PROMOTING BEHAVIOR CHANGE IN OLDER ADULTS: A MIXED METHODS STUDY

by

AMY METCALF KEMP

(Under the Direction of Katy H. O'Brien)

ABSTRACT

Although older adults have the highest rates of traumatic brain injury (TBI) incidence, mostly from falls, little research has examined rehabilitative approaches for fall prevention in older adults. Health-behavior changes can help older adults maintain health, safety, and independence and are critical in implementing rehabilitation strategies. Therefore, this mixed-method intervention study examined behavior change and individual health beliefs around fall prevention, as well as the feasibility of the intervention. Participants used mental contrasting with implementation intentions (MCII) to increase adoption and execution of fall prevention recommendations. Behavior change was evaluated in active, passive, and generalized changes. Guided by the Health Belief Model (HBM), the intersection of health beliefs (HB) and behavior changes was also examined. Sixteen older adults participated (10 without TBI and 6 with TBI). There was an unbalanced control group with 2 participants without TBI and 1 with TBI. Question one explored MCII as a strategy for behavior change. Participants in the experimental group demonstrated more change in all types of behavior than control group (65.4% vs 33.3%), and 42.5% generalized MCII. Between injury status, more participants without TBI completed reoccurring events (70%) and passive behaviors (2.8) than the TBI group (16.7%; 1.5). Question two addressed HB related to fall prevention. Despite similar increases in all HBM constructs in all

conditions, people with TBI reported more self-efficacy than those without TBI (U=11.0, z=-2.06, p=.039). Interviews captured how MCII was used for behavior change, as well as how beliefs were related to fall prevention. Finally, question three targeted feasibility of MCII. Clinicians rated the intervention (out of 5) as acceptable: 4.6(.53), appropriate: 4.4(.63), and feasible: 4.6(.53). Similarly, participants in both injury status groups rated MCII as acceptable: 4.8(.40), appropriate: 4.9(.23) and feasible: 4.9(.37). Lastly, people with TBI required more modifications to treatment (e.g., repeating instructions) to participate successfully in MCII (U=11.3, z=-2.0, p=.043). Results suggest MCII may be an acceptable intervention for fall prevention, especially for participants with TBI. Discussions on how health beliefs interact with behavior change, as well as direct instruction for behavior change, can benefit older adults and their participation in fall prevention.

INDEX WORDS: Older Adults, Brain Injury, Behavior Change, Fall Prevention, Health Beliefs, Implementation Outcomes

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DEDICATION

"The work wants to be done, and it wants to be done by you."

-Elizabeth Gilbert, *Big Magic*

If that quote resonates with you, this work, and the surrounding effort, is dedicated to you.

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CHAPTER 1

INTRODUCTION

Falls are the leading cause of death and nonfatal injuries among people 65 and older (older adults) in the United States. In recent surveillance, older adults had the highest number of emergency room visits, hospitalizations, and decreased functional outcomes than any other age group (Peterson et al., 2021). After a fall, older adults can experience reduced mobility, loss of independence, and are at increased risk of future falls and cognitive decline, including earlier onset of dementia (Ambrose et al., 2013; Florence et al., 2018). Currently, 90% of primary care providers (PCP) report discussing fall prevention with older adults, but specific suggestions varied substantially between different types of PCPs (i.e., family practice or nurse practitioner; Burns et al., 2018). Standardized recommendations or assessments are rarely made and therefore decrease older adult exposure and ability to make appropriate fall prevention changes. Effective prevention may be better achieved by implementing techniques within current fall prevention practices to increase older adult awareness and planning to decrease falls and subsequent negative outcomes.

Traumatic Brain Injury Incidence in Older Adults

People 65 and older have the highest rates of emergency room visits, hospitalization, and traumatic brain injury (TBI) related deaths than any other age group (Faul et al., 2010). Older adults with TBI are hospitalized four times more often than younger populations (Coronado et al., 2005). Additionally, recent surveillance found that 26.5% of older adults 75 years and older died from TBI-related injuries, almost all of them due to a fall (Faul et al., 2010). After a fall,

older adults can experience a cascade of consequences of TBI, including reduced mobility or cognitive function (Florence et al., 2018), threatening the independence of an older adult.

A TBI is a physical force that is sufficient to cause structural alteration or physiological disruption of brain function (Centers for Disease Control and Prevention, 2019). A TBI can result in altered consciousness, amnesia, a change in mental state, neurological deficits, and intracranial lesions that are particularly damaging to older adults (Langlois et al., 2006). The severity of TBI is classified as mild, moderate, or severe, depending on three indicators: duration of loss of consciousness, duration of time spent disoriented or confused (post-traumatic amnesia; PTA), and responsiveness, measured by the Glasgow Coma Scale (GCS; Teasdale et al., 2014). In the acute phase of TBI, PTA has been identified as the strongest predictor of outcome as it shows a degree of neuronal loss (Schönberger et al., 2009; Wilde et al., 2006), (cognitive impairment (Draper & Ponsford, 2008; R. L. Wood & Rutterford, 2006), functional outcomes (Doig et al., 2001; Ponsford et al., 2008; Ponsford & Spitz, 2015; Tate et al., 2005), and long-term care costs (Ponsford et al., 2013). TBI can impact multiple domains, such as thinking and learning (i.e., processing, communication, or attention and memory), motor skills, hearing and vision (i.e., weakness in extremities, decreased coordination and balance, changes in sensory perception), emotion/mood (i.e., agitation, aggression, anxiety, or depression), and behavior (i.e., personality changes, impulsivity). The main physiological risk factors place older adults at a significant risk of substantial damage post-TBI: weaker blood vessels, less robust dura mater, and chronic conditions that influence clotting (Alvis & Hughes, 2015). Due to other premorbid conditions that can reduce mobility, strength, or balance and reduce sensory input (e.g., hearing or vision), older adults are multifariously and uniquely at higher risk for falls and TBI (Alvis & Hughes, 2015; Florence et al., 2018). Furthermore, because older age is recognized as a predictor

of worse outcomes post-TBI (Coronado et al., 2005; Czosnyka et al., 2005; Hukkelhoven et al., 2003), addressing fall prevention is an important public health need.

Annually in the US, falls and fall deaths account for $50 billion in direct medical costs (Florence et al., 2018). Alone, TBI is a significant burden on health service resources, with unintentional falls accounting for 47.9% of emergency room visits related to TBI and 52.3% of all hospital stays related to TBI (CDC, 2019). It is estimated that 30-40% of older adults living in the community experience a fall annually and 10% of those who fall experience a significant injury (Michael et al., 2010). This incidence is expected to increase as the US population ages. Older adult patients also have a higher rate of rehospitalizations, home health visits, and weekly hours of unpaid care (Thompson et al., 2012). The consequences after TBI, including greater dependence on others and less functional independence (Mosenthal et al., 2002; Pentland et al., 1987), magnify the economic burden for the care and rehabilitation of older adults post-TBI. Identifying behavioral goals to reduce falls in older adults can decrease spending on post-TBI care.

Behavioral Targets for Fall Prevention

Given that older adults have a higher incidence of TBI and are more likely to experience poorer outcomes after TBI, there are several preventive measures and clinical management guidelines. Although 90% of healthcare providers report providing fall prevention education in some capacity (Burns et al., 2018), there is a lack of standardization that decreases the likelihood of older adults implementing fall prevention behaviors. For example, although falls may be discussed, less than 60% of PCPs routinely screen their older patients for fall risk (T. S. Jones et al., 2011; Smith et al., 2015) or discuss risk factors for falls (Smith et al., 2015). Most PCPs reported a lack of educational material or training on clinical guidelines (Jones et al., 2011).

Components of educational materials for older adults have previously been identified in several evidence-based interventions (Calhoun et al., 2011; Howland et al., 2018; Tricco et al., 2017). A recent review to generate a level of agreement among all current programs found 15 guidelines that are present in the literature and programs, such as assessment tools, exercise intervention, and environmental modifications (Montero-Odasso et al., 2021).

Fall prevention programs should include a multifaceted approach to include all essential fall risks and intervene as necessary to decrease falls (Avin et al., 2015; Tricco et al., 2017). CDC's Stopping Elderly Accidental Deaths and Injuries (STEADI) is an initiative designed to help healthcare providers standardize the screening, evaluating and intervening process related to fall risk and risk factors for falls (Stevens & Phelan, 2013). This toolkit allows healthcare providers to identify and treat modifiable risk factors for falls with effective interventions. The STEADI initiative has coordinated care plans and Evaluation Guides for care providers to implement a STEADI-based clinical fall prevention program (Eckstrom et al., 2017; Johnston et al., 2019). STEADI has been implemented successfully in several large primary care health systems (Casey et al., 2016; Eckstrom et al., 2017; Smith et al., 2017). Current practice involves an assessment and algorithm that determines a low, moderate, or high risk of falling and appropriate educational materials. Although the implementation of STEADI has demonstrated a 30% decrease in falls in a large health system, 49% of patients still experienced a fall in the reporting period (Parker et al., 2017). Therefore, screening and education alone may not be enough to successfully reduce falls. Furthermore, behavior change is difficult from passive health education alone because it places too much burden on the person to identify and overcome obstacles needed to be successful (Cheng et al., 2018), thus contributing to the decreased success of such preventive measures.

Health Belief Model

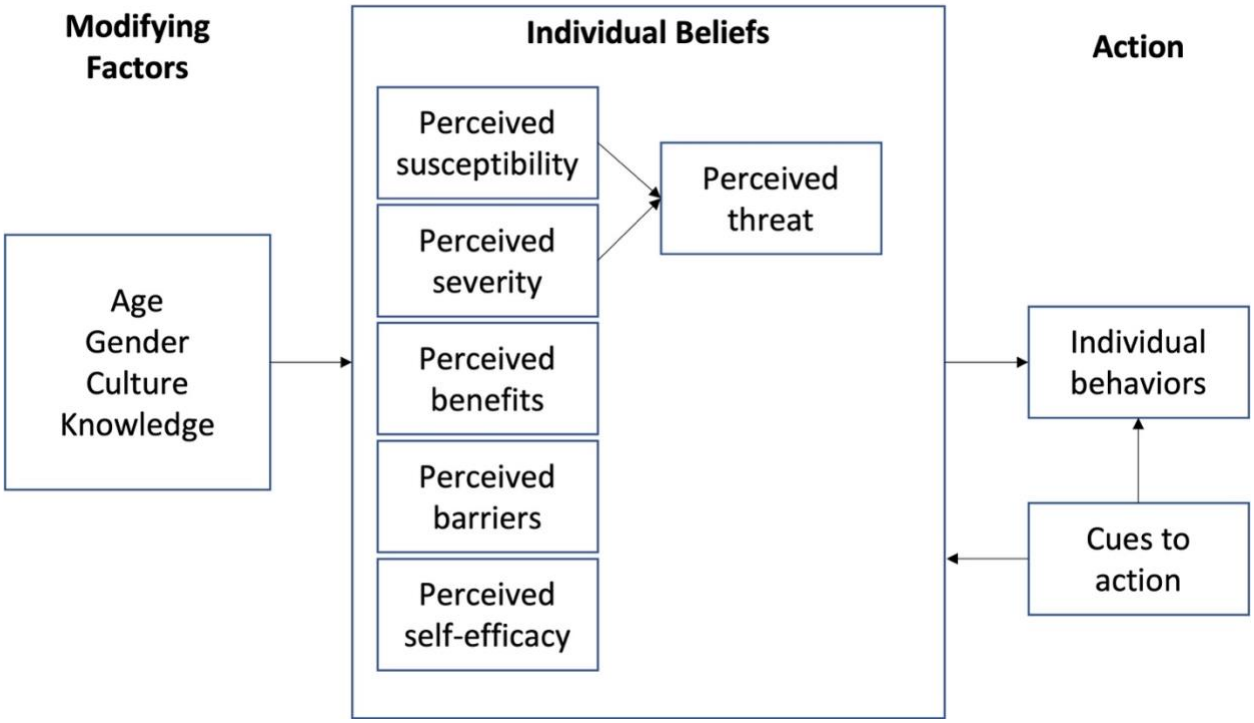
The Health Belief Model (HBM) is used to predict health behaviors (Rosenstock, 1974) and has been applied to several diverse behaviors such as drug use, participation in exercise, and cessation of smoking (Carpenter, 2010). The HBM constructs are commonly divided into five sections (Rosenstock, 1974). These are knowledge, perceived susceptibility, perceived seriousness, decisional balance (perceived benefits versus perceived barriers), and cues to action. As more research was conducted on HBM, self-efficacy was also added as an important modifying factor (Janz & Becker, 1984). In the context of falls prevention, *knowledge* is defined as the amount of information someone understands about falls (i.e., prevention, risk factors, signs and symptoms, and management). *Perceived susceptibility* refers to one's view on how vulnerable one is to a fall, while *perceived severity* is defined as the anticipated consequences of a person that can result after a fall. *Perceived threat* is the combined effect of susceptibility and severity. *Decisional balance* encompasses the weight of each positive or negative action. For example, making a vision appointment may be beneficial, but the lack of eye insurance may be perceived as a barrier. *Cues to action* refer to factors that alert someone to action, such as educational materials. Finally, *self-efficacy* is a person's individual belief in their ability to take necessary steps for specific goals or behaviors (Bandura, 1996).

The HBM helps distinguish constructs that may be involved with health behaviors. Several research studies have found that HBM constructs predict behavior, actions required for desired outcomes, and intentions, self-instructions to perform actions directed toward attaining a desired outcome (Azizi et al., 2018; Langley et al., 2018; Saunders et al., 2013; Winfield & Whaley, 2002). Sheeran (2002) meta-analyzed 10 previous meta-analysis, finding a large correlation between intentions and subsequent behaviors (r=.53). Figure 1 demonstrates how the

constructs are related to each other and action enactment. As shown, modifying factors, such as knowledge, may moderate the relationship between health beliefs and health actions. Additionally, cues to action may influence individual behaviors or individual beliefs.

Figure 1

Health Belief Model (Rosenstock, 1974; Janez & Beck, 1984)

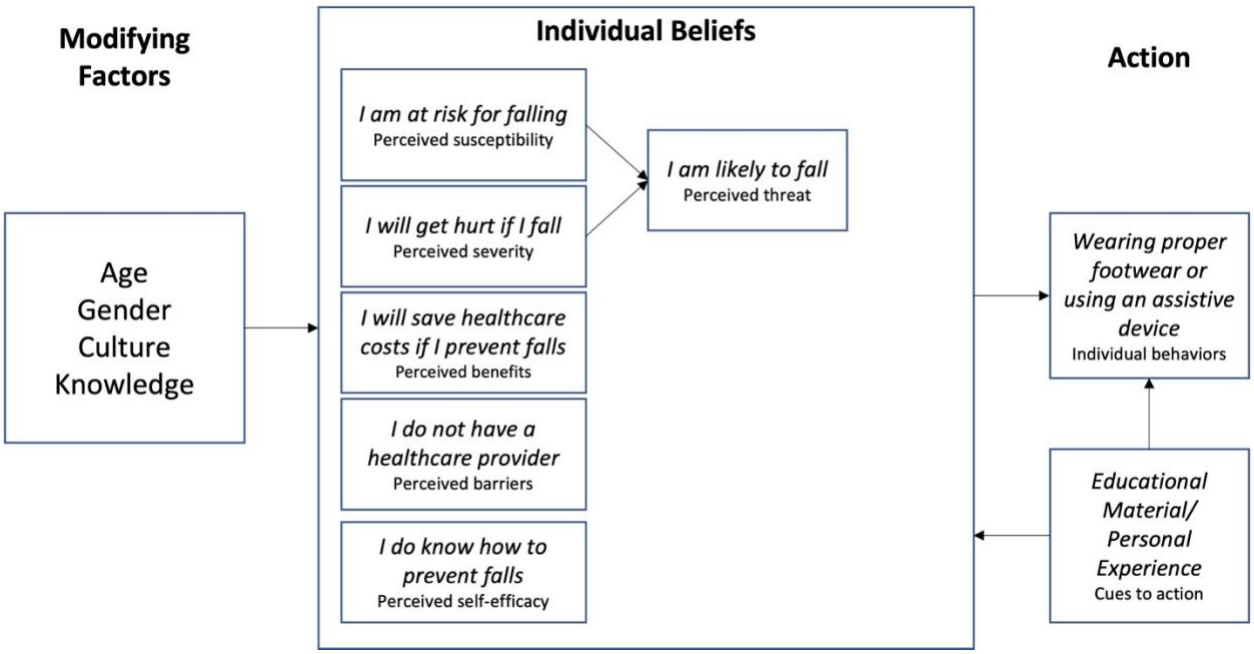


An application of HBM in fall prevention is demonstrated in Figure 2, which models Figure 1 but with examples of each construct as it applies to fall prevention. As demonstrated, the interaction between variables influences whether an older adult will complete recommended preventive health actions, such as wearing proper footwear. There can be positive or negative influences on individual perceptions and beliefs about the likelihood of falls and absent or significant modifying factors that can affect action enactment. The HBM provides a framework for considering factors that may influence decisions about health behaviors and participating in

preventive measures, as well as how cues to action may impact health beliefs and individual behaviors.

Figure 1

Application of Health Belief Model (Rosenstock, 1974) adapted for fall prevention



Implementation Intentions

Although most research has indicated that intentions are the biggest predictor of behavior change (Ajzen, 1991; Bandura & Watts, 1996), there is still a discrepancy between intentions and behavior change (Webb & Sheeran, 2006). In fact, intentions only become action approximately 50% of the time (Sheeran, 2002). Certain characteristics of intentions can be helpful in closing the intention-behavior gap (Sheeran & Webb, 2016). Particularly for health-related behaviors, the development of effective interventions to develop strong intentions and promote sustained self-initiated behavior change can potentially decrease the intention-behavior gap and lead to reduction of several behavioral risk factors for falls. Self-regulation strategies

that can be easily implemented in cost-effective, scalable ways in public health settings are one method of implementing behavior change (Sheeran et al., 2013).

One self-regulation approach that has been implemented in a variety of health behavior settings is mental contrasting with implementation intentions (MCII; Oettingen, Mayer et al., 2010; Oettingen, 2012). MCII combines two strategies that each provide complementary benefits to support behavior change. *Mental contrasting* involves comparing thoughts about the future with the present reality, thereby providing direction for achieving desired futures (Oettingen, 2000; Oettingen et al., 2001). For example, picturing oneself finishing a major project while just beginning it can produce strong goal commitment. Mental contrasting is based on fantasy realization theory (Oettingen, 2000, 2012), which classifies mental contrasting as a self-regulation imagery tool. Mental contrasting has shown effectiveness in improving cognitive, affective, motivational and behavioral outcomes (Johannessen et al., 2012; Kappes et al., 2012; Oettingen, 2000, 2012; Sevincer & Oettingen, 2013). Mental contrasting helps people to discriminate between feasible and unfeasible futures and strengthens associative links between obstacles and instrumental behaviors to overcome (Kappes et al., 2012). In the health domain, mental contrasting alone has demonstrated effectiveness in promoting behaviors to manage chronic pain (Adriaanse et al., 2013). A recent meta-analysis found that mental contrasting has a significant and small-to-moderate effect on changing health behaviors within 24 hours to 1 month (g=0.27; Cross & Sheffield, 2019). However, a significant limitation with mental contrasting is that some individuals are not successful in developing practical goal commitment and goal-directed behavior (Oettingen, 2012), and thus in establishing sustained changed behavior.

Another common self-regulation tool used in behavior change is the use of implementation intentions. Implementation intentions detail when, where, and how goal intentions will be executed to automate goal-directed behaviors (Gollwitzer, 1999, 2014). Typically provided in the format of “if-then” plans, participants specify a relevant cue and then link the cue to appropriate and desired goal-directed responses. For example, in studies aimed at increasing healthy snacking, the participant can identify the cue: 'if I have a chocolate craving' and tie the cue to a goal-directed response: 'then I will eat a healthier alternative, such as an apple.' Greater goal attainment is achieved by instigating an automatic action control plan to a specific cue situation. The efficacy of implementation intentions has been confirmed in a meta-analysis with 94 studies, finding a medium to large effect (*d*= 0.61; Gollwitzer & Sheeran, 2006). However, behavior change is not always successful with implementation intentions, as some individuals are not able to target strong goal commitments or obstacles that may interfere with goal pursuit.

Mental contrasting with implementation intentions (MCII) therefore combines two complementary strategies for increasing behavior change. Mental contrasting (MC) provides targeted goal pursuit (desired outcomes and the obstacles that hinder it), and implementation intentions (II) further strengthen the associative link between obstacle and instrumental behavior (Oettingen et al., 2018). By using both techniques, the outcome is better formed intentions and identified obstacles (MC) that can be linked to goal-directed behaviors, thereby reducing the cognitive effort in changing behavior, and addressing other hurdles for behavior changes (II). MCII has been observed to be more successful than mental contrasting or implementation intentions alone in the change of healthy eating behavior (Adriaanse et al., 2010), integrative bargaining (Kirk et al., 2013), and creative expression (Thürmer et al., 2017). Most recently in

the health domain, MCII was found to be successful in managing stress reduction behaviors (Gollwitzer et al., 2018) and reducing sleep procrastination (Valshtein et al., 2020). Additionally, studies in educational psychology have found that MCII is more effective in building study habits (Duckworth et al., 2011, 2013). More research is needed to evaluate whether MCII is more strongly associated with behavior change compared to each strategy individually; however, results from several health domains (healthy eating, procrastination of sleep, stress reduction) support MCII as an effective tool for behavior change. In essence, MCII helps identify the most important idiosyncratic person obstacle (the *if*-part) and link to an action (the *then*-part). As such, MCII should increase the application of self-regulation strategies through better situational awareness or greater self-efficacy due to the personalized and automatic elicitation of targeted responses. Hence, strategic planning with MCII may be a successful educational tool for promoting fall prevention in older adults, and thus reduce falls.

Research Questions

Research questions and goals evaluated the feasibility of MCII as an intervention for behavior change for fall prevention compared to status quo care. The primary objective of the study was to explore MCII as a behavior change intervention for older adults with and without a history of traumatic brain injury. Research questions to meet the objective were:

> **RQ1:** Was there behavior change in completing fall prevention acts, and how did older adults describe if and how the strategy was used?
>
> **RQ2:** Did MCII change HBM constructs and how are HBM constructs perceived by older adults as related to fall prevention health decision-making?
>
> **RQ3:** How do older adults and clinicians evaluate MCII as an intervention for fall prevention, and what are areas the HBM contributes to the intervention?

Question one addressed how successful MCII is in promoting behavior change for fall prevention acts. To measure the success of MCII as an intervention, the dependent variables were active behavior change, passive behavior change, and exploratory generalized change. The independent variables were the instructional intervention (condition) group and injury status group. Active behavior change was measured with the two active plans created in the intervention: one single event and one reoccurring. Active plans were classified binarily (completed or not completed). Passive behavior change included two measures: intended and actual. Intended behaviors were behaviors selected from the education materials the participant felt they would address for the first time during the study period. Intended behaviors did include the active plans created at Time 1. Actual passive behavior was categorized as other behavior changes that were provided in the educational materials the participant reported as completed at Time 2. Actual passive behavior did not include the active plans created at Time 1. A subset of participants from the experimental group provided qualitative data about MCII generalization, or if the MCII strategy was used to execute untrained plans for a new behavior or setting. Mixed measures evaluated if MCII was successful, as well as elaborating on why the behavior did or did not happen.

The second question of this mixed methods study examined the extent to which HBM constructs changed because of the intervention and how they had contributed to the implementation of the behavior changes for fall prevention. The dependent variable was the HBM questionnaire at two time points, pre-intervention and post-intervention, with each construct assessed on a Likert scale. A subset of participants provided qualitative data in a follow-up interview. Mixed measures evaluated how knowledge, susceptibility, severity, threat, benefits, barriers, self-efficacy, and cues to action were associated with the intervention.

Furthermore, participants described specific barriers or facilitators to MCII and reflected on any behavior changes to reduce falls due to the intervention. The interviews provided insight into perceptions that affected behavior change, such as perceptions of threat to brain health posed by falling, and factors that influenced the decision to practice health-promoting behavior, such as maintaining autonomy and independence while aging.

The third question evaluated the feasibility of the intervention from both a participant and a clinical perspective. Evaluation of MCII as an intervention itself was conducted with four dependent measures: implementation outcome measures (IOM) from participations and clinicians, Therapist-Adherence and Client Participation (TACP; clinicians), Modifications to Treatment (MT; clinicians), and Pragmatic-Explanatory Continuum Indicator Summary Tool (PRECIS-2; clinicians). Implementation outcome measures included ratings of the feasibility, acceptability, and appropriateness of the intervention (Weiner et al., 2017). Feasibility data was compared between groups (condition and injury status) to evaluate differences between the experimental intervention and status quo education. A subset of participants was asked interview questions related to the study and methods to improve implementation (Curran et al., 2012). Clinician data also included written response questions related to the study and its application of MCI. The TACP and MT measures (Wiltsey Stirman et al., 2013, 2015) provided quantitative data to inform the feasibility of the intervention from a clinical perspective. Finally, at the end of the study, all clinicians completed an evaluation using the PRECIS-2 (Loudon et al., 2015). This tool assessed the applicability of the intervention in preparation for future large-scale evaluation.

CHAPTER 2

LITERATURE REVIEW

Traumatic Brain Injury from Falls in Older Adults

Although sports- and military-related traumatic brain injuries (TBI) are often represented in the media, the highest combined incidence of TBI-related emergency room visits, hospitalizations, and deaths occurs in older adults (Faul et al., 2010; Ramanathan et al., 2012; Taylor, 2017). The injury mechanism, patient characteristics, and biological sequelae of TBI in older adults are different from those of younger populations. Epidemiologically, TBI is more likely to occur from an unintentional fall in older adults, while younger populations are more likely to sustain a TBI from motor vehicle accidents (CDC, 2019). Biologically, older adults have white matter and vasculature that are more susceptible to injury or complicated injury from an otherwise mild TBI (Ikonomovic et al., 2017; Liu et al., 2017). Furthermore, biological response mechanisms, such as autophagy and removal of damaged or old proteins and organelles, are less regulated, resulting in increased susceptibility to neurological disorders such as Alzheimer's (Yin et al., 2017). Pre-existing neurological or systemic comorbidities increase with age, which also places older adults at higher risk of TBI. Older adults with cerebrovascular disease, high depression symptoms, and reduced independence from activities of daily living had a higher incidence of TBI (Dams-O'Connor et al., 2016).

As a result, older adults with TBI experience higher morbidity and mortality (Coronado et al., 2005; Dams-O'Connor et al., 2013; McIntyre et al., 2013; Ramanathan et al., 2012) as well as slower recovery trajectories (Frankel et al., 2006; Green et al., 2008; Mosenthal et al., 2004),

often resulting in worse functional, cognitive and psychosocial outcomes compared to younger populations (Cuthbert et al., 2015; Mosenthal et al., 2004; Rapoport & Feinstein, 2001; Stocchetti et al., 2012; Thompson et al., 2006, 2012). Although older adults are at higher risk for mortality, some older adults who survive TBI, including severe TBI, recover well. In fact, an adjusted age-related decline in cognitive function demonstrates that older adults have equivalent or even better cognitive outcomes than younger populations with TBI (Mathias & Wheaton, 2015), suggesting that chronological age and severity of TBI alone are not good prognostic markers (De Bonis et al., 2010; Lilley et al., 2016; Taussky et al., 2012). Additionally, evidence suggests that inpatient rehabilitation benefits older adults with TBI (Uomoto, 2008), with overall net functional gains not differing from younger populations (Frankel et al., 2006).

However, given the high incidence and mortality risk, there is still a need to develop a consensus on geriatric-specific guidelines for clinical management in all areas of treatment, management guidelines and targeted fall prevention strategies (Gardner et al., 2018; Montero-Odasso et al., 2021; Røe et al., 2015; Staples et al., 2016). The inclusion of older adults in TBI treatments can better inform the development of the clinical guidelines needed (Gardner et al., 2018). Furthermore, older adults can benefit from interventions for fall prevention, particularly in cost-effective, efficient solutions for disseminating information and by incorporating pre-injury function and comorbidities to inform healthy aging and fall prevention.

Current Fall Prevention Guidelines and Practice

There are several systematic reviews to provide guidelines for fall prevention and management (American Family Physician, 2018; American Geriatrics Society, British Geriatrics Society, et al., 2001; Baraff et al., 1997; Feder et al., 2000; Rimland et al., 2017; Stevens & Phelan, 2013). A recent systematic review (Montero-Odasso et al., 2021) evaluated clinical

guidelines for fall prevention. Fifteen high-quality practice guidelines for fall prevention and management were identified for the assessment, prevention, and management of risk of falls in older adults. Table 1 provides the 15 guidelines along with Montero-Odasso et al.'s (2021) mode Grades of Recommendation, Assessment, Development, and Evaluation (GRADE; Andrews et al., 2013) ratings which indicate the strength of recommendation (1= strong; 2=weak) and quality of evidence (A=high quality; B=moderate quality; C=low quality).

Table 1

Fall Prevention Guidelines from Montero-Odasso et al., 2021

Guidelines	No (%) of articles providing guideline	Mode of GRADE score
Assessment Tools	15 (100)	1A
Exercises interventions	15 (100)	1A
Environment modification	14 (93)	1A
Medication review	14 (93)	1A
Multifactorial interventions	14 (93)	1A
Physiotherapy referral	13 (87)	1A
Risk stratification	13 (87)	1A
Footwear evaluation and intervention	12 (80)	1A
Fractures and osteoporosis management	11 (73)	1A
Cardiovascular intervention	13 (87)	1B
Vision modification	13 (87)	1B
Falls education	12 (80)	Mixed
Cognitive factors management	11 (73)	Mixed
Vitamin D supplementation	11 (73)	Mixed
Hip Protectors	9 (60)	Underrepresented
Technology	7 (47)	Underrepresented

Nine of the 15 recommended guidelines had the highest GRADE rating (1A). In all articles, assessment tools were recommended to detect fall risk and exercise interventions. The modification of the environment, the review of medications, and multifactorial interventions to manage falls were recognized in 14 of the guidelines. Physiotherapy referral and risk

stratification were recommended in 13 articles. Risk stratification involves case-finding with self-report on fall history, fear of falling and gait and balance report, and reserving gait and balance screening for high-risk individuals. Finally, the evaluation and intervention of proper footwear (n = 12) and the treatment of fractures and osteoporosis (n = 11) were included in the highest rated guidelines.

Mixed findings on fall education and cognitive factors management were mainly due to variation in settings (e.g., community-dwelling vs. skilled nursing facilities) and a lack of specific recommendations. Cognitive evaluation is recommended in most assessments due to the high risk factor for falls in older adults with executive function deficits, even in those without a formal diagnosis of cognitive impairment or dementia (Deandrea et al., 2010; Fernando et al., 2017; Kearney et al., 2013; Muir et al., 2012). In previous studies, exercise with cognitive training can reduce the risk of falls in older adults with mild cognitive impairment (Lipardo et al., 2017). A systematic review found that targeting executive function in fall prevention has increased reaction time and attention, thus reducing fall rates (Montero-Odasso & Speechley, 2018). More evidence is needed to confirm the benefit of cognitive training for fall prevention and further determine the specific components of cognitive training implementation.

However, in the most current fall prevention guidelines, few include clinical applications such as implementation recommendations (n=3, 20%) or implementation procedures (n=5, 33%; Montero-Odasso et al., 2021). The best example of a program designed specifically to address implementation recommendations and procedures is provided in the Centers for Disease Control and Prevention initiative Stopping Elderly Accidents, Deaths, and Injuries (STEADI; *CDC*, 2021). STEADI is an initiative designed to help healthcare care providers standardize the process of screening, evaluating and intervening with respect to risk of falls and risk factors for falls

(Stevens & Phelan, 2013). This tool was originally developed in primary care facilities (Phelan et al., 2015). However, physical therapists and nurses have also used the STEADI fall risk algorithm to assess fall risk (Reinoso et al., 2018; Taylor, 2017). The STEADI toolkit has coordinated care plans and evaluation guides for care providers to implement (Eckstrom et al., 2017; Johnston et al., 2019), including a questionnaire and algorithm that provide a classification system of low, moderate, or high fall risk (Stevens & Phelan, 2013). Furthermore, STEADI incorporates all recommended guidelines summarized by the US Preventive Services Task Force (Montero-Odasso et al., 2021; see Table 1) and is closely aligned with the French Society of Geriatrics and Gerontology, the American Geriatrics Society, the British Geriatrics Society and the American Academy of Orthopedic Surgeons Panel on Falls Prevention. The materials used in STEADI have been found to be effective in preventing falls in older adults, potentially up to 25% (Houry et al., 2016), making the materials highly appropriate for clinical settings.

Intention-Behavior Gap

Especially for change in health behavior, interventions should consider the intention-behavior gap. A meta-analysis of experiments that manipulated the intention of participants demonstrated that a medium to large change in intentions only led to a small to medium change in behavior (d=.36, Webb & Sheran, 2006). This finding shows that intentions are related to, but do not always guarantee, behavior change (Fife-Schaw et al., 2007). The intention-behavior gap is created when the intention to act is not enough to prompt behavior change people (Rhodes & de Bruijn, 2013). For behaviors that lead to health outcomes, most require reoccurring behaviors for permanent change, which are incredibly challenging compared to one-time behaviors for change (Neal et al., 2006). To improve the translation of intention into action, investigating what

creates stable intentions and overcomes critical problems often comes from tools and strategies such as goal-setting, planning, and progress monitoring approaches.

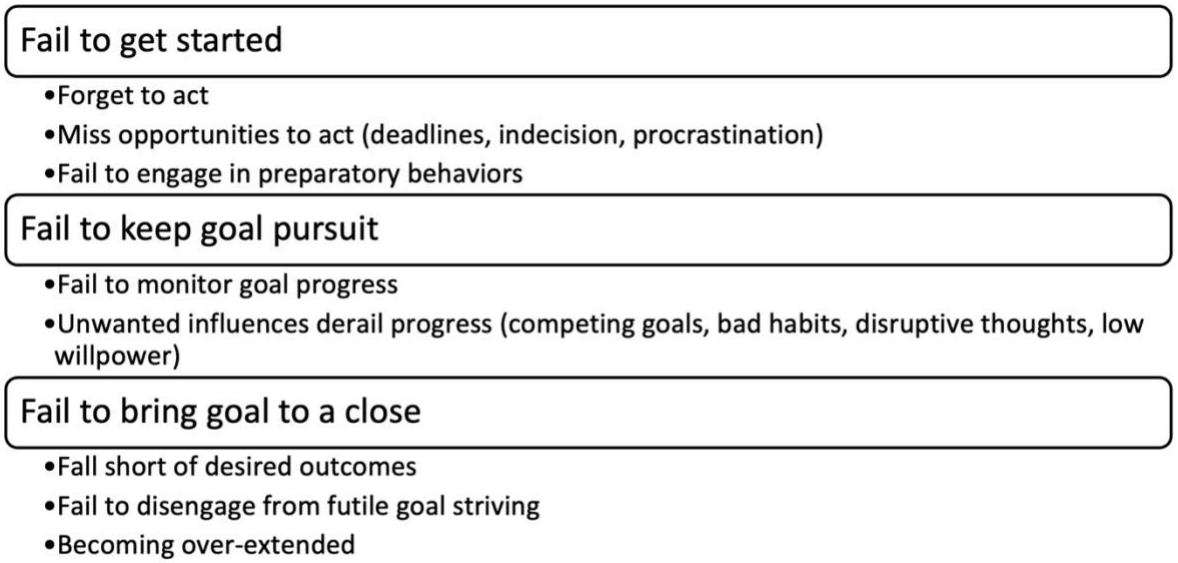
First, investigating what creates stable intentions includes examining goal dimensions, the basis of intention, and the properties of the intention. Previous research has found that when a person's goal is focused on promotion vs. prevention (Higgins, 1997), autonomy vs. control (Ryan & Deci, 2000), learning or mastery vs. performance (Dweck & Leggett, 1988), and is concrete vs. general (Locke & Latham, 2013), more achievement is demonstrated. Additionally, defining the difficulty of a goal is also essential, which includes resources, abilities, skills, opportunities, time, and effort (Sheeran, 2002). The basis of intention is also essential to consider, as it includes the factors that guide intention formation. The theory of reasoned action and planned behavior (TRA/PB; Ajzen, 1991), which assesses psychosocial components that influence intentions, found attitudes were more influential than social norms and knowledge in creating intentions (Sheeran & Orbell, 1999). Other past research has found that when a person has greater feelings of moral obligations or anticipated regret about failing to act, they may also guide stronger intentions (Conner et al., 2006; Godin et al., 2014). Several factors can challenge or strengthen an intention, including conflicts of desire (De Witt Huberts et al., 2014; Taylor et al., 2014), relevance to personal identity (Gollwitzer et al., 2009; Rise et al., 2010), experience with behavior (Sheeran et al., 2017). Experience with the behavior has paradoxical effects, proposed to be dependent on the degree to which the behavior is incorporated into sense of self or identity over time or, rather than as a standalone habit (Gollwitzer et al., 2009). For example, older adults who do not identify or consider themselves vulnerable may be less likely to persist in fall prevention efforts even after education and a period of behavior change.

Examining the properties of intentions also provides reasonable indications of goal commitment. If an intention has a direction ("I will finish this paper"), intensity ("…no matter what happens"), accessibility ("…with the help of my committee"), certainty ("I know I can do this"), and temporal and intention stability ("In 3 months, I will still have to finish this paper"), it is more likely that substantial goal commitment and achievement will result (Conner & Godin, 2007; Cooke & Sheeran, 2013). Temporal and intention stability have the strongest association with goal achievement because it represents firm goal commitment (Cooke & Sheeran, 2013).

People face several self-regulation challenges as they align their intentions with behaviors (Gollwitzer et al., 2009; Gollwitzer & Sheeran, 2006). Of these, three are the most prominent: getting started, maintaining pursuit, and bringing goal pursuit to a close. Figure 3 shows how each of these can present a challenge.

Figure 2

Key problems impacting goal achievement and behavior change (Gollwitzer et al., 2018)



Therefore, progress monitoring and goal-setting and planning tools can address creating appropriate and strong intentions and goals as well as overcoming critical problems. Planning is

considered the most prominent strategy to overcome the intention gap (Sheeran & Webb, 2016). Furthermore, older adults may particularly benefit from planning to reach health goals, as demonstrated in studies for increasing physical activity in older adults (Klusmann et al., 2012; Reuter-Lorenz & Park, 2010). The prominent goal setting and planning tools in the literature include mental contrasting (MC), implementation intentions (II), and the combination of mental contrasting and implementation intentions (MCII).

Mental Contrasting

Mental contrasting (MC) was first introduced by Oettingen (2000) to increase goal desirability and reflect on the main obstacles to achieving it. There are three steps to mental contrasting; 1) defining an important desire; 2) identifying the best outcomes of goals and vividly imagining them, and 3) identifying and subsequently imaging an obstacle in the present reality that stands in the way of obtaining the desired future. This process leads to high goal desirability and goal attainment, resulting in a greater commitment to goals (Oettingen, 2012). MC alone interventions have created strong commitment in various domains and demonstrated immediate effects lasting up to several weeks (Johannessen et al., 2012; Sevincer & Oettingen, 2013). Previous research has focused on achievement and interpersonal domains, finding that MC has increased management of everyday life (Oettingen, Stephens, et al., 2010) and heightened creative performance (Oettingen et al., 2012). In health domains, MC has shown utility in promoting protective health behaviors and the treatment of chronic conditions (Adriaanse et al., 2013), chronic back pain and stroke rehabilitation (Marquardt et al., 2017), and smoking reduction (Mutter et al., 2020). MC provides support for setting feasible and realistic goals and identifying activities to disengage from to reach the desired future (Oettingen et al., 2001). Cross & Sheffield (2019) found a small to moderate effect on changing health behavior for up to four

weeks. However, some studies found longer-term effects (up to 1 year; Marquerdt et al., 2017). Mental contrasting activates, compared to alters, an individual's expectations of success (Adriaanse et al., 2010; Oettingen, 2012; Oettingen et al., 2001). By teaching people MC as a metacognitive strategy, people can better prioritize which goals to pursue and ignore (Adriaanse et al., 2010, 2013; Stadler et al., 2009, 2010). Furthermore, MC helps process the information needed to analyze obstacles and categorize them into manageable parts (Kappes et al., 2013), which provides the energy needed to overcome them (Oettingen et al., 2009).

Mental contrasting has not been specifically evaluated in TBI populations; however, the use of visual imagery interventions has shown some efficacy. For example, people with TBI who were instructed to visual press a button when seeing a specific cue word had higher performance than those without the strategy (McFarland & Glisky, 2011). Visual imagery has also been used with participants with stroke for event-based and time-based tasks in laboratory studies (Griffiths et al., 2012; Mitrovic et al., 2016), making visual imagery a strategy for prospective memory tasks in clinical populations.

However, MC may not be effective for people who do not have high expectations of success, as MC could potentially reduce goal striving and lead to goal disengagement (Oettingen, 2012). Further, some people may have trouble translating their commitments into actions, especially when asked to adjust engrained behaviors (Armitage & Conner, 2001; Webb & Sheeran, 2006).

Implementation Intentions

When behavior change is challenging – like adapting, replacing, or establishing habitual behaviors – implementation intentions (II) can be helpful to automate goal attainment (Gollwitzer, 1999, 2014). Typically, in an if/when-then plan, II defines precisely when, where,

and how one wants to act to reach a goal (Gollwitzer, 1993, 1999). Whereas goal intentions merely specify a desired future outcome, an II specifies a cue and a goal-directed response. The *if*-component of II specifies when and where to act on this goal (i.e., specific situational cue). The *then*-component of an II specifies the response to be taken. II increases activation levels and creates stronger associative links between the mental representation of the situation and the specified response (Webb & Sheeran, 2007, 2008). This association has been stable over time, lasting more than a year in some experiments (Papies, 2017). The strategic automaticity created by II makes the execution of the desired response more immediate, efficient, and automatic (Gollwitzer, 1999), thereby providing guidance when capabilities limit goal-achieving (Bayer & Gollwitzer, 2007), barriers limit progress (Trötschel & Gollwitzer, 2007), or in habitual behavioral responses (Wood & Neal, 2007). The strong associative link to behavior has also been demonstrated in electroencephalography (EEG) data when people with phobias create if-then plans for an ignore response (Gallo et al., 2009). II demonstrated decreased reflexive fear responses and increased automatic ignore responses (reflected in smaller P1). Additionally, Gollwitzer & Sheeran (2006) conducted a meta-analysis to examine the effectiveness of II finding that medium effects for goal attainment (d=.61), and similar effects for health goals (d=.59). Further, II had similar effectiveness when goals were experimenter and user-generated, noting that both result in comparable goal achievement (Gollwitzer & Sheeran, 2006).

Implementation intentions specifically address the key problem of behavior change, namely, initiation. II enhances prospective memory in time- and event-based scenarios (e.g., (Chasteen et al., 2001; Chen et al., 2001; Mcdaniel et al., 2008; Rummel et al., 2012; Zimmermann & Meier, 2010). Recent studies have found that II helps implement a new vitamin or medication routine (Brown et al., 2009; Scholz et al., 2009; Sheeran & Orbell, 1999),

increasing vaccination rates (Milkman et al., 2011), and increasing voter turnout (Nickerson & Rogers, 2010). Furthermore, II helps to overcome reluctance to act, as demonstrated in several preventive health scenarios, such as obtaining a mammography (Rutter et al., 2006), undertaking a testicular self-examination (Sheeran et al., 2005), and performing cervical cancer screening (Sheeran & Orbell, 2000), or colorectal cancer screening (Neter et al., 2014). In addition, II helps to promote health actions such as resuming activity after joint replacement surgery (Orbell & Sheeran, 2000), eating a low-fat diet (Armitage, 2004), or engaging in more physical exercise (Milne et al., 2002). Other promotional activities like recycling (Holland et al., 2006), using public transportation rather than one's car (Bamberg, 2002), and purchasing organically produced food (Bamberg 2002) have also increased because of II interventions.

Specifically for older adults, IIs have been used as a mnemonic strategy for prospective memory interventions. Several studies have shown that II have increased prospective memory performance (Jones et al., 2021). For example, Zimmerman & Meier (2010) demonstrated that older and younger adults benefitted from II in an ongoing lexical decision task ("when I see an animal word, I will press the 1 key with my left index finger as quickly as possible;" pg. 7). More recently, Henry et al. (2020) found that older adults using II performed similarly to younger adults without strategies in Virtual Week stimulation, a game of recalling tasks as if it were a normal day (i.e., at 10 a.m. attend the doctor's office by rolling the dice). In natural settings, II have been observed in older adults in remembering to check blood pressure (Brom & Kliegel, 2014) or writing the day at the top of forms (Burkard, Rochat, Emmenegger, et al., 2014; Chasteen et al., 2001; McFarland & Glisky, 2011). II have therefore been successful with health older adults as a prospective memory strategy in immediate to 2-week intervals.

The results of the II interventions have mixed efficacy in clinical groups. Two studies have shown benefit in using II with older adults with cognitive impairment on the Virtual Week task (Alzheimer's Disease; Shelton et al., 2016; Parkinson's; Foster et al., 2017; and multiple sclerosis; Kardiasmenos et al., 2008). Others have shown that those with lower memory indexes (Burkard et al., 2014) and advanced aged (M=81; Schnitzspahn & Kliegel, 2009) did not benefit from the use of II. One study found no differences in objective tasks in a mixed cognitive impairment sample, but participants subjectively reported increased memory (Burkard et al., 2014).

Even so, implementation intentions are only effective when they are based on solid goal commitment (Sheeran et al., 2005), specific and critical situational cues readily detected when encountered in real life (Parks–Stamm et al., 2007), and related to a single goal (Verhoeven et al., 2013). Weak goal commitments undermine the effectiveness of if-then plans because people do not act on their plans (Sheeran et al., 2005).

Mental Contrasting with Implementation Intentions

Mental contrasting with implementation intentions (MCII) combines both mental contrasting and implementation intentions (Oettingen and Gollwitzer, 2010). MCII is a strategy that is evidence-based, process-oriented, and uses complementary strategies to improve goal pursuit (goal commitment and goal striving) and implementation. Participants first complete mental contrasting (MC) to create strong goal commitment and identify obstacles that may be in the way of goal attainment. Then participants complete implementation intentions (II) to help translate goal commitment into actual behavior. When MC and II are used in combination, the identification of personally relevant obstacles can be specified with critical cues and associated actions, therefore increasing goal commitments with high expectations of success.

MCII has been effective as an intervention in numerous studies, many in the health domain. MCII has been used to increase healthy eating and physical exercise for 4 months (Stadler et al., 2009), increase fruit and vegetable consumption for more than 2 years (Stadler et al., 2010), and decrease red meat intake for 5 weeks (Loy et al., 2016). MCII has also increased physical exercise and weight loss in patients who had a stroke for over 1 year (Marquardt et al., 2017), and increased physical activity in patients with chronic back pain for over 3 months (Christiansen et al., 2010). Sailer et al. (2015) also reported increasing autonomy in exercise routines in patients with schizophrenia in a clinical hospital. MCII has also been applied to student study programs (Duckworth et al., 2013), online course completion (Kizilcec & Cohen, 2017), decreasing sleep procrastination (Valshtein et al., 2020), increasing stress management strategies in nurses (Gollwitzer et al., 2018), and improving time management in students (Oettingen et al., 2012), and working mothers returning to school (Oettingen et al., 2015).

A recent meta-analysis (Cross & Sheffield, 2019) analyzed a subgroup of MCII studies (n=7) and found that MCII had a similar effect to MC or II alone; however, studies without a control group were excluded (i.e., Adriaanse et al., 2010). More research is needed to determine whether MCII is the most effective strategy compared to just MC or II alone. However, in the experimental study by Adriaanse et al. (2010), MCII, MC, and II were all compared in an intervention to reduce unhealthy snacking habits. All three groups received the same educational material on healthy snacking, alternative snacks, and consequences of unhealthy snacking for three weeks and then engaged in their respective technique. The MCII group had more success in reducing unhealthy snacking than mental contrasting or implementation intentions alone. MCII provides at least the same effect, if not more effective, behavior changes compared to other goal-setting and planning strategies.

Additionally, MCII has been used in an intervention with spousal care partners of persons with dementia (Monin et al., 2022) to achieve attainable goals in everyday life to improve care partners' well-being and improve relationships with partners with dementia. Monin et al. (2022) randomized 45 dyads into a MCII training or waitlist condition. After 3 months, the care partners with MCII training had a decreased perceived stress, a higher quality of life, and a positive affect. Therefore, MCII is also beneficial in improving mental health and coping strategies in care partners of people with dementia. This is consistent with the use of MCII in other mental health contexts (Oettingen, 2014).

MCII targets internal factors with the use of conscious imagery to help regulate nonconscious cognitive, motivational, and emotional processes that may mediate behavior change (Kappes et al., 2012, 2013; Kappes & Oettingen, 2014; Oettingen et al., 2009; Wittleder et al., 2019). All of which can increase fall prevention behaviors in older adults.

Health Beliefs in Fall Prevention

In general, patient and caregiver perceptions are not consistently included when generating clinical practice guidelines (Hämeen-Anttila et al., 2016), thereby affecting perspectives and adherence to fall prevention programs. A previous systematic review (McMahon et al., 2011) summarized older adults' perceptions of fall risk and views of fall prevention programs. In general, perceptions of risk of falling are related mainly to fear of vulnerability, maintaining autonomy and independence, and interpreting risk. This synthesized view provides an understanding of how older adults may interpret information about falls or risk of falls and then decide whether to implement it in their own lives or not. Additionally, themes also addressed the views of fall prevention programs and what influences a participant's decision to participate. Namely, older adults consider participant and program characteristics, relevance

and preference, maintaining autonomy and independence, and support and access to programs. McMahon et al. (2012) identified that individual and interpersonal factors were critical to consider when assessing and identifying fall risk.

Supporting McMahon et al. (2012) findings that individual attitudes and beliefs were the most influential in the participation in fall prevention, the Health Belief Model (HBM) has been used to better understand the perspectives of older adults on fall prevention (Rosenstock, 1974). Fall prevention has been previously evaluated in osteoporosis and fall prevention programs for early old age women (65 to 74 years) women (Ahn & Oh, 2021). This intervention provided education and counseling for 3 HBM constructs – decisional balance, knowledge, and self-efficacy – in group sessions over a 2-month intervention, while the control group received only group counseling. The results demonstrated increased knowledge on osteoporosis prevention and fall prevention, self-efficacy in exercises, and behavior change during follow-up visits and fall prevention, which was consistent with previous studies for osteoporosis prevention (Evenson & Sanders, 2016; Kalkm & Dahan, 2017).

However, examining older adults' participation in fall prevention in less rehabilitation-intensive settings, such as primary care facilities or educational seminars, may be more realistic for most older adults. Vincenzo & Patton (2021) conducted semi-structured interviews to evaluate adherence to recommendations after screening and counseling 6 months post-exposure to STEADI education. Although previous research found STEADI educational materials resulted in better risk stratification, more systemized care, and lower risk of falls (Johnson et al., 2019), Vincenzo and Patton (2021) found actual implementation was less than half of their sample. After 6 months, 79% of the participants accurately recalled their risk level of falls (low, medium, or high), only 57% followed a recommendation, and 32% did not recall any recommendations

correctly. The recommendation most recalled was physical exercise, but no participant (n=28) recalled a medication review, a vision check, a podiatrist visit or physical therapy. This low behavior change was reported to be due to decreased recall of recommendations for fall prevention, time conflicts, being too busy, already completing fall prevention behaviors, or being identified as low risk (Vicenzo & Patton, 2021), all of which aligned with Justine et al. (2013) study of external and internal barriers to physical activity in older adults. Interestingly, an important finding from Vicenzo & Patton's (2021) interviews, which used the HBM framework, was that many participants were motivated to participate in learning activities as well as had high beliefs that medical providers would help with fall risk and barriers associated with adhering to prevention recommendations. This information suggests that older adults have high intentions and motivation to participate in fall prevention programs, and trust their providers to provide education, support, and cues to action.

As a follow-up to this work, Vincenzo et al. (2022) conducted interviews to assess how older adults engage in fall prevention programs in general. Again, using HBM as a framework, the main reasons older adults were not participating in fall prevention were lack of perceived severity, susceptibility, self-efficacy, and decreased provider information (cues to action) as reasons for decreased participation in fall prevention. The interviewees also identified reasons to participate in fall prevention, which included being more informed about fall risks, participating in fall prevention currently, and having opportunities for socialization during fall prevention activities. Cues to action were also recommended by older adults, specifically using family and friends, physicians, pharmacists, and insurance companies in print, audiovisual, online, or reminders to promote awareness of fall prevention.

However, barriers to falling prevention appear to outweigh perceived benefits. Shankar et al. (2017) found that even in older adults who fell and were seen in the emergency room, after 90 days, only 37% spoke to their providers about fall prevention, 22% spoke about the risk of medication for falls, 2% contacted community-based fall prevention programs, and none had participated in a fall prevention program (Shankar et al., 2017). Jansen et al. (2015) also found that in older adults with a history of falls, only 16% identified as susceptible to falls and only 10% prioritized fall prevention. Previous research has found that recommendations from a healthcare provider to enroll in a fall prevention program did not increase participation (Kiami et al., 2019), indicating that a more personalized approach may be necessary to involve older adults in fall prevention efforts.

As such, both internal and external factors must be addressed to increase engagement in education and behavior change to prevent falls. Further, by targeting both intentions and behaviors simultaneously, it is predicted that better outcomes can be seen in fall prevention efforts (Klusmann et al., 2021). Additionally, internal factors related to fall prevention are personal and idiosyncratic, which contrasts with the materials used in fall prevention protocols. STEADI is a standard protocol that does not consider in general the perspectives of older adults, including personalized approaches to individual needs (Sandlund et al., 2017; Stevens & Sogolow, 2005). Although, non-tailored approaches to fall prevention (i.e., handouts or brochures) have been found to be associated with a decreased rate of falls, multifactorial interventions had a greater association (Hopewell et al., 2018), and individually tailored fall prevention interventions are more effective (Gillespie et al., 2012). MCII is well positioned to address a more individualized and thoughtful approach to improve adherence and use of fall prevention recommendations.

Summary of the Literature

In most healthcare settings, education is provided to the patient to independently manage all follow-up activities, with little consideration given to barriers around behavior change, follow-up, and implementation of health prevention and promotion behaviors. Past research estimates that for older adults, the average length of visits with a primary care provider is 20.4 minutes (Young et al., 2018). The average number of topics in a visit was 6.5, including "major" and "minor" topics. The longest topic, the major topic, is typically 2.3 minutes in length, while minor topics received just 1.1 minutes (Tai-Seale et al., 2007). Regardless of whether fall prevention may be a major or minor topic (depending on the reason for the visit), this leaves minimal time for the kind of educational delivery that results in lasting change. Cost-effective and time-efficient, an MCII intervention takes an average of 7 minutes when administered (Kizilcec & Cohen, 2017), and has the potential to increase self-regulation and self-management of health behaviors, such as prevention of falls. There are several modifiable factors that increase the risk of falling in older adults: fear or falling, decreased strength or balance, unstable gait, visual and foot impairment, environment, and some medications (Gillespie et al., 2012). Evidence-based interventions targeting at least one factor have demonstrated the ability to decrease falls and have the potential to save $94 to $422 million in medical costs (Stevens & Lee, 2018). Strategies to increase older adults' participation and adoption of intervention factors are imperative to decrease falls. Using a self-regulation technique grounded in reflection of one's own health beliefs may improve behavior change.

MCII does not require high self-efficacy or attitudes (Oettingen et al., 2001; Oettingen et al., 2009); in fact, low self-efficacy does not affect a participant's ability to demonstrate behavior change with MCII (Oettingen et al., 2001; Oettingen et al., 2010). MCII provides an autonomous

method to regulate one's own cognition, emotions, and actions (Marquardt et al., 2017; Mutter et al., 2020; Valshtein et al., 2020; Wittleder et al., 2019), eliminating the need for guided assistance outside of initial instruction. Because MCII asks participants to reflect on internal obstacles (e.g., emotion, cognition, ingrained habit) compared to external obstacles, more surmountable change can be acquired (e.g., I can change the lighting in my home, but my lack of insurance is harder to change). Research informed by HBM can improve understanding of how older adults assess their risk of falls, as well as their ability and desires to participate in fall prevention activities. Therefore, this study investigated MCII as a fall prevention behavior change method in older adults, while also exploring how older adults evaluate their fall risk as related to their individual health beliefs.

In summary, the objectives of this study were as follows:

1) investigate if and how MCII impacts behavioral change in fall prevention;
2) characterize how HBM constructs are associated behavior change; and
3) appraise implementation of MCII as an intervention for behavior change in fall prevention.

CHAPTER 3

Methods

Design

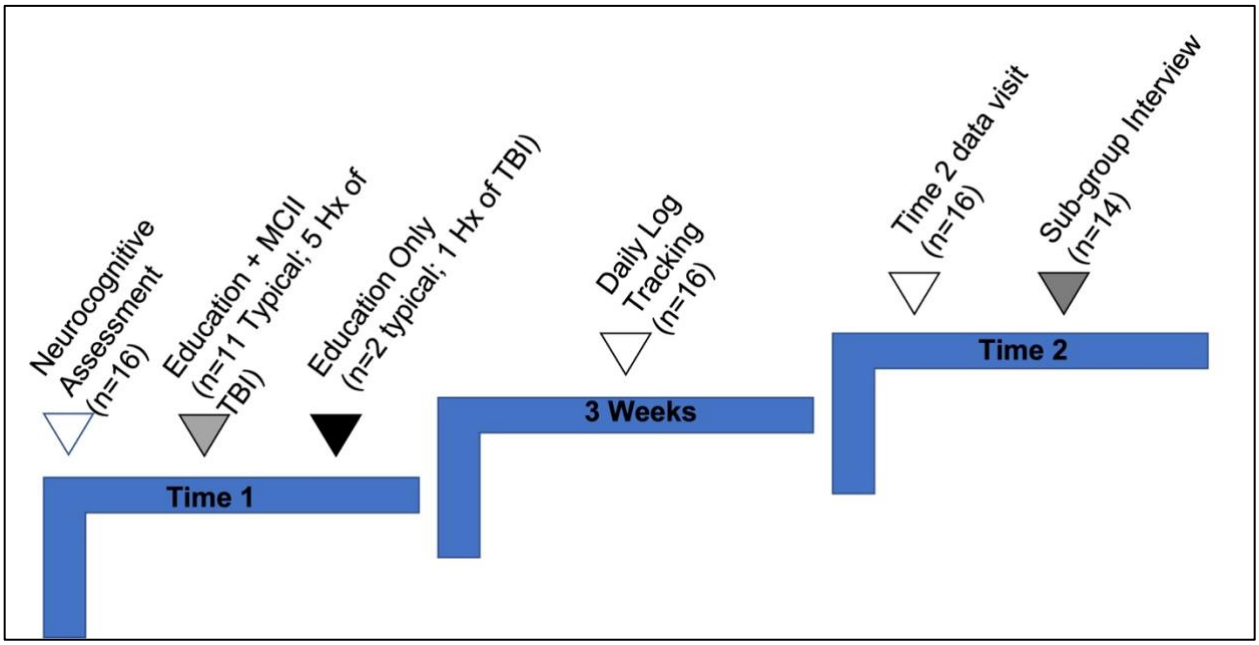
This was a feasibility study designed to evaluate the use and acceptance of a self-regulation strategy to promote behavior change for fall prevention. For this, a mixed method experimental (intervention) design where the quantitative component (QUAN) and the qualitative component (QUAL) were implemented concurrently, followed by an explanatory sequential component. This design blended QUAN and QUAL methods to assess varied facets of the same phenomenon -- behavior change. The purpose of this design was to provide richness and detail or complementarity (Greene, 2007) as to whether and why older adults have greater behavior change with the use of MCII. Additionally, pilot data on older adults with a history of TBI may prompt new interpretations and suggest areas for further exploration, serving as an initiation purpose to mixing (Rossman & Wilson, 1985). The design had interaction between QUAN and QUAL data, with overlap in both measures and data collection times. However, there were some independent sections for each. The QUAN included standardized cognitive assessments and behavior and HBM scale measurements as well as implementation outcome measurements (Mettert et al., 2020; Weiner et al., 2017). The QUAL included clinical observation and a semi-structured interview with a purposively selected sample of older adults. Additionally, as a feasibility study, the implementation outcome measurements were collected from both the participants and the administering clinicians.

This study used a quasi-randomized experimental design. Randomization was based on pre-HBM scores (low or high beliefs) and other characteristics (i.e., sex and history of traumatic brain injury). Pre-HBM scores were calculated at Time 1. Participants were assigned to one of two groups: Group 1 was guided through MCII with fall prevention education and Group 2 only encountered fall prevention education, without MCII. There were two parts to data collection, the clinical assessment and educational intervention at Time 1 and the follow-up survey and semi-structured interview at least 3 weeks later (Time 2). Both QUAL and QUAN were collected at each time. Participants were purposively selected for the QUAL interview based on their post-HBM score (low or high beliefs), group (condition and injury status), and demographics; however, if the participant expressed interest in completing the interview, no participants were denied the opportunity. The data was merged and interpreted in the analysis phase to inform the research questions and provide a detailed understanding of the behavior change, the HBM constructs, and their overlap. Feasibility data was also merged and interpreted for analysis. Figure 4 demonstrates the design components.

Both Time 1 and Time 2 explored MCII as an intervention to promote behavior change in older adults. Both QUAL and QUAN data allowed for the examination of the association of HBM constructs with behavior change and use of MCII. Furthermore, QUAL and QUAN produced a comparison between and within both conditions and targeted populations. QUAL data collected in the semi-structured interview expanded upon the QUAN data collected in both the control and experimental group, as well as between older adults with and without a history of brain injury. Implementation outcome measures were also collected at Time 1 and Time 2 quantitatively and elaborated on in the participant QUAL interviews and clinician written interviews.

Figure 4.

Study Design



Participants

The participants were community-dwelling older adults (65+ years old) with and without a history of traumatic brain injury (TBI) living the state of Georgia. Participants were selected based on the following inclusion criteria: 1) able to speak, read and write in English with a high degree of fluency; 2) able to sit upright for two hours at a time; 3) able to see text and images in print at approximately 20 inches; 4) able to independently transport to and from the UGA campus once; 5) able to hear conversation and directions in a quiet environment, with or without hearing aids, 6) no more than mild cognitive impairment: global deterioration scale no higher than 2-3; Clinical Dementia Rating Scale no higher than 0.5 (sum of boxes), 7) able to provide informed consent (based on responses to questions on study purpose, tasks, benefits, incentives, and risks), and 8) have a computer or tablet connected to the broadband Internet or a landline or cellular phone. A telephone screening was completed to determine eligibility for the study and to

schedule a visit from enrollment. Participants were not eligible if the individual 1) had below eighth grade ability to read/write in English, 2) had cognitive functioning higher than 2-3; Clinical Dementia Rating Scale greater than 0.5 (sum of boxes) and 3) did not pass the evaluation to complete consent; 4) had more than mild expressive or receptive language processing deficits. Essentially, all participants must have been able to participate in the intervention safely and fully.

Recruitment occurred primarily through community settings, sites, and partners. For example, local physical therapy offices agreed to hang a flyer in their lobbies for patrons to encounter. In addition, specific and targeted advertising (flyers, newspaper advertisements, and social media posts) was used to recruit participants. As we specifically recruited older adults and people with a history of TBI, there was an increased likelihood the population was living with or was at risk of cognitive impairment. Given that the in-person tests necessary to establish full cognitive status were time intensive and potentially frustrating, a telephone screening was conducted to determine whether a participant met basic cognitive, memory, and language requirements. The screening process was also used to determine whether participants met the other eligibility criteria.

Additionally, as a feasibility study, we collected data from a clinical perspective from eight first-year Master's student clinicians in speech-language pathology. Student clinicians were assigned the research study as their clinical assignment to receive practicum clock hours. The student clinicians were IRB-trained and then subsequently trained in the MCII protocol over three sessions using role playing and mock interviews. The training manual was adapted based on student feedback and the final version was used in a checklist format. All data collected from

clinicians was blinded to the principal investigator (PI) until the end of the semester and clinical hours were approved.

General Procedures

Participants who expressed interest in participating were called by a researcher. The researcher confirmed that the participant was in a low-distraction private environment and had 30 minutes of uninterrupted time to answer the screening questions. Once that had been confirmed (or the appointment had been rescheduled for a time when the participant could be in a low-distraction environment), the researcher conducted a structured telephone interview, using the Telephone Interview Cognitive Status Screener (TICS; Appendix A). Next, to ensure autonomy in decision making, participants were provided a copy of the informed consent document without signature lines in the mail or via email. Any questions on the informed consent were answered at Time 1 when signatures were collected. As this was a pilot study, our goal was to enroll a meaningful sample to generate a credible effect size range to inform an appropriately powered RCT and identify potential mechanisms of change to include in a full-scale efficacy trial. All data was collected in person at Time 1 and virtually at Time 2.

Time 1

Once the participant's eligibility was established in the screening call, the participant's first visit to the clinic was scheduled. At Time 1, participants arrived at the clinic and given a parking permit by a clinician research assistant (RA). The participant was escorted to the interview room and the informed consent process took place. First, a new consent form with signature lines was reviewed with the participant. The RA then completed an Evaluation to Sign Consent Form. If participants were deemed eligible, the document was stored with the consent

form. If a participant was deemed ineligible on the basis that they were not able to provide informed consent, they would have been dismissed from the study.

All portions of the study were audio/video recorded. At Time 1, participants completed three sections of measures: 1) self-report questionnaires, 2) assessment of neurocognitive communication, and 3) the fall prevention educational intervention. Table 2 summarizes Time 1 measures and Appendix B provides complete descriptions of each measure taken in Time 1 by section.

Table 2

Time 1 Data Collection Measures and Tools

Section 1: Self-Report Questionnaire
Health Belief and Behavior Change Questionnaire- Part A (Appendix C)
Demographic Information
Neuro-Quality of Life Cognitive Function Form
Participation Assessment with Recombined Tools-Objective (PART-O)
Pittsburgh Sleep Quality Index (PSQI)
Yale Physical Activity Survey (YPAS)
Medical Outcomes Survey- Short From 36 (MOS-SF 36)
Depression, Anxiety, and Stress Scales (DASS)
Patient-Reported Outcomes Measures Information System (PROMIS)
CDC STEADI Fall Risk Self-Assessment
Section 2: Neurocognitive Assessments
Repeatable Battery of Assessment of Neurological Status (RBANS)*
Behavior Rating Inventory of Executive Function (BRIEF)
Delis-Kaplan Executive Function System (D-KEFS) Verbal Fluency and Trail Making Test
CNS Vital Systems (CNSVS)*
Section 3: Fall Prevention Education Intervention (MCII or status quo)
Health Belief and Behavior Change Questionnaire- Part B (Appendix C)
Therapist Adherence and Client Participation Checklist (TACP)
Modifications to Treatment Tool (MT)
Implementation Outcomes Measures (IOM)

Note. *Counterbalanced in order

In Section 1, participants completed approximately 15-minutes of questionnaires using an iPad, including Part A of the Health Beliefs and Behavior Change Questionnaire (Appendix C).

Section 2 included a battery of neurocognitive assessments administered by an RA which were overseen by the PI, a licensed speech-language pathologist (SLP). The testing order was counterbalanced to start with either the CNSVS or the RBANS. To complete the CNSVS, participants were seated in front of a computer with a full QWERTY keyboard. The program was self-paced; participants used the keyboard to progress through each of the tests in the battery. The RA was in the room if the participant had questions about any of the tests, but the RA otherwise did not actively engage with the participant during computerized neurocognitive testing. After the test batteries and CNSVS were complete, the RA offered a brief break to the participant, lasting 5-10 minutes. During the break, the health belief (HB) scores from the Health Belief and Behavior Change Questionnaire (Appendix C) were calculated (into high and low beliefs) and the participant was quasi-randomized into a group (MCII or status quo).

After the break, Section 3 began with the educational intervention and the group protocol explained below. All participants received the CDC STEADI "What You Can Do" fall prevention handout (accessible for free at https://www.cdc.gov/steadi/pdf/STEADI-Brochure-WhatYouCanDo-508.pdf). All groups used the same stimuli materials including the CDC STEADI educational handout, environmental modifications list, and fall prevention plans handout with behavior tracker. Each participant was provided the materials to take home after the intervention.

Both groups started each section with the same procedure: first, the participant reviewed the educational handout and then completed a four-question recall test ("what are the four things you can do to prevent falls?") and offered the opportunity to ask questions. Second, the completed Part B of the Health Belief and Behavior Change Questionnaire which was the intended behavior section. This section included the list of recommended behaviors (Table 4).

Participants were asked to select what behaviors they were likely to complete for the first time between Time 1 and Time 2. The number of behaviors the participant selected as "likely or very likely" created the intended passive behavior.

Control Group. Clinicians then followed the control group protocol. Participants were given a handout of the recommended behaviors (Table 4) with two sides divided based on single event and reoccurring events. Participants were asked to pick one modification they do not already complete from each side. The following prompt was said, "we would like you to focus on home modifications that you can do in the next 3 weeks; take a look at these lists and indicate which two you may complete." The two selected recommendations were then labeled as the active plans. Participants then completed the implementation outcome measures (Weiner et al., 2017). Participants were provided with the education materials and a handout with daily log to take home. The participants scheduled a follow-up visit with the researcher 21-30 days after the initial meeting date.

During and immediately after, clinicians completed the Therapist Adherence and Client Participation Tool (TACP), the Modifications to Treatment Tool (MT), and clinician IOM.

Table 3

List Provided to Participants of Recommended Change Created from Literature (Avin et al., 2015; Erkal, 2010; Gell et al., 2020)

Reoccurring Event	Single Event
Proper footwear	Non-slip mats in bathroom
Clear pathways daily	Rearrange closet
Awareness of stability in home	Rearrange kitchen
Awareness of stability outside of home	Add sensory lights to stairs/bathroom
Turn on lights at night	Remove small throw rugs
Create and use bathroom routine	Place chairs around home for rest spots
Use internal checklist when getting up	Talk with loved ones about making changes
Use assistive device	

Experimental Group. The RA then implemented the MCII self-regulation strategy using a scripted manual based on research summarized by Oettingen (2012, 2014; see Table 5 with script from Gollwitzer et al., 2018). Step 1 and 2 (Table 5) were MC components. First, participants picked an action from the recommended behaviors list (Table 4). Step 1 asked participants to identify the most important positive outcome of completing this fall prevention (e.g., "I will not have to go to the hospital"), and participants imagined events and experiences associated with that positive outcome. Step 2 had participants pinpoint the most critical internal obstacle that might prevent them from completing the task (e.g., getting started, remembering to complete, continuing to do the task) and they imagined events and experiences associated with the obstacle. Now, participants completed II (Steps 3 and 4) In Step 3, participants generated solutions by identifying cues and an action to overcome their obstacle by answering one of following questions (Stadler et al., 2010): (a) "When and where does the obstacle occur, and what can I do to overcome or circumvent the obstacle?"; (b) "When and where is an opportunity to prevent the obstacle from occurring, and what can I do to prevent it from occurring?"; and (c) "When and where is a good opportunity for me to act in a goal-directed way, and what would the goal-directed action be?" Finally, Step 4 was to form an if-then plan using the cues and actions identified from Step 3. Participants then were asked to pick another item from the opposite category from their first plan (single or reoccurring event) and complete the MCII steps again to form a second plan. Two plans in total were created in the session; however, the handout had a space for a third plan although no instructions were given to create a third plan.

The two selected plans, one single event and one reoccurring event, were then labeled as the active plans.

Table 4

Educational Intervention Procedure

Step	Instructions	
Educational Materials and Goal Formation Condition	Includes CDC STEADI educational materials for the clinician to provide education and recommend fall prevention strategies. Selection options for goal formations are also based on CDC STEADI materials	
	Status Quo	MCII
	• STEP 1: W*e would like you to focus on home modifications that you can do in the next 3 weeks; take a look at this list and pick one thing you don't already complete from each side.*	Step-by-step prompt for MCII strategy for clinician to follow and use with the older adult. *Pick one of these options from this list that you don't already do to focus on over the next three weeks.* • MC: ○ Step 1: Identifying Behavior: *Imagine all the reasons why (fall prevention strategy) is important for fall prevention.* ○ Step 2: Identifying Obstacles: *What might impact your ability to complete this recommendation?* • II: ○ Step 3: Generating solutions: *When and where does the obstacle occur, and what can I do to overcome or circumvent the obstacle?; (b) When and where is an opportunity to prevent the obstacle from occurring, and what can I do to prevent it from occurring?; OR (c) When and where is a good opportunity for me to act in a goal-directed way, and what would the goal-directed action be?* ○ Step 4: Forming an if-then plan: *An important tool to help you prevent falls is forming an if-then*

	plan. This tool creates an action plan for our goals. ○ *The if-then plan will be: If (identified cue), then I will (generated solution)*
Behavior Tracking	Paper-based calendar for older adults to track was provided under each plan.

The following is an example of MCII implementation used in the training sessions with clinicians: This participant identified "clearing a commonly walked path every day" as their fall prevention strategy. Clearing a pathway daily was important because the entryway was a high-risk area with hard, concrete floors. The obstacle identified was forgetting to put garden shoes away (Steps 1-2). The participant then answered the question "when and where does the obstacle occur, and what can I do to overcome or circumvent the obstacle?" The participant identified the obstacle occurs when they come in from outside, and they could overcome the obstacle by putting their shoes on the shelf instead of on the floor. The if-then plan was then created from this answer to connect the cue (coming in from outside) to the desired action (putting garden shoes on the shelf). This participant's plan was "If I come in from outside, then I will put my garden shoes on the shelf" (Steps 3-4).

Participants then completed the implementation outcome measures (Weiner et al., 2017). Participants received a handout with the four steps of the MCII procedure and were encouraged to use the active plans as often as possible during the coming weeks to reduce risk of falls. A tracking log was provided for the participant to mark if and when the behavior occurred. Although the handout had a space for a third plan and the steps to MCII were provided, no instruction was given to create any additional MCII plans. The participants scheduled a follow-up visit with the researcher 21-30 days after the initial meeting date.

Identical to the control procedure, clinicians completed the Therapist Adherence and Client Participation Tool (TACP), the Modifications to Treatment Tool (MT), and clinician IOM during and immediately after the session.

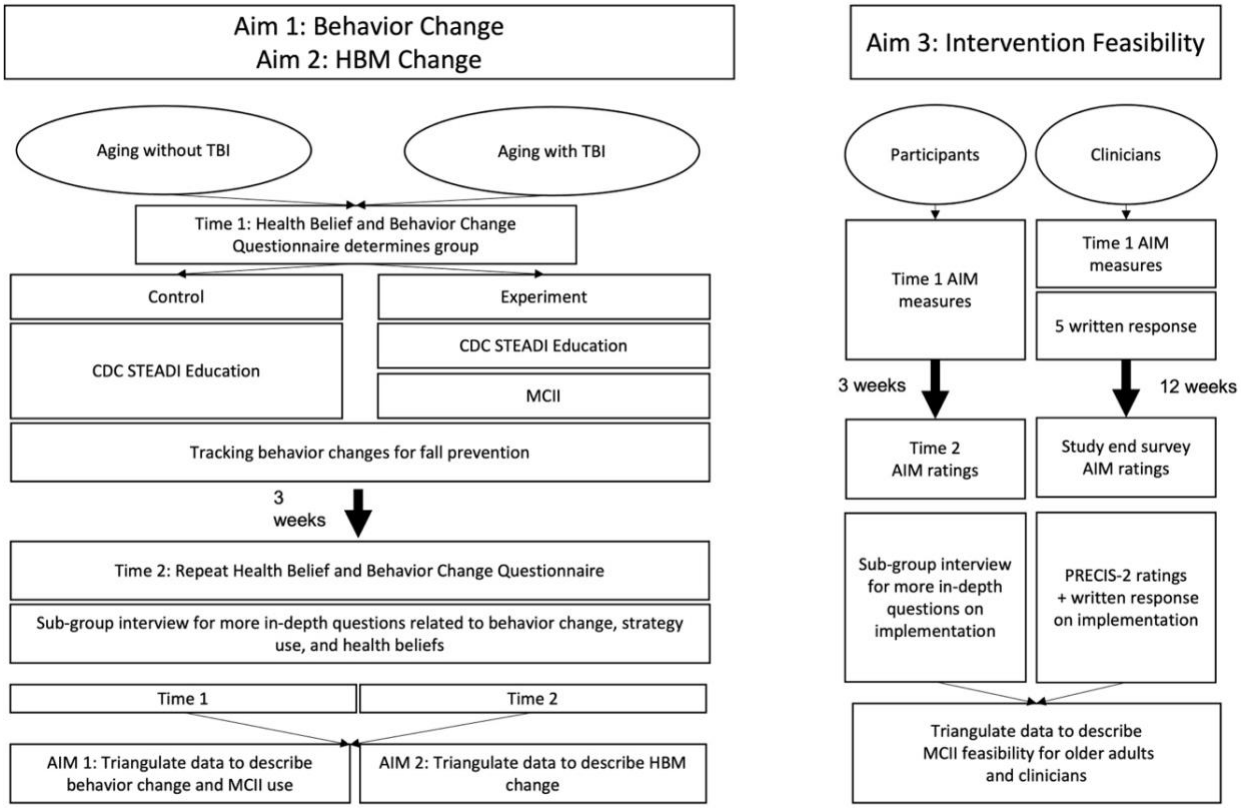
Time 2

In the format chosen by the participant (phone or Zoom), participants first completed Part A of the Health Beliefs and Behavior Change Questionnaire (HBM constructs) again, as well as reported behavior change. Active change was self-reported from their behavior log was used to track if and when the active plans (single and reoccurring) were completed. Participants were also asked if they used MCII to create any new plans that produced behavior change. This was categorized as generalized change. Finally, participants completed an actual passive behavior change questionnaire where participants reported if they completed any other recommended behaviors (Table 4). Passive change did not include active or generalized behaviors. Finally, participants completed the implementation outcome measure again. Next, if purposively selected or interested, participants completed the semi-structure interview. The semi-structured interview had questions related to how behavior change in fall prevention may be related to each HBM construct, as well as more in-depth feasibility and implementation outcome questions. Participants were contacted at the scheduled time and format selected at the initial visit and reminded of the audio recording. Figure 5 demonstrates the aims as they correspond with the data collection design.

After all data collection was complete, all clinicians completed the final IOM summary and PRECIS-2 Tool. Clinicians answered the same questions about strengthens, barriers, and modifications to MCII as an intervention for fall prevention in as written format as the participants did in Time 2.

Figure 5

Study Aims with Procedure



Dependent Variables and Data Collection

Several outcomes were evaluated in this study to assess MCII as an intervention for behavior change. The dependent variables included behavior change, health beliefs, participant and clinician implementation outcome measures (IOM), and PRECIS-2. We collected independent variables for demographics, general health, and neurocognitive assessments at Time 1. Data for each dependent variable was collected at both Time 1 and Time 2.

Behavior Change

Behavior change was collected in three formats, active, passive, and generalized. Active behaviors included a single event and a reoccurring event. Passive behaviors included an intended report and an actual completed. Generalized behaviors were the application of MCII to

another behavior or setting. In both conditions (MCII and status quo), participants completed the same questionnaires (Appendix C). Prior to receiving any education at Time 1, participants received a list of 14 environmental changes from the literature that they could do to reduce fall risk (Avin et al., 2015; Erkal, 2010; Gell et al., 2020), which they rated on a Likert scale of 0 to 5 based on likelihood to completing a behavior and overall importance of the behavior (0=not likely at all/not important; 5= very likely/very important). Participants could also select "not applicable" if they already completed the behavior pre-intervention. Intended behaviors were the number of recommendations from the list the participant indicated they were "likely" or "very likely" to do for the first time over the study period. The plans selected as active plans were those chosen by the participants to specifically enact during the study period. Plans were written down on their handout and the participant was instructed to track the behavior on a provided daily chart and report at Time 2 what day(s) and how often the behavior was completed.

At Time 2, participants reported any behavior change to the PI. First, participants responded to the questions "did you complete [inserted if/then plan], and if so what day or days?" and "tell me about how these plans worked or didn't work for you." The active behavior change resulted in a binary report of completed or not completed, with reoccurring events considered completed if the participant did over 50% of the opportunities or days between Time 1 and Time 2. Participants were asked to elaborate on their active plan use, including discussing if and why they did not complete an intended behavior change. Participants in the experimental condition were also asked if they created a new if/then plan, thus categorized as generalized plans. Actual passive was measured in both groups by reading the list of 14 recommendations, besides the active plans and, if applicable, generalized behaviors, to the participant. Participants

reported binarily (yes/no/not applicable) if they completed the behavior for the first time between Time 1 and Time 2.

HBM Constructs

At Time 1 and Time 2, participants completed the same questionnaire in pre- and post-timepoints to measure HBM constructs (knowledge, susceptibility, severity, threat, barriers, benefits, cues to action, and self-efficacy) as related to fall prevention (Appendix C). HB measures were on a 5-point Likert scale (1=do not agree to 5=agree a lot). Scores were summed and averaged to create an overall health belief score which was then used to quasi-randomize in Time 1 (1-2.5 indicated low beliefs and 2.6-5 indicated high beliefs). Scores in each domain were also created for both Time 1 and Time 2 evaluate change in different health belief constructs. At Time 2, the subgroup that completed the qualitative interviews was asked to expand on HBM constructs related to fall prevention and overall health decision making.

Feasibility of MCII for Behavior Change

Feasibility measures were collected from participants and clinicians at Time 1 and participants at Time 2. Both participants and clinicians completed IOM at Time 1 and Time 2 to evaluate the feasibility, acceptability, and appropriateness of the strategy (Weiner et al., 2017). The questions were on a 4-point Likert scale, with 4 indicating complete agreement with the statement. Scores were summed and average in each category. Participants who completed the interview at Time 2 also answered several implementation questions on the strategy use, modifications, and "real-world" implementation (Curran, 2020; Mettert et al., 2020).

To appraise intervention fidelity and participant involvement in study activities, a protocol and script were provided to a trained RA with a checklist of steps for the intervention and to quantify client participation. The purpose of these measures was two-fold: first, to validate

participant capability and understanding of educational materials and interventions, and second, to characterize support needed to participate. For this, clinicians completed the Therapist Adherence and Client Participation (TACP) and Modifications to Treatment protocol (MT) at Time 1. These tools were created from past research on treatment fidelity (Wiltsey-Stirman et al., 2013) and modified to encompass MCII or control steps. TACP is an observation measure used to assess provider fidelity (i.e., adherence) and client participation (i.e., ability). The TACP measures 9-14 (based on the treatment group) items to assess adherence (scored as 0= not adherent; 1= adherent) and client participation (scored as 0=unable, 1=needed some support, 2=independent) matching specific components of the educational session. This protocol was used during the education session as a checklist for study protocol. The acting therapist scored each section during or immediately after the session and a second assessor evaluated video playback. The MT is a session-based measure to assess adaptations made to treatment. Two observing assessors recorded the frequency of 14 possible modifications made by therapists. Modifications to treatments are conceptualized as "fidelity consistent" (modifications do not change the core elements of the treatment in a manner that alters or reduces the impact of the intervention protocol, or make it challenging to generalize between treatments), or "fidelity-inconsistent" (modifications that alter the inclusion or delivery of core elements of the intervention protocol and/or make it difficult to generalize between treatments). Examples of fidelity-consistent modifications include "tailoring or refining, which are modifications that do not change the main principles or techniques (e.g., altering the language, extending the time spent on a component, cultural adaptions). Examples of fidelity-inconsistent modifications include the removal, skipping, drifting, or loosening of components that are essential to the intervention or using other techniques not involved in the treatment protocol (Wiltsey Stirman et al., 2015).

Clinicians also completed the same IOM the participant completed at Time 1, as well as written response questions to elaborate on details on the use of the strategy. Written feedback was used to assess the use of the strategy for each individual participant, as well as ratings of the intervention for each client. Time 1 IOM were blinded to the PI until the end of data collection.

Finally, after all data collection was complete, each clinician completed overall IOM and the PRECIS-2 ratings, as well as open-ended questions on general impressions and use of the tool after using with several participants. The PRECIS-2 tool provides ratings for different aspects of the intervention that may need to be adapted or changed for clinical use and larger-scale trials (Loudon et al., 2015). The tool includes nine domains used to evaluate readiness of an intervention to be implemented in a real-world clinical setting, as opposed to “ideal" research settings (see Table 5). Each domain is rated on a scale of 1 to 5 with scores closer to 5 indicating that the intervention is more pragmatic (closer to usual conditions) than when the scores are closer to 1 indicating that the intervention is more explanatory (closer to ideal conditions). Pragmatic, or usual conditions, for this intervention is compared to a clinical setting such as a rehabilitation setting or primary care setting, while explanatory, or ideal conditions, is compared to an experimental lab setting. The intervention was conducted in a university clinic with Master student clinicians with the purpose of evaluating if MCII could be implemented under usual conditions. The PRECIS-2 Tool outcomes can therefore identify areas that are not as pragmatic and could be improved for more clinical applicability of the MCII intervention.

Table 5

PRECIS-2 Tool Domains

Domain	Evaluation Question
Eligibility	To what extent were the participants in the trials are similar to those who would receive this intervention if part of usual care?

Recruitment	How much effort is made to recruit participants over and above what would be used in the usual care setting to engage with patients?
Setting	How different the setting of the trial and usual care settings?
Organization	How different are the resources, provider expertise, and the organization of care delivery in the intervention arm of the trial and those available in usual?
Flexibility (delivery)	How different is the flexibility in how the intervention is delivered and the flexibility in usual care?
Flexibility (adherence)	How different is the flexibility in how participants must adhere to the intervention and the flexibility in usual care?
Follow-Up	How different is the intensity of measurement and follow-up of participants in the trial and follow-up in usual care?
Primary Outcome	To what extent is the trial's primary outcome relevant to participants?
Primary Analysis	To what extent are all data included in the analysis of the primary outcome?

Independent Variables

Questionnaires and standardized assessments were used to better understand the general health and neurocognitive functioning of each participant. All general health information was self-reported by the participant. The only health information collected from a healthcare provider was for participants with a history of TBI, in which medical records were requested from their primary care physician. For participants with a history of TBI, information such as date of injury, injury mechanism, medical diagnosis, and related treatment was requested. During Time 1, measures on physical activity, sleep quality, social participation, overall subjective health ratings, and neurological quality of life (listed in Section 1 of Table 2 and elaborated in Appendix B). All of these are considered risk factors for falls if indexed as low.

Overall neurocognitive function was also assessed to better characterize the participants. Five measures of neurocognitive-communication function were collected (listed in Section 2 of Table 2 and elaborated in Appendix B). As previous research has shown that very mild cognitive impairment (measured as the cutoff score on the Mini Mental Status Exam) is associated with the

rate of falls (Gleason et al., 2009), overall cognitive function was evaluated with two assessments: The CNS Vital Signs Computerized Neurocognitive Test Battery (Gualtieri & Johnson, 2006) and Repeatable Battery of the Assessment of Neurological Status (RBANS; Randolph et al., 1998). Older adults with lower cognitive scores, specifically in executive function and processing, have more falls and are at risk of recurrent falls (Chen et al., 2012). The Delis-Kaplan Executive Function System (D-KEFS; Delis et al., 2001) verbal fluency subtest and Trail Making Test are standardized tasks to evaluate executive function, while the Behavior Rating Inventory of Executive Function (BRIEF; Delis et al., 2001) is a self-reported measure of executive function.

Data Analysis

Research Question 1

The first question explored how MCII may have aided in initiating self-reported behavior change. The relationship between the MCII intervention and the change in behavior for fall prevention was examined with both quantitative and qualitative data. For this, behavior change was explored in three ways: active, passive, and generalized. Behavior change was examined descriptively to compare groups (condition and injury status). The following describes each data type and then elaborate on the integration for analysis.

Quantitative data. Behavior change produced several dependent variables for each type of change. These included two measures of active change (single event and reoccurring event), two measures of passive change (intended and actual), and, for the experimental group, generalized change. Only intended behavior, the sum of behaviors reported as “likely” or “very likely” to be completed during the study period, was calculated at Time 1. All other changes were recorded at Time 2. Participants in both groups used their behavior logs to report when and how often they

completed their two active plans. Each plan was scored as completed or not completed. Actual passive behavior change, or behaviors from the education materials that were completed without an active plan or a new if/then plan, were recorded as a count. Finally, experimental participants were also asked if they applied the strategy to create a new if/then plan to execute a new behavior, or a generalized behavior. These were reported binarily. Results are summarized descriptively due to the small and unequal sample sizes.

Qualitative Data. In Time 2, participants were asked questions related to the interaction with the educational material and the ease of integration of MCII into their lifestyle, if applicable. All participants completed the same questionnaires, which included an open-ended self-report of their action plans. If MCII was used, participants were asked to describe how and when MCII was used. Interviews were transcribed by Sonix (https://sonix.ai/), an auto-transcription service, and each transcript was reviewed for corrections by a trained RA. Data analysis followed a flexible coding approach. First, transcripts were indexed based on topic (behavior change, use of MCII, application of education, and other behavior change discussion), then an inductive, iterative approach was used to generate themes from the data (Deterding & Waters, 2021).

Research Question 2

The next question evaluated whether the MCII intervention influenced health beliefs about fall prevention. The dependent variable was the HB measures collected at Time 1 and Time 2 from the same questionnaire (Appendix C). The combination of QUAN and QUAL data was used to fully explore how health beliefs influenced behavior change in fall prevention. As the participants themselves openly discussed fall prevention and recommendations for fall prevention, specific HBM constructs, and reactions could be evaluated. The following describes each data type and then elaborate on the integration for analysis.

Quantitative data. The HB questionnaire produced an overall score that consisted of a sum of the averages of each construct. Scores ranged from 0 (low beliefs) to 4 (high beliefs). In addition, scores were calculated within each construct to reflect the mean rating across items. Assumptions of homogeneity were not met for all HBM constructs, therefore, a Wilcoxon signed rank test was used to investigate differences in HBM constructs between Time 1 and Time 2. Injury group data was not normally distributed; therefore, a Mann-Whitney U Test was used to describe differences between injury status groups. This tests for differences between medians in two samples (Hart, 2001).

Qualitative Data. An informed grounded theory approach was used to explore older adults' perceptions of falls, fall prevention, and strategies to improve behavior change for fall prevention using the HBM as the guiding theory. Informed grounded theory supports using existing literature and theories to inform the approach to qualitative research and subsequently evaluate how the data compares or contrasts with the theory (Thornberg, 2012). The semi-structured interview guide was informed by previous research on HBM and falls prevention (Vincenzo et al., 2022; Vincenzo & Patton, 2021). As above, interviews were transcribed by Sonix and reviewed by a trained RA. Data was analyzed using flexible coding (Deterding & Waters, 2021), which uses both the deductive and inductive content analysis approach to identify, analyze, and interpret meaning and themes. In the directed approach, analysis starts with a theory as a guide for initial codes (Hsieh & Shannon, 2005), in which key categories were determined by the HBM (perceived susceptibility, perceived severity, threat, benefits, barriers, cues to action, and self-efficacy). The steps involved in data analysis include:

1. Identification of behavior change theory: Health Belief Model;
2. Deductive analysis: sort data into meaningful units based on *a priori* themes;

3. Inductive analysis: generate meaningful units based on the data;

4. Abductive analysis: evaluating how the data (inductive units) interacts with the theory (deductive units) to search for the best possible explanations (Thornberg, 2012);

5. Researchers reach consensus on interrelationships between research questions, codes, and core theme (Bingham & Witkowsky, 2021). Researchers agree that the data has reached saturation and no new themes have emerged (Bailey & Bailey, 2017).

Trustworthiness was ensured with member verification and investigator triangulation (Wilson, 2014). Investigator triangulation was applied by having two trained coders read and code separately, followed by discussion and agreement on codes, themes, and meaningful units. Finally, a review report of the final themes and interpretations of the themes was sent by email to each interview participant to complete the member checking. Participants were given two weeks to provide any revisions. By use of this approach, investigator bias in directed grounded theory is lessened.

Research Question 3

The purpose of this question was to assess the overall feasibility of MCII as a fall prevention behavior change intervention. Dependent variables included feasibility measures and IOM collected from participants and treating clinicians. Appendix B lists the measures collected and time. The QUAN and QUAL data were integrated to better understand how both participants and clinicians evaluated the intervention and its application. The following lists how the data was used in the analysis.

Quantitative Data. At the end of each session, both the participant and the clinician completed the IOM (Weiner et al., 2017) which asked about the acceptability, appropriateness, and feasibility of MCII for fall prevention. The clinicians also completed the TACP and MT during

or immediately after the session. A second coder viewed 100% of the interactions and produced an inter-rater reliability score for both TACP and MT. At the end of the study, clinicians also completed the IOM overall and used the PRECIS-2 tool to assess the intervention broadly. A Mann-Whitney U test was used to compare feasibility data between injury status groups for both participant and clinician data.

Qualitative Data. QUAL data was collected from both participants and clinicians on the feasibility of the intervention. Participants provided feedback on the intervention itself at the Time 2 interview answering questions about their overall impression of the MCII intervention and the applicability of MCII. Clinicians provided written responses on implementation barriers and benefits after each session as well as in the final PRECIS-2 survey. A similar flexible coding approach was taken as in research question 1, in which questions were indexed and then inductive coding was used for both participant and clinician data to create general themes and categories on the implementation, application, and use of the MCII intervention.

CHAPTER 4

RESULTS

In total, 16 older adults participated in the study. Participants labeled with a "TE" were in the TBI experimental group and "NE" were in the experimental group with no TBI. The participant labeled with a "TC" was in TBI control group and participants with "NC" were in the control group with no TBI. All 16 participants completed Part 1 and Part 2, and although only five interviews were needed to reach saturation, all but two participants (NC1 and TE2) accepted the invitation or inquired to participate in the interview. Therefore, 14 interviews were completed.

Eight master's student clinicians completed the training for the intervention and then created their own clinical schedules. Most clinicians completed 3 sessions (range 1 to 5) and all clinicians completed an MCII intervention. Eight sessions were completed in pairs and eight were completed with one clinician. Time 1 lasted on average 3 hours (range 2.5 to 4 hours) and Time 2 lased on average 65 minutes (range 35 minutes to 120 minutes). Time 2 occurred on average 25.2 days (range 19 to 37 days) after Time 1.

Participant Characteristics

Table 6 describes the demographic characteristics of the 16 participants. Six had a history of traumatic brain injury, ranging from mild (n=4) to severe (n=2) with a range of time post onset (TPO) of 7 to 50 years. All people with a history of brain injury provided medical validation of their most recent injury. Four self-reported receiving more than one head injury; however, only the most recent injury was reported with a medical report. The data are still

included in Table 7 which describes the characteristics of the TBI group. There was an unbalanced ~1:4 control in each injury group (2 controls without TBI and 1 history of TBI control. All participants were white, college educated, and the majority were women (n = 13). All participants were screened with TICS and met the criteria for no more than mild cognitive impairment. Table 8 describes the overall health and neurocognitive domains selected for this study among the participants. Participants generally scored "average" or "normal" on standardized neurocognitive assessments. The MOS-General, which considered general health perceptions in general, was average in both groups. HB scores were considered low at the pre- and post- time points in both groups. Older adults without TBI have a medium risk of falling, while older adults with TBI had a high risk of falling. Participants with TBI had a lower-than-average Neuro Quality of Life-Cognitive score, while participants without TBI were average. The PART-O and YPAS provide information about typical levels of social participation and physical activity. Overall, both groups had high levels of participation and physical activity. Both groups had lower than average PROMIS scores, which measured general self-efficacy. Depression and anxiety were within normal ranges for both groups; however, stress was averaged as "mild" for the participants with TBI but "normal" for participants without TBI as measured with the DASS. Finally, PSQI indicated that participants with TBI had worse sleep than participants without TBI, however, both were considered "moderate" quality sleep.

Due to the small sample size of the control group, we were unable to statistically assess group differences by condition; however, descriptively, the three controls had scores close to their respective group averages. Injury groups were compared using a nonparametric Mann-Whitney U Test. There were significant differences between the injury status groups in 4 domains, CNSVS NCI ($U=3.0$, $z=-2.9$, $p=.003$), Complex Attention ($U=11.5$, $z=-2.02$, $p=.043$),

Cognitive Flexibility (U=9.5, z=-2.2, p=.026), and Neuro-QoL Cognitive Short Form (U=7.0, z=-2.51, p=.012). In all domains, participants without TBI had higher scores than participants with TBI.

Results below address behavior change from the intervention based on the integrated QUAL and QUAN data. Each question explores the differences between injury status groups, and, as much possible, between condition groups.

Table 6

Participant Demographics and Characteristics

Demographics and Characteristics	Aging without TBI (n=10)	Aging with TBI (n=6)
	n (%)	*n* (%)
Gender		
Female	8 (80%)	4 (66.7%)
Male	2 (20%)	2 (33.3%)
Race		
White	10 (100%)	5 (100%)
Employment Status		
Working Full-Time	1 (10%)	1 (20%)
Not working (retired)	9 (90%)	5 (80%)
Highest level of education		
Bachelor's Degree	4 (40%)	1 (16.7%)
Graduate or Professional Degree	6 (60%)	5 (83.3%)
Previous Employment		
Educational Services	4 (40%)	4 (60%)
Healthcare Services	3 (30%)	1 (20%)
Other (Industry, Retail, Administrative etc.)	3 (30%)	1 (20%)
Health Insurance (can select more than 1)		
Medicare	8 (80%)	6 (100%)
Medicaid	0 (0%)	1 (10%)
Private Insurance	2 (20%)	1(10%)
Household Income		
Less than 25k	1 (10%)	1 (16.7%)
25-49k	1 (10%)	3 (50%)
50-74k	2 (20%)	1 (20%)
75-99k	3 (30%)	1 (20%)

100-150k	1 (10%)	0 (0%)
More than 150k	1 (10%)	0 (0%)
Prefer not to say	1 (10%)	0 (0%)
Marital Status		
Married	5 (50%)	2 (33.3%)
Widowed	1 (10%)	0 (0%)
Divorced	2 (20%)	2 (33.3%)
Never Married	2 (20%)	2 (33.3%)
Living Environment		
In Own Home	10 (100%)	5 (83.3%)
Independent Living Facility	0 (0%)	1 (16.7%)
Health Conditions (can select more than one)		
Hearing loss	4 (40%)	3 (50%)
Chronic Vestibular Dysfunction	1 (10%)	1 (20%)
Decreased Muscle Strength	1 (10%)	3 (50%)
Chronic Urological Changes	2 (20%)	1 (20%)
Cardiovascular Disease	3 (30%)	0 (0%)
Hypertension	3 (30%)	0 (0%)
Diabetes (I or II)	2 (20%)	0 (0%)
Osteoporosis	3 (30%)	0 (0%)
Osteoarthritis	1 (10%)	3 (50%)
Cancer (Melanoma)	1 (10%)	0 (0%)
Depression	2 (20%)	0 (0%)
Anxiety	1 (0%)	3 (50%)
Psychological Disorder Requiring Hospitalization (PTSD)	0 (0%)	1 (16.7%)
Bipolar Disorder	1 (10%)	0 (0%)
None	1 (10%)	1 (0%)
Other	0 (0%)	2 (40%)
History of Sport Involvement		
Yes	2 (20%)	3 (50%)
No	8 (80%)	3 (50%)
Military history		
Yes	1 (10%)	1 (16.7%)
No	9 (90%)	5 (83.3%)

Table 7

Injury Characteristics of Participants with TBI

Injury Characteristics	Aging with TBI (n=6)
	n (%)
TBI Severity	
Mild	3 (40%)
Severe	2 (40%)
Mixed Incidences (Mild-Mod)	1 (20%)
Number of TBIs	
1	1 (16%)
2	2 (20%)
More than 3	3 (60%)
How long has it been since your last injury?	
Less than 5 years ago	0 (0%)
5-10 years ago	3 (50%)
More than 10 years ago	3 (50%)
Mechanism of Injury (can select more than one)	
Car Accident	5 (80%)
Struck by/Against Something	2 (40%)
Physical abuse	1 (40%)
Sport Injury	1 (20%)

Table 8

Participant Neurocognitive and General Health Measures

Variable	Aging without TBI (n=10)	Aging with TBI (n=6)	Mann-Whitney U Test		
	Mean (SD)	Mean (SD)	U	z-score	p-value
CNSVS NCI	106.3 (5.3)	89.0 (11.9)	3	-2.9	.003*
RBANS Total	106.11 (14.2)	103.2 (15.5)	27.5	-.27	.786
Immediate Memory (RBANS)	104.9 (10.7)	99.5 (14.4)	22.5	-.82	.42
Delayed Memory (RBANS)	97.1 (19.4)	95.8 (18.2)	29	-.61	.55

Visual-Constructive (RBANS)	111.8 (19.4)	113.7 (26.3)	24.5	-.49	.62
Language (RBANS)	96.6 (7.9)	99.3 (5.6)	25.5	-.49	.62
Complex Attention (CNSVS)	108.1 (6.2)	86.3 (23.2)	11.5	-2.0	.043*
Simple Attention (CNSVS)	102.8 (7.4)	89.5 (14.8)	13.5	-1.8	.069
Cognitive Flexibility (CNSVS)	104.6 (5.6)	80.7 (25.2)	9.5	-2.2	.026*
Executive Function (TMT)	12.1 (2.1)	12.1 (5.0)	25.5	-.50	.62
Executive Function- GEC (BRIEF)	69.3 (17.3)	62.8 (11.6)	24.0	-.65	.52
MOS-General	107.8 (16.0)	105 (12.8)	25	-.88	.38
HB Score					
Pre-	1.9 (.64)	1.9 (.31)	25.5	-.49	.63
Post	2.3 (.40)	2.3 (.28)	24.0	-.65	.52
Fall Risk Score	3.4 (2.3)	5.6 (2.9)	14.5	-1.7	.091
Neuro-Quality of Life-Cognitive	33.5 (6.8)	22.8 (6.9)	7.0	-2.5	.012*
PART-O Averaged Total Score	34.3 (10.4)	33.7 (9.6)	30.0	.00	1
PROMIS	36.3 (5.1)	34.7 (5.3)	23.5	-.71	.48
DASS-Depression	4.9 (5.3)	9.2 (11.9)	25.0	-.71	.48
DASS-Anxiety	2.9 (2.7)	4.4 (4.8)	23	-.55	.58
DASS-Stress	8 (9.3)	11.2 (9.0)	22	-.88	.38
PSQI	6.6 (4.8)	8.2 (2.8)	18	-1.3	.19
YPAS Total Activity Summary	69.8 (26.6)	69.0 (32.68)	19	-.15	.88

Note. *p>.005; CNSVS Index and Domains, RBANS Total and Domains, TMT, BRIEF, and MOS-General all produce standard scores; HB, Fall Risk, Neuro-QoL, PART-O, PROMIS, DASS scores, PSQI, and YPAS all produce average scores or weighted average scores.

Research Question 1

Research question 1 reported behavior change and explored MCII as an intervention for people with and without TBI. Due to the small and unequal sample sizes, results are reported

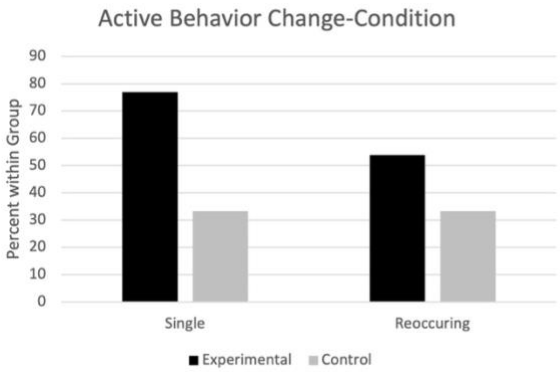
descriptively. Change was categorized into three types: active behavior, passive behavior and generalized behavior change. Active behavior change was composed of a single event and a reoccurring event. Passive behavior change had two measures: intended and actual change. Generalized change was the independent application of MCII to a different behavior or setting. Time 2 had a self-report of behavior change as well as a more detailed explanation of the active plans and behavior changes. Open-ended questions for reporting behavior change allowed a more thoughtful consideration of behavior change, whether successful or not. Below are the results related to behavior change.

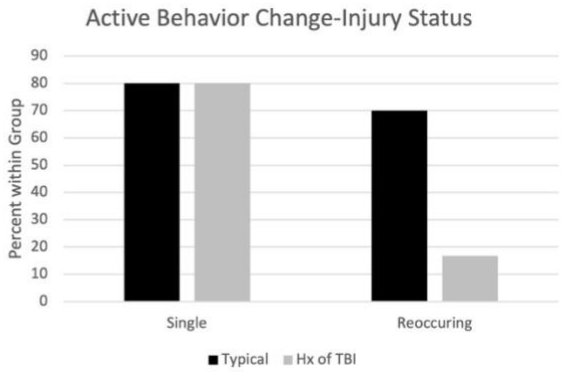
Active Behavior Change

Figure 6 demonstrates the percentage of participants in each group (injury and condition) who self-reported changes in active behaviors. Each participant completed a single time event and a reoccurring event for active behavior changes. Ten experimental participants (76.9%) completed a single event compared to one control (33.3%). Seven experimental participants (53.8%) completed a reoccurring event compared to one control (33.3%). Between the injury status groups, 8 participants without TBI (80%) completed a single event compared to 4 participants with TBI (80%). Seven participants without TBI (70%) completed reoccurring events compared to 1 participant with TBI (16.7%).

Figure 6

Active Behavior Change





Passive Behavior Change

At Time 1, prior to any educational materials, the number of intended behaviors was calculated first. Intended behaviors were the number of recommendations from the list the participant indicated they were "likely" or "very likely" to do for the first time over the study period. Intended behaviors included the two active plans, as well as any other recommendations from the list (Table 4). At Time 2, the number of actual passive behaviors was measured. Actual passive behaviors were other recommendations from the education materials (Table 4) outside of active plans or generalized plans, that the participant reported completing for the first time during the study period. In other words, passive behavior did not include active plans. Figure 7 displays *passive* behavior measures. On average, participants in the experimental condition reported the intention to complete 1.6 (SD=2.6) behaviors during the 3-week intervention period, compared to 3 (SD =1) behaviors intended by the control group. At Time 2, the experimental group reported completing 2.7 (SD =2.4) passive behaviors, while the control group reported completing .33 (SD =.57) passive behaviors. Table 9 displays passive behavior change data between injury status groups.

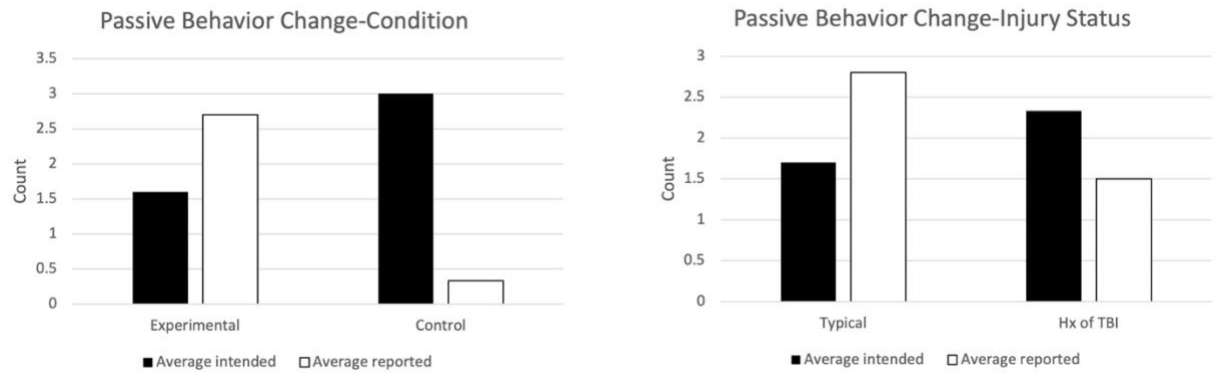
Table 9

Passive Behavior Measurements for Injury Status Groups

	Participants without TBI		Participants with TBI	
	Average (SD)	range	Average (SD)	range
Time 1: Intended to complete	1.7 (1.33)	0-3	2.33 (3.88)	0-10
Time 2: Reported completing (does not include active or generalized plans)	2.8 (2.5)	0-7	1.5 (2.0)	0-5

Figure 7

Passive Behavior Change



Strategy Generalization

Although only two plans were generated with participants at Time 1, the handout had a space for a third plan, but no instruction was given to create a third plan. During the Time 2 report, some participants talked about independently creating a new if/then plan with the MCII instruction sheet. Any additional behaviors completed from the recommended list (Table 4) in the control group or behaviors reported that did not have a *new* if/then plan were reported as passive behaviors. Six experimental participants (46.2%) reported using MCII independently to

enact more fall prevention behaviors, whether it be from the recommended list or a novel modification. Four were participants without TBI and 2 were participants with TBI. All new MCII plans were related to fall prevention but were not directly discussed at Time 1. Therefore, MCII was demonstrated to be generalized to other fall prevention efforts. For example, NE6's Time 1 plan was "When I get to the grocery store, I will hang my legs out the door for a minute before getting out." At Time 2, NE6 reported completing this plan every time she went to the grocery store, as well as added on to the plan to increase stability when walking into the story by saying "When I get out of the car, then I will grab a shopping cart." She further expanded on this generalized use of the strategy by explaining, "But when I do remember, I absolutely do it. That's why I was thinking, if I add that shopping cart piece in, that would be good. Because if I don't stretch my legs out for long enough or whatever, or at least I'll have the shopping cart to brace me." Two other participants also applied the strategy to a different recommendation. TE8 used MCII independently to prevent falls from dizziness when sitting up from bed saying, "Another thing is a reminder that when I get up in the middle of the night or the morning, I will sit on the edge of my bed and let my body know that I'm in that upright position before I start moving." NE1 applied the strategy to remind herself to ask her housekeeper to help clean a different area of her home to prevent falls, "The next thing I've got going is 'When Rosy (the housekeeper) comes next month, she will help me clean the closet so I don't trip on my clothes on the floor.' I think having Rosy will really help accomplish some of these things that I could get hurt on." Another participant (NE7) also provided an example, of how she generalized her reoccurring event plan "When I get up to use the bathroom at night, I will turn on the light" to a different setting. Her original plan was connecting "not being able to see well in the dark" to "using a light." She explained this by saying, "I even applied this to when I'm outside. Like last week, I

went to a party and the parking lot was really dark, so I thought 'I'm going to turn on my flashlight here on my phone.' That really helped."

Qualitative Report of Behavior Change

Most people were successful in completing at least one of their created plans, with more single events reported as being successfully completed than reoccurring events. Table 9 demonstrates the use of MCII in the experimental condition. The table includes selected responses to the questions in the follow-up questionnaire: "did you complete [inserted if/then plan], and if so what day or days?" and "tell me about how these plans worked or didn't work for you." Most experimental participants who did complete their plans confirmed how the cue they set influenced their execution of their action, as well as a general increased awareness of the risk of falls. The steps in MCII were dedicated to imagining the scenarios in which the goal-directed actions (e.g., pausing prior to getting up) would be successful. Plans that had specific and explicit cues (e.g., when I want to get out of the chair) were reported as successful. The awareness of these cues and then the related actions also increased the generalization of the behavior changes to other settings, such as in NE2 who also applied his strategy when he went out of town and was in a new setting (i.e., a hotel). In addition, the cues and actions allowed participants to overcome key problems in goal achievement. For example, TE1 demonstrated the ability to use her plan to maintain her goal pursuit and bring the goal to a close by trying several different bathmats until it met her needs.

General heightened awareness of fall prevention was also present in those who did not complete their plans, particularly about their surroundings. However, key barriers in behavior change impacted the participants success. Gollwitzer et al. (2018) identified three main barriers to behavior change: failing to get started, failing to keep goal pursuit, and failing to bring the

goal to a close. Participants who did not complete their active plans reported difficulty with two barriers: *failing to get started* and *failing to bring the goal to a close*. *Failing to get started* included missing opportunities to act, such as indecision on bathmats to purchase (NE4: "We just couldn't pick one we both liked so we're still working on that") and forgetting to act (TE2: "Oh gosh, I just now remembered this was the plan.") *Failing to bring the goal to a close* still provided some benefit for participants, even though their goal was never achieved. For example, NE5 (Table 9) intended to write in a health journal, but instead reported only thinking about her stability each day. Thus, she was considering her own stability daily, but did not execute the explicit plan to write her thoughts in her journal.

Table 10

Quotes From Time 2 Interviews Related to MCII Use

Participant	Completed	Plan	Quote
NE2*	Y	When I remove my shoes, then I will put them in the closet	It makes you think about things. It makes you think about before you went to bed. Is there a clear path to the bathroom? Especially when you're staying at a hotel or something. It makes you think about, you know, turning on the light in the bathroom, closing the bathroom door so you can still sleep, but having light when you go in there because you might not know where the light is.
NE3	N	When I go to the store, then I will buy new shoes to replace my Chacos.	I have not bought new shoes, but I have been wearing my lace-ups. I think I might have had them on the day I was there. I will wear my lace-up. Allbirds shoes that are not as heavy as my Chacos. And they're not flubby. I've found that when I trip is when I'm going upstairs and I'm not picking my feet up high enough. My Chacos will catch the edge of the stair. So, I've been trying different shoes. I've been

			wearing shoes I already have, and I've been wearing them all the time.
NE4	Y	When my wife and I talk about clearing pathways, then we will decide what to move to remove obstacles.	Yea, we did it right away. We moved the table and that got the cord out of the way. I've also noticed a few other things and moved them right then.
NE5	N	When I wake up, then I will write in my health journal how I feel about my stability that day.	I did not do that. But I thought about it all the time. I'll tell you when I did it, mainly thinking about it. So, I was aware of fall prevention stuff all since I've seen you because it's been very helpful. I just did not write things down.
NE6*	Y	When I get to the grocery store, I will hang my legs out the door for a minute before getting out.	I think it was real helpful because it made me stop and think, you know, without the plan, without specifics, it's one thing to say I'm going to be more careful. It is another thing entirely to have a specific goal that you say 'oh, wait, I am getting up out of my chair, I need to take it slow,' and I need to, because what I have started doing is when I get up out of my chair, I just stand right by the chair.
NE7*	Y	When I get up to use the bathroom at night, I will turn on the light.	What I began doing is using more lights at night, like when I get up to go to the bathroom or just if I want to get a drink of water or check on something. Normally, I walk through my house. Now I turn the lights on to walk through my house.
NE8*	Y	When I want to get up from my chair, then I will stop for 10 seconds prior to walking	I think I'm beginning to associate. 'Okay. I need to stop for a minute. ' When I look back when we started and where I am now, I am doing so much better. I'm remembering more times than not that that is just something I have to do moving forward.

TE5*	Y	When I get home, I will put in a request for my power strip to be installed. AND When my power strip is installed, then I will clear the pathway by the chair every day.	It wasn't just those two things that changed. I'm just much more aware of what's on the floor. And to be really careful that I have ways to move in my small apartment, which is easy to get filled up with junk. I mean, it's not junk. It's important stuff, but it doesn't have to be in my path. So that has been really useful.
TE1	Y	When I go to the store, then I will buy a longer rug for the bathroom.	We had talked about maybe getting a runner. So, I did that. And it doesn't fit from one wall to the next by about two feet, so I bought another one with the intention of cutting off extra if I needed to, but I don't need to do that. I just put it down and it worked where there isn't anything sticking out. But I've been walking over it, I realized that I have a lazy left foot. I scrape it when I walk by that's how I know that's where the problem is. Now I'm working on that in physical therapy.
TE2	N	When I step out of my door, then I will hold on to the railing.	Oh gosh, I just now remembered this was the plan. But you know, I watch everywhere I go now. And before I was stepping all over the place, it's probably why I used to fall even more actually, when I wasn't paying attention. So, this forced me that when I'm feeling this wobbly or once I get up, it's like I have to pay attention.
TE3*	Y	When I go to the YMCA, then I will use my cane.	You know, it's so obvious to me that that using a cane is beneficial. So why I didn't think about that before, I don't know. But after doing the evaluation and the strategies, I thought, 'well we only did two and we didn't really present the option of the possibility of doing three. But this cane is so important to use so I'm gonna make another.

TE4	Y	When I shop online, then I will order bathmats	You were like ‘let's get you a mat, let's sit down and order it on Amazon’. You know, I might have to operate that way here and now. But by doing this and then making myself a list and then I did it, you know, it was all done and all getting the stuff. The tape was done in one day and it took me about a week to get my shoes, but I had to decide on. But I got my shoes.

Note. T indicates a participant from the TBI group, while N indicates a participant in the group without TBI; *indicates participants who generalized their plan to another setting or action; Y=the participant completed the plan listed, N=the participant did not complete the plan listed.

Additionally, participants with TBI primarily completed single event changes rather than reoccurring events. Although reoccurring events, or forming new habits, are more difficult than single time changes, the TBI group had less success in executing reoccurring events than the group without TBI. Like the overall experimental group, key barriers in behavior change were discussed, namely *failure to get started* and *failure to keep goal pursuit.* For example, TE4 had aimed to set a routine to combat urgency with a bathroom routine, “When I am about to leave the house, I will use the restroom;” however, she was not successful in *getting started*. In the interview she did elaborate on how she could incorporate more preparatory behaviors such as alarms to be successful (“It's not that I haven't thought about it. I need to figure out the best way. And I was thinking about, I could set my alarms for when I have to leave. I could start setting them every 15 minutes until I have to leave.”) Similarly, TE3 described that picking up his shoes each day was “an ongoing effort. I think it's more part of my routine but it’s an effort to remember to do it.” TE1 failed to *maintain her goal pursuit* when her husband disrupted her cues to execute her plan to take her time when getting out of the car: “I think I did it four days in a row, immediately. And then [my husband] started complaining. So that was my challenge, is just

making sure I take my time, but not too much time. Like a couple of nights ago, I stepped out of the car, and I didn't even think about it until after I almost fell. So, I need to think about it before I get out of the car."

Similarly, the control group, was primarily impacted by *failure to get started* and *failure to keep goal pursuit.* For example, participants had a hard time *getting started* with their active plans by failing to engage in preparatory behaviors (NC2: It's hard to determine how to monitor your stability. What exactly is stability and how to you monitor it?), forgetting to act (TC1: "I just forgot to do that. I wasn't sure what I was supposed to be doing with this information, so I just forgot about it."), and procrastination (TC1: "I'm thinking it's actually worse for me in trying to do stuff if I'm cold. Then, you know, so it's better for me to stay warm, and then once I'm warm again, then I can be active.") However, participants also explained why they did not *keep their goal pursuit*, such as disruptive thoughts (NC2: "My nickname is Grace because I am not noted for my grace…I'm sure I'm going to fall. That's what's going to kill me—a fall…I hope not though so I have to make a special effort not to do that.") and competing goals (NC1: "I've been wanting to do that forever, but my other shoes are so cute and they're just adorable, but they absolutely suck at walking long distances.")

Overall, the education and take-home handout provided to the control group did produce some behavior change (NC2: "It's just a reminder. I mean, you don't always have a reminder. Be careful, you know, do this, do this, do this. And it gives you the opportunity to go through and check and see, okay, do I have this? Do I have this? Do I? Yeah, I've done that"). However, only one of the three controls successfully completed their active plans, and the average actual passive behaviors was less than 1. Although the key problems were like the group as a whole, more

examples of *failure to get started* were explained (i.e., forgetting to act or procrastination) as reasons why the behavior change was not achieved.

Although the experimental group also encountered similar key challenges in behavior change as the control group, MCII appears to provide better preparation to overcoming the barriers. Descriptively, there were more people in the experimental group who completed environmental changes than in the control. Additionally, those in the experimental group provided more in-depth answers on what they changed and why it was important. MCII was also generalized to other actions and settings, perhaps because of the increased awareness and health beliefs associated with the steps involved in MCII. Although there were differences in the interviews, the control group may not have reached saturation; therefore, some findings may not have been revealed in the interviews. Further, reoccurring events appear to be more difficult for people with TBI to overcome as they are often missed opportunities to act.

Research Question 2

Quantitative Results

HB Questionnaire. The second question investigated health beliefs as they were relevant to participating in fall prevention actions. The HB questionnaire and the follow-up interview were used to inform the results. The HB questionnaire was completed twice during the study, once before any education, and again at Time 2. Figure 8 displays overall differences between timepoints. A Wilcoxon signed rank test revealed that exposure to fall prevention education, regardless of condition, significantly improved health beliefs in overall HB ($z=-3.3$, $p<.001$), severity ($z=-2.21$, $p=.027$), benefits ($z=-3.3$, $p=<.001$), cues to action ($z=-2.68$ $p = .007$), and self-efficacy ($z=-2.69$, $p = .007$). The other constructs, knowledge ($z=-1.76$, $p=.078$),

susceptibility (z=-1.73, p=.084), barriers (z=-1.89, p=.059), and threat (z=-.32, p=.75) were not significant.

Figure 8

HB Change Between Time 1 and Time 2

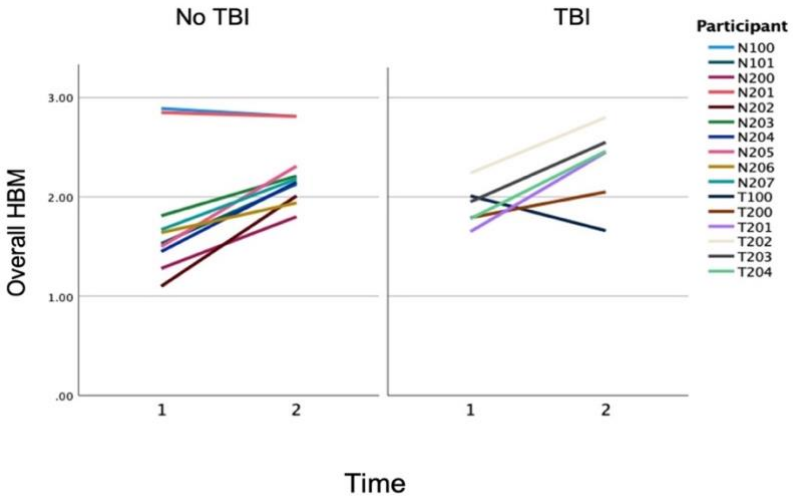


Figure 9

HBM Construct Change Between Injury Groups

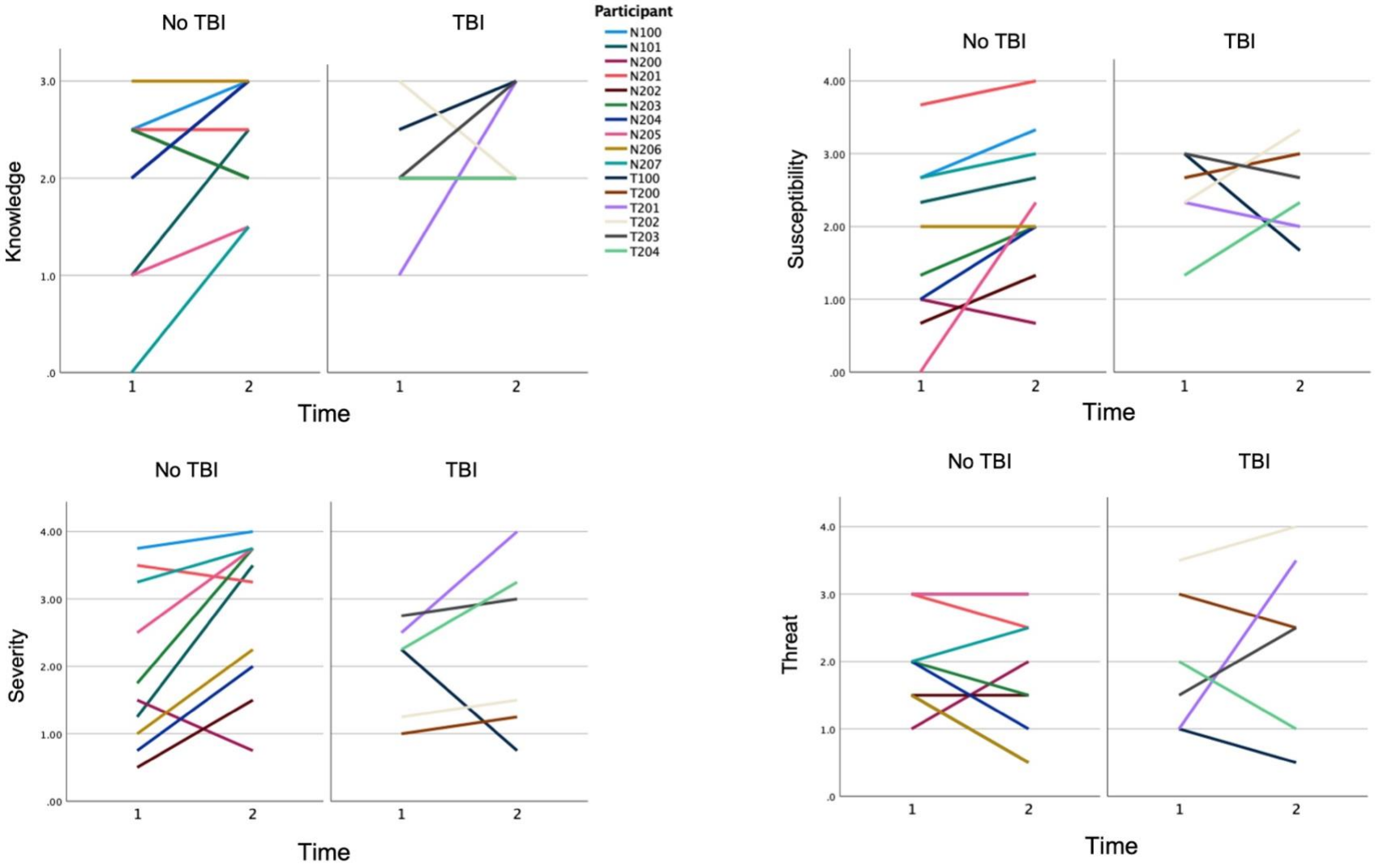


Figure 10

HBM Construct Change Between Injury Groups cont'

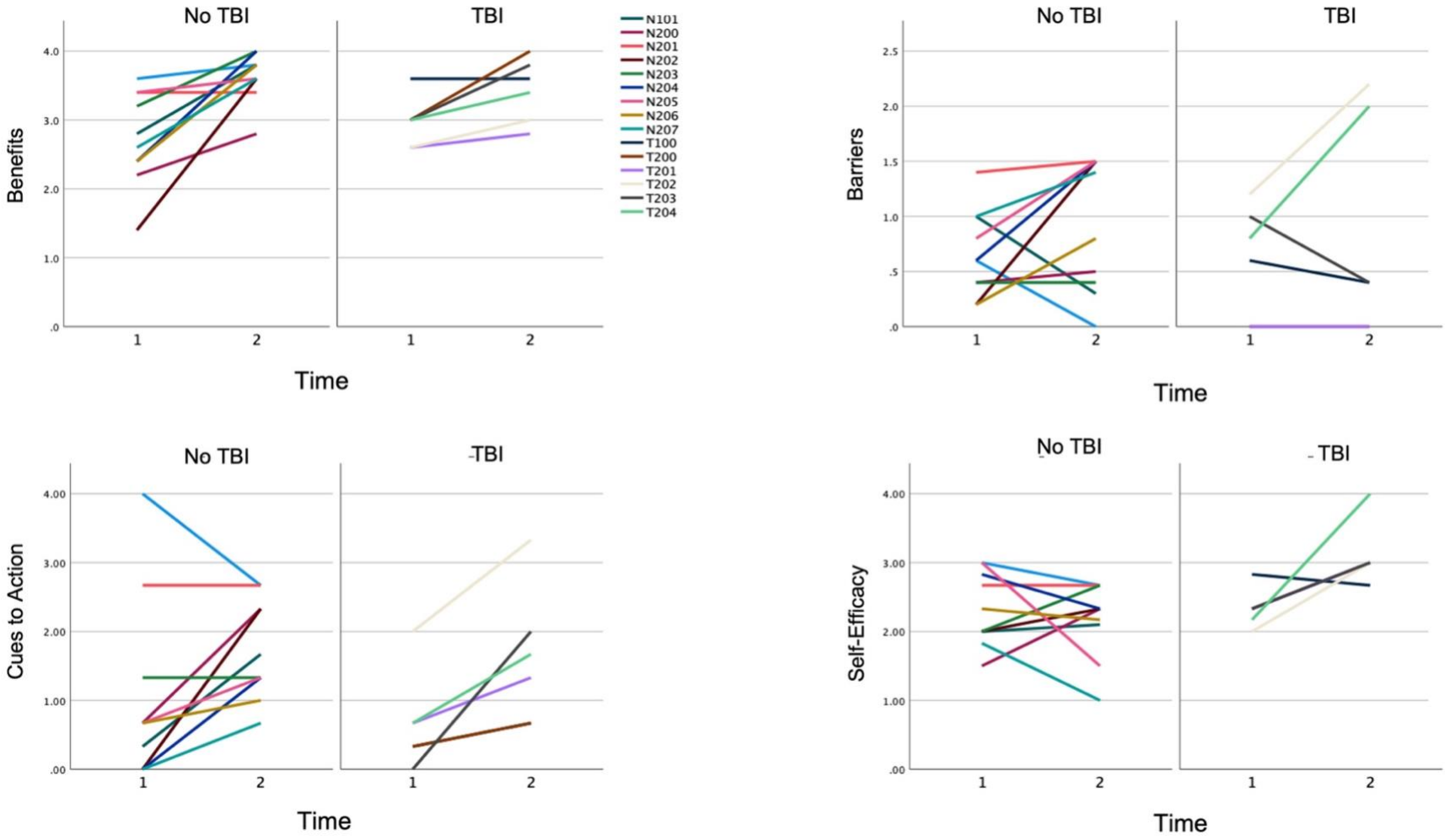


Table 11 shows the Mann-Whitney U test results of the difference in scores between injury status groups, noting that only self-efficacy was significantly different. People with TBI had more gains in self-efficacy (Md=3.5, n=6) than those without TBI group (Md=2.73, n=11).

Table 11.

HBM Construct Differences Between Injury Status Group

Construct	Participants without TBI Mean; median	Participants with TBI Mean; median	z	p-value
Overall HB Score	2.29; 2.22	2.32; 2.37	-.33	.75
Knowledge	2.32; 2.17	2.5; 2.5	-.11	.91
Susceptibility	2.27; 2.00	2.5; 2.5	-.77	.44
Severity	2.68; 2.75	2.29; 2.25	-.88	.38
Benefits	3.66; 3.70	3.43; 3.50	-1.26	.21
Barriers	1.01;1.20	.83; .40	-.71	.48
Threat	3.05; 3.25	2.86; 2.50	-.33	.74
Cues to Action	1.67; 1.33	1.61; 1.50	-.66	.51
Self-Efficacy	2.73; 2.9	3.50; 3.33	-2.06	.039*

Note. *$p>.001$

Individual Behaviors. The likelihood of participating in behavior change was captured by measuring both motivation and commitment to completing fall prevention acts. Commitment to fall prevention was collected at baseline, post-education, and at Time 2. Motivation was only asked at baseline and was reported as "very high" (3.67 (SD=.47); range 3-4). Commitment was high throughout the intervention: baseline (3.29 (SD=1.1); range 0-5), although variability of responses was reduced after education (3.67 (SD=.47); range 3-4) and Time 2 (3.47 (SD=.81); range 2-4).

In addition to motivation and commitment, participants also rated how important they felt each recommended behavior change was for older adults generally, with 5 being very important. (Table 12).

Table 12

Rated Environmental Changes by Importance

Recommended Change	Rated importance		Completed pre-intervention	Selected as Active Plan (n=32[a])
	Mean (SD)	Median (Range)		
Proper footwear	4.87 (.35)	5 (4-5)	9	2
Awareness of stability in home	4.8 (0.39)	5 (4-5)	11	2
Clear pathways daily	4.73 (0.46)	5 (4-5)	9	2
Awareness of stability outside of home	4.73 (0.46)	5 (4-5)	10	2
Non-slip mats in bathroom	4.64 (0.50)	5 (4-5)	8	2
Rearrange closet	4.57 (0.65)	5 (3-5)	10	4
Rearrange kitchen	4.53 (0.83)	5 (2-5)	11	3
Add sensory lights to stairs/bathroom	4.53 (0.64)	5 (3-5)	11	3
Remove small throw rugs	4.5 (1.03)	5 (1-5)	9	1
Turn on lights at night	4.5 (0.76)	5 (3-5)	12	1
Place chairs around home for rest spots	4.45 (0.73)	5 (3-5)	4	2
Talk to loved ones about making changes	4.1 (0.92)	4 (1-5)	10	1
Create and use bathroom routine	4.0 (0.91)	4 (2-5)	3	3
Use internal checklist when getting up	4.0 (1.1)	4 (1-5)	4	2
Use assistive device	3.64 (1.6)	5 (1-5)	4	0
Create and use a health journal to monitor stability	3.07 (1.6)	3.07 (1-5)	0	2

Note. Bold indicates a single action; [a]each participant completed two active plans (one single and one reoccurring).

Qualitative Results

The HBM has several constructs that can predict whether and why people will take action to prevent falls. The overall premise of HBM is that people will engage in a health behavior if

they believe they are at risk (susceptibility), the consequences would be severe (severity), and the behavior is beneficial to them and outweigh the barriers. Cues to action and self-efficacy are different ways that a health message can promote a behavior change (Rosenstock et al., 1988). Modifying factors can also influence individual health beliefs. These can include age, gender, and knowledge, as well as in our sample, condition and injury status. Results are discussed by construct in the HBM and the findings overall. Table 13 displays each HBM construct with the QUAL findings and Figure 11 displays how the data corresponded to the HBM.

Table 13

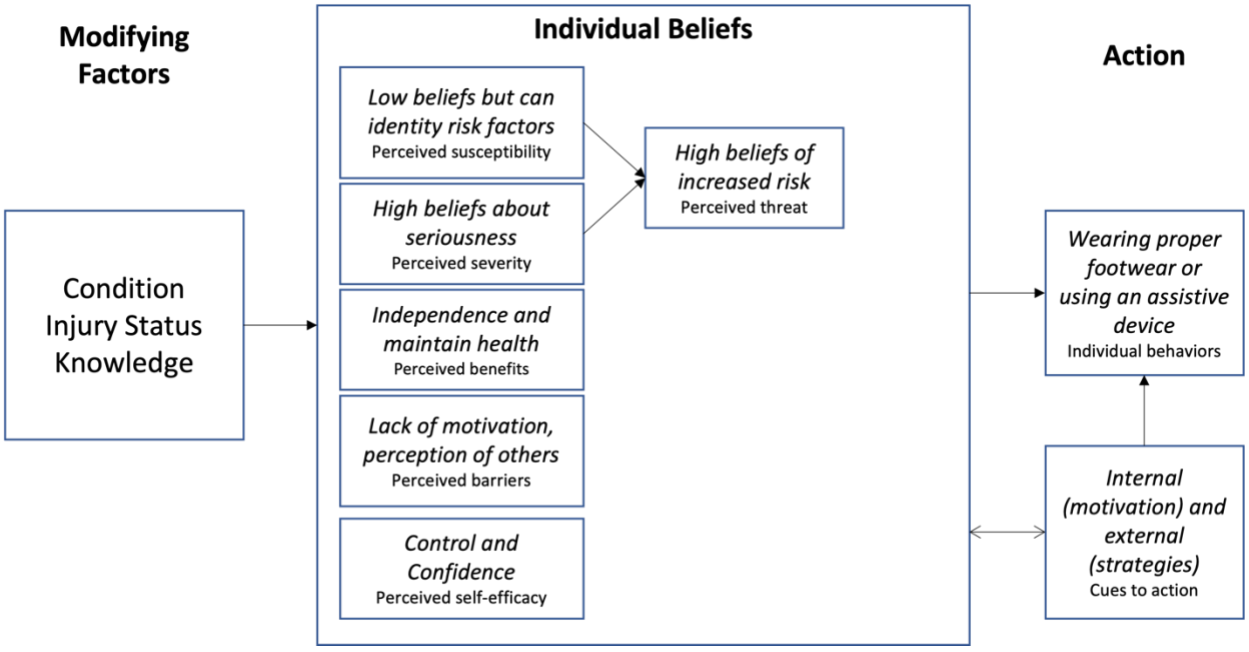
Informed Grounded Theory Approach for Fall Prevention

Construct	Definition	Themes from interviews
Modifying factors		
Condition	Participants who received the MCII as an intervention and therefore may have focused specifically on HBM constructs)	Awareness
Injury status	Participants who have had a previous head injury (exposure to a major medical event)	None
Knowledge	Previous experience professionally or personally that may influence a person's beliefs	Motivation Awareness
Susceptibility	Beliefs about the likelihood of falls happening to older adults (i.e., I am at risk)	Low beliefs personally due to engagement in prevention Factors that influence risk: physical aging, cognitive ability, premorbid medical conditions, living environment
Severity	Beliefs about the seriousness of a fall happening, including consequences	High beliefs that a fall will be serious for older adults
Threat	Combined effect of susceptibility and severity that a fall will happen (i.e., I am likely to fall)	High beliefs that older adults are at increased risk for falls

Benefits	Beliefs about the positive aspects of adopting a behavior (i.e., completing fall prevention acts will prevent falls)	Independence Maintaining health
Barriers	Beliefs about obstacles to preforming a behavior, and the negative aspects (tangible and psychological costs) of adopting a behavior	Internal: Lack of motivation/willpower, beliefs of others External: Resources
Cues to action	Internal or external factors that could trigger the health behavior	Internal: motivation, acceptance, fear External: friends/family, doctors
Self-efficacy	Beliefs that one can perform the recommended health behavior	Control Confidence

Figure 11

Data applied to the HBM



Modifying Factors. Of the 14 participants who completed the semi-structured interviews (2 controls and 12 experimental), 5 were in the TBI group and 9 were in the group without TBI.

There were no differences between how people with TBI and people without TBI described their health beliefs related to fall preventions. However, between condition groups, those in the experimental group discussed more awareness of when and where they could do prevention acts. For example, both TC1 and NC1 talked about "figuring out how" or "getting more information" to prevent falls, as well as acknowledging that "more could be done" to prevent falls. In contrast, most people in the experimental group were "more aware" and "recognized that I can do something." These differences are elaborated below in two HBM constructs: *cues to action* and *self-efficacy.*

Additionally, quantitative HB scores of knowledge, motivation, and commitment were considered highly aligned with positive fall prevention beliefs. Qualitative data addressing these constructs suggests that the high levels of knowledge captured in the quantitative data may have resulted in more motivation to learn about fall prevention and more baseline awareness that fall prevention education was important. Several participants in the interviews highlighted experience gained in a profession (i.e., nursing), exercise class, or previous personal experience (NE8: "I practiced as a nurse for 40 years, and it was just always there. It was one of those things that it's like brushing your teeth. It's just always in the back of my mind to prevent falls.") Additionally, most of the participants reported they had some fall prevention knowledge, but none reported seeing the CDC STEADI Handout before. The education on the handout was well received by the participants (NE1: My daughter looked it over, her husband looked it over, a couple of my neighbors looked it over. So, I would say that it helped a few other people that you didn't expect to have to help.") For this sample, knowledge (and specifically, high levels of knowledge) was a consistent factor that may have modified individual health beliefs (NE3: "I don't think [I learned anything]. I think your goal was to make me think about what I'm already

doing. But I don't know that. I don't know that I really learned anything. Maybe I just learned something about myself.")

Susceptibility. Overall, participants felt that their personal susceptibility to falls was low, with most discussing baseline preventative measures such as "lots of movement," "taking care of my body" and "getting enough sleep" or personal factors like "good balance," "strong core," "healthy bones" as reasons for their low perceived risk for falls. However, most participants agreed that older adults generally have an increased risk of falling. Participants primarily discussed what they felt would make older adults, including themselves, more susceptible to falls. Factors identified were physical aging, decreased cognitive ability, premorbid medical conditions, and living environment (Table 14).

Table 14

Susceptibility and Severity Influencing Beliefs about Fall Prevention

Individual Factor	Quote
Physical aging	NE8: As we age, we may not exercise as we used to NE6: I think there's a vulnerability there. Part of it is just a process of aging, you know, in terms of changes in vision, changes in gait, changes in bone density. Those kinds of thing, it puts them more at risk
Decreased cognitive ability	NE1: Yeah, the brain works in funny ways and people, as they age, get frustrated because these things occur. Like you're talking, you're having a conversation, and the word disappears, or somebody's name disappears on you, and it's very frustrating TE1: My reaction time is not as quick. So, I know I'm going to fall but I can't do anything about it for a couple of seconds. I don't know how to explain it
Premorbid medical conditions	NE4: I have some chronic diseases, but some of them are genetic. Some of it is probably what happened when I was in my 20s and 30s. But it's kind of funny as you get closer to the end, if you want to call it that, you start to reevaluate what you've been doing and maybe correcting that a little too late TE4: I think having a titanium spine, having so many broken bones, and having lupus and RA, my bones wouldn't handle it real well

Living Environment	TE3: I'm not the only one who probably doesn't really want to identify what might be a trouble area. Or admit, if I lived alone, I really wouldn't want to admit to anybody. I'm clumsy around the house because, you know, I drag my foot a little or something like that NE6: You know, multigenerational homes are almost unheard of now. And so, there are a lot of older adults that are living alone. And they're not necessarily their environments aren't necessarily safe

Severity. Participants had neutral beliefs about severity on the HBM questionnaire; however, participants elaborated on their beliefs in the interview. All interviewees felt falls would have serious physical and social consequences for older adults. Participants stated that it was "harder for older adults to recover." Additionally, participants compared their own recovery to a younger person explaining, "I might have some residual nerve damage or inability to move (NE7)" as well as social consequences, "If I got hurt, I would have to have someone help me, and that would be a major difference (NE5)." Personal factors, such as premorbid conditions (Table 14), also increased perception of severity if they were applicable to an older adult.

Threat. Threat is how susceptibility and severity combine to evaluate the likelihood of a fall. Overall, threat was quantitatively higher than susceptibility and severity, with older adults elaborating in the interviews that they felt they were likely to fall, regardless of their lower perceived susceptibility and severity (NE8: "A fall can happen at any time and the damage can be catastrophic.") Discussing more broadly about older adults, NE6 summarized feelings of how susceptibility (low physical function) impacted the overall severity of a fall:

> "Once someone's mobility is affected, they are at higher risk of all the other complications, whether it's pneumonia… blood clot…infection or wound. Everything is affected by mobility. So, if we can keep people moving and keep them healthy, there's

more chance for them to overcome some of those post-operative surgical complications that face everybody but seem to have a larger impact on somebody who's older."

Benefits. The interview data better explained what participants perceived as benefits and barriers when deciding to engage in fall prevention acts. Confirming quantitative score for benefits, participants felt that fall prevention had many benefits. Benefits of fall prevention aligned with most participants' overarching health goal of maintaining their highest quality of health. To achieve this goal, participants felt the perceived benefits of fall prevention included protecting independence and maintaining physical health. Several participants explained the benefits of prevention, primarily physical health: NE8: "It all comes down to physical health. Moving and being able to do the things yourself like get dressed or shower. If you can't move, it's all going to go downhill. So, I'll prioritize having a strong core and good balance;" NE3: "I think what you have to realize is that if you can't move, it's basically over. I don't want to break a hip and it all be over."

Additionally, benefits included maintaining independence by preventing falls. NE2 described how engaging in fall prevention was related to independence:

"If you're healthy, you're more independent. You don't have to ask family members or other people to help you. You also have much more freedom to do the things you want to do as far as travel or exercise and things like that. You don't have a health barrier to that."

Similarly expressed by TE5, "a lot of it is more that I can be helpful to someone and the community and that feels good to me. It's a useful way to be and I want to do that as long as I can." Participants had clear beliefs on the benefits that fall prevention would reduce their risk of falls and assist in maintaining their overarching health goals.

Barriers. Although participants had low beliefs about barriers related to fall prevention, barriers were prominent in the discussion of possible obstacles to fall prevention. Barriers are obstacles that may impede action or subsequent engagement with fall prevention. Barriers can be tangible (external) or psychological (internal). Internal factors included lack of motivation or acceptance of the need for fall prevention efforts (NE4: "I think you have to be cognizant of what your goal is in life, not necessarily what [healthcare providers] want them to do"; NE6: The best way to stop a fall is prevention, but if you're not willing to manage it, that's a problem. That goes back to the whole commitment piece. What's important to you and what are you willing to do to sustain your health?"; NE7: "I don't, and other people don't, want to do the extra unless they're really motivated.")

Related to motivation, the acceptance of risk or need was also identified as an internal barrier to fall prevention. As described by TE3, "I would frame it as stubbornness, but I think this notion of how you look to other people might be a real barrier." NE5 also elaborated on the social consequence of completing fall prevention acts, "a person is used to being a certain way, and then if they become different because of aging or whatever, then sometimes it's hard to other people to understand what's going on, which could interfere socially." NC1 also talked about why she did not use her cane saying, "I'm just not ready for that." TE4 explained in more detail on lack of acceptance:

> "It's a stubbornness thing. It's a pride thing. I don't know. I just think I look like an old lady. What's next? You know? But I need to, because when I walk with that cane it gets me to hold my head up, my spine up. But when I'm running around the university, I don't want to be the old lady. You know, people are already starting to call me ma'am. And I'm like, Oh, come on, I'm not ready for this."

Additionally, some participants talked about external barriers that may impede fall prevention acts, which were included on the QUAN questionnaire. Barriers included lack of resources, such as financial ability, and access to education about fall prevention. NE4 discussed financial ability as "the only barriers I can think of for me are probably financial... some of the small things you can do are not that expensive, but I think they should be emphasized" and further relating financial barriers to his commitment stating, "I'm not committed to remodeling or putting grab bars up on my cement walls. I'm committed to doing the easy things." NE2 touched on both financial and educational resources: "maybe one thing would be not enough good information on something or people that didn't have money or resources like a car or bus to take them somewhere." TC1 related her personal experience with falls as "people don't have the information so they can't really prevent any falls."

The internal barriers identified in the interviews, primarily psychological, were not barriers listed in the QUAN questionnaire. Participants felt that fall prevention acts would impede on an older adult's identity or perception of themselves as NC1 explains "…if you show a sign of weakness, you're in trouble." Addressing psychological barriers as part of fall prevention may help increase behavior change, as indicated with the MCII intervention.

Cues to Action. The most discussed topic in the interviews were on cues to action. Cues to action included internal and external triggers that encourage fall prevention behaviors. Again, the questionnaire did not capture all the cues to action participants may be using to trigger behavior change in fall prevention. However, it did adequately capture the gap in information available from providers or other health education opportunities. In the interviews, participants identified internal cues to action as the motivation to prevent falls and acceptance of need for fall

prevention, while external cues to action were healthcare education and strategies for fall prevention (i.e., MCII).

Internal cues were mirrored to the high baseline commitment and motivation to prevent falls. Participants focused on their ability to complete fall prevention acts, as one participant says, TE5: “I want to be as educated as possible about ramifications. I know what my goals are and always have, and that's to be as healthy as I can be, as strong as I can be. But I have to be realistic.” NC1 provided similar sentiments stating, “I can do some preventative things so learning about them is important for us older folks.” NE8 talked explicitly about motivation saying, “the motivation comes from within, for yourself or for a loved one that you're going to do everything you can to help myself or my loved one not fall.”

A prominent internal cue discussed as a trigger for engaging with fall prevention was acceptance of need for preventative measures; however, acceptance was only discussed by the experimental group. Table 15 has quotes related to internal cues related to acceptance of fall prevention acts.

Table 15

Participant Quotes Related to Internal Cues to Action

Participant	Quote
NE1	Acceptance means to accept aging processes. Your brain processes things slower. Your muscles continue to work faster but less accurate. You have a disconnect and you have to accept that to move on.
NE2	I never thought about myself needing to make changes [for fall prevention], but I do need to. I want to be healthy for as long as I can and wearing different shoes, paying attention, you know. That will help.
NE3	It's so hard to recover. I find as I get older, like just like when I fell and I scraped my knee, it took a while to heal, and there's nothing I can do about that. Which is a shame. I mean, there's things you can do to keep yourself active, just to make sure that you can recover from things. But there's some things you just can't do. It's just natural. I think accepting that is probably the hardest thing.”

NE5	I thought, how can I take care of myself better so that I can enjoy my retirement? I'm making myself a priority.
NE6	I need to pay attention…because I have terrible balance and am an accident waiting to happen. I need to figure out a way to make this work so that I can stay independent. But that was an eye opener for me to realize that I truly am at risk for falls, whether I want to accept that or not, the bottom line is that I am at risk.
TE1	I think sometimes they get embarrassed, and their body isn't working the same way. When you get to be my age or over 75, you're still thinking in terms of your ability as a 40-year-old or a 20-year-old. To make that adjustment in thinking about yourself is a real effort. All your blueprint of who you are is from your twenties, thirties, and forties, and that's where your brain goes to first. So, it's a real effort to say, 'well, wait a minute, you're 80 years old and it's okay to- whatever it is.'
TE3	[using a cane] was something that I just did and was very helpful. I don't think I would have done it if I hadn't done this process. I think it just helped me. You know, and it's silly because I worked at [a rehabilitation center], and, you know, I thought about all this in other contexts, but not about myself."

Furthermore, external cues came from health education materials and using strategies to decrease fall risk. First, health education was discussed by both conditions. However, most participants described not receiving any information from their providers. TC1 described, '[Doctors] have a lot of education, but the thing missing from primary care is fall prevention. They're just treating the problem that might have already caused a fall, not falls." Another participant suggested more cues to action are needed, NE2: "I think maybe health care people need to talk about it more to the elderly rather than just having a pamphlet in a waiting room or something." Another issue with cues to action was how fall prevention may not be perceived as an issue by providers (NE6: "I think probably at this point, my provider doesn't see fall prevention as my issue. You know, he has a little checklist of vision, colonoscopy, bone density... But we've never had a talk about falls, and I've never brought it up to him;" TC1 "why is no one giving us support for fall prevention? I just don't understand how I don't have any of this information already.") One participant described how she felt education would have

benefitted her mom if she had had fall prevention education (TC1: “I know that my mom fell, and it ruined her life. She fell two years ago. She was 93 or 92, and now she's 94 and her life sucks. And it's because she fell, but she didn't have any fall prevention information.”)

Perhaps due to perceived low quality and availability of information provided by medical professionals, participants described gathering information from the internet or learning from peers. The internet was primarily used to find information on fall prevention (NC1: “I am just bound to have a fall and I need to know how to prevent it, so I Google it;” NE7: “I think most people go to the internet, you know Mayo Clinic or John Hopkins.”) NE2 described his experience with gathering and assessing health information by saying,

> “I would say most of the information we get, maybe 65%, you get it from reading things. Whether it’s reading articles in AARP or reading things on the Internet, maybe seeing a TV show about something. Then I would say at least 30 or 35% comes from talking with your friends about their experiences and them sharing what happened. Then when they talk about their injuries and the things that they have gone through, then that’s how you learn. You learn what to expect, and maybe some things you can do to prevent what they had.”

Participants described the role that cues to action had on their individual actions for fall prevention behaviors, as well as how cues to action related to their individual beliefs (TE1: “I reflect on how my health is compared to what I’m learning or searching. Things that are relevant to those thoughts are what I’m going to change.”)

An emerging difference between conditions included how MCII was used as a cue to action. Specifically using the opportunity to join several health beliefs, such as threat, benefits, or barriers. Table 16 has examples from the experimental group explaining how MCII was used as

an external cue to action. MCII is a strategy that specifically links cues to actions, so this outcome was expected.

Table 16

Participant Quotes Related to External Cues to Action

Participant	Quote
NE7	With the checklist: talk to your health care provider and get your eyes checked, etc. That was too vague. However, when you said, well, let's do a strategy. That was extremely helpful. And I don't know if you meant to do this, but you said, 'you've got a habit of getting up in the morning and going through this routine?' Why not just add this?' I think that is very effective. I mean, for someone who's coming to this uneducated and I know it's important, but [you saying] 'what am I going to do for you to say stack it on to this other habit' That was excellent.
TE4	I'm thankful for all of it because I wouldn't have thought about this, and I probably would have gotten hurt. I finally got that bathmat. I knew I needed bathmats; I've been here for five months. I really kept thinking, 'You're going to go down one day and you're going to fall on that concrete…' I took this and it made me focus some time on this. Now I'm very aware of where I'm walking, and I can't believe that that's all it took. I had home health therapies that didn't do anything like this.
TE5	I do believe if you can't see something, then you'll probably never get there. So, the first thing has to be an awareness that you could achieve it or a vision of what you'd want. If I have a vision of trying to keep the floor clear of things where I'm walking and recognizing that that's an important thing to do for my safety, then I'll be doing it. And it won't be once a month. It'll be a daily thing

Self-efficacy. Finally, improvements in self-efficacy on the questionnaire were confirmed in interviews, as well as expanded on how the MCII strategy in the experimental group created increased feelings of control and success. Participants in both conditions experienced an increase in self-efficacy; but the participants with TBI experienced more quantitative increased self-efficacy beliefs. Further, only experimental participants discussed self-efficacy; however, data from the control group did not reach saturation.

Participants without TBI primarily described feelings of increased control, or how MCII increased feelings of active involvement with fall prevention efforts. People with TBI differed slightly by discussing how MCII improved their confidence to participate in fall prevention. Table 17 lists examples of these differences in self-efficacy.

Table 17

Participant Quotes Related to Self-Efficacy

Participant	Quote
Participants without TBI	
NE2	You don't control your health 100%, but you can control some. There are a lot of things that you can do to make yourself fit in the right direction, like cleaning up the floor.
NE4	You don't want to necessarily make people feel like you're controlling their life. You want to have us pick out the answers. I think it's a plus in that I was actively involved instead of being told what to do because so often in the in the medical field, we're given the answers. 'Well, you need to do this, this, and this,' but [your way] identified what some of the changes could be and let me decide how to do them.
NE5	When you're young, you might not [care for yourself] as much. Maybe that's because of the work or things like that. But when you're older, you're more aware of things, so you have more options to be healthy. So, you have to do things to increase your awareness.
NE6	I think that's really important because we're in control at that point. You know, we haven't prioritized [control] in health care. We strip a lot of stuff away and people end up feeling powerless. I think with your intervention…[you asked] what can you do to control that? I thought that was really helpful because people do need to know they still have control.
Participants with TBI	
TE1	I was aware that something was a risk, but I didn't want to identify with it. But this has helped me. Listening and asking me questions was very helpful and I've made what I'll call life changes. You're making older people aware of how they're living their life, how they're managing their lives, and helping them apply their abilities to the situation.
TE3	I think I've moved from giving up—feeling like [using my cane] was an indication of giving up to an indication of not giving up.

TE4	I can't believe that's all it took. I just had to take a moment, focus, and that's all it took. I just need to take a second and think about it. There's probably a lot more I could be doing.
TE5	Getting that confidence, having that confidence made all the difference in the world.

Although participants likely self-selected into the study based on their interest in fall prevention, as all had high motivation per baseline HBM results, mean health beliefs were relatively low in pre- and post-measures, from 1.8 to 2.3 (out of 5), respectively. Scores significantly increased from pre- to post-measures in overall HBM, severity, benefits, cues to action, and self-efficacy. Interviews elaborated on the change in scores. First, although the control group did not reach saturation, those who received MCII, independently discussed it as an external cue to action. MCII was described to assist in overcoming barriers in motivation or acceptance of need. Second, differences in self-efficacy scores between the TBI group and the group without TBI were examined. People with TBI spoke more about how their perception of their abilities changed and their confidence around participating in fall prevention improved, while those without TBI explained having more control in their fall prevention efforts.

Research Question 3

Finally, at each time point in the study, data was collected to assess the general feasibility of the MCII for clinical use to promote fall prevention. Both participants and clinicians participated in the evaluation of implementation outcome measures (IOM). Four measures were collected: IOM (participants and clinicians), TACP (clinicians), MT (clinicians), and PRECIS-2 (clinicians). Each measure included a quantitative and qualitative component.

Participants

Older adults in both conditions completed IOM ratings at Time 1 and Time 2. There was no change in IOM between Time 1 and Time 2, and since Time 2 offered more elaboration on

ratings, those are reported here (Table 18). IOM were evaluated on a 1 to 5 Likert scale with 5 being "completely agree." Participants in the experimental condition rated the intervention as 4.8 (SD=.37) acceptable, 4.9 (SD=.22) appropriate, and 4.9 (SD=.35) feasible. Participants in the control condition rated the intervention as 4.3 (SD=.25) acceptable, 4.2 (SD=.29) appropriate, and 4.3 (SD=.25) feasible. There were no differences in the ratings between the injury status (acceptable: U=21.5, z=-.993; appropriate: U=23.5, z=-8.1, p=.417; feasible: U=23.0, z=-.87, p=.38).

Table 18

Implementation Outcome Measures- Participant

	Experimental			Control		
	Average (SD)	Median	Range	Average (SD)	Median	Range
Acceptable	4.8 (.37)	5	3.75-5	4.3 (.25)	4.25	4-4.5
Appropriate	4.9 (.22)	5	4.25-5	4.2 (.29)	4	4-4.5
Feasible	4.9 (.35)	5	3.75-5	4.3 (.25)	4.25	4-4.5

To elaborate on perceptions and feedback on the intervention, the interview specifically asked participants in both conditions and injury status to elaborate on their impressions of the study, as well as benefits, barriers and modifications to improve implementation. Participants mainly talked about benefits of teaching MCII to older adults to change behaviors, as status quo education often lacked support at to actual application in everyday settings. During interviews, the HBM constructs frequently intersected with participant feedback on the intervention (Table 19).

Table 19

Participant Quotes about Intervention as Related to HBM

Participant	Quote	HBM
NE4	"I think it basically calls you to task instead of just as a passing thought. It's kind of cements it into an action."	Cues to action

NE5	"I think just having people to recognize that they have a problem, like I recognized that I have fallen. And so, this helped me identify something I need to be aware of."	Threat
NE6	"…the thing that's the most positive about the intervention is that you're not necessarily telling someone what they're going to need to do. They're telling you what they think they can do."	Self-efficacy
TE1	"We want to talk to you about ourselves, and I was able to give you my world and where I'm at risk. Maybe I hadn't thought about it clearly, you know, but I was aware that something was a risk, but I didn't want to deal with it. I didn't want to identify it. This has helped me with you listening and asking me questions has been very helpful and made what I'll call life changes."	Susceptibility
TE3	"I think this notion of how you look to other people might be a real barrier. I think that's a tough one for me to get over because was so athletic. I think making that transition to not being oversensitive about how I might appear to somebody else, you know, because I always looked at people in the wheelchairs differently. I think [your intervention] certainly made me think more about it and I made that leap finally."	Barriers (decisional balance)
TE4	"Doing stuff to prevent falls is important to me and can keep me from falling. Why would I not participate in anything that lets me live in this house for as long as I can?"	Benefits (decisional balance)

Strengths of the intervention were primarily the included follow-up to hold the person accountable as described by the following participants, NE4: "a lot of people know what to do, but they just don't do it. Maybe you call them to report, or self-report online might be the answer too;" TE1: "If you call me and I know you're going to call me, then I feel responsible to work with you.") One participant (TE3) also said that a follow-up was necessary because "I think that this follow up is needed. I began to think about [using my assistive device] right afterwards but

didn't think about it while we were doing it. So, I needed to talk to again to let you know how I used the strategy."

Areas of improvement included addressing motivation more broadly, specifically for those who may have lower perceptions of risk or susceptibility. One participant targeted individual perceptions and acceptance of the need:

> NE6: "People don't like that [they're at risk]. Their image is wrapped up in who they are, what they've done, what they've been able to do. And now you're saying, 'you can't go out because you're not safe. And if you do go out, you have to use this walker or this cane.' That's really hard to accept. I think getting people to that acceptance point is probably the first thing that needs to happen before they'll follow through with the other stuff."

Additionally, another participant discussed how education must be relevant to the underlying benefits of completing fall prevention acts:

> NE3: I think if you want people to participate or I think if you want it to appeal to people, it can't just be a general, 'Hey, this is what we're going to do.' I think it has to apply to what interests them or what they're afraid of. Like, I'm afraid of not being independent. However, that may not interest somebody who's only 50. They don't think about it. You have to get them to think about it."

Only one participant recommended a modification to the intervention: (NE1) "I would change the word obstacle. I don't know what's a better word for a mental obstacle. I'd have to think on that a little bit to come up with a mental type of obstacle.") Interestingly, a suggestion from a control interview made the observation that initiation of behavior change influenced her application of changes and hinted at using a strategy to improve behavior change, NC1: "I don't

initiate that kind of stuff real well. I don't know other than having alarms set all over the place. But I'm not sure if that would do it or if there is something better. I mean, this is where I'm at a loss."

Other areas of implementation concern included the appropriate setting for the intervention. Most participants commented that the time to complete MCII would be difficult for primary care settings (NE2: My doctor does not have time to get to know me or ask me about my barriers. They only have X number of minutes, and I don't think they're gonna spend it getting to know me.") Suggestions to address this included having a "education nurse" (NE3) to provide education and follow-up, putting the intervention "in gyms or with physical therapists who could address fall risks" (NE5), or in a more specialized setting, much like the research design as described here:

> TE1: "Let's say I did not volunteer, but I fell and I went to the doctor and the doctor said 'I think you need to talk to Amy'. That's where it would come in, not the doctor taking time to chit chat about this and that and my house. But she would then give a recommendation to me and then I would call you or she would say, 'I'm going to have Amy call you.' Because if you leave it up to me, I'm going to either forget it or be too busy."

An interviewee in the control group also felt that the information would be appropriate in therapy settings (NC1 "The only thing I would suggest is to have this in home health settings. There should be a checklist that a physical therapist can use when they see your home and tell you how to make the changes there and then.")

Additionally, both controls focused on the handout information and how it appeared to be well suited for older adults (NC1: "I think this handout has all the things that need to be on there

and is written well, very clear, short and to the point. I wouldn't change anything." TC1: "I would change is making this information more available. I would put it in a therapy office, doctors' offices, buses, billboards.") Although less reflection on health beliefs was noted in the control group, the low number of controls in the study overall makes comparisons between groups hard to fully establish.

Clinicians

Administering clinicians completed IOM at Time 1 and 5 open-ended questions on clinical use for that specific client (Table 20). In sessions with paired clinicians, both clinicians independently completed the IOM. A total of 24 IOMs were collected in all sessions. On a scale of 1 (do not agree at all) to 5 (highly agree), the clinicians in the experimental condition rated the intervention as 4.5 (SD= .52) acceptable, 4.6 (SD =.49) appropriate, and 4.5 (SD=.74) feasible. Clinicians in the control condition rated the intervention as 3.0 (SD=.90) acceptable, 3.3 (SD=.63) appropriate, and 4.3 (SD = .58) feasible. For injury status, clinicians rated the intervention for 4.6 (SD= .68) acceptable, 4.4 (SD=.62) appropriate, and 4.7 (SD=.51) feasible for people without TBI and 4.1 (SD= .86) acceptable, 4.1 (SD=.67) appropriate, and 4.3 (SD=.96) feasible for older adults with TBI. There were no significant differences between injury status groups (acceptable: U=45, z=-1.5, p=.131; appropriate: U=53.5, z=-.87, z=.38; feasible: U=51.5, -1.01, p=.31). Clinicians were also asked if they felt that the participant, regardless of group, would execute the active plans, with 16 (72.7%) feeling that the older adult would make the changes. IOM ratings were also taken at the end of the study for the general use and perception of MCII as an intervention. Clinicians overall rated the intervention as 4.7 (SD=.52) acceptable, 4.6 (SD=.52) appropriate, and 4.4 (SD=.62) feasible for fall prevention for all older adults.

Table 20

Implementation Outcome Measures-Clinicians

	Average (SD)	Median	Range
Experimental			
Acceptable	4.5 (.52)	4.5	4-5
Appropriate	4.6 (.49)	5	3.5-5
Feasible	4.5 (.74)	4.75	2-5
Control			
Acceptable	3.0 (.90)	2.75	2.25-4
Appropriate	3.3 (.63)	3.25	2.75-4
Feasible	4.3 (.58)	4.0	4-5
Participants without TBI			
Acceptable	4.6 (.68)	5	2.75-5
Appropriate	4.4 (.62)	4.5	3.25-5
Feasible	4.7 (.51)	5	3.5-5
Participants with TBI			
Acceptable	4.1 (.86)	4	2.25-5
Appropriate	4.1 (.67)	4	2.75-5
Feasible	4.3 (.96)	4.75	2-5
Overall Ratings			
Acceptable	4.7 (.52)	5	3.75-5
Appropriate	4.6 (.52)	5	4-5
Feasible	4.4 (.62)	4.5	3.5-5

At Time 1, TACP and MT measures described fidelity of intervention delivery across participants. The TACP produced two scores: therapist adherence and client participation. The inter-rater reliability for TACP and MT was 98% and 97%, respectively. Therapist adherence included a checklist for the intervention protocol components consisting of 14 steps, each receiving a score of 0 (absent) or 1 (present). Client participation included a checklist of each protocol component that the therapist rated from 0 (could not complete independently) to 2 (could complete independently) and was scored from 0 to 28, with lower scores indicating more support. To categorize the type of support needed, the MT produced two measures, fidelity consistent modifications and fidelity inconsistent modifications. Therapist adherence (TA) to the experimental condition was 98% and 100% for the control conditions. Client participation (CP)

was 88% for typical aging and 78% for history of TBI. There were no differences between injury status (TA: U= 29, z=-.16, p=.873; CP: U=14, z=-1.78, p=.076).

The MT was used to describe how participants needed support by reporting the number of times a type of modification was used during the intervention. It should be noted that the MCII intervention is designed to be customized to the responses of each client, so it was expected that there would be fidelity consistent modifications, specifically "tailoring/tweaking/refining" as to engage the client in conversation that was relevant to their own described cues and actions. MT scores in the participants without TBI group revealed that an average of 3.3 (SD=2.7; range 1-5) fidelity consistent modifications (e.g., repeating instructions) occurred during the intervention. An average of 0.20 (SD=.133; range 0-1) fidelity inconsistent modifications (i.e., removing an element based on time or participant interest) occurred in the participants without TBI group. In the TBI group, an average of 6.83 (SD=3.1; range 1-10) fidelity consistent modifications occurred and .33 (SD=.52; range 0-3) fidelity inconsistent modifications occurred. The TBI group compared to the group without TBI required more adding or repeating of elements in MCII to be successful (U= 9.0, z=-2.3, p=.021), as well as total fidelity consistent modifications (U=11.3, z=-2.0, p=.043). All other types of modifications were not different between injury status groups (Table 21).

Table 21

MT Count for Each Modifications that Occurred During the Intervention

Modification Item (from Stirman et al., 2013)	Aging without TBI Mean (SD)	Aging with TBI Mean (SD)	Z score	p-value
Fidelity-consistent modifications	3.3 (2.7)	6.8 (3.1)	-2.0	.043*
Tailoring/tweaking/refining: The intervention was modified for a particular participant (i.e., simplifying language, changes to increase	1.2 (.42)	1.3 (.52)	-.58	.56

cultural relevance) while leaving all major intervention principles intact				
Adding/repeating elements: Additional materials or activities are provided that are consistent with the intervention (i.e., adding a list of obstacles or giving more examples)	1.7 (1.7)	4.3 (1.9)	-2.3	.021*
Shortening/condensing (pacing/timing): A shorter amount of time than prescribed is used to complete the intervention (i.e., going faster through the steps, shorter spaces between tasks)	0	0	---	--
Lengthening/extending (pacing/timing): A longer amount of time than prescribed is used to complete the intervention (longer sessions, more sessions, spending more time on certain components)	.4 (.97)	1.2 (.98)	-1.7	.091
Fidelity-inconsistent modifications	.20 (.42)	.33 (.52)	-.57	.56
Integration of conceptually inconsistent treatment strategies: Another intervention is used but the original intervention elements are still introduced (i.e., using motivational interviewing during MCII protocol)	0	0	---	--
Removing elements: Elements of the intervention are not included (i.e., leaving out the mental imagery portion of the intervention)	.10 (.32)	.17 (.41)	-.38	.71
Loosening structure: Elements intended to structure the intervention sessions do not occur as prescribed (i.e., clinician does not follow the steps or ask imagery questions)	.10 (.32)	.17 (.41)	-.38	.71
Drifting from protocol: The intervention is not used or is stopped	0	0	---	--

Note. *p<.005

In addition, clinicians were asked open-ended questions related to implementation outcomes and MCII execution at both Time 1 and at the end of data collection in a final summary survey. Similar to participant feedback, clinicians supported that MCII increased self-awareness and could be applied to different clients. One clinician stated: “If/then strategies appear promising because they allow individualization. Each participant I worked with was at different stages in life and at different levels of ability. As a result, some were able to better

implement the strategies and plan because they understood the importance of it within their lives. But overall, I think all could use the strategy." A clinician even reported using the strategy to another client outside of the study: "I recently used the implementation strategy with an Aural Rehab client to teach listening repair strategies in everyday situations. It was beneficial to start with the topics of the strategies that could be implemented in the client's life and find areas of need that should be addressed in the plan. Then catering the needs or aspects of the client to the wording of the if/then plans engages the client as well."

Barriers and modifications to the MCII intervention included addressing participant motivation, adapting based on participant ability, and recommending peer modeling. Clinicians made the following comments about the intervention: "overall, the intervention is easy to administer but depending on the motivation of the participant, the intervention was harder to administer." Another detailed: "MCII is definitely easy to implement and use for those without any disabilities, but difficulties might be present for those with any kind of disorder/disability. For this reason, MCII might not be for every person out there. I believe that caregivers aiding in the implementation of MCII is a great possibility." One clinician had this suggestion: "one potential modification to the clinical intervention that could be made to maximize implementation may be exposing clients to real-life examples from people who implemented MCII and benefited from it." The examples provided by the clinicians were related to their IOM ratings that the intervention was *acceptable* and *feasible*; however, the areas of improvement or barriers to the intervention were primarily in *appropriateness*, mostly dependent on the motivation of the client or the ability to participate in the creation of a plan.

Clinicians struggled with the effort involved in the MCII intervention. Effort was described as energy required to implement MCII, specifically managing a session and

responding to individual concerns ("The hardest part of implementing the MCII plans is listening to help the participant create an if/then statement. However, I believe that the implementation of the MCII was easy and can be done effectively through following the script to become proficient at what questions will breed conversation that is beneficial for prevention statements"). Another clinician states that "...the guided planning process while creating MCII plans [was the hardest part]. In the beginning, it was not fluid when explaining how to create the if/then plans or ways to implement them in their daily lives. This intervention became easier to explain as the sessions progressed." Both statements demonstrate the effort that the clinician may need to guide the intervention and may be supplemented by additional training or clinical experience.

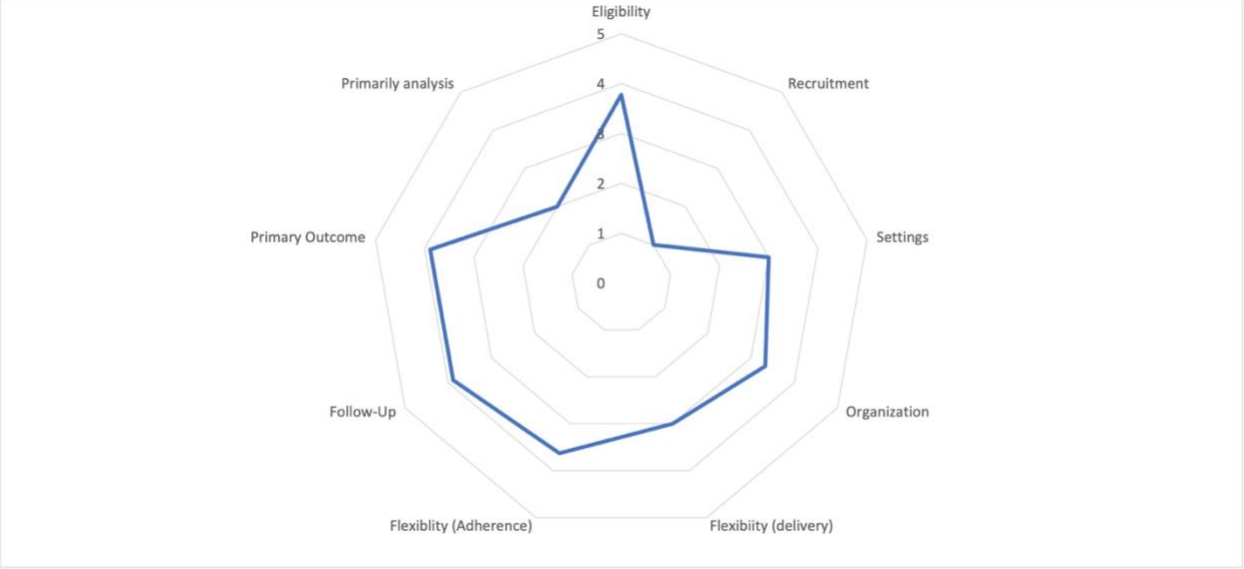
After all interventions were completed, clinicians participated in a PRECIS-2 rating to assess if the intervention was suited for more "real-world" settings (i.e., a clinic or hospital). Figure 12 shows the PRECIS-2 ratings for this sample. Scores closer to 5 on a rating of 1 to 5 indicate that the intervention is more pragmatic (usual conditions) than explanatory (ideal conditions). Overall, the intervention was scored as 3.4 (SD=.58), or equally pragmatic and explanatory. The domains that leaned more towards pragmatic included primary outcome (3.89, SD=1.5) and follow-up (3.89, SD=1.5). The domains that leaned more towards explanatory included recruitment (1) and primary analysis (2), both of which were only scored by the PI. All other domains were roughly equally pragmatic/explanatory: eligibility (3.78, SD=1.5), setting (3, SD=1.2), organization (3.33, SD=1.2), flexibility-delivery (3, SD=1.5), and flexibility-adherence (3.63, SD=1.18). As the student clinicians were not involved in some aspects of the study, the PI was the only one who rated the study components (recruitment and analysis), which likely added bias to the scoring in those domains and thus is only a preliminary exploration of how MCII fits with current clinical practice and might be further readied for implementation in real-world

settings. However, the overall PRECIS-2 rating and most domains fell into the "equally pragmatic/explanatory" rating, indicating that application of MCII had components that were related to ideal conditions and usual conditions.

Overall, MCII was perceived as an acceptable and feasible intervention by both clinicians and participants. However, more support for clinicians may need to be provided or developed to address appropriateness, particularly for clients with lower levels of motivation to complete fall prevention behavior change.

Figure 12

PRECIS-2 Ratings



Note. Ratings closer to 1 are explanatory (ideal conditions) while ratings closer to 5 are pragmatic (usual conditions)

CHAPTER 5

DISCUSSION

In this mixed method study, MCII was used as a self-regulation strategy to promote behavior change for the prevention of falls in older adults with and without TBI. The first question explored MCII as a strategy for behavior change and whether there was behavior change in fall prevention. The second question evaluated the change in HBM constructs and how they were perceived by older adults as related to decision-making for fall prevention. The final question evaluated the implementation outcome measures (feasibility, acceptability, and appropriateness) of the intervention from both a clinician and a participant perspective. MCII was delivered to 13 people, 5 of whom had a history of TBI, and the results indicate that it may be relevant, feasible, and acceptable for both clinicians and older adults as a strategy for behavior change to prevent falls. The results were compared with 3 controls, 1 with TBI, who received "status quo" education. More participants in the experimental group reported behavior change and provided elaboration in the interviews on how MCII contributed to their perceived success. There were some differences between the older adults with TBI group and those without, namely those without TBI completed more reoccurring events and passive behaviors. Interviews captured how behavior change for fall prevention is perceived and how beliefs relate to the application of MCII. The second question targeted how health beliefs intersected with behavior change. All participants experienced a change in HBM constructs, particularly perceived severity, benefits, cues to action, and self-efficacy. Participants in the TBI group had more perceived self-efficacy than people without TBI, which was further elaborated in the interviews.

Furthermore, evaluation of the MCII protocol revealed that clinicians can adhere to the directions and provide protocol consistent fidelity modifications as needed. Additionally, older adults, with and without a history of TBI, can actively participate in the intervention. These findings have several implications.

Aim 1. Behavior Change

Behavior change was measured in three primary ways: active, passive, and generalized behavior change. All participants, regardless of their condition or injury status, received the same educational material and surveys to measure change. Behavior change was examined based on experimental condition and injury status to explore if and how MCII may contribute to successful behavior change and for whom. Due to small sample sizes, results were reported descriptively and should be interpreted lightly. Active behavior change included two plans, a single time event and a reoccurring event. Although condition groups were unbalanced, more single-time events occurred than reoccurring events across all groups, which is consistent with previous literature citing that single event changes are easier than reoccurring or creating habits (Reber & Reber, 2001). The participants discussed an unexpected finding in the self-report of generalization of behavior change, in which the experimental participants reported creating their own if/then plans outside of the two active plans made at Time 1. The experimental group also completed more passive behavior change than the control group, as well as their active plans. More passive behaviors were completed by those in the experimental condition (2.7 behaviors) compared to the control condition (.33 behaviors). Similar to the differences between the condition groups, participants without a history of TBI completed more single and reoccurring events, as well as more passive behavior changes. This was also an anticipated outcome of the study. However, unexpectedly, people with TBI were similar to people without TBI when

generalizing MCII to achieve additional behavior changes for fall prevention. In general, all participants in this sample identified and executed actions from the recommended list to prevent falls; however, MCII may have provided a tool that made it easier to implement change, particularly for people with TBI.

Differences between MCII and Control

Hypothesis 1 predicted that those in the experimental group would demonstrate more behavior change than those in the control group. This hypothesis could not be statistically evaluated due to the small sample size; however, some descriptive differences were noted. Approximately three-quarters of the experimental participants (76.9%) completed a single event compared to a control (33.3%), and almost half of the experimental participants (53.8%) completed a reoccurring event compared to a control (33.3%). Furthermore, almost half of the experimental participants (46.2%) created their own if/then plan or generalized MCII. A similar increase in behavior change was demonstrated in passive behaviors, with the experimental group completing approximately three additional behavior changes. On average, the control group did not report any additional behaviors outside of their active plans.

Although the control group was unbalanced and therefore may not be representative of true group differences, the qualitative interview provided some indication of reasons underlying differences in behavior change outcomes across conditions. As expected from the study design, the control group endorsed that their experience in the intervention matched that of status quo education (i.e., provided a handout without discussion). This is contrasted to those in the experimental group who spoke at length about the strategy, increased awareness, and better integration of fall prevention education into their lifestyles. As a result, MCII may have provided participants with a greater variety and complexity of cues and planning (tenants of MCII) than

traditional education. For example, in addition to the handout, the intervention group was given the opportunity to discuss personal details about fall prevention efforts and problem solving with a clinician. As each intervention was customized to the individual's responses, natural conversation and planning could occur. This may have resulted in greater cue detection and subsequent behavior change. MCII supports more individualized discussion on cues and actions when recommending behavior change, and that component of MCII may have contributed to behavior change for fall prevention. In fact, such individualized discussion is recommended to increase participation in fall prevention activities (Shanker et al., 2017; Jansen et al., 2015; Kiami et al., 2019). Although health education alone has generally shown an impact on change in health behavior in a variety of outcomes (e.g., cardiac health, smoking cessation, healthy activity, and nutrition), as well as decreased falls (Hopewell et al., 2018); education produces less change in behavior than when partnered with a strategy to implement change (Klusmann et al., 2021). Therefore, when targeting education and strategy use simultaneously, as MCII posits, better outcomes may be achieved.

Passive behavior changes may in part be explained by the use of MCII as a strategy. Passive behavior changes were those that were completed in addition to active plans but did not have an if/then plan paired with it. Constellations of behaviors are when a person performs a variety of individual behaviors that are conceptually clustered together (Heimlich & Ardoin, 2008). As the recommended changes in this study did not require a high level of external resources (i.e., money, physician visit, exercises), and were all similar in concept (e.g., takes place in home), this sample of motivated participants may have grouped all behaviors together, thus forming a constellation of behaviors all supporting environmental modifications to prevent falls.

Regardless, MCII may be a strategy that older adults could use as a tool to accomplish a particular task; therefore, targeting a teachable and transferable option to address behavior change. The literature on behavior change emphasizes that strategies or skills that are achievable and successful are enough to achieve goals (Latham & Locke, 1991; Locke & Latham, 2013). MCII offers a method to provide education for fall prevention while also embedding skills and habits into a person's life to promote greater change in behavior. Those in the experimental group were trained on a strategy that targeted underlying motivators to complete the behaviors and, in turn, could have resulted in participants who were internally motivated to take all possible actions and use any available resources to prevent falls. Furthermore, almost half (42.5%) of the experimental group reported creating a new if/then plan and generalizing the strategy to different settings or actions. Given that participants independently discussed strategy generalization during the interviews, it may be possible that a wider constellation of behaviors (i.e., getting feet or eyes checked), could be addressed with MCII. As MCII encourages participants to imagine the benefits and barriers to completing a behavior, additional actions for fall prevention could be targeted.

Differences Between Injury Status

We also hypothesized that a) older adults without TBI would demonstrate more behavior change than those with TBI and b) older adults with TBI would benefit more from MCII as a behavior change strategy. Our results tend to support these hypotheses, indicating that older adults without TBI may have more behavior change than older adults with TBI; however, older adults with TBI may benefit more from MCII. Older adults without TBI were generally more successful in completing behavior change actions than older adults with TBI (single: 80% to 50%; reoccurring 70% to 16.7%). Similar results were observed in the creation of new plans

(50% in the group without TBI, 33% in the TBI group) and in the completion of additional passive behaviors. Participants with TBI reported completing fewer passive behaviors (1.5 behaviors) than participants without TBI (2.8 behaviors). The pattern of results was in line with literature supporting explicit direct instruction (i.e., MCII) compared to passive instruction (i.e., passive behavior or status quo) for individuals with TBI. This means that older adults with TBI may need more explicit education for behavior change to be successful, which is supported in the larger literature on TBI (Jeffay et al., 2023; Kennedy et al., 2008; R. Tate et al., 2014; Togher et al., 2014; Toglia et al., 2010).

Aim 2. Health Belief Change

Health beliefs were evaluated at two time points, before any education at Time 1 and at follow-up Time 2. The same survey was used to evaluate any changes in the HBM constructs. The change was evaluated in general, as well as between conditions and injury status. In general, participation in the study produced increases in overall health beliefs about fall prevention and HBM constructs: severity benefits, cues to action, and self-efficacy. The baseline assessment of health beliefs related to fall prevention was comparable to previous literature (Vincenzo et al., 2022), where severity, susceptibility, self-efficacy, and cues to action were all perceived as low and, therefore, considered barriers to the person engaging in fall prevention behaviors. Vincenzo et al. (2022) found that older adults felt that improved knowledge and cues to action would increase fall prevention engagement. Addressing this need, this intervention study provided older adults with knowledge and cues to action in the experimental and the control condition by providing both with fall prevention handouts and discussion on fall prevention in a healthcare clinic setting. For this reason, post-intervention HB scores, regardless of the group, may have increased and promoted cues to action to participate in fall prevention, as well as reinforced the

benefits of fall prevention. Furthermore, the interviews also aligned with the existing literature, that individual beliefs, particularly fear of vulnerability, maintaining autonomy and independence, and low-risk assessment were all factors people considered when assessing their own fall risk and prevention engagement (McMahon et al., 2012). Finally, the use of informed grounded theory provides a flexible and iterative approach to apply existing theory (HBM) to the processing of older adults' fall prevention education.

Differences between MCII and Control

Hypothesis 2 was that participants in the experimental group would have a greater increase in HBM constructs related to fall prevention (i.e., greater feelings of risk). This hypothesis could not be statistically evaluated due to the small sample size; however, some descriptive differences were noted. Specifically, the experimental group quantitatively reported more barriers to fall prevention than the control group. Furthermore, in the interview, only participants who learned MCII discussed how it was used as a cue to action. Both can be expected given that MCII dedicates specific awareness to internal obstacles and actions to overcome them (Kappes & Oettingen, 2014). Those in the experimental group were exposed to thoughtful consideration of barriers through the mental contrasting process. As mental contrasting can strengthen mental associations between obstacles and behaviors needed to overcome them (Kappes et al., 2012), the experimental group may have had more opportunity to evaluate how barriers manifested in their own lives. MCII directly supports the development of specific strategies for overcoming obstacles and strengthens the association between obstacles and strategic behaviors to achieve goal behaviors, often with more success than just mental contrasting or implementation intentions alone (Adriaanse et al., 2010; Kirk et al., 2013). Given that there was more change in behavior (passive and active) in the experimental group with the

use of MCII, the time spent identifying obstacles and then subsequently making plans may offer the necessary skills to overcome obstacles. According to the HBM, decisional balance is how a person weighs the benefits compared to the barriers when deciding to complete an action (Rosenstock, 1974). Although there was an increase in perceived barriers, there were also general increases in health beliefs related to the prevention of falls. The decision to complete fall prevention, although with greater recognition of barriers, may have been easier in the experimental group, as their implementation intention plan was designed to overcome the barriers expressed during the intervention.

Previous work on how HBM is related to fall prevention identified several HBM constructs (perceived severity, susceptibility, self-efficacy, and cues to action) interfere with engaging in fall prevention (Vincenzo et al., 2021), and therefore older adults suggested that more education and cues to action were needed to promote fall prevention (Vincenzo et al., 2022). Some intervention research in fall prevention has targeted HBM constructs (decisional balance (benefits versus barriers), knowledge and self-efficacy) and have subsequently demonstrated an increase in the respective HBM constructs, as well as increased behavior change (Ahn & Oh, 2021). This study is in line with these previous findings in that older adults feel that education and cues to action are needed for more participation in fall prevention, as well as MCII as an intervention for fall prevention can be used to address and improve HBM constructs, specifically barriers and self-efficacy, as well as offering opportunities to discuss all other HBM constructs.

Differences Between Injury Status

Hypothesis 2a was that people with TBI would have higher health beliefs related to fall prevention and would subsequently experience an increase in health beliefs following the

intervention. This hypothesis was partially supported as there were no baseline differences in health beliefs and only one HBM construct, self-efficacy, was significantly different after the intervention. On a scale of 1 to 5, with 5 indicating 'very much agree', people in the TBI group reported more feelings of self-efficacy (Md=3.0) post intervention than those without TBI (Md=2.3). In both the TBI group and the non-TBI group, all participants reported high levels of motivation and commitment to fall prevention, which may have influenced the effort that the participants applied during the intervention. In addition, the interviews revealed some difference in the nuance of how self-efficacy changes between people with and without TBI. Specifically, people with TBI spoke about “confidence” and “abilities” while people without TBI explained a change in “control.” Both experienced a change is evaluation of success, but the underlying object of evaluation may have a meaningful difference.

Motivation is built from task persistence and self-evaluation (Zentall & Morris, 2010), and can be related to self-efficacy. Self-efficacy theory is based on an individual’s personal beliefs about their ability to perform a task (Bandura, 1986) and can positively influence motivation and the use of self-regulation strategies. Self-efficacy also appears to play an essential role in the self-evaluative processes involved in assessing success (Judge et al., 2007). When motivating themselves to complete tasks or use strategies to accomplish goals with the perceived success of the strategy, participants may have experienced an increase in self-efficacy beliefs related to preventing falls. Self-efficacy is particularly important, as it is positively associated with participation in adaptive health outcomes (Blanchard et al., 2015; Schmitt et al., 2014; Selzler et al., 2016), and is generally important in the management of chronic health conditions (Bodenheimer et al., 2002; Paech & Lippke, 2017). This means that MCII can offer older adults with chronic TBI a set of skills that can increase the strength and precision of self-efficacy

beliefs in participation in fall prevention, particularly since motivation to prevent falls already be high. Finally, higher perceived self-efficacy of cognitive function has been found to be a predictor of community integration and life satisfaction in the later or chronic stages of TBI (Cicerone et al., 2004; Dumont et al., 2004; Wood & Rutterford, 2006), which can contribute to the overall health and functioning of older adults with TBI and increase the ability to participate in self-management of chronic TBI consequences (Lorig & Holman, 2003).

An informed grounded theory approach allowed the *process* of older adults making decisions about fall prevention to be investigated, as well as describe if and when that process might be influenced by health beliefs. The findings highlight psychological benefits and barriers, namely independence and motivation, that drive fall prevention behaviors. Additionally, MCII as a cue to action may influence older adults' decision to complete fall prevention actions, as it can increase self-efficacy and provide a method to reflect on one's own beliefs and create action plans to overcome personal barriers.

Aim 3. Feasibility of MCII

Satisfaction ratings and no dropouts from the study suggest that the MCII intervention is acceptable and feasible to implement for fall prevention, as well as indictive of being able to be implemented in a more clinical setting for a large-scale trial. Both have implications on the delivery of MCII as a fall prevention health education intervention for older adults, with and without TBI. Participants reported that the intervention was acceptable and adaptable to the individual's needs, as well as feasible and relevant to the individual's health goals. These findings align with research that has called for rehabilitation to focus on enabling people, particularly those with TBI, to participate in self-management and prevention efforts, which in turn can improve quality of life and social participation (McCabe et al., 2007; McColl, 2007).

From a clinical point of view, the MCII protocol is sufficiently structured to provide consistency while simultaneously allowing for individualization and modification to support client success.

Participants

Participants rated the intervention as acceptable, feasible, and appropriate for fall prevention. In part, participants related the feasibility of MCII to how it intersected with HBM constructs, namely barriers, cues to action, knowledge, and self-efficacy. Our data support previous findings that low individual beliefs and limited cues to action decrease participation in fall prevention in older adults (Vincenzo et al., 2022; Vincenzo & Patton, 2021). However, participants felt that MCII addressed major psychological barriers, such as motivation or acceptance of the need, while simultaneously increasing cues to action. In addition, most of the participants asked about participating in the interview, which may be indicative of the high interest and motivation for information and discussion about fall prevention.

Most of the participants did not feel that MCII would be appropriate in a primary care setting due to physician time constraints, and instead felt that MCII should be in other healthcare settings, such as outpatient rehabilitation or home health. Alternatively, the intervention could be structured as a referral or elective program for older adults to participate with a trained professional. There are community programs for fall prevention (e.g., Matter of Balance; Healy et al., 2008), however community-based programs require the older adult to independently initiate and implement recommendations (Tricco et al., 2017; Calhoune et al., 2013). The current study used materials from the CDC STEADI initiative, which was designed to help healthcare providers standardize the screening, evaluation, and intervention process to prevent falls (Stevens & Phelan, 2013). Current practice consists only of an assessment and algorithm that determines risk and then provides education or treatment referrals (Johnston et al., 2019;

Eckstrom et al., 2017). Furthermore, STEADI has been implemented and evaluated primarily in primary care health systems, such as hospitals or primary care offices (Casey et al., 2016; Eckstrom et al., 2017; Smith et al., 2017). Implementing STEADI also relies primarily on older adults to apply recommendations independently, which less than 50% ultimately do (Vincenzo & Patton, 2021). In the current study, participants felt that rehabilitation settings, much like the setting of the current study, would be appropriate for a fall prevention program, instead of a primary care setting. These settings would offer more opportunities to discuss barriers to fall prevention and generate individualized solutions to prevent falls. Future testing should address the use of STEADI in rehabilitation settings including outpatient treatment, assisted living facilities, or community day programs.

In addition, MCII appears to complement STEADI health education by disseminating information while simultaneously addressing the implementation of recommendations. MCII has been successfully used in programs for other health-related goals (e.g., health eating and exercise; Stadler et al., 2009, physical exercise and weight loss for people post stroke; Marquardt et al., 2017). MCII has also been shown to be of high utility in managing more psychologically based goals such as managing stress (Gollwitzer et al., 2018), reducing sleep procrastination (Valshtein et al., 2020), and adjusting care partner expectations of people with dementia (Monin et al., 2020). As the barriers to fall prevention were described by the participants as more psychological, MCII provided a strategy to evaluate these obstacles and overcome them. MCII can help regulate non-conscious cognitive, motivational, and emotional processes that can mediate behavior change (Kappes et al., 2012, 2013; Kappes & Oettingen, 2014; Oettingen et al., 2009; Wittleder et al., 2019), all of which were endorsed by the participants as a result of MCII.

Finally, participants identified the lack of motivation as a significant barrier to a wider dissemination of MCII. Although this sample was highly committed to prevent falls at baseline, participants also identified lack of motivation, as well as acceptance of need, as barriers to their own behavior change. Commitment to fall prevention also increased slightly and had less variability after the intervention and remained constant at Time 2. These findings support that MCII may still be beneficial for older adults with lower levels of motivation or commitment and may even increase commitment during the process. Although more evaluation is needed to fully explore how baseline motivation levels and commitment impact behavior change for fall prevention, previous research has found that MCII does not require high levels of motivation to promote change (Oettingen et al., 2001; Oettingen et al., 2009). Therefore, MCII can still produce desirable outcomes to reduce falls in a larger population of older adults.

Clinicians

Similarly to the participants, clinicians rated the intervention as acceptable, feasible, and appropriate for the prevention of falls for older adults; however, the effort to implement the intervention was the biggest barrier for the clinician. Effort, in this intervention, is related to the mental effort (e.g., active listening, flexibility/adaption) required by clinicians to implement the MCII strategy. This may be explained by the limited experience of clinicians and their emerging familiarity with applying evidence-based practice (EBP) tenants (i.e., client needs/value, clinical expertise and evidence-based research; ASHA, n.d.). Previous research on graduate students in SLP programs found that first-year students rate their confidence as 'low to medium confident' in clinical evaluation and interventions (Pasupathy & Bogschutz, 2013). Given that graduate students are building clinical skills, the effort involved with MCII can be expected. However, a recent investigation of EBP perceptions in the field found that most SLPs consider client

preferences as their main source of evidence-based practice (Greenwell & Walsh, 2021), as compared to clinical experience and evidence-based research. As MCII is an evidence-based research procedure that uses an individualized protocol based on client responses, this strategy complements the EBP practice most used by SLPs, albeit more effortful for novice clinicians in administration.

Furthermore, although MCII was previously reported to take an average of 7 minutes to complete (Kizilcec & Cohen, 2017), this study included a sample of college students, while the current study included only older adults. Our intervention with MCII was longer in duration (45 mins; range 30-50 mins). This can be explained for a few reasons. First, older adults may need more support to complete MCII successfully. Therapist adherence of the clinician to the protocol was high, indicating that all steps in MCII were delivered; however, client participation required clinician support for the participant to be successful. Measures on the MT indicated that tailoring was required, as well as repeating or rephrasing instructions. Additionally, more MTs were needed for people with TBI to successfully participate in the intervention. Second, as described above, the participants in this study had high baseline motivation to engage in fall prevention materials, indicating that interest may have contributed to the lengthy implementation of MCII. Participants led the conversation during the intervention and therefore had opportunities to ask questions or discuss health beliefs about fall prevention. Furthermore, the lack of healthcare education discussed by participants may also have contributed to the longer administration of MCII, as the study could have been an exciting opportunity to discuss fall prevention with a healthcare profession. Third, the effort reported as the biggest barrier to MCII administration indicated that more clinical support may be required. Improved training protocols and models, as suggested by clinicians, may provide easier integration of MCII into therapeutic practice,

therefore reducing the time to implement MCII. It should be noted that over time and with more MCII sessions, clinicians reported a decrease in effort in the MCII protocol. With clinician modifications and increased training, larger-scale MCII trials may have a reduced time commitment to execute MCII; however, older adults, especially those with TBI, may still need more time than 7 minutes to successfully learn MCII.

The PRECIS-2 tool evaluated the current applicability of the intervention, asking if the intervention would work under ideal conditions, as well as under usual conditions. Scores are rated from 1 to 5 with 1 being working under ideal conditions, such as in a controlled research setting, and 5 being working under usual conditions, such as an outpatient clinic with unpredictable distractors or barriers (Trabacca et al., 2021). The MCII intervention was overall rated 3.46, indicating that it was equally pragmatic/explanatory. The elements most similar to usual conditions were follow-up (3.89) and primary outcome (3.89). These elements support the goal of the study aligned with the usual clinic procedures, such as reviewing the use of education or strategies and evaluating whether there was change in behaviors and why. Elements least similar to usual care included recruitment (1) and primary analysis (2). These domains were based on ideal research settings by not recruiting through a typical setting but rather with targeted invitations with incentives. Furthermore, the primary analysis excluded any ineligible responses, which is not typical for clinic settings. Implementation science tools such as PRECIS-2 are used to promote strategies for efficient transfer to clinical practice (Olswang & Prelock, 2015). Of particular note, clinicians had minimal exposure to research design and practices and, although each domain was defined with examples at each end of the spectrum, raters may have had a low frame of reference for research settings compared to usual clinic conditions. Repeat analysis of the PRECIS-2 tool in a larger-scale trial with more experienced clinicians may

provide a more accurate rating of the status of the MCII intervention. However, current evaluation and written feedback support that more training and guidance may be needed to refine the protocol for clinicians to apply in clinical practice. After continued improvement to the MCII protocol, MCII could be an accessible and time-friendly strategy for clinical use, particularly given that EBP in clinical care results in measurable returns, such as improved health outcomes (Melnyk et al., 2010).

Study Considerations

The present study has several factors that should be considered when interpreting the results. First, the pre-post unbalanced design allows for more exploration and evaluation of the feasibility of MCII as an intervention; however, future studies should utilize more robust study designs such as a balanced randomized controlled trial. This would provide greater reliability in assessing the degree to which outcome changes can be attributed to the intervention. Second, it is possible that the self-reported behavior change did not actually occur or that the participants did not accurately track reoccurring behaviors. However, self-report behavior change is commonly used with older adults to track physical activity (Bauman et al., 2016). Additionally, the convenience sample consisted of people who chose to participate in fall prevention education on their own volition; therefore, the results may only be generalizable to people highly motivated to prevent falls. Furthermore, the sample was homogeneous in terms of race and level of education, making the results difficult to apply to other cultural and educational differences in addition to various levels of motivation.

However, these limitations are balanced by several strengths. First, the study was designed to mimic a 'real-world' clinical setting by being held in a university clinic and using protocol-trained clinicians, therefore, maximizing ecological validity of the results and provided

an opportunity to evaluate the feasibility of the study in a clinic setting. The control condition was also designed to replicate the 'status quo' education for prevention to compare the results of the MCII intervention with participants with identical educational materials. Second, although the adaptable and individualized nature of MCII can be difficult to generalize, several strategies (i.e., training, session supervision, use of structured protocol) were used to promote the delivery of the intervention as intended (Glasgow et al., 2012), and key instructions for each step of MCII were used in every session. Most notably, the manualized format of MCII was helpful to ensure fidelity (Breitenstein et al., 2010) and can be used to facilitate knowledge translation into clinical settings (Douglas & Hickey, 2015). Third, the concurrent mixed-method design allowed the combination of quantitative and qualitative data to produce more comprehensive results, as well as to triangulate data from each research objective.

Future Directions

This study should be expanded to explore more diversity of participants, including demographic characteristics, motivation, and other health variables and beliefs to capture a more representative sample of older adults. Additionally, a larger-scale implementation in diverse settings (e.g., outpatient clinics) should be evaluated to investigate key domains influential in the success of behavior change and the adoption of fall prevention recommendations in general. Additionally, MCII should be developed into other health-related outcomes that may prevent falls, such as increasing balance and strength or communicating with a doctor about medications. Finally, Douglas & Hickey (2015) recommended strategies that increase the implementation of EBP that include informal knowledge sharing, onsite coaching, consistent access to data/feedback or performance, positive reinforcement, and organizational support. Thus,

continued implementation trials should focus on promoting implementation of EBP from all stakeholders, such as SLPs, administrators, or family/caregivers.

Conclusions

The results of this quasi-randomized mixed method intervention study indicate that MCII was feasible and acceptable to the target group and able to be implemented by novice clinicians. Results suggest that future efficacy or effectiveness trials would be merited in order to evaluate behavior change for fall prevention using MCII. Descriptively, participants who used MCII reported more change in active, passive, and generalized behavior than the status quo, or control, group. Participants with TBI completed fewer reoccurring and passive behavior changes than participants without TBI; however, a similar generalization of MCII was present in both injury status groups. The intervention also appeared to increase health beliefs related to fall prevention in all groups (condition and injury status). The interviews elaborated on how health beliefs intersect with behavior change, as well as how MCII complimented that. Older adults emphasized psychological barriers and cues to action as targets for behavior change, both of which were met with the MCII. Finally, MCII was considered an appropriate intervention by older adults and clinicians. Further investigation of the MCII intervention in balanced comparative effectiveness research is suggested, as well as with more experienced clinicians in typical clinic settings.

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APPENDIX A

Telephone Interview for Cognitive Status

When the interviewer has the participant on the telephone, the following script should be used to greet the participant and provide instructions for administration of the test.
Interviewer: "Hi Mr/Ms. _____. My name is _____ and I am a researcher at the University of Georgia's Department of Communication Sciences and Disorders. I am calling to follow up with you today to discuss the Fall Prevention Research Study. We appreciate your interest in this study and for providing us with your contact information. The purpose of this study is to see how older adults engage with and learn from educational materials for fall prevention. We hope the main study will help decease falls in older adults. Do you think you might be interested in participating in this study?

{If No}: Thank you very much for your time.
{If yes}: But before enrolling people in this study, we need to ask you some questions to determine if you are eligible for our main study. And so what I would now like to do is to ask you a series of questions about your thinking and knowledge. If now is a good time, we can complete the telephone questions which will take about 30 minutes. Are you able to talk with me for that amount of time?"
Yes ____ No _____ (Rescheduled for: _____)
{If no}: When would be a better time for you? Thank you very much, I will call you then.
{If yes}: Continue script below.

Hearing Screener:
1. "Do you use a hearing device?" Yes ____ No ____
{If yes}: "Is it in place?" Yes ____ No ____ N/A ____
{If no}: Can you put in place now or should we reschedule for another time?
Yes____ (move to next question) No_____ (Rescheduled for: _____)

2. "I need to make sure you can hear me well enough. Will you repeat this statement. . . I have a cat so all I need is a dog." Individual repeated properly Yes ____ No ____

{If no}: "Thank you very much Mr./Ms._____ but I am concerned you may not be able to hear me well enough to complete the questions so I will not continue at this time. I would like to set another time that we can make sure you can hear me well enough. What other time may work for you?
(Rescheduled for: _____)
Attempt x2 prior to setting appointment with participant to participate in eligibility screener in person. Initial here if this occurred: _____

{If yes}: Great. Let's get started. There is a possibility that some of these questions may make you uncomfortable or distressed; if so, please let me know. You don't have to answer those questions if you don't want to.

All information that I receive from you during this phone interview, including your name and any other information that can possibly identify you will be strictly confidential and will be kept under lock and key. Remember, your participation is voluntary; you can refuse to answer any questions, or stop this phone interview at any time without penalty or loss of benefits to which you are otherwise entitled.

Do I have your permission to ask you these questions?

{If No}: Thank you very much for your time.

{If yes}: Thank you. If you have any questions about this research project, please feel free to call me at 706-408-7528.Questions or concerns about your rights as a research participant should be directed to the Institutional Review Board (IRB) Chairperson at (706) 542-3199 or irb@uga.edu.

All of the questions are designed to be asked over the telephone. Your responses should be provided according to your thinking and knowledge therefore, pencil/paper is not needed so I need for you to remove pens, pencils, paper, calendars or newspapers. At the end of this interview, we will tell you if you qualify or not to participate in the main study. If you don't qualify, all the information you gave me will be immediately destroyed.
Some questions may be easier than others. I don't want you to worry. Just do the best you can. Are you ready?

[BEGIN TELEPHONE INTERVIEW FOR COGNITIVE STATUS FORM]

APPENDIX B

Measurements Taken During Study

Measure	Description	Rationale	QUAN or QUAL
Section 1: Questionnaires			
Neuro-QoL Cognitive Function Short Form (Neuro-QOL Cognitive-SF; Cella et al., 2012)	The Neuro-QOL has 13 brief short forms for use in clinical neurology research, including the Cognitive-General Concerns. The Short From includes 8 questions about cognition on a 5-point Likert scale from "none" to "cannot do." Lower scores indicate lower quality of life.	Measure to compose General Health Index- Older adults with lower cognitive quality of life scores had higher fear of falling (Silva et al., 2021), which in turn increases risk of falling (Schoene et al., 2019).	QUAN
Participation Assessment with Recombined Tools-Objective (PART-O; Bogner et al., 2013)	PART-O is an outcome scale assessing social participation in the community. PART-O combined 3 measures of societal participation to measure 3 domains: Productivity, Out and About, and Social Relations. The score produces an index of social participation.	Measure to compose General Health Index- Older adults with social support have higher quality of life ratings (Lee & Oh, 2020)	QUAN
Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1988)	The PSQI is a common generic measure of sleep quality that has been validated in older adult populations. This tool asks participants to answer 10 questions about their sleep habits 1 month retrospectively in Likert scale and time-scaled formats. The score produces an index to determine "good" and "poor" sleepers.	Measure to compose General Health Index- Older adults with excessive daytime sleepiness are at higher risk for falls (Teo et al., 2006), and the use of sedative drugs for sleep increases fall risk (Stone et al., 2008).	QUAN

Yale Physical Activity Survey (YPAS; DePietro et al., 1993)	The YPAS evaluated older adults' physical activity in a wide range of activities across household, recreational, and exercise settings, including assessment of light, moderate, and vigorous-intensity activities in 9 time-scaled items. This tool provides an index of how much time, in what ways, and how intense an older adult participates in physical activity.	Measure to compose General Health Index- Older adults with high physical activity have reduced fall risk (DiPietro et al., 2019).	QUAN
Medical Outcomes Survey-Short From 36 (MOS-SF1-36; RAND Corporation, n.d.)	The MOS-SF-36 assesses 8 health domains: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health using a rating scales and yes/no questions. From these questions, several scores are produced in different health domains, with lower score indicating poorer subjective general health. We only use the "overall health" score.	Measure to compose General Health Index- Older adults with lower quality of life scores had more fall risk and falls (Schoene et a., 2019).	QUAN
Depression, Anxiety, and Stress Scales (DASS; Lovibond & Lovibond, 1995)	The DASS is a self-report measure of three 7-item scales to assess dimensions of psychological distress. Participants select to what degree each question applies to them on a 4-point Likert scale. Each subscore produces an indicator of clinical significance in depression, anxiety, and stress.	Measure to compose General Health Index- Older adults with higher depression scores experience more falls (Iaboni et al., 2013).	QUAN
Patient-Reported Outcomes Measurement Information System (PROMIS; Hong et al., 2016)	PROMIS is a general self-efficacy measure about people's confidence in their ability to manage various situations, problems, and events. The scale includes 10 items to rate on a 5-point Likert scale, from "I am not at all confident" to "I am very confident."	HBM construct- self-efficacy. Self-efficacy can improve behavior change in older adults (Klusman et al., 2021)	QUAN
CDC STEADI Fall Risk Self-Assessment (CDC, 2022)	The CDC STEADI education handout used in the intervention has a self-assessment of fall risk containing 12 yes/no questions. A score of 4 or more indicates a higher risk of falling.	General Health Index-related to fall risk	QUAN
Health Belief and Behavior Change	Questionnaire created for this study based on the literature of HBM constructs (Vincenzo et al., 2022 & Vincenzo & Patton, 2021) and measures for	HBM constructs	QUAN/QUAL

Questionnaire- Part A (Appendix C)	intentions, commitment, expectancies, and benefits of changing behavior, with higher ratings indicating higher health beliefs regarding fall prevention. Part A assesses HBM prior to exposure to any intervention materials.		
Section 2: Neurocognitive Assessment			
Repeatable Battery of the Assessment of Neurological Status (RBANS; Randolph, 1998)	RBANS was originally development on the assessment of dementia but is also used as a screener for neurocognitive status. It covers five domains: immediate memory, visuospatial/constructional, language, attention, and delayed memory in 12 subtests, which yield index scores and a total scale score.	Older adults with lower cognitive scores, specifically executive function and processing have more falls and are at risk for recurrent falls (Holzer et al., 2007).	QUAN
Delis-Kaplan Executive Function System (D-KEFS) Verbal Fluency and Trail Making Test (Delis et al., 2001)	The D-KEFS assesses the components of executive function with nine stand alone tests. Verbal Fluency Test has three tasks: letter fluency, category fluency, and category switching to measure multiple aspects of cognitive flexibility and semantic search effectiveness. Trail Making Test isolates sequence-shifting from other executive function skills (letter sequencing and visual scanning) in a visual-motor cognitive flexibility task.	Older adults with poor executive function, slower speed of processing and slower psychomotor speeds is associated with higher fall incident (Chen et al., 2012)	QUAN
Behavior Rating Inventory of Executive Function (BRIEF; Roth et al., 2014)	The BRIEF is a self- and informant-report of everyday functioning. Nine clinical scales (inhibit, self-monitor, shift, emotional control, initiate, working memory, plan/organize, organization of materials, monitor) two broader indexes (Behavioral Regulation and Metacognition) and a Global Executive Composite are generated from 75 items answered on with *never*, *sometimes,* or *often.*	Risk for falls is predicted by executive function in a five year longitudinal study (Mirelman et al., 2012).	QUAN
CNS Vital Signs Computerized Neurocognitive Test	The CNSVS is used to measure global cognitive function (neurocognitive index) as well as function in specific domains (memory, attention, reasoning	Older adults with lower cognitive scores, specifically executive function and	QUAN

Battery (CNSVS; Gualtieri & Johnson, 2006)	ability, etc). CNSVC is comprised of computerized tests of verbal and visual memory, finger tapping, symbol digit coding, the Stroop Test, a test of shifting attention, and the continuous performance test. A neurocognitive index as well as specific domain measures can be drawn from the CNS.	processing have more falls and are at risk for recurrent falls (Holzer et al., 2007). Additionally, subtle cognitive impairment (at cutoff of mild cognitive impairment) is associated with rate of falls (Gleason et al., 2009).	
Section 3: MCII Intervention or Status Quo			
Health Belief and Behavior Change Questionnaire- Part B (Appendix C)	Part B assesses environmental modifications likeliness, importance, and commitment post intervention.	HBM constructs	QUAN/QUAL
Therapist Adherence and Client Participation Tool (TACP)	Checklist created from MCII protocol for standardization of the intervention. Each step received a therapist rating (1 or 0) and a client independence (0-2, with 2 indicating complete independence). Higher scores in both scores indicated high feasibility of the intervention	Feasibility of intervention	QUAN
Modifications to Treatment Tool (MT; Stirman et al., 2013)	Number of fidelity and non-fidelity modifications made during the treatment were counted and categorized based on step. More modifications indicated additional support for participant to complete the intervention	Feasibility of intervention	QUAN
Implementation Outcomes Measures (IOM; Weiner et al., 2017)	Three Likert scale ratings from 1 to 4 were used to evaluate the acceptability, appropriateness, and feasibility of MCII from both a clinician and participant perspective.	Feasibility of intervention	QUAN
Time 2: Follow-Up Visit			
Health Belief and Behavior Change Questionnaire- Part A & B (Appendix C)	Part A & Part B provide post-measures of HBM constructs and active/passive behavior change	Behavior changes and HBM constructs	QUAN/QUAL

Implementation Outcomes Measures (IOM; Weiner et al., 2017)	Three Likert scale ratings from 1 to 4 were used to evaluate the acceptability, appropriateness, and feasibility of MCII from a participant perspective.	Feasibility of intervention	QUAN
Semi-structure interview	A portion of the participants were asked more in-depth questions about each HBM construct as it related to fall prevention as well as broader health-decision making. Additionally, implementation and feasibility questions were discussed.	All dependent variables	QUAL
*PRECIS-2 Tool (Loudon et al., 2015)	The PRECIS-2 tool provides ratings for different aspects of the intervention that may need to be adapted or changed for clinical use and larger-scale trials.	Feasibility of intervention	QUAN/QUAL

APPENDIX C

Health Beliefs and Behavior Change Questionnaire

Health Beliefs and Behavior Change Questionnaire

Construct/Measure	Time	Question
PART A: HBM Constructs (created from Vincenzo et al., 2022 & Vincenzo & Patton, 2021)		
Knowledge (1= none; 5=a lot)	T1 & T2	I feel like I know a lot about fall prevention Have you had a previous fall? If so, how many? I feel I know what to do if I fell
Perceived Susceptibility (1=not high; 5=very high)	T1 & T2	I am high risk of falling in general People my age are at risk for falling
Perceived Severity (1=don't agree at all; 5=very much agree)	T1 & T2	I believe that falling would be very serious for me in general If I fall, I will most likely get hurt. If I fall, I may die. If I fall, other members of my family will be affected.
Perceived Benefits of Fall Prevention (1=don't agree at all; 5=very much agree)	T1 & T2	Preventing falls will make me feel safe Preventing falls will save me healthcare costs Preventing falls will help me maintain my autonomy and independence Preventing falls may be an opportunity for social engagement I need fall prevention education to prevent falls
Perceived Barriers of Fall Prevention (1=don't agree at all; 5=very much agree)	T1 & T2	Fall prevention efforts will not stop me from falling Fall prevention efforts will be difficult for me to do Fall prevention efforts will be too expensive for me to do I cannot access any fall prevention programs or support I will not remember what to do to prevent falls even if I learn about it
Perceived Threat (1=not very likely; 5=very likely)	T1 & T2	I am likely to fall in the next year. Someone I know if likely to fall in the next year
Cues to Action (1=don't agree at all; 5=very much agree)	T1 & T2	My family/friends check in on me often to make sure I'm not at risk for falling My healthcare provider has given me information on fall prevention I have seen fall prevention materials at my doctor's or pharmacists I need reminders on how to prevent falls for it to work

Decisional Balance	T1 & T2	Are there more benefits or barriers to completing fall prevention acts? (benefits, barriers, they do not matter, they are equal)
Self-Efficacy (1=don't agree at all; 5=very much agree)	T1 & T2	I do not know what to do if I fall I do not know how to prevent falls I know a healthcare professional will help me prevent falls I, myself, can prevent falls I know someone who will help me prevent falls If I needed it, I know where to find fall prevention materials
PART B: Behavior Change		
Commitment/Motivation (1=none; 5=very much)	T1a, T1b, & T2	How committed are you to preventing falls? How motivated are you to preventing falls?
Intended Passive Behavior 1=not likely; 5 very likely)	T1	How likely do you think you are to do the following to prevent falls over the next 3 weeks: Non-slip mats in bathroom Rearrange closet Rearrange kitchen Add sensory lights to stairs/bathroom Remove small throw rugs Place chairs around home for rest spots Talk to loved ones about making changes Turn on lights at night Proper footwear Awareness of stability in home Clear pathways daily Awareness of stability outside of home Create and use bathroom routine to combat urgency Use internal checklist when getting up Use assistive device Create and use a health journal to monitor stability
Individual Behaviors	T1	How important is it for you to… (1=not important; 5=very important) Non-slip mats in bathroom Rearrange closet Rearrange kitchen Add sensory lights to stairs/bathroom Remove small throw rugs Place chairs around home for rest spots Talk to loved ones about making changes Turn on lights at night Proper footwear Awareness of stability in home

		Clear pathways daily Awareness of stability outside of home Create and use bathroom routine to combat urgency Use internal checklist when getting up Use assistive device Create and use a health journal to monitor stability
Active Behavior	T2	"Did you complete [single event plan], and if so what day or days?" "Did you complete [reoccurring event plan], and if so what day or days?" "Tell me about how these plans worked or didn't work for you." {Experimental Group only} "Did you create any other if/then plans? If so, tell me about that plan?"
Actual Passive Behavior	T2	In the last 3 weeks, did you complete any of the following… (yes, no, not applicable) Put non-slip mats in bathroom Rearranged closet Rearranged kitchen Added sensory lights to stairs/bathroom Removed small throw rugs Placed chairs around home for rest spots Talked to loved ones about making changes Turned on lights at night Wore proper footwear Had awareness of stability in home Cleared pathways daily Had awareness of stability outside of home Created and used bathroom routine to combat urgency Used an internal checklist when getting up Used an assistive device Created and used a health journal to monitor stability