognitive symptoms with moderate severity. Both the *Feeling "slow"* and *Difficulty concentrating* symptoms were rated severity level 5, and the *Feeling "foggy"* and *Difficulty remembering* symptoms were rated severity level 4. The *cognitive symptom cluster* score was observed to be 18, and the *total symptom severity* score was observed to be 73. Prior to the experimental phase, symptom severity ratings were observed to decrease for all four cognitive symptoms. The *Difficulty concentrating* symptom decreased to level 4, the *Difficulty remembering* symptom decreased to level 2, and both the *Feeling "slow"* and *Feeling "foggy"* symptoms decreased to level 1. The reduction in these symptom severity

ratings reduced the *cognitive symptom cluster* score to 8 and contributed to a reduction in the *total symptom severity* score to 27. At the conclusion of the study, severity ratings for all cognitive symptoms were again observed to decrease or remain the same as the prior rating. The *Feeling "slow"* symptom was observed to remain at level 1, while the *Feeling "foggy", Difficulty concentrating,* and *Difficulty remembering* symptoms were observed to decrease to ratings of 0, 3, and 1, respectively. The *cognitive symptom cluster* score decreased to 5, while the *total symptom severity* score increased to 32. Table 21 displays all symptom severity ratings, *cognitive symptom cluster* scores, and *total symptom severity* scores obtained for Participant 3.

Table 21

Participant 3 PCSS Symptom Severity Ratings

Item	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Headache	5	2[a]	3
Nausea	2	0	0
Vomiting	0	0	0
Balance problems	4	1	2
Dizziness	2	1	1
Fatigue	3	0[a]	2
Trouble falling asleep	2	3	1
Excessive sleep	2	0	0

Table 21 continued

Item	Pre- baseline phase	Pre-experimental phase	Post-experimental phase
Loss of sleep	2	3	1
Drowsiness	5	1[a]	2
Light sensitivity	6	2[a]	4
Noise sensitivity	5	3	4
Irritability	5	1[a]	1
Sadness	2	0	1
Nervousness	2	1	2
More emotional	4	1[a]	1
Numbness	3	0[a]	1
Feeling “slow”*	5	1[a]	1
Feeling “foggy”*	4	1[a]	0
Difficulty concentrating*	5	4	3
Difficulty remembering*	4	2	1
Visual problems	1	0	1
Cognitive symptom cluster score	18	8[b]	5
Total symptom severity score	73	27[c]	32

*Denotes item representing the *cognitive symptom cluster.*

[a] Denotes change in symptom severity rating three or greater compared to preceding administration; [b] denotes change in *cognitive symptom cluster* rating five or greater compared to preceding administration; [c] denotes change in *total symptom severity* score 10 or greater compared to preceding administration.

Treatment Fidelity

Acceptable treatment fidelity ratings were obtained from both observers. As the first observer, I obtained an overall fidelity rating of 95.99% across the three participants, which accounted for the observation of all treatment sessions. The second observer viewed 18 total sessions across the three participants and obtained an overall fidelity rating of 80.56%. Noteworthy, however, is that unacceptable treatment fidelity was obtained from both observers on the delivery of treatment components for Participant 2's third and fourth sessions in which she was introduced to personalized cognitive strategy instruction and transitioned to the experimental phase, suggesting the identification and implementation of a strategy was more challenging for her.

Weighted Cohen's *Kappa* with quadratic weights was calculated to assess the level of agreement between myself and the independent observer on the delivery of treatment components. The calculation results are displayed in Table 22. The obtained result indicated acceptable treatment fidelity, $K = .608$, $p < .001$, 95% CI [.437, .778].

Table 22

Weighted Cohen's Kappa Results

	K	*p*	95% CI	
			LL	*UL*
Value	.608	< .001	.437	.778

Note. Weighed Cohen's *Kappa* calculated with quadratic weights.

Social Validity and Treatment Appropriateness

Descriptive analysis of the modified TARF-R (Reimers et al., 1992) response data suggested that participants found the intervention appropriate and effective, as well as beneficial to achieving their treatment goals. All three participants agreed to the first two items of the survey rating (a) *the clinician's teaching of the cognitive strategy was effective*, and (b) *I was motivated to use my cognitive strategy outside of therapy sessions*. One participant agreed to the third item that *the duration of time to learn the cognitive strategy took longer than anticipated*, while the other two participants replied *neutral*. Two participants agreed and one participant strongly agreed to the fourth and fifth items rating (a) *I am confident I learned my cognitive strategy*, and (b) *Learning a cognitive strategy helped me reach my school and other goals*. The sixth item, *I liked attending therapy sessions*, obtained one response each of *strongly agree, agree,* and *neutral.* The seventh item, *I experienced discomfort learning and implementing a cognitive strategy to address my school and other goals*, obtained two *disagree* responses and one *neutral* response. Table 23 displays all participant responses to the modified TARF-R.

Table 23

Participant Responses to the Modified TARF-R

Item	Participant		
	Participant 1	Participant 2	Participant 3
The clinician's teaching of the cognitive strategy was effective	Agree	Agree	Agree
I was motivated to use my cognitive strategy outside of therapy sessions	Agree	Agree	Agree
The duration of time to learn my cognitive strategy was longer than anticipated	Agree	Neutral	Neutral
I am confident I learned my cognitive strategy	Agree	Strongly agree	Agree
Learning a cognitive strategy helped me reach my school and other goals	Strongly agree	Agree	Agree
I liked attending therapy sessions	Strongly agree	Agree	Neutral
I experienced discomfort learning and implementing a cognitive strategy to address my school and other goals	Disagree	Neutral	Disagree

CHAPTER V

DISCUSSION

The purpose of this study was to evaluate the effect of personalized cognitive strategy instruction on facilitating RTL for adolescents experiencing PCS. First, I hypothesized that participant outcome on collaboratively developed goals, representing their RTL target, would improve with the introduction of personalized cognitive strategy instruction. Second, I hypothesized that selected scores on the pre/post outcome measurements that assisted in the treatment selection process would improve following the delivery of personalized cognitive strategy instruction. To evaluate social validity and treatment appropriateness, I administered a modified version of the TARF-R (Reimers et al., 1992) to obtain data on participants' perceptions of benefit, effectiveness, and appropriateness of the intervention. This chapter first interprets the results for both research questions with respect to the corresponding hypotheses. This is followed by a discussion of the study limitations and suggestions for how to address those limitations in future research studies. The chapter concludes with a discussion of the clinical implications of this study and proposed directions for future research.

Profiles of Clinical Response

Although the obtained results did not support the existence of a functional relation per the methodological standards of single case experimental designs (Horner et al., 2005; Kratochwill et al., 2013), a positive result of this study was that two of the three participants did respond to the intervention and appeared to benefit from the implementation of personalized cognitive strategy instruction. Moreover, all three participants achieved and maintained the expected level of performance or greater on

their GAS hierarchy, providing proof of concept for the intervention to address the needs of adolescents experiencing PCS. This finding is clinically important as each participant achieved their selected RTL goal and encourages continued exploration of the personalized strategy approach.

The literature documents the inherent difficulty in treating youth with prolonged concussion symptoms due to the complex interaction of cognitive, psychological, somatic, ocular-motor, and/or vestibular symptoms (Gioia, 2016; Gioia et al., 2016; Lumba-Brown et al., 2019). The heterogeneity of the PCS population and the potential variability in treatment response call for an individualized intervention to address specific profiles. Moreover, previous literature has documented that small treatment effects, such as the obtained *Tau-U* result in the present study, are expected from the PCS population due to (a) methodological limitations and (b) the heterogeneity of the population representing various profiles of need and functional deficit; however, these small effects still represent clinical significance (Rohling et al., 2009). The three unique profiles in the present study underscore both the heterogeneity in adolescents with PCS and their response to treatment, which are further discussed.

Participant 1 Profile

Participant 1 represented a response profile in which her outcome aligned with the hypothesis of the first research question but not the second. Her status tracking measurement demonstrated marked improvement with the implementation of personalized cognitive strategy instruction; however, selected responses to the BRIEF-2, CLASS, and PCSS were observed to gradually worsen or remain elevated over the course of the study.

Participant 1's results indicated a client profile that benefits from the collaborative development of a treatment goal with a GAS hierarchy where status on the goal is repeatedly measured to facilitate discussion on the obstacles and/or catalysts to achieving the desired level of performance. However, the gradual worsening of her responses to the BRIEF-2 and CLASS suggest she perceived more negative abilities of herself on school and functional tasks over the course of treatment. One potential explanation for the emergence of Participant 1's profile is the course of her PCSS responses across all items and symptom clusters. While her responses to the items representing the *cognitive symptom cluster* remained relatively stable and elevated across the three collections, it is noteworthy that her severity ratings of all items also remained stable and relatively elevated, generating *total symptom severity* scores across the three collection points of 71, 76, and 77, respectively. Such high severity ratings so far removed from the onset of her injury would suggest a very complex recovery highlighted by the interaction of multiple symptoms from various symptom clusters. Therefore, Participant 1 offers a response profile sensitive to positive change on a functional goal but overall recovery and perception of performance hampered by complex symptomology beyond the scope of practice of speech-language pathology.

Participant 2 Profile

Participant 2 represented a response profile in which her outcome aligned with the hypotheses of both research questions. Her weekly status tracking measurement experienced substantial improvement with the introduction of personalized cognitive strategy instruction, and selected responses on her final post-treatment responses to the

BRIEF-2, CLASS, and PCSS yielded the most positive outcome compared to the two preceding collection times.

Participant 2's results suggest the existence of a profile sensitive to positive benefits from all components of the intervention. Specifically, a clinical interview and input from outcome measurements influenced the collaborative development of a functional goal to be measured through a GAS hierarchy and ongoing status tracking of performance towards achieving the expected level of performance or greater on the GAS. By the completion of the study, Participant 2 reported the ability to generalize her learned strategy to other courses, further cementing a positive response profile to the intervention highlighted by the ability to independently implement strategies as needed to manage academic needs.

Participant 3 Profile

Participant 3 represented a response profile in which her outcome aligned with the hypothesis of the second research question but not the first. Her status tracking measurement demonstrated immediate improvement over the course of the baseline phase achieving its peak performance at her sixth session prior to the implementation of personalized cognitive strategy instruction. Her performance then remained stable for the remainder of the study and did not demonstrate a significant improvement or decrease upon the implementation of personalized cognitive strategy instruction. Conversely, selected responses to the pre/post outcome measurements showed general improvement at the conclusion of the study compared to two preceding collection times.

Participant 3's results suggest a client profile where the identification and implementation of a personalized strategy did not facilitate functional change on a

collaboratively developed goal. However, the relatively quick achievement and maintenance of her goal may indicate that Participant 3 benefited the most from the ongoing status tracking of the goal, which may have provided the external accountability to achieve and maintain the desired performance. Generally, Participant 3 reported her most positive responses to the pre/post outcome measures at the conclusion of the study. Therefore, it could be the case that Participant 3 represents a profile wherein status tracking of goal performance provides the accountability needed to achieve functional change, and strategy implementation facilitates greater self-perception of cognitive and academic performance when measured formally.

One additional explanation for the emergence of Participant 3's profile was her age compared to Participants 1 and 2. Personalized cognitive strategy instruction directly targets individual metacognitive skills, particularly the ability to reflect on one's own thoughts and behavior in relation to the desired treatment goal, and recent literature has suggested metacognitive abilities demonstrate a prolonged developmental trajectory over the course of adolescence (Weil et al., 2013). Participants 1 and 2, ages 16 and 15 respectively, appeared more adept to reflect on their behavior and participate in collaborative discussion with the clinicians, which may have influenced their profile of positive response to the intervention as indicated by the status tracking measurement. Conversely, at age 13, Participant 3 may not have possessed the metacognitive maturity to fully engage in the intention of the intervention; therefore, this age and maturity difference may have influenced Participant 3's profile and provides some context as to her neutral demeanor towards attending clinical sessions and neutral response to the

implementation of personalized cognitive strategy instruction, as measured by the TARF-R.

Summary of Participant Profiles

Although the three participants presented unique profiles, the three profiles all shared commonalities. First, and most important, all three participants achieved and maintained the desired level of performance or greater on their treatment goal to increase a desired behavior. All three goals represented challenges with executive functioning skills, particularly task completion and time management, highlighting how academic difficulty may manifest post-concussion (Gioia et al., 2016; Ransom et al., 2015). Second, responses from the TARF-R suggest all participants endorsed the intervention to be appropriate and effective to assisting them achieve their goals. Although Participant 3 did not demonstrate the same level of engagement as Participants 1 and 2 as outlined above, the third commonality is that, generally, all participants did engage in the intervention process and willingly worked with the clinicians to implement strategies to address their goals.

Importance of Naturalistic Contexts. Conducting this study longitudinally revealed the challenges of evaluating functional change on a desired behavior where participant outcome was vulnerable to the influence of their natural contexts. Specifically, the variability in academic demands that naturally occurs in school settings made measurement of participant performance on both their status tracking measurements and responses to the final collection of pre/post outcome measurements challenging as there were extenuating circumstances.

First, Participant 3 reported a dramatic decrease in the weekly number of assignments to be completed between her first five sessions and final eight sessions. This significant decrease in the number of weekly assignments may explain why she eclipsed her expected level of performance at session 6 prior to the implementation of personalized cognitive strategy instruction. Second, Participant 2 reported two peak levels of performance of her status tracking measurement. The first peak coincided with the timing of her midterm exams, and the second peak occurred at the time of her final exams, suggesting her personal motivation to perform well on exams was a strong influence on achieving her goal behavior to increase the duration of time spent studying for Spanish class. Third, although Participant 1 demonstrated a positive response to the intervention as indicated by the status tracking measurement, her responses to the BRIEF-2 and CLASS were observed to worsen over the course of the study. When prompted to reflect on the gradual decrease in her responses during the last session, Participant 1 stated her most positive responses to the BRIEF-2 and CLASS were collected at the beginning of the study because it occurred at the beginning of the school year. By the time of the last collection, the ongoing demands of school across all classes, such as increases in the number of upcoming exams and assignments, negatively influenced her responses to the BRIEF-2 and CLASS.

The variability in academic demands suggest it may be more ideal to administer this intervention in a school setting where the clinician has both the ability to communicate with teachers and more knowledge of the variable academic demands of the individual in order to adapt the intervention as needed. Overall, the dynamic nature of school-related responsibilities across participants underscores the challenge of attempting

to interpret change in functional behavior. Therefore, it is important to explore the profiles of response to make sense of factors that either contributed to or prevented positive outcome and to acknowledge that some factors, such as differences in academic demands, are beyond research control.

Measurements

This study utilized measurements to facilitate a dynamic intervention where the measurement of participant performance at baseline dictated treatment development, and the ongoing measurement of participant performance dictated service delivery in the experimental phase. The benefits and challenges of the types of measurements used in the study are discussed.

Repeated Measurements

The benefit of conducting this study within a single case experimental design is that it provided the opportunity to repeatedly track both goal progress and the impact of strategy use and helpfulness. Data collection of these measurements directly facilitated client-participant discussion and reflection on participant performance. The plotted measurements presented in the Results chapter were consistently presented to the participants during sessions to assist in collaborative discussion as to whether identified strategies were (a) being utilized consistently and (b) helpful towards achieving the participants' treatment goal.

Data driven discussion was particularly useful for Participants 1 and 2. Both participants quickly achieved peak performance on their status tracking measurement after the implementation of strategies followed by a decrease in performance. For both participants, the opportunity to visualize their weekly status tracking performance data

and responses to the measurements of strategy use and perceived helpfulness guided discussion on how to incorporate a second strategy to maintain expected and more than expected performance on their GAS hierarchy. Specific to Participant 2, who experienced a significant decrease in status tracking performance during the experimental phase, the opportunity to visualize and discuss her first peak performance followed by a precipitous decrease provided the opportunity to collaboratively reflect on performance and to identify barriers to maintaining the expected level of performance on the GAS hierarchy. When Participant 2 reported her lowest level of performance on the status tracking measurement during the 10th session, the clinicians utilized the ongoing collection of data to leverage her previous success into a collaborative discussion to both reinforce the notion that she can succeed and that, as a team, they needed to identify another strategy she believed would help her regain the consistent ability to study for Spanish class at least 16 minutes per week.

Empirically driven and dynamic interventions to address ongoing cognitive deficits post-concussion have not been addressed in the literature to date. Instead, existing treatment literature has focused on the evaluation of manualized programs where session topics are pre-determined (Huckans et al., 2010; Storzbach et al., 2017; Twamley et al., 2014). The results of this study provide evidence to suggest a dynamic treatment approach constructed around the identification of strategies that match the individual profile and the ongoing collection of data to measure status performance and strategy use and perceived helpfulness may be an effective intervention to treat adolescents with PCS.

Pre/Post Outcome Measurements

The BRIEF-2 and CLASS proved to be the most influential measurements that guided treatment development when collected during the first session. Scores and responses to both measurements from participants and their parents provided the clinicians with additional input to characterize the nature of the participants' academic challenges and facilitate goal development. Symptom severity ratings of cognitive symptoms on the PCSS did not contribute to treatment development to the same extent as the BRIEF-2 or CLASS, but it is important to note that the pattern of symptom severity followed similar patterns to the BRIEF-2 and CLASS in that selected responses to all three measures generally improved or worsened in tandem across the three administrations. As previously stated, differences in participant academic demands are likely responsible for the difference in response patterns to the outcome measurements across the three administrations. What is noteworthy, however, is the slight discrepancy between self- and parent-responses to the BRIEF-2 and CLASS for Participants 1 and 2 at the beginning of the study. Both Participants 1 and 2 reported perception of deficits and academic challenges greater than their parents, a finding that aligns with previous research utilizing the same measurements that determined self-report scores and responses were more sensitive than parent-report responses to identify students with academic difficulty post-concussion (Ransom et al., 2016). The results of this study support the notion presented in Ransom et al. (2015) and Ransom et al. (2016) that self-report measures of executive dysfunction (e.g., BRIEF-2), academic difficulty (e.g., CLASS), and symptom severity (e.g., PCSS) are useful tools to identifying the needs of students recovering from concussion.

Measurements Summary

From a research perspective, it was helpful to obtain multiple perceptual measurements of functional behavior (BRIEF-2), school performance (CLASS), and symptom severity (PCSS) in order to explore potential change in response longitudinally. From a clinical perspective, the multiple administrations of the measurements was observed to be tedious for the participants and may have negatively impacted their engagement in treatment. Ultimately, the development of a GAS hierarchy and ongoing status tracking of performance on the GAS was found to be the most important measurement of the study. Moreover, the first administrations of the BRIEF-2 and CLASS were useful to assist in the process of identifying participant needs and establishing a course of treatment, both in goal development and the eventual identification and implementation of strategies.

Study Limitations

Although this study is one of the first to experimentally evaluate the treatment of PCS in adolescents, findings must be interpreted with caution. This section discusses two types of limitations that affect the strength of the evidence and conclusions that can be drawn from the results. Specifically, contextual and methodological limitations weaken the generalizability of the results, and both are discussed below.

Contextual Factors

The primary contextual limitation to this study is the modality in which it was administered. The study was designed to be executed in-person in a university outpatient clinic; however, due to the COVID-19 pandemic, all sessions were delivered remotely via telehealth. An evaluation of treatment delivered in-person versus telehealth is beyond the

scope of this study, and all treatment objectives were successfully implemented across the three participants (see Results chapter for treatment fidelity result); however, the ongoing COVID-19 pandemic did appear to negatively impact the overall wellbeing of the three participants. Specifically, all three participants were participating in remote school due to the pandemic and all expressed their displeasure with remote learning and the present state of the pandemic, which may have negatively influenced progress on their status tracking measurement, corresponding to their treatment goal and RTL target. Further, the existence of the pandemic and its effect on both service delivery and schooling was observed to directly impact the goals developed for the study. Participant 1 developed a treatment goal targeting increased participation in online Literature class lecture, a goal that would not have been established prior to the pandemic, which limits generalizability of findings to in-person service delivery. Overall, the COVID-19 pandemic represents a substantial history effect that threatened the internal validity of this study.

Methodological Factors

Although the demonstration of an effect across three separate baselines is sufficient to determine the existence of a functional relation in single case experimental designs (SCED) (Horner et al., 2005; Kratochwill et al., 2013), the small sample size of three individuals does limit the generalizability of findings from this study to the larger population. The advantage of utilizing a SCED was that it allowed to explore the viability of personalized cognitive strategy instruction (Byiers et al., 2012); however, evaluation of the intervention on a larger sample size would strengthen the statistical power and generalizability of results.

An additional methodological limitation is the small number of data points obtained in the baseline phase for Participant 2. The collection of three data points per phase is acceptable, but the collection of at least five data points per phase is the recommended method of single case standards (Horner et al., 2005; Kratochwill et al., 2013). As discussed in the Methods chapter, randomization of IV implementation was utilized to strengthen internal validity since the study was conducted non-currently. The rationale to randomize implementation of the IV after three baseline sessions for one participant was primarily to prevent attrition from the study across all participants since the other two participants were held in the baseline phase for a prolonged period of six and eight sessions, respectively. Fortunately, there was no participant attrition, but the reduced number of baseline phase data points for Participant 2 inhibits both visual and statistical analysis because she did not acquire the recommended number of data points in the baseline phase to establish a more accurate pattern of her performance on her status tracking measurement prior to the implementation of personalized cognitive strategy instruction.

A third methodological limitation is the reliance on participant self-report for the status tracking measurement. Although the intervention was grounded in the establishment of functional goals that the participants addressed outside of the therapy session, there is the possibility that the participants either exaggerated or diminished their weekly status tracking measurement, which weakens experimental control and overall internal validity. The addition of a direct measure obtained in session and observed by the clinician would reduce this bias in future studies.

Summary and Clinical Implications

The limited PCS treatment literature provides preliminary evidence to support the treatment components of psychoeducation and cognitive strategy instruction as feasible and effective treatment ingredients to managing PCS. Further, the existing PCS treatment literature is limited to the evaluation of manualized treatment programs administered to homogenous and small sample sizes (e.g., military veteran population) weakening the generalizability of findings. A primary goal of this study was to evaluate the addition of personalized cognitive strategy instruction to psychoeducation when delivered in a dynamic treatment model where treatment sessions in the experimental phase were driven by client performance on weekly measurements corresponding to the status of their GAS hierarchy as well as their perception of strategy use and helpfulness. Although a functional relation was not identified, the positive response to the intervention from two of the three participants suggests the use of personalized cognitive strategy instruction may be suitable to mitigate ongoing cognitive challenges in adolescents with PCS. This study provides preliminary evidence to suggest an empirical and dynamic approach to PCS management can be successful; therefore, further research on this topic is warranted to provide clinicians with more evidence on how to implement such interventions in their clinical practice.

Another critical intervention outcome of this study was that all participants achieved and maintained the expected level of performance or greater on their GAS hierarchy. The development of functional RTL goals was an essential aspect of the intervention as it facilitated participant progress on behaviors determined to be relevant and meaningful. Moreover, the comparison of performance on a GAS hierarchy pre- and

post-intervention is the most validated method to measure the degree to which there is change on a functional goal (Krasny-Pacini et al., 2013). It was not the purpose of this study to evaluate the validity of GAS, but the results open the door to further investigation on the validity of GAS to measure progress on goals for the PCS population.

Overall, the results suggest positive response to the intervention, which is strengthened by participant endorsement of the treatment revealed by social validity and treatment appropriate ratings on the modified TARF-R (Reimers et al., 1992). All three participants rated the use of personalized cognitive strategy instruction as highly appropriate and effective to achieving their goals, further supporting the relevance of the intervention. Future research should continue to measure social validity and treatment appropriateness of personalized cognitive strategy instruction to increase understanding of its impact and value to clients receiving the treatment.

Next Steps

The advantage of evaluating personalized cognitive strategy instruction with a SCED was the repeated measurement of participant performance. From a clinical perspective, this ongoing measurement guided the dynamic treatment, and from a research perspective, it provided a method to evaluate participant response to the intervention. Although a SCED did not identify a functional relation between the addition of personalized cognitive strategy instruction to psychoeducation and the achievement of student RTL targets in this study, the elements of single case research, specifically the repeated measurement of a target behavior over time, may be useful to evaluating this intervention in a group design. Therefore, an interrupted time series (ITS) design is

recommended to evaluate this intervention in future research. Similar to SCEDs, an ITS is designed to repeatedly measure the same target longitudinally (St.Clair et al., 2014). The utilization of an ITS to address the first research question would provide two advantages. First, as a group design, results from an ITS would generate greater statistical power and generalizability, strengthening both internal and external validity. Second, every participant in an ITS can be introduced to the IV at the same time point; therefore, no participant would be held in the baseline phase for a prolonged period of time, as is typically the case for a multiple baseline SCED (St.Clair et al., 2014).

Personalized cognitive strategy instruction has the potential to provide clinicians with an intervention to address meaningful goals and obtain functional progress in adolescents with PCS, and evaluating the intervention in a group study with an ITS design may be more sensitive to understanding its impact on helping adolescents achieve RTL targets.

APPENDIX

TREATMENT ACCEPTABILITY RATING FORM-REVISED (TARF-R; REIMERS ET AL., 1992)

Please score each item by circling the number that best indicates how you feel about the teaching of cognitive strategies to support concussion recovery

1. The clinician's teaching of the cognitive strategy was effective.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. I was motivated to use my cognitive strategy outside of therapy sessions.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. The duration of time to learn my cognitive strategy was longer than anticipated.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. I am confident that I learned to use my cognitive strategy.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

5. Learning a cognitive strategy helped me reach my school and other goals.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

6. I liked attending therapy sessions.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

7. I experienced discomfort learning and implementing a cognitive strategy to address my school and other goals.

1	2	3	4	5
Strongly	Disagree	Neutral	Agree	Strongly

REFERENCES CITED

American Speech-Language Hearing Association. (2017). *Clinician's guide to cognitive rehabilitation in mild traumatic brain injury: Application for military service members and veterans*. Retrieved from https://www.asha.org/uploadedFiles/ASHA/Practice_Portal/Clinical_Topics/Traumatic_Brain_Injury_in_Adults/Clinicians-Guide-to-Cognitive-Rehabilitation-in-Mild-Traumatic-Brain-Injury.pdf.

Arbabi, M., Sheldon, R. J. G., Bahadoran, P., Smith, J. G., Poole, N., & Agrawal, N. (2020). Treatment outcomes in mild traumatic brain injury: a systematic review of randomized controlled trials. *Brain Injury*, *34*(9), 1139–1149. https://doi.org/10.1080/02699052.2020.1797168

Babcock, L., Byczkowski, T., Wade, S. L., Ho, M., Mookerjee, S., & Bazarian, J. J. (2013). Predicting postconcussion syndrome after mild traumatic brain injury in children and adolescents who present to the emergency department. *JAMA Pediatrics*, *167*(2), 156–161. https://doi.org/10.1001/jamapediatrics.2013.434

Baker, J. G., Leddy, J. J., Darling, S. R., Shucard, J., Makdissi, M., & Willer, B. S. (2016). Gender differences in recovery from sports-related concussion in adolescents. *Clinical Pediatrics*, *55*(8), 771–775. https://doi.org/10.1177/0009922815606417

Barkhoudarian, G., Hovda, D. A., & Giza, C. C. (2011). The molecular pathophysiology of concussive brain injury. *Clinics in Sports Medicine*, *30*(1), 33–48.

Bazarian, J. J., Blyth, B., Mookerjee, S., He, H., & McDermott, M. P. (2010). Sex differences in outcome after mild traumatic brain injury. *Journal of Neurotrauma*, *27*, 527–539.

Borrelli, B. (2011). The assessment, monitoring, and enhancement of treatment fidelity in public health clinical trials. *Journal of Public Health Dentistry*, *71*, 1–21. https://doi.org/10.1111/j.1752-7325.2011.00233.x

Broglio, S. P., Surma, T., & Ashton-Miller, J. A. (2012). High school and collegiate football athlete concussions: A biomechanical review. *Annals of Biomedical Engineering*, *40*(1), 37–46. https://doi.org/10.1007/s10439-011-0396-0

Broshek, D. K., De Marco, A. P., & Freeman, J. R. (2015). A review of post-concussion syndrome and psychological factors associated with concussion. *Brain Injury*, *29*(2), 228–237. https://doi.org/10.3109/02699052.2014.974674

Byiers, B. J., Reichle, J., & Symons, F. J. (2012). *Single-subject experimental design for evidence-based practice*. *21*, 397–414. https://doi.org/10.1044/1058-0360(2012/11-0036)

Cancelliere, C., Hincapié, C. A., Keightley, M., Godbolt, A. K., Côté, P., Kristman, V. L., Stålnacke, B.-M., Carroll, L. J., Hung, R., Borg, J., Nygrren-de Boussard, C., Coronado, V. G., Donovan, J., & Cassidy, D. (2014). Systematic review of prognosis and return to play after sport concussion: Results of the international collaboration on mild traumatic brain injury prognosis. *Archives of Physical Medicine and Rehabilitation*, *95*(3), 210–229. https://doi.org/10.1016/j.apmr.2013.06.035

Carter, M. (2013). Reconsidering overlap-based measures for quantitative synthesis of single-subject data: What they tell us and what they don't. *Behavior Modification*, *37*(3), 378–390. https://doi.org/10.1177/0145445513476609

Churchill, N. W., Hutchison, M. G., Graham, S. J., & Schweizer, T. A. (2017). Symptom correlates of cerebral blood flow following acute concussion. *NeuroImage: Clinical*, *16*, 234–239. https://doi.org/10.1016/j.nicl.2017.07.019

Clark, D. M. (2013). Developing and disseminating effective psychological treatments: Science, practice and economics. *Canadian Psychology*, *54*(1), 12–21. https://doi.org/10.1037/a0031258

Cohen, J. (1968). Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological Bulletin*, *70*(4), 213–220. https://doi.org/10.1037/h0026256

Combs, H. L., Berry, D. T. R., Pape, T., Babcock-Parziale, J., Smith, B., Schleenbaker, R., Shandera-Ochsner, A., Harp, J. P., & High, W. M. (2015). The effects of mild traumatic brain injury, post-traumatic stress disorder, and combined mild traumatic brain injury/post-traumatic stress disorder on returning veterans. *Journal of Neurotrauma*, *32*, 956–966. https://doi.org/10.1089/neu.2014.3585

Cooper, D. B., Bowles, A. O., Kennedy, J. E., Curtiss, G., French, L. M., Tate, D. F., & Vanderploeg, R. D. (2016). Cognitive rehabilitation for military service members with mild traumatic brain injury: A randomized clinical trial. *Journal of Head Trauma Rehabilitation*, *32*(3), E1–E15. https://doi.org/10.1097/HTR.0000000000000254

Dachtyl, S. A., & Morales, P. (2017). A collaborative model for return to academics after concussion: Athletic training and speech-language pathology. *American Journal of Speech-Language Pathology*, *26*, 716–728.

Dean, P. J. A., O'Neill, D., & Sterr, A. (2012). Post-concussion syndrome: Prevalence after mild traumatic brain injury in comparison with a sample without head injury. *Brain Injury*, *26*(1), 14–26. https://doi.org/10.3109/02699052.2011.635354

DiFazio, M., Silverberg, N. D., Kirkwood, M. W., Bernier, R., & Iverson, G. L. (2016). Prolonged activity restriction after concussion: Are we worsening outcomes?

Clinical Pediatrics, *55*(5), 443–451. https://doi.org/10.1177/0009922815589914

Ellis, M. J., Leddy, J. J., & Willer, B. (2015). Physiological, vestibulo-ocular and cervicogenic post-concussion disorders: An evidence-based classification system with directions for treatment. *Brain Injury*, *29*(2), 238–248.

Emerson, C. S., Headrick, J. P., & Vink, R. (1993). Estrogen improves biochemical and neurologic outcome following traumatic brain injury in male rats, but not in females. *Brain Research*, *608*(1), 95–100. https://doi.org/10.1016/0006-8993(93)90778-L

Emery, C. A., Barlow, K. M., Brooks, B. L., Max, J. E., Villavicencio-Requis, A., Gnanakumar, V., Robertson, H. L., Schneider, K., & Yeates, K. O. (2016). A systematic review of psychiatric, psychological, and behavioural outcomes following mild traumatic brain injury in children and adolescents. *Canadian Journal of Psychiatry*, *61*(5), 259–269. https://doi.org/10.1177/0706743716643741

Evans, J. J., Gast, D. L., Perdices, M., & Manolov, R. (2014). Single case experimental designs: Introduction to a special issue of neuropsychological rehabilitation. *Neuropsychological Rehabilitation*, *24*(3–4), 305–314. https://doi.org/10.1080/09602011.2014.903198

Fleiss, J. L. (1973). The equivalence of weighted Kappa and the Intraclass Correlation Coefficient as measures of reliability. *Educational and Psychological Measurement*, *33*(3), 613–619.

Foy, K. (2009). Post-concussion syndrome. *British Journal of Hospital Medicine*, *70*(8), 440–443.

Gallagher, V., Kramer, N., Abbott, K., Alexander, J., Breiter, H., Herrold, A., Lindley, T., Mjaanes, J., & Reilly, J. (2018). The effects of sex differences and hormonal contraception on outcomes after collegiate sports-related concussion. *Journal of Neurotrauma*, *35*(11), 1242–1247. https://doi.org/10.1089/neu.2017.5453

Gioia, G.A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2015). Test Review: Behavior Rating Inventory of Executive Function, second edition (BRIEF-2). *Canadian Journal of School Psychology*, *34*(1), 73–78. https://doi.org/10.1177/0829573518797762

Gioia, Gerard A. (2016). Medical-school partnership in guiding return to school following mild traumatic brain injury in youth. *Journal of Child Neurology*, *31*(1), 93–108. https://doi.org/10.1002/oby.21042.Prevalence

Gioia, Gerard A., Glang, A. E., Hooper, S. R., & Brown, B. E. (2016). Building statewide infrastructure for the academic support of students with mild traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *31*(6), 397–406. https://doi.org/10.1097/HTR.0000000000000205

Gioia, Gerard A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). Behavior rating inventory of executive function. *Child Neuropsychology*, *6*(3), 235–238. https://doi.org/10.1076/chin.6.3.235.3152

Giza, C. C., & Hovda, D. A. (2014). The new neurometabolic cascade of concussion. *Neurosurgery*, *75*(4), 24–33. https://doi.org/10.1227/NEU.0000000000000505

Glang, A. E., McCart, M., Slocumb, J., Gau, J. M., Davies, S. C., Gomez, D., & Beck, L. (2019). Preliminary efficacy of online traumatic brain injury professional development for educators: An exploratory randomized control trial. *Journal of Head Trauma Rehabilitation*, *34*(2), 77–86. https://doi.org/10.1097/HTR.0000000000000447

Grant, M., & Ponsford, J. (2014). Goal attainment scaling in brain injury rehabilitation: Strengths, limitations and recommendations for future applications. *Neuropsychological Rehabilitation*, *24*(5), 661–667. https://doi.org/10.1080/09602011.2014.901228

Grool, A. M., Aglipay, M., Momoli, F., Meehan, W. P., Freedman, S. B., Yeates, K. O., Gravel, J., Gagnon, I., Boutis, K., Meeuwisse, W., Barrowman, N., Ledoux, A.-A., Osmond, M. H., & Zemek, R. (2016). Association between early participation in physical activity following acute concussion and persistent postconcussive symptoms in children and adolescents. *Jama*, *316*(23), 2504–2514. https://doi.org/10.1001/jama.2016.17396

Halstead, M. E., McAvoy, K., Devore, C. D., Carl, R., Lee, M., & Logan, K. (2013). Returning to learning following a concussion. *Pediatrics*, *132*(5), 948–957. https://doi.org/10.1542/peds.2013-2867

Harmon, K. G., Clugston, J. R., Dec, K., Hainline, B., Herring, S., Kane, S. F., Kontos, A. P., Leddy, J. J., McCrea, M., Poddar, S. K., Putukian, M., Wilson, J. C., & Roberts, W. O. (2019). American Medical Society for Sports Medicine position statement on concussion in sport. *British Journal of Sports Medicine*, *53*(4), 213–225. https://doi.org/10.1136/bjsports-2018-100338

Harvey, M. T., May, M. E., & Kennedy, C. H. (2004). Nonconcurrent multiple baseline designs and the evaluation of educational systems. *Journal of Behavioral Education*, *13*(4), 267–276. https://doi.org/10.1023/b:jobe.0000044735.51022.5d

Hawley, D. R. (1995). *Assessing change with preventive interventions : The reliable change index*. *44*(3), 278–284.

Heyer, G. L., Schaffer, C. E., Rose, S. C., Young, J. A., McNally, K. A., & Fischer, A. N. (2016). Specific factors influence postconcussion symptom duration among youth referred to a sports concussion clinic. *Journal of Pediatrics*, *174*, 33–38. https://doi.org/10.1016/j.jpeds.2016.03.014

Hinton-Bayre, A. D., Geffen, G. M., Geffen, L. B., McFarland, K. A., & Friis, P. (1999). Concussion in contact sports: Reliable change indices of impairment and recovery. *Journal of Clinical and Experimental Neuropsychology*, *21*(1), 70–86. https://doi.org/10.1076/jcen.21.1.70.945

Horner, R. H., Carr, E. G., Halle, J., Mcgee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, *71*(2), 165–179. https://doi.org/10.1177/001440290507100203

Huckans, M., Pavawalla, S., Demadura, T., Kolessar, M., Seelye, A., Roost, N., Twamley, E. W., & Storzbach, D. (2010). A pilot study examining effects of group-based cognitive strategy training treatment on self-reported cognitive problems, psychiatric symptoms, functioning, and compensatory strategy use in OIF/OEF combat veterans with persistent mild cognitive disorder a. *Journal of Rehabilitation Research and Development*, *47*(1), 43–60. https://doi.org/10.1682/JRRD.2009.02.0019

Iverson, G. L., Gardner, A. J., Terry, D. P., Ponsford, J. L., Sills, A. K., Broshek, D. K., & Solomon, G. S. (2017). Predictors of clinical recovery from concussion: A systematic review. *British Journal of Sports Medicine*, *51*(12), 941–948. https://doi.org/10.1136/bjsports-2017-097729

Jacobson, N. S., Roberts, L. J., Berns, S. B., & McGlinchey, J. B. (1999). Methods for defining and determining the clinical significance of treatment effects: Description, application, and alternatives. *Journal of Consulting and Clinical Psychology*, *67*(3), 300–307. https://doi.org/10.1037/0022-006X.67.3.300

Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, *59*(1), 12–19. https://doi.org/10.1037/0022-006X.59.1.12

Katzman, M. A., Bleau, P., Blier, P., Chokka, P., Kjernisted, K., Van Ameringen, M., Antony, M. M., Bouchard, S., Brunet, A., Flament, M., Rabheru, K., Grigoriadis, S., Richter, P. M. A., Mendlowitz, S., O'Connor, K., Robichaud, M., Walker, J. R., Asmundson, G., Klassen, L. J., … Szpindel, I. (2014). Canadian clinical practice guidelines for the management of anxiety, posttraumatic stress and obsessive-compulsive disorders. *BMC Psychiatry*, *14*(Suppl 1), 1–83. https://doi.org/10.1186/1471-244X-14-S1-S1

Kenzie, E. S., Parks, E. L., Bigler, E. D., Lim, M. M., Chesnutt, J. C., & Wakeland, W. (2017). Concussion as a multi-scale complex system: An interdisciplinary synthesis of current knowledge. *Frontiers in Neurology*, *8*(513), 1–17. https://doi.org/10.3389/fneur.2017.00513

Kerr, Z. Y., Zuckerman, S. L., Wasserman, E. B. W. B., Vander Vegt, C. B., Yengo-

Kahn, A., Buckley, T. A., Solomon, G. S., Sills, A. K., & Dompier, T. P. (2017). Factors associated with post-concussion syndrome in high school student-athletes. *J Sci Med Sport Journal of Science and Medicine in Sport*, *21*(5), 447–452. https://doi.org/10.1016/j.jsams.2017.08.025

Kontos, A. P., Elbin, R. J., Schatz, P., Covassin, T., Henry, L., Pardini, J., & Collins, M. W. (2012). A revised factor structure for the post-concussion symptom scale: Baseline and postconcussion factors. *American Journal of Sports Medicine*, *40*(10), 2375–2384. https://doi.org/10.1177/0363546512455400

Krasny-Pacini, A., Hiebel, J., Pauly, F., Godon, S., & Chevignard, M. (2013). Goal Attainment Scaling in rehabilitation: A literature-based update. *Annals of Physical and Rehabilitation Medicine*, *56*(3), 212–230. https://doi.org/10.1016/j.rehab.2013.02.002

Krasny-Pacini, A., Pauly, F., Hiebel, J., Godon, S., Isner-Horobeti, M. E., & Chevignard, M. (2017). Feasibility of a shorter Goal Attainment Scaling method for a pediatric spasticity clinic — The 3-milestones GAS. *Annals of Physical and Rehabilitation Medicine*, *60*(4), 249–257. https://doi.org/10.1016/j.rehab.2017.01.005

Krasny-Pacini, Agata, Evans, J., Sohlberg, M. M., & Chevignard, M. (2016). Proposed criteria for appraising goal attainment scales used as outcome measures in rehabilitation research. *Archives of Physical Medicine and Rehabilitation*, *97*(1), 157–170. https://doi.org/10.1016/j.apmr.2015.08.424

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education*, *34*(1), 26–38. https://doi.org/10.1177/0741932512452794

Kratochwill, T. R., & Levin, J. R. (2010). Enhancing the scientific credibility of single-case intervention research: Randomization to the rescue. *Psychological Methods*, *15*(2), 124–144. https://doi.org/10.1037/a0017736

Lovell, M. R., Iverson, G. L., Collins, M. W., Podell, K., Johnston, K. M., Pardini, D., Pardini, J., Norwig, J., & Maroon, J. C. (2006). Measurement of symptoms following sports-related concussion: Reliability and normative data for the post-concussion scale. *Applied Neuropsychology*, *13*(3), 166–174. http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=ShowDetailView&TermToSearch=17361669&ordinalpos=5&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVDocSum

Lumba-Brown, A., Ghajar, J., Cornwell, J., Bloom, O. J., Chesnutt, J., Clugston, J. R., Kolluri, R., Leddy, J. J., Teramoto, M., & Gioia, G. (2019). Representation of concussion subtypes in common postconcussion symptom-rating scales. *Concussion*, *4*(3). https://doi.org/10.2217/cnc-2019-0005

Lumba-Brown, A., Yeates, K. O., Sarmiento, K., Breiding, M. J., Haegerich, T. M., Gioia, G. A., Turner, M., Benzel, E. C., Suskauer, S. J., Giza, C. C., Joseph, M., Broomand, C., Weissman, B., Gordon, W., Wright, D. W., Moser, R. S., McAvoy, K., Ewing-Cobbs, L., Duhaime, A. C., … Timmons, S. D. (2018). Centers for disease control and prevention guideline on the diagnosis and management of mild traumatic brain injury among children. *JAMA Pediatrics*, *172*(11), 1–13. https://doi.org/10.1001/jamapediatrics.2018.2853

Maassen, G. H. (2004). The standard error in the Jacobson and Truax reliable change index: The classical approach to the assessment of reliable change. *Journal of the International Neuropsychological Society*, *10*(6), 888–893. https://doi.org/10.1017/S1355617704106097

Malec, J. F. (2001). Impact of comprehensive day treatment on societal participation for persons with acquired brain injury. *Archives of Physical Medicine and Rehabilitation*, *82*(7), 885–895. https://doi.org/10.1053/apmr.2001.23895

Manolov, R., & Moeyaert, M. (2017). How can single-case data be analyzed? Software resources, tutorial, and reflections on analysis. *Behavior Modification*, *41*(2), 179–228. https://doi.org/10.1177/0145445516664307

McAvoy, K., Eagan-Johnson, B., & Halstead, M. (2018). Return to learn: Transitioning to school and through ascending levels of academic support for students following a concussion. *NeuroRehabilitation*, *42*(3), 325–330. https://doi.org/10.3233/NRE-172381

McCrory, P., Meeuwisse, W., Dvořák, J., Aubry, M., Bailes, J., Broglio, S., Cantu, R. C., Cassidy, D., Echemendia, R. J., Castellani, R. J., Davis, G. A., Ellenbogen, R., Emery, C., Engebretsen, L., Feddermann-Demont, N., Giza, C. C., Guskiewicz, K. M., Herring, S., Iverson, G. L., … Vos, P. E. (2017). Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016. *British Journal of Sports Medicine*, *51*(11), 838–847. https://doi.org/10.1136/bjsports-2017-097699

McNally, K. A., Patrick, K. E., LaFleur, J. E., Dykstra, J. B., Monahan, K., & Hoskinson, K. R. (2018). Brief cognitive behavioral intervention for children and adolescents with persistent post-concussive symptoms: A pilot study. *Child Neuropsychology*, *24*(3), 396–412. https://doi.org/10.1080/09297049.2017.1280143

Medley, A. R., & Powell, T. (2010). Motivational Interviewing to promote self-awareness and engagement in rehabilitation following acquired brain injury: A conceptual review. *Neuropsychological Rehabilitation*, *20*(4), 481–508. https://doi.org/10.1080/09602010903529610

Miller, W. R., & Rollnick, S. (2004). Talking oneself into change: Motivational interviewing, stages of change, and therapeutic process. *Journal of Cognitive*

Psychotherapy, *18*(4), 299–308. https://doi.org/10.1891/jcop.18.4.299.64003

Mittenberg, W, Canyock, E. M., Condit, D., & Patton, C. (2001). Treatment of post-concussion syndrome following mild head injury. *Journal of Clinical and Experimental Neuropsychology*, *23*(6), 829–836. https://doi.org/10.1076/jcen.23.6.829.1022

Mittenberg, Wiley, DiGiulio, D. V., Perrin, S., & Bass, A. E. (1992). Symptoms following mild head injury: Expectation as aetiology. *Journal of Neurology Neurosurgery and Psychiatry*, *55*, 200–204. http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L22111841%5Cnhttp://sfxhosted.exlibrisgroup.com/dal?sid=EMBASE&issn=00223050&id=doi:&atitle=Symptoms+following+mild+head+injury%3A+Expectation+as+aetiology&stitle=J.+NEUROL.+NEUROSUR

Moeyaert, M., Ugille, M., Ferron, J. M., Onghena, P., Heyvaert, M., Natasha Beretvas, S., & Van den Noortgate, W. (2014). Estimating intervention effects across different types of single-subject experimental designs: Empirical illustration. *School Psychology Quarterly*, *30*(1), 50–63. https://doi.org/10.1037/spq0000068

Morgan, C. D., Zuckerman, S. L., King, L. E., Beaird, S. E., Sills, A. K., & Solomon, G. S. (2015). Post-concussion syndrome (PCS) in a youth population: defining the diagnostic value and cost-utility of brain imaging. *Child's Nervous System*, *31*(12), 2305–2309. https://doi.org/10.1007/s00381-015-2916-y

Murata, N. M., Oshiro, R., Furutani, T., & Tsushima, W. T. (2019). Maximizing recovery from concussions for youth participating in sports and recreational activities. *American Journal of Physical Medicine and Rehabilitation*, *98*(1), 73–80. https://doi.org/10.1097/PHM.0000000000001015

Nelson, L. D., Tarima, S., Laroche, A. A., Hammeke, T. A., Barr, W. B., Guskiewicz, K., Randolph, C., & McCrea, M. A. (2016). Preinjury somatization symptoms contribute to clinical recovery after sport-related concussion. *Neurology*, *86*(20), 1856–1863. https://doi.org/10.1212/WNL.0000000000002679

Oldenburg, C., Lundin, A., Edman, G., Nygren-de Boussard, C., & Bartfai, A. (2016). Cognitive reserve and persistent post-concussion symptoms—a prospective mild traumatic brain injury (mTBI) cohort study. *Brain Injury*, *30*(2), 146–155. https://doi.org/10.3109/02699052.2015.1089598

Ownsworth, T. L., McFarland, K., & Young, R. M. D. (2000). Self-awareness and psychosocial functioning following acquired brain injury: An evaluation of a group support programme. *Neuropsychological Rehabilitation*, *10*(5), 465–484. https://doi.org/10.1080/09602010050143559

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap

and trend for single-case research: Tau-U. *Behavior Therapy*, *42*(2), 284–299. https://doi.org/10.1016/j.beth.2010.08.006

Playford, E. D., Siegert, R., Levack, W., & Freeman, J. (2009). Areas of consensus and controversy about goal setting in rehabilitation: A conference report. *Clinical Rehabilitation*, *23*(4), 334–344. https://doi.org/10.1177/0269215509103506

Polich, G., Iaccarino, M. A., Kaptchuk, T. J., Morales-Quezada, L., & Zafonte, R. (2020). Nocebo effects in concussion: Is all that Is told beneficial? *American Journal of Physical Medicine & Rehabilitation*, *99*(1), 71–80. https://doi.org/10.1097/PHM.0000000000001290

Ponsford, J., Willmott, C., Rothwell, A., Cameron, P., Ayton, G., Nelms, R., Curran, C., & Ng, K. (2001). Impact of early intervention on outcome after mild traumatic brain injury in children. *Pediatrics*, *108*(6), 1297–1303. https://doi.org/10.1542/peds.108.6.1297

Ponsford, Jennie, Cameron, P., Fitzgerald, M., Grant, M., Mikocka-Walus, A., & Schönberger, M. (2012). Predictors of postconcussive symptoms 3 months after mild traumatic brain injury. *Neuropsychology*, *26*(3), 304–313. https://doi.org/10.1037/a0027888

Prescott, S., Fleming, J., & Doig, E. (2015). Goal setting approaches and principles used in rehabilitation for people with acquired brain injury: A systematic scoping review. *Brain Injury*, *29*(13–14), 1515–1529. https://doi.org/10.3109/02699052.2015.1075152

Ransom, D. M., Vaughan, C. G., Pratson, L., Sady, M. D., McGill, C. A., & Gioia, G. A. (2015). Academic effects of concussion in children and adolescents. *Pediatrics*, *135*(6), 1043–1050. https://doi.org/10.1542/peds.2014-3434

Ransom, Danielle M., Burns, A. R., Youngstrom, E. A., Vaughan, C. G., Sady, M. D., & Gioia, G. A. (2016). Applying an evidence-based assessment model to identify students at risk for perceived academic problems following concussion. *Journal of the International Neuropsychological Society*, *22*(10), 1038–1049. https://doi.org/10.1017/S1355617716000916

Reimers, T. M., Wacker, D. P., Cooper, L. J., & Deraad, A. O. (1992). Clinical evaluation of the variables associated with treatment acceptability and their relation to compliance. *Behavioral Disorders*, *18*(1), 67–76. https://doi.org/10.1177/019874299201800108

Rohling, M. L., Faust, M. E., Beverly, B., & Demakis, G. (2009). Effectiveness of cognitive rehabilitation following acquired brain injury: A meta-analytic re-examination of Cicerone et al.'s (2000, 2005) systematic reviews. *Neuropsychology*, *23*(1), 20–39. https://doi.org/10.1037/a0013659

Root, J. M., Zuckerbraun, N. S., Wang, L., Winger, D. G., Brent, D., Kontos, A., & Hickey, R. W. (2016). History of somatization is associated with prolonged recovery from concussion. *Journal of Pediatrics*, *174*, 39–44. https://doi.org/10.1016/j.jpeds.2016.03.020

Roy-Byrne, P., Craske, M. G., Sullivan, G., Rose, R. D., Edlund, M. J., Lang, A. J., Bystritsky, A., Welch, S. S., Chavira, D. A., Golinelli, D., Campbell-Sills, L., Sherbourne, C. D., & Stein, M. B. (2010). Delivery of evidence-based treatment for multiple anxiety disorders in primary care: A randomized controlled trial. *JAMA - Journal of the American Medical Association*, *303*(19), 1921–1928. https://doi.org/10.1001/jama.2010.608

Ryan, L. M., & Warden, D. L. (2003). Post concussion syndrome. *International Review of Psychiatry*, *15*(4), 310–316. https://doi.org/10.1080/09540260310001606692

Scheenen, M. E., Visser-Keizer, A. C., Van Der Naalt, J., & Spikman, J. M. (2017). Description of an early cognitive behavioral intervention (UPFRONT-intervention) following mild traumatic brain injury to prevent persistent complaints and facilitate return to work. *Clinical Rehabilitation*, *31*(8), 1019–1029. https://doi.org/10.1177/0269215516687101

Schmidt, A. T., Li, X., Hanten, G. R., McCauley, S. R., Faber, J., & Levin, H. S. (2016). A longitudinal investigation of sleep quality in adolescents and young adults after mild traumatic brain injury. *Cognitive Behavioral Neurology*, *28*(2), 53–62. https://doi.org/10.1097/WNN.0000000000000056.

Schwartz, I. S., & Baer, D. M. (1991). Social validity assessments: Is current practice state of the art? *Journal of Applied Behavior Analysis*, *24*(2), 189–204. https://doi.org/10.1901/jaba.1991.24-189

Segev, S., Shorer, M., Rassovsky, Y., Pilowsky Peleg, T., Apter, A., Fennig, S., Peleg, T. P., Apter, A., & Fennig, S. (2016). The contribution of posttraumatic stress disorder and mild traumatic brain injury to persistent post concussive symptoms following motor vehicle accidents. *Neuropsychology*, *30*(7), 800–810. https://doi.org/10.1037/neu0000299

Shadish, W. R., Rindskopf, D. M., & Hedges, L. V. (2008). The state of the science in the meta-analysis of single-case experimental designs. *Evidence-Based Communication Assessment and Intervention*, *2*(3), 188–196. https://doi.org/10.1080/17489530802581603

Signoretti, S., Lazzarino, G., Tavazzi, B., & Vagnozzi, R. (2011). The pathophysiology of concussion. *Pm&R*, *3*(10S2), S359–S368. https://doi.org/10.1007/s11916-016-0573-9

Silverberg, N. D., & Iverson, G. L. (2011). Etiology of the post-concussion syndrome:

Physiogenesis and psychogenesis revisited. *NeuroRehabilitation*, *29*(4), 317–329. https://doi.org/10.3233/NRE-2011-0708

Silverberg, N. D., Panenka, W. J., & Iverson, G. L. (2018). Fear avoidance and clinical outcomes from mild taumatic brain injury. *Journal of Neurotrauma*, *35*(16), 1864–1873. https://doi.org/10.1089/neu.2018.5662

Sohlberg, M. M., Harn, B., MacPherson, H., & Wade, S. L. (2014). A pilot study evaluating attention and strategy training following pediatric traumatic brain injury. *Clinical Practice in Pediatric Psychology*, *2*(3), 263–280. https://doi.org/10.1037/cpp0000072

Sohlberg, M. M., & Ledbetter, A. K. (2016). Management of persistent cognitive symptoms after sport-related concussion. *American Journal of Speech-Language Pathology*, *25*, 138–149.

St.Clair, T., Cook, T. D., & Hallberg, K. (2014). Examining the internal validity and statistical precision of the comparative interrupted time series design by comparison with a randomized experiment. *American Journal of Evaluation*, *35*(3), 311–327. https://doi.org/10.1177/1098214014527337

Storzbach, D., Twamley, E. W., Roost, M. S., Golshan, S., Williams, R. M., O Neil, M., Jak, A. J., Turner, A. P., Kowalski, H. M., Pagulayan, K. F., & Huckans, M. (2017). Compensatory cognitive training for Operation Enduring Freedom/Operation iraqi Freedom/Operation New Dawn veterans with mild traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *32*(1), 16–24. https://doi.org/10.1097/HTR.0000000000000228

Tamura, K., Furutani, T., Oshiro, R., Oba, Y., Ling, A., & Murata, N. (2020). Concussion recovery timeline of high school athletes using a stepwise return-to-play protocol: Age and sex effects. *Journal of Athletic Training*, *55*(1), 1–4. https://doi.org/10.4085/1062-6050-452-18

Tator, C. H., Davis, H. S., Dufort, P. A., Tartaglia, M. C., Davis, K. D., Ebraheem, A., & Hipoylee, C. (2016). Postconcussion syndrome: Demographics and predictors in 221 patients. *Journal of Neurosurgery*, *125*(5), 1206–1216. https://doi.org/10.3171/2015.6.JNS15664

Tiersky, L. A., Anselmi, V., Johnston, M. V., Kurtyka, J., Roosen, E., Schwartz, T., & DeLuca, J. (2005). A trial of neuropsychologic rehabilitation in mild-spectrum traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, *86*(8), 1565–1574. https://doi.org/10.1016/j.apmr.2005.03.013

Toglia, J., & Kirk, U. (2000). Understanding awareness deficits following brain injury. *NeuroRehabilitation*, *15*(1), 57–70. https://doi.org/10.3233/nre-2000-15104

Toglia, J., Lee, A., Steinberg, C., & Waldman-Levi, A. (2020). Establishing and measuring treatment fidelity of a complex cognitive rehabilitation intervention: The multicontext approach. *British Journal of Occupational Therapy*, *83*(6), 363–374. https://doi.org/10.1177/0308022619898091

Towns, S. J., Silva, M. A., & Belanger, H. G. (2015). Subjective sleep quality and postconcussion symptoms following mild traumatic brain injury. *Brain Injury*, *29*(11), 1337–1341. https://doi.org/10.3109/02699052.2015.1045030

Treble-Barna, A., Sohlberg, M. M., Harn, B. E., & Wade, S. L. (2016). Cognitive intervention for attention and executive function impairments in children with traumatic brain injury: A pilot study. *Journal of Head Trauma Rehabilitation*, *31*(6), 407–418. https://doi.org/10.1097/HTR.0000000000000200

Twamley, E. W., Jak, A. J., Delis, D. C., Bondi, M. W., & Lohr, J. B. (2014). Cognitive Symptom Management and Rehabilitation Therapy (CogSMART) for veterans with traumatic brain injury: Pilot randomized controlled trial. *Journal of Rehabilitation Research and Development*, *51*(1), 59–70. https://doi.org/10.1682/JRRD.2013.01.0020

Vanderploeg, R. D., Belanger, H. G., Curtiss, G., Bowles, A. O., & Cooper, D. B. (2019). Reconceptualizing rehabilitation of individuals with chronic symptoms following mild traumatic brain injury. *Rehabilitation Psychology*, *64*(1), 1–12. https://doi.org/10.1037/rep0000255

Walker, W. C., Franke, L. M., Mcdonald, S. D., Sima, A. P., & Keyser-Marcus, L. (2015). Prevalence of mental health conditions after military blast exposure, their co-occurrence, and their relation to mild traumatic brain injury. *Brain Injury*, *29*(13–14), 1581–1588. https://doi.org/10.3109/02699052.2015.1075151

Walker, William C., Franke, L. M., Sima, A. P., & Cifu, D. X. (2017). Symptom Trajectories After Military Blast Exposure and the Influence of Mild Traumatic Brain Injury. *Journal of Head Trauma Rehabilitation*, *32*(3), 16–26. https://doi.org/10.1097/HTR.0000000000000251

Wares, J. R., Hoke, K. W., Walker, W. C., Franke, L. M. L. M., Cifu, D. X., Carne, W., & Ford-Smith, C. (2015). Characterizing effects of mild traumatic brain injury and posttraumatic stress disorder on balance impairments in blast-exposed servicemembers and veterans using comuterized posturography. *Journal of Rehabilitation Research and Development*, *52*(5), 591–604.

Watson, P. J., & Workman, E. A. (1981). The non-concurrent multiple baseline across-individuals design: An extension of the traditional multiple baseline design. *Journal of Behavior Therapy and Experimental Psychiatry*, *12*(3), 257–259. https://doi.org/10.1016/0005-7916(81)90055-0

Weil, L. G., Fleming, S. M., Dumontheil, I., Kilford, E. J., Weil, R. S., Rees, G., Dolan, R. J., & Blakemore, S. J. (2013). The development of metacognitive ability in adolescence. *Consciousness and Cognition*, *22*(1), 264–271. https://doi.org/10.1016/j.concog.2013.01.004

Williams-Butler, M. A., & Cantu, R. C. (2019). Concussion practice patterns among speech-language pathologists. *Health*, *11*, 880–895. https://doi.org/10.4236/health.2019.117071

Wright, J., Sohlberg, M. M., Watson-Stites, R., & McCart, M. (2020). Identification of key therapy ingredients for SLPs serving on multidisciplinary teams facilitating return to learn for students with prolonged cognitive effects after concussion: A retrospective case series analysis. *Topics in Language Disorders*, *40*(1), 6–35. https://doi.org/10.1097/TLD.0000000000000198

Yang, J., Peek-Asa, C., Covassin, T., & Torner, J. C. (2015). Post-concussion symptoms of depression and anxiety in division I collegiate athletes. *Developmental Neuropsychology*, *40*(1), 18–23. https://doi.org/10.1080/87565641.2014.973499

Zemek, R. L., Farion, K. J., Sampson, M., & McGahern, C. (2013). Prognosticators of persistent symptoms following pediatric concussion: A systematic review. *JAMA Pediatrics*, *167*(3), 259–265. https://doi.org/10.1001/2013.jamapediatrics.216

Zhang, A. L., Sing, D. C., Rugg, C. M., Feeley, B. T., & Senter, C. (2016). The rise of concussions in the adolescent population. *Orthopaedic Journal of Sports Medicine*, *4*(8), 1–7. https://doi.org/10.1177/2325967116662458