

Implementation of Traumatic Brain Injury Screening in Behavioral Health Organizations:

A Prospective Mixed Methods Study

Dissertation

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By

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Abstract

Background: Approximately 50% of individuals seeking treatment for substance use and mental health conditions in behavioral healthcare settings have a lifetime history of TBI affecting their ability to engage in behavioral health treatment. Identifying lifetime history of TBI using validated screening methods can optimize interventions for these individuals, however, TBI screening adoption has failed in these settings. Drawing on the Theory of Planned Behavior and Diffusion of Innovations Theory, this explanatory sequential mixed methods study aimed to improve our understanding about how provider characteristics (attitudes, subjective norms, perceived behavioral control (PBC), intentions), innovation-level factors (acceptability, feasibility, appropriateness), and contextual determinants affect TBI screening adoption in behavioral healthcare settings.

Methods: In Phase I, 215 behavioral health providers in the United States completed a training introducing the OSU TBI-ID, followed by a web-based survey assessing attitudes, PBC, subjective norms, and intentions to screen for TBI (Time 1). After one-month, providers completed a second survey assessing the number of TBI screens conducted, and the acceptability, feasibility, and appropriateness of TBI screening (Time 2). Data were analyzed using structural equation modelling with logistic regressions (SEM) and logistic regression with moderation effects. Results informed development of a qualitative interview guide. In Phase II, 20 providers from Phase I

participated in interviews to build upon the quantitative results. Data were analyzed thematically and integrated with the quantitative results. Barriers to adoption were also identified and linked to constructs from the Consolidated Framework for Implementation Research (CFIR).

Results: Approximately 25% of providers adopted TBI screening, which was driven by motivations to trial the innovation. SEM demonstrated that more favorable attitudes toward TBI screening were associated with an increased odds of screening intentions and adoption, which providers expanded upon in interviews, explaining advantages in guiding diagnostic assessments. Greater subjective norms also demonstrated increased odds of intentions to screen for TBI and adoption. However, providers reported lack of external pressures from state governing boards and internal pressures from leadership to adopt TBI screening. Although PBC was not associated with TBI screening adoption in SEM, providers reported the desire for additional training and education to improve self-efficacy in administering TBI screening. Furthermore, although no interaction effects were found between characteristics of providers and innovation-level factors, descriptive ratings and qualitative appraisals of the acceptability feasibility, and appropriateness of TBI screening were high. Providers confirmed in qualitative interviews that the OSU TBI-ID is helpful in guiding clinical decisions, easy to use, and relevant to clinical practice. However, 10 barriers were identified to affect adoption, which linked to CFIR's Inner-Setting, Outer-Setting, Individual Characteristics, and Process.

Implications: Results inform identification of 12 multilevel implementation strategies to increase TBI screening adoption. Strategies that target norms include involving executive boards, obtaining formal commitments, mandating changes, informing local opinion leaders, and identifying/preparing champions. Strategies that target knowledge-acquisition and awareness-building include conducting consensus discussions, educational meetings, and distributing educational materials. Strategies that target PBC include shadowing experts and ongoing training. Strategies that target motivations to adopt TBI screening include revising professional roles and funding/contracting for TBI screening.

Dedication

To my dad, Dr. Douglas Coxe (1953 – 2017) who taught me the power of earning an education and who encouraged me from the very beginning to fulfill my greatest potential.

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Earning a PhD is never an individual accomplishment; many people helped me to this point, and I am forever grateful to them. First, thank you to all the behavioral health providers who took the time to participate in this dissertation study. I quite literally could not have accomplished this work without all of you. Special thanks to those who reached out to me to discuss traumatic brain injury (TBI) and behavioral health beyond this study – you share my passions and together we can make a difference in the lives of individuals impacted by TBI.

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Field of Study

Major Field: Social Work

Specialization: Implementation Science, with a specialization in traumatic brain injury research-to-practice translation

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Chapter 1. Introduction

Background

Traumatic brain injury (TBI) is a global public health problem that disproportionately affects the most vulnerable individuals in society (Maas et al., 2017). TBI is the leading cause of death and disability compared to any other traumatic injury worldwide (Rubiano et al., 2015). According to the National Institute of Neurological Disorders and Stroke (NINDS), a TBI is a type of acquired brain injury that occurs when an object hits the head forcefully, when the head hits an object, or when an object pierces the skull and enters the brain tissue (National Institute of Neurological Disorders and Stroke, 2019). A TBI may also occur as a result of blast-induced head trauma or whiplash effects. Primary mechanisms for sustaining a TBI include blunt forces to the head resulting from falls, violent assault, or sports injuries; penetrating head injury through firearms or other external piercing forces; whiplash effects from motor vehicle crashes; or blast induced head trauma resulting from explosions (Deng et al., 2018; Meaney et al., 2014).

Approximately 50 million people globally and 5.3 million people in the United States are living with a TBI or TBI-related disability (Capizzi et al., 2020; Maas et al., 2017). An estimated 50% of the global population will incur at least one TBI over the course of their lifetime (Maas et al., 2017). The immediate and long-term consequences that contribute to the disability burden following TBI include cognitive dysfunction, physical health problems, and psychiatric comorbidities (National Institute of Neurological Disorders and Stroke, 2019; Schwarzbald et al., 2008). Unlike most injuries, TBI often presents no outward physical signs of injury, such as bruising or

swelling, making this injury more difficult to detect, particularly when the TBI is mild (Rusnak, 2013; Vaishnavi et al., 2009). However, even mild damage to the brain can cause subtle but significant short and long-term neurological and neurobehavioral changes in the brain that are not always immediately evident and which may be difficult to distinguish from other mental health conditions or behavioral health problems (Leo & McCrea, 2016; Masel & DeWitt, 2010; Rusnak, 2013). Furthermore, neurological changes can continue to occur within the brain structures over time, making TBI a chronic, life-long process rather than a single, finite event (Masel & DeWitt, 2010).

Longitudinal studies have demonstrated that sustaining a TBI during childhood or adolescence can result in the development of new or worsened anxiety, depression, alcohol misuse, and/or illicit drug use, as well as increase the likelihood of mental health service utilization, psychiatric hospitalization, welfare reciprocity, and disability pension in later life (Albicini & McKinlay, 2018; Corrigan et al., 2013; Sariaslan et al., 2016). Similarly, sustaining a TBI in adulthood can also lead to an increased risk for the development of new or worsened substance use disorders (Alway et al., 2016; Beaulieu-Bonneau et al., 2018), depression (Fisher et al., 2016; Stein et al., 2019), anxiety (Alway et al., 2016), and suicidal ideation and attempts (Dreer, 2018; Fisher et al., 2016). Strikingly, individuals with TBI may be 11 times more likely to die from unintentional overdose than the general population (Harrison-Felix et al., 2015). Therefore, identifying lifetime history of TBI among individuals with substance use disorders and mental health conditions is exceedingly important to the immediate and long-term health outcomes for these individuals. Specifically, short and long-term outcomes could be improved by

accommodating executive function problems in formal behavioral health treatment environments, such as through cognitive remediation for goal management, problem-solving, or self-awareness training (Raymer et al., 2018), as well as connections to community services and supports such as the Home and Community-Based Service Waivers (Corrigan, 2021).

Statement of the Problem

An estimated 50% of clients who seek treatment for substance use disorders or other mental health conditions have a lifetime history of TBI that might be affecting their ability to fully engage in behavioral health treatment (Corrigan & Mysiow, 2012). Screening for TBI is the first step toward optimizing client outcomes by identifying which clients need adapted behavioral health treatment (i.e., shortened treatment sessions or frequent check-ins) and/or referrals to appropriate services (i.e., TBI rehabilitation, vocational rehabilitation, or specialized treatment for co-occurring TBI and behavioral health problems) (Bogner & Corrigan, 2013; Corrigan, 2021; Fadyl & McPherson, 2009; Mateer & Sira, 2006; Vungkhanching et al., 2007). Behavioral health providers (e.g., social workers, counselors, and psychologists) employed in behavioral health treatment settings are often the first line of professionals to assess, diagnosis, and intervene with individuals who have substance use disorders and mental health comorbidities, and thus, are well-positioned to adopt TBI screening into routine practice. However, behavioral health providers in behavioral health treatment settings have yet to adopt TBI screening due to lack of awareness of the association between TBI and behavioral health problems (Coxe et al., 2021). Absent or inadequate TBI identification efforts for clients with

substance use disorders or mental health conditions may result in misdiagnosis or misattribution of the symptoms of TBI to another behavioral health condition, or could result in behavioral health providers mislabeling the client as poorly motivated or ‘noncompliant’ with treatment (McHugo et al., 2017). As a result, behavioral health treatments may be less effective, or clients may drop out of treatment due to inappropriate clinical or intervention decisions that do not accommodate TBI-related sequelae. However, this first requires systematic screening of clients to determine which clients may need adapted interventions.

One TBI screening intervention that could be adopted in behavioral healthcare settings is the Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID). The OSU TBI-ID is an evidenced-based TBI screening method that behavioral health providers can use to screen for lifetime history of TBI in 3 – 5 minutes (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007). However, this screening method has not been widely adopted within behavioral health treatment settings. To date, studies have yet to investigate factors that may affect why this screening method has failed to be adopted in these settings.

Implementation of Interventions in Behavioral Health Settings: Current Gaps

Numerous obstacles can affect whether or not an evidence-based practice (EBP) innovation (i.e., intervention) (Bauer & Kirchner, 2020; Kirchner et al., 2020), such as the OSU TBI-ID, becomes adopted within behavioral health treatment settings. Previous research and behavioral theory demonstrates that the individual characteristics of behavioral health providers who are employed in behavioral health treatment settings

affect EBP adoption during the initial stages of EBP implementation (Benjamin Wolk et al., 2015; Damschroder et al., 2009). Specifically, the characteristics of individuals from the Theory of Planned Behavior may include attitudes toward the EBP, the level of perceived behavioral control over adopting the EBP, or the extent to which social pressures exist within the organization toward adopting the EBP (Ajzen, 1991; Benjamin Wolk et al., 2015). In addition to the individual-level characteristics, determinants (i.e., barriers and facilitators) that may affect EBP adoption are factors that relate to the intervention itself (Rogers, 2003). Specifically, drawn from Roger's Diffusion of Innovations Theory, these factors include the *appropriateness* of the intervention to the service context or to the clients, the level of perceived *feasibility* at which the innovation can be adopted within the behavioral health context, and the perceptions about whether the innovation is considered *acceptable* to adopt (Damschroder et al., 2009; Proctor et al., 2011; Rogers, 2003).

Yet, factors related to the innovation and to the individual are unlikely to function alone during the initial adoption phases, and may instead operate together to dictate whether or not the EBP becomes adopted within the service setting (Damschroder et al., 2009; Fitzgerald et al., 2002). For example, although providers may consider the EBP to be appropriate (i.e., relevant to their context and clients), and the providers may report strong intentions to adopt the EBP, the adoption of the EBP may fail due to lack of feasibility of incorporating the EBP into the behavioral health service context (Coxe-Hyzak et al., 2022). As a result, EBP adoption may fail, and treatment practices do not change. However, the interactions that may exist between provider-level characteristics,

innovation-level factors, and implementation outcomes (i.e., adoption) are understudied, resulting in our lack of understanding about how these determinants interact to affect the uptake of the EBP (Smith et al., 2020).

Our understanding about how implementation determinants affect EBP adoption and service integration for individuals with TBI and mental health and/or substance use disorders within behavioral health treatment settings can be improved by identifying relationships between constructs through theory-driven hypothesis testing (Damschroder, 2020; Lewis et al., 2018, 2020, 2021; Proctor et al., 2011). Currently, over 61 implementation frameworks and models exist and include a range of multi-level constructs that might affect EBP adoption (Damschroder et al., 2009; Nilsen, 2015; Tabak et al., 2012). This makes selecting which constructs to study more difficult particularly when these models and frameworks fail to specify the relationships between constructs necessary to understanding the mechanisms leading to EBP adoption (Lewis et al., 2020). Of particular importance to understanding EBP adoption is delineating the implementation mediators, moderators, and predictors that act as drivers to EBP adoption using theory-driven hypotheses. Identifying and specifying these variables can help us to target where along the implementation cascade EBP adoption unfolds (Lewis et al., 2018, 2020; Proctor et al., 2011). By not specifying these mediators, moderators, and predictors, our understanding of the implementation process is restricted, and our ability to select implementation strategies tailored to target these modifiers is inhibited (Lewis et al., 2018). However, using theory, rather than larger frameworks or models, can offer deeper insights into what constructs to test, how to specify relationships between them,

and where they should be placed along the implementation cascade (proximally or distally) (Damschroder, 2020; Proctor et al., 2011) so that implementation strategies can be more precisely selected (Sales et al., 2021; Smith et al., 2020).

What further complicates this matter is that few implementation studies have addressed the treatment integration for clients who live with physical and mental health comorbidities who seek treatment in behavioral healthcare settings. Interventions that integrate physical and mental health comorbidities are inevitably complex because they must include multiple components to address multiple, co-occurring health needs, which is often the case for individuals who have sustained a TBI (Corrigan, 2021). Multi-component interventions may include identification of the problem(s), clinical decision-making skills to address these problems, intervention and treatment planning, and connecting clients between health providers and systems. These complexities may affect how providers view the clients or their own abilities to provide care, which may result in immediately referrals to other providers to address their complex health needs instead (Coxe et al., 2021). Implementation strategies have not been designed to address the interconnectedness or complexity of multiple health comorbidities specifically for individuals with TBI (Lumba-Brown et al., 2021), nor have they targeted mechanisms that affect adoption (Lewis et al., 2021; Powell et al., 2019). As a result, this leaves a chasm in our understanding about why EBPs developed for these clients have failed to be adopted within this service landscape (Coxe-Hyzak et al., 2022). Although research in TBI care has demonstrated enhanced symptom delineation between behavioral health problems and neuropsychological symptoms that lead to behavioral health referrals

(Gress Smith et al., 2020) and that evidence-based TBI screening methods can improve clinical care decisions (Dams-O'Connor et al., 2014), we do not know what processes increase the adoption of these services in behavioral healthcare settings. As a result, integrated care pathways involving multicomponent interventions (e.g., screening, intervention adaptation, referral) (Seys et al., 2019) for individuals with TBI and psychiatric comorbidities have not been adopted in behavioral health settings, leaving questions as to why clients do not experience more successful outcomes (Coxe-Hyzak et al., 2022). This dissertation study begins to address these gaps in the TBI and implementation science literature.

Theoretical Overview

Previous research has demonstrated that characteristics of providers and factors related to the innovation affect early EBP adoption in behavioral healthcare contexts (Damschroder et al., 2009). Therefore, theories that specify individual-level constructs and innovation-level factors have been selected for this dissertation study. First, the Theory of Planned Behavior asserts that provider-level characteristics, which include attitudes, perceived behavioral control, and subjective norms, predict an individual's intentions to perform a behavior, which in turn predicts actual behaviors (Ajzen, 1991; National Cancer Institute, 2005). In this dissertation study, these provider-level characteristics (i.e., attitudes, perceived behavioral control, and subjective norms) could be affecting providers' intentions to adopt TBI screening in behavioral health treatment settings (Glegg et al., 2013). Second, Roger's Diffusions of Innovations Theory suggests that innovation-level factors (i.e., feasibility, acceptability, and appropriateness of the

innovation) are also powerful predictors to whether innovations are actually used (Damschroder et al., 2009; Proctor et al., 2011; Rogers, 1983). However, studies have yet to examine how the relationship between *intentions* and *actual TBI screening behaviors* may be moderated by the feasibility, acceptability, and appropriateness of the TBI screening innovation (i.e., the OSU TBI-ID) in behavioral health treatment settings. Uncovering these mechanisms could improve our knowledge about why TBI screening has failed to translate to the behavioral health service context. Therefore, I address the following specific aims in this dissertation study:

- (1) ***Aim 1:* Examine the relationships between behavioral health providers' attitudes, perceived behavioral control, and subjective norms as predictors to TBI screening intentions and examine whether intentions to adopt TBI screening mediate actual TBI screening behaviors at a one-month follow-up.**

H1: Providers who have more favorable attitudes, greater perceived behavioral control, and greater perceived social pressure within the organization to screen for TBI will demonstrate higher TBI screening adoption.

- (2) ***Aim 2:* Investigate whether the acceptability, feasibility, and appropriateness of the TBI screening innovation (OSU TBI-ID) moderates the relationship between TBI screening intentions and actual TBI screening behaviors.**

H2: Greater perceived acceptability, feasibility, and appropriateness of TBI screening using the OSU TBI-ID will strengthen the relationship between TBI screening intent and actual TBI screening behaviors.

- (3) ***Aim 3:* Assess the contextual determinants to TBI screening adoption to expand on the quantitative results.**

Determinants to TBI screening adoption were investigated through qualitative, semi-structured interviews with n = 20 behavioral health providers.

Overview of the Study

Guided by the Theory of Planned Behavior (Ajzen, 1991) and Roger's Diffusions of Innovations Theory (Rogers, 1983), this study utilizes an explanatory sequential mixed

methods design (QUANT → qual) (Creswell, 2015; Creswell & Plano Clark, 2018; Ivankova et al., 2006) to prospectively investigate the provider-level characteristics, innovation-level factors, and contextual determinants to TBI screening adoption in behavioral health treatment settings.

Phase I (QUANT). Licensed behavioral health providers employed in behavioral health treatment settings throughout the United States participated in the study. Participants completed an in-person or a web-based TBI educational module introducing the OSU TBI-ID and the relevance of TBI to behavioral health treatment. Participants then completed an electronic survey measure investigating their attitudes, perceived behavioral control, subjective norms, and intentions to adopt the OSU TBI-ID to screen for TBI into service delivery (Aim 1). After one month following completion of this survey, providers received a second survey assessing the number of TBI screens conducted over the past month, as well as their perceptions of the acceptability, feasibility, and appropriateness of using the OSU TBI-ID after they had the opportunity to trial the intervention (Aim 2).

Phase II (qual). Using the quantitative results from Phase I, a qualitative interview guide was developed, with questions oriented to constructs of the Theory of Planned Behavior and Diffusions of Innovations Theory. A subset of providers (n = 20) who participated in Phase I of the study were asked to complete a semi-structured interview over Zoom assessing the contextual determinants affecting adoption of the OSU TBI-ID into their behavioral health treatment settings (Aim 3).

Study Rationale and Significance

The objective of this dissertation study is to investigate the factors affecting TBI screening adoption in behavioral health treatment settings in the United States. The rationale for this study is the potential to identify strategies for improving widespread TBI screening adoption in behavioral health treatment settings for clients who seek treatment for substance use disorders and other mental health comorbidities. By increasing the adoption of TBI screening in these settings, access to appropriate resources and accommodations for individuals with TBI, substance use disorders, and mental health comorbidities could be improved. Subsequently, the disability burden associated with TBI could be reduced. The results from this study will be used to inform the selection of implementation strategies that can be tested in subsequent studies which are aimed to increase the adoption, reach, fidelity, sustainment, and scale-up of TBI screening in behavioral health contexts. In addition, qualitative studies investigating client experiences in receiving TBI screening and care in behavioral health treatment settings can be conducted to determine how TBI care can be integrated with a client focus. This dissertation study is foundational to conducting these subsequent studies and will offer insights into the determinants affecting TBI screening adoption in behavioral health treatment settings.

Chapter 2: Literature Review and Theoretical Underpinnings

Literature Review

Traumatic brain injury (TBI) is an underrecognized global public health problem that can lead to lifelong physical and mental health problems contributing to overall disability burden (Maas et al., 2017). TBI is the leading cause of death and disability compared to any other traumatic injury worldwide (Rubiano et al., 2015). Increasing evidence suggests that the risk factors and outcomes associated with a TBI mirror the social determinants of health (Young & Hughes, 2020) and may lead to extreme vulnerabilities such as homelessness (Stubbs et al., 2020), social exclusion, poverty, and marginalization (Young & Hughes, 2020). The consequences associated with TBI may be particularly pronounced among vulnerable populations who lack access to health-related resources or among individuals who live in locations where health infrastructure is inadequate (Rubiano et al., 2015). Further complicating the breadth of the problem is that TBI has been termed the ‘silent epidemic’ because unlike other injuries, TBI often has no visible signs of damage, such as bruises or breaks often associated other traumatic injuries, such as orthopedic injuries (Rusnak, 2013). However, even without visible signs of damage, TBI can be a debilitating condition affecting all facets of the individual’s life. Problems often associated with TBI include reduced earning potential due to job loss or economic hardship resulting from medical costs incurred following the injury (Chu et al., 2017; Fallesen & Campos, 2020; Humphreys et al., 2013), housing instability (Stubbs et al., 2020), poor community participation and reintegration (Dillahun-Aspillaga & Powell-Cope, 2018; McGarity et al., 2017; Pugh et al., 2018), and increased likelihood of developing psychiatric comorbidities (Hammond et al., 2019; Perry et al., 2016; Ponsford

et al., 2018; Rogers & Read, 2007; Schwarzbald et al., 2008; Wojtowicz et al., 2017).

Despite challenges in identifying TBI because of its invisibility, as well as challenges in differentiating the effects of TBI from psychiatric comorbidities that often result from and co-occur with the injury (Juengst et al., 2017; Miles et al., 2017), validated and comprehensive screening methods are available and can be implemented in behavioral health settings where these individuals often seek treatment.

The Global Burden of Traumatic Brain Injury

An estimated 55 to 69 million people worldwide are living with a TBI (Dewan et al., 2018; GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators, 2019). In the U.S., an estimated 5.3 million people are living with a TBI or TBI-related disability (Capizzi et al., 2020; Centers for Disease Control and Prevention, 2015; Dewan et al., 2018; GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators, 2019). Between 1990 – 2016, there was estimated 8.5% increase in TBI prevalence and a 3.6% increase in TBI incidence (GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators, 2019). In the United States and other countries, mild TBIs constitute the majority of TBI injury severity types, where approximately 81% are mild, 11% are moderate, and 8% are severe (Dewan et al., 2018). A mild TBI, including concussions (Mayer et al., 2017), constitutes loss of consciousness (LOC) for less than 30 minutes or altered state of consciousness (AOC) (i.e., dazed or confused) for 24 hours or less (O’Neil et al., 2012). Post-traumatic amnesia may be present for up to 24 hours post-injury. A moderate TBI is classified as having LOC for 30 minutes or more but less than 24 hours, or AOC for more than 24 hours. A severe TBI is classified as LOC or AOC for

more than 24 hours. For many TBIs, neuroimaging may indicate absence of structural damage (i.e., intracranial hematoma), however functional (e.g., poor memory), or behavioral problems may still persist but are less detectable through imaging (Dambinova et al., 2016; Shin et al., 2017). The use of imaging should not be the only means to determine presence of TBI and cannot determine lifetime history of TBI (Dams-O'Connor et al., 2014; O'Neil et al., 2012).

Incidence of Traumatic Brain Injury

Global incidence of TBI ranges from 369 to 939 cases per 100,000 people (Dewan et al., 2018; GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators, 2019). In 2016, age-standardized TBI incidence rates constituted approximately 27 million new cases in that year alone (GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators, 2019). Some studies estimate greater TBI incidence in high-income countries, including the United States, Canada, some Western European countries, and Korea, while lower incidence rates are estimated in low/middle income countries, including most countries in Africa, Asia (e.g. Laos, Nepal), and South America (e.g. Cuba, Columbia, Brazil) (Dewan et al., 2018). Incidence rates in the high-income countries are estimated to be 1,507 per 100,000 cases annually, versus 811 per 100,000 cases in low- and middle-income countries. Specifically, TBI incidence is reported to be the highest in the United States and Canada (approximately 1,299 cases per 100,000 people) and lowest throughout the continent of Africa (801 cases per 100,000 people) (Dewan et al., 2018). Incidence of TBI the United States and other high income countries is thought to be caused by an increase in older adult falls, sports-related TBIs,

abusive head trauma, firearm-related injury, and armed conflict (Capizzi et al., 2020; Deng et al., 2019; Maas et al., 2017). However, in low/middle income countries, incidence is likely attributable to road traffic crashes where seatbelt and traffic laws are absent or inadequate, or may be due to armed violence or assault (Maas et al., 2017).

Prevalence of Traumatic Brain Injury

Although the incidence estimates are higher in high-income countries compared to low/middle income countries, TBI prevalence estimates are higher in low/middle income countries compared to high income countries. This may be due to faster symptom resolution among individuals who have sustained a TBI in higher income countries attributable to advances in medical care for TBI over the last decade (Leo & McCrea, 2016). Specifically, an estimated 50 million people in low/middle income countries are living with TBI impairment compared to approximately 18 million people in high income countries (Dewan et al., 2018). In the United States, prevalence of TBI is estimated in 2.3 to 5.3 million people, while prevalence in the Southeast Asia Region (a low-income region with the greatest prevalence) is estimated in about 18.3 million people (Capizzi et al., 2020; Dewan et al., 2018; GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators, 2019; Maas et al., 2017; World Health Organization, 2006).

Consequences of Traumatic Brain Injury

A TBI can lead to short and long-term neuropsychological sequela, including cognitive dysfunction (i.e., memory problems, poor comprehension, attentional and learning problems, poor problem-solving skills, slow processing speed, and poor impulse control); psychiatric conditions (i.e., substance use disorders, anxiety, and depression);

social problems (i.e., problems with daily living requiring increased assistance and loss of employment); and behavioral problems (i.e., aggression and irritability) (Draper et al., 2007; Iaccarino et al., 2015; Lowe et al., 2020; Mathias & Alvaro, 2012; Ponsford et al., 2014; Rabinowitz & Levin, 2014; Stein et al., 2019; Whelan-Goodinson et al., 2010). Notably, some of the poorest outcomes following TBI are associated with alcohol and substance misuse (Rubiano et al., 2015).

The Intersection Between TBI and Substance Use Disorders

Traumatic brain injury is a major risk factor contributing to and resulting from substance use disorders (Beaulieu-Bonneau et al., 2018; Weil et al., 2016). The relationship between substance misuse or substance use disorders and TBI is bidirectional, where alcohol and other drugs may be a cause of sustaining a TBI, which may reflect the relationships between substance use, risk taking behaviors, and sustaining an injury (Alway et al., 2016; Beaulieu-Bonneau et al., 2018; Corrigan, 1995; Ponsford et al., 2018). Previous reviews of the literature have estimated that between 36% to 51% of people who sustained a TBI also tested positive for alcohol intoxication at the time of their injury (Corrigan, 1995; Parry-Jones et al., 2006). Another study estimated that between 35% to 75% of people who presented to emergency departments for traumatic injuries tested positive for illicit drugs, with the most prevalent drugs being cocaine and marijuana (Downar et al., 2015). Following TBI, inherent damage to the frontal lobes that is the hallmark of TBI can lead to impulsivity, aggression, and risk taking behaviors that can subsequently lead to risky substance use or to substance use disorders (Beer et al., 2006; Dixon et al., 2005; Merkel et al., 2017). This is problematic because use of alcohol,

prescription drugs, or illicit substances can exacerbate social, emotional, and behavioral problems post-injury (Weil et al., 2016).

Alternatively, a TBI may lead to increased alcohol or drug consumption (Beaulieu-Bonneau et al., 2018) or the development of a new substance use disorder (Fann et al., 2004). Development of a new substance use disorder may be particularly likely if the TBI was sustained during childhood (Kennedy, Cohen, et al., 2017; Kennedy, Heron, et al., 2017; McKinlay et al., 2014; Timonen et al., 2002). An estimated 20% of individuals with TBI will develop a new substance use disorder post-injury (Corrigan, 1995; Kreutzer et al., 1996). In one study, adults who had no prior substance use disorder treatment in the year preceding their TBI were 4.5 times more likely to develop a substance use disorder in the year following the injury requiring treatment (Fann et al., 2004). Another study conducted with a representative sample of Ohioans found that having a lifetime history of TBI was associated with a 1.5 higher odds of binge drinking, 1.7 higher odds of heavy drinking, 2.1 higher odds of depressive disorders, and 2.3 higher odds of reporting poor mental health for two weeks or more during the last month (Bogner et al., 2020). Furthermore, evidence suggests that prescription opioids may be more harmful for individuals with TBI due to the cognitive, psychological, and emotional outcomes following the TBI that may predispose these individuals to misuse opioids, such as higher risk-taking behaviors or memory loss (Adams et al., 2019; Adams et al., 2020). Most alarming is that individuals with TBI may be 11 times more likely to die from unintentional overdose from alcohol, opioids, and other drugs than the general population (Harrison-Felix et al., 2015).

The Intersection Between TBI and Common Mental Health Comorbidities

Anxiety. Anxiety is common following TBI (Mallya et al., 2015). Studies estimate that between 19% to 50% of individuals who sustain a TBI develop an anxiety disorder post-injury (Ashman et al., 2004; Diaz et al., 2014; Gould et al., 2011; Ponsford et al., 2018; van Reekum et al., 1996; Whelan-Goodinson et al., 2010). One study of adults who sustained a mild, moderate, or severe TBI between 0 – 17 years of age demonstrated that anxiety persisted up to 13 years following the TBI and into adulthood (Albicini & McKinlay, 2018). As with any TBI, neurological changes resulting from the injury can contribute to the development of psychiatric problems, such as anxiety (McKee & Daneshvar, 2015). However, psychosocial problems associated with TBI can also contribute to the development of anxiety disorders post-injury, which may include uncertainty about the prognosis, new cognitive deficits, social isolation, or problems with community reintegration (Fleminger, 2008).

Post-traumatic stress disorder. Because of the traumatic nature of the mechanisms by which many TBIs are sustained, post-traumatic stress disorder (PTSD) is a common condition following TBI. A recent systematic review and meta-analysis published in the *Journal of Neurotrauma* on the prevalence of PTSD among civilians with TBI found that individuals with TBI had 1.73 higher odds of having PTSD compared to the general population (Van Praag et al., 2019). Although prevalence of PTSD did not significantly differ between mild TBI and moderate or severe TBI, pooled prevalence of PTSD among individuals with mild TBI was 13.5% compared to 11.8% for moderate or severe TBI. In veterans and service members, estimated prevalence of PTSD

may be even higher. An estimated 27% of these veterans and service members may have PTSD following TBI (Loignon et al., 2020). Compared to civilian populations, veterans and service members with TBI may be 5.44 times more likely to have a PTSD diagnosis following their TBI (Loignon et al., 2020).

Mood disorders. Mood disorders are the most common psychiatric condition following TBI and occur at higher rates among individuals with TBI than the general population (Gould et al., 2011; Jorge et al., 2004; Ponsford et al., 2018). Depression is one of the most common mood disorders following TBI, which often co-occurs with anxiety (Ponsford et al., 2018) and may also co-occur with aggressive behaviors (Jorge et al., 2004). Approximately three out of four people who have depression following TBI also have an anxiety disorder (Bryant et al., 2010; Gould et al., 2011; Jorge et al., 2004; Ponsford et al., 2018). Similar to anxiety, disruptions to employment, social functioning, lack of adequate psychoeducation about the injury, and poor sleep quality may contribute to depression and higher endorsement of depressive symptoms post-TBI (Malec et al., 2007; Mathias & Alvaro, 2012; Osborn et al., 2014).

Several studies have also provided evidence for the development of bipolar disorders following TBI, although the prevalence of bipolar disorder is considerably lower compared to other mood disorders. Studies estimate the prevalence of bipolar disorder among individuals with TBI ranges up to 16% (Deb et al., 1999; Fann et al., 1995; Hibbard et al., 2000; Jorge et al., 1993; Koponen et al., 2002; Silver et al., 2001; van Reekum et al., 1996; Whelan-Goodinson et al., 2010). A recent study examining the incidence of TBI using insurance claims data in a representative sample of adults found

that 1.8% of individuals developed a bipolar disorder following the injury (Albrecht et al., 2020).

Suicide. Although suicide is not a mental health disorder, it is often the biproduct of mental health conditions, and is particularly problematic among individuals with TBI and mental health-related comorbidities. Specifically, increased risk-taking behaviors, impulsivity, and comorbid psychiatric conditions following TBI makes suicide risk especially concerning for individuals with TBI. Recent incidence estimates of suicides among individuals *without* TBI is approximately 19.9 per 100,000 compared to 40.6 per 100,000 *with* TBI (Madsen et al., 2018). One recent study found that the hazard ratio of suicide completions by drug overdose was 1.41 for mild TBI and 1.51 for moderate or severe TBI, while suicide completion by firearms was 1.09 for mild TBI and 1.33 for moderate or severe TBI (Byers et al., 2020). Global pooled prevalence estimates of suicidal ideation among individuals with TBI is approximately 19% and suicide attempts are about 2% (Chen et al., 2022). In the United States, pooled prevalence estimates of suicidal ideation are approximately 19% and 3.7% for suicide attempts (Chen et al., 2022). Having a history of suicide attempts is one risk factor for suicidal behaviors post-TBI. Studies have found that 27% of civilians and service members who experienced a TBI and post-TBI suicidal behaviors reported having pre-morbid history of suicide attempts (McIntire et al., 2021). The most significant risk factor for suicidal behaviors following a TBI include having a history of depression, as well as history of substance use disorders and PTSD (McIntire et al., 2021). Data from the 2017 Ohio Violent Death Reporting System found that the age-adjusted suicide rate among Ohio residents with

reported TBI was 14.5 per 100,000 people (Ohio Department of Health, 2017). Among the 1,712 suicide deaths reported among Ohioans with TBI in 2017, suicide rate was highest overall among males, which matches U.S. national data (Daugherty et al., 2019), while the suicide death rate among black, non-Hispanic males was seven times higher than the suicide death rate for black, non-Hispanic females. Firearms represented 57% of all suicide deaths among males and 33% of suicide deaths among females. However, females used drug poisoning at a rate three times higher than males. Sixty-four percent of these Ohioans with TBI were diagnosed with a mental health condition, and 40% were receiving mental health treatment at the time of their suicide. In a national sample of service members and veterans, individuals who died by suicide who also had mental health conditions were 6 times more likely to also have a lifetime history of TBI (Greer et al., 2020; Simonetti et al., 2020).

Treating individuals with comorbid TBI, psychiatric conditions, and suicidal ideation may be particularly complicated because the way in which treatment is often approached may be less effective due to frontal lobe damage resulting from TBI (Corrigan, 2021). Specifically, these individuals may be more likely to terminate treatment early due to high cognitive demands in behavioral health treatment or due to poor self-esteem when clients or providers are unaware about how or why TBI may be causing cognitive difficulty (Corrigan, 2021). The high prevalence of comorbid TBI, psychiatric conditions, and suicidal ideation and attempts paired with risk-taking behaviors and the chronicity of TBI should motivate behavioral health providers to identify TBI among clients.

The Importance of Screening for Lifetime History of TBI in Behavioral Healthcare Settings

Approximately 50% of clients seeking treatment for substance use disorders or mental health conditions in behavioral health treatment settings have a lifetime history of TBI (Corrigan & Mysiow, 2012). The symptoms of TBI can imitate the symptoms of substance use disorders or other mental health conditions, which risks misdiagnosis and poor intervention decisions if TBIs are not screened for among providers who frequently intervene with or treat these individuals (Dams-O'Connor et al., 2014; McHugo et al., 2017). Screening for TBI among individuals seeking treatment in behavioral health treatment settings could reduce the disability burden associated with the injury. Early identification of a TBI at the start of the therapeutic relationship could affect the course of intervention or treatment decisions. For example, individuals who are identified to have a TBI may be eligible for disability provisions, including home health care or other resources through Home and Community-Based Services (HBCS) waivers. Screening for TBI could help these individuals to obtain the resources they need to re-integrate into the community or obtain disability benefits through this waiver, which could also reduce costs associated with treatment obtained through nursing homes, hospitals, and other types of institutional services (Friedman & VanPuymbrouck, 2018; Hendrickson & Blume, 2008). Similarly, screening for TBI in behavioral health treatment settings could alter diagnoses and/or treatment decisions. Screening for TBI in these contexts is particularly critical because “failure to identify TBI as a possible contributing factor to symptoms among people with co-occurring disorders could lead to inappropriate and ineffective treatments” (McHugo et al, 2017, pg. E72). Clinicians may attribute a client’s

lack of engagement with treatment as ‘noncompliance’ or ‘resistance’ to treatment when in actuality, the treatment services were not tailored to fit the client’s unique cognitive or behavioral health needs that resulted from the TBI. For example, memory problems due to the injury could make it seem like the individual is uninterested in engaging in treatment. Specifically, some individuals with TBI may have trouble remembering appointments, recalling what was said during treatment or tasks that need to be completed, or they may appear to be inattentive (Corrigan & Bogner, 2013). This could result in mislabeling the client as ‘non-compliant’ and could result in early treatment termination. Furthermore, because TBI is a major risk factor contributing to worsened substance use disorders, psychosocial outcomes, and re-injury (Lasry et al., 2017), screening for TBI could potentially be lifesaving. Therefore, this study is significant for its public health potential to improve TBI identification in behavioral healthcare settings for clients with co-occurring TBI, substance use disorders, and mental health comorbidities.

The Evidence-Based Practice Intervention

The Ohio State University TBI Identification Method (OSU TBI-ID) is one of the most effective methods for identifying lifetime history of TBI among individuals with behavioral health problems (Corrigan & Bogner, 2018; O’Rourke et al., 2016; Stubbs et al., 2020). The OSU TBI-ID is a comprehensive, evidence-based TBI screening method that behavioral health providers can use to screen for lifetime history of TBI in 3 – 5 minutes (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007) and was first validated among a cohort of clients seeking substance use disorder treatment in behavioral health

treatment settings (Corrigan & Bogner, 2007). Since its development in 2017, the OSU TBI-ID has been used in numerous health and treatment settings, and in studies with vulnerable populations, including individuals who are homeless or precariously housed (Stubbs et al., 2020), individuals involved in the criminal justice system (O'Rourke et al., 2016), older adults in Area Agencies on Aging (Schneider-Cline et al., 2019), and veterans and service members seeking mental health or substance use disorder treatment (Bogner et al., 2015; Brenner et al., 2013).

The OSU TBI-ID is a structured clinical interview that uses optimal recall methods to prompt a client's lifetime history of TBI (Warner et al., 2005) including age of first injury, worst injury (based on length of loss of consciousness), most recent injury (moderate or severe injuries in recent months or any TBI in recent weeks), multiple injuries, and TBI from mechanisms such as blasts or whiplash (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007). Ascertaining lifetime exposure to TBI through multiple prompts rather than relying on only medical record data, single questions about TBI (i.e., "Have you ever sustained a TBI?"), or neuroimaging will likely lead to better TBI identification among vulnerable populations who may not have sought treatment for the injury initially.

Known Barriers to Implementing TBI Screening in Behavioral Health Organizations

Despite the strong evidence demonstrating the relationship between TBI and psychiatric comorbidities, and existing evidenced on the effectiveness of the OSU TBI-ID in identifying lifetime history of TBI, TBI screening has failed to be adopted into behavioral health treatment contexts. Preliminary exploratory research conducted in 2019

with 17 masters-level, licensed social workers employed in seven publicly and privately funded outpatient substance use disorder treatment organizations throughout the greater Columbus area demonstrated several factors that may affect TBI screening adoption in these organizations (Coxe et al., 2021). Guided by the Theoretical Domains Framework (TDF) and the Consolidated Framework for Implementation Research (CFIR), this study found that implementation of TBI screening and care practices was linked to CFIR's "Characteristics of the Individuals" which included lack of knowledge about TBI, lack of self-efficacy in delivering TBI screening and accommodations, and enthusiasm to learn and acquire skills needed to screen for TBI and treat clients with co-occurring TBI and psychiatric comorbidities. Most providers reported obtaining knowledge about TBI through their own reading, while fewer reported receiving training through organization-sponsored trainings. Pertaining to the TDF, providers identified professional identity and role responsibilities in treating these clients as central to their job functions. This research also found that providers who previously worked with a client with a TBI or who had a personal experience with TBI were able to recognize a possible TBI in other clients. Nonetheless, use of formal screening methods in these organizations was sparse. Despite provider enthusiasm toward acquiring knowledge and skills to identify clients with TBI, beliefs about screening for TBI and the usefulness of the OSU TBI-ID may pose barriers to the adoption of TBI screening in these organizations. In a more recent study that surveyed a sample of over 800 licensed social workers in Washington State assessing the knowledge, self-efficacy, training experiences, and practices with treating clients with TBI, results demonstrated that only one-third had any prior training on TBI and that most

training came through reading articles on TBI or training from coworkers (Conrick et al., 2022). However, social workers who completed formal training in TBI, such as through continuing education courses, were 1.31 times more likely to have high knowledge about TBI compared to social workers without formal training. Despite social worker's reporting that serving clients with TBI is of critical importance, the level of confidence in working with these clients was significantly lower among social workers with no formal training or continuing education courses.

To increase the effectiveness of behavioral health treatment and to improve appropriate services accessibility among vulnerable populations with TBI, it is crucial that behavioral health providers are trained on how to recognize the symptoms of TBI among clients, how TBI impacts behavioral health treatment, and how to screen for lifetime history of TBI using validated screening methods, such as the OSU TBI-ID (Dams-O'Connor et al., 2014). Although providing training on how to screen for TBI can increase provider knowledge in delivering the EBP (Kirchner et al., 2020; Powell et al., 2012, 2015), training alone is insufficient to increase the uptake of the innovation particularly when the innovation is new to the implementation context (Beidas et al., 2012; Rogers, 2003). Understanding the role of the providers and their perceptions about the TBI screening innovation could reveal why TBI screening adoption has failed in behavioral health treatment settings.

Theoretical Underpinnings of the Research Study

Using established theories, rather than implementation frameworks or models, is critical to understanding the adoption of TBI screening in behavioral health contexts. On

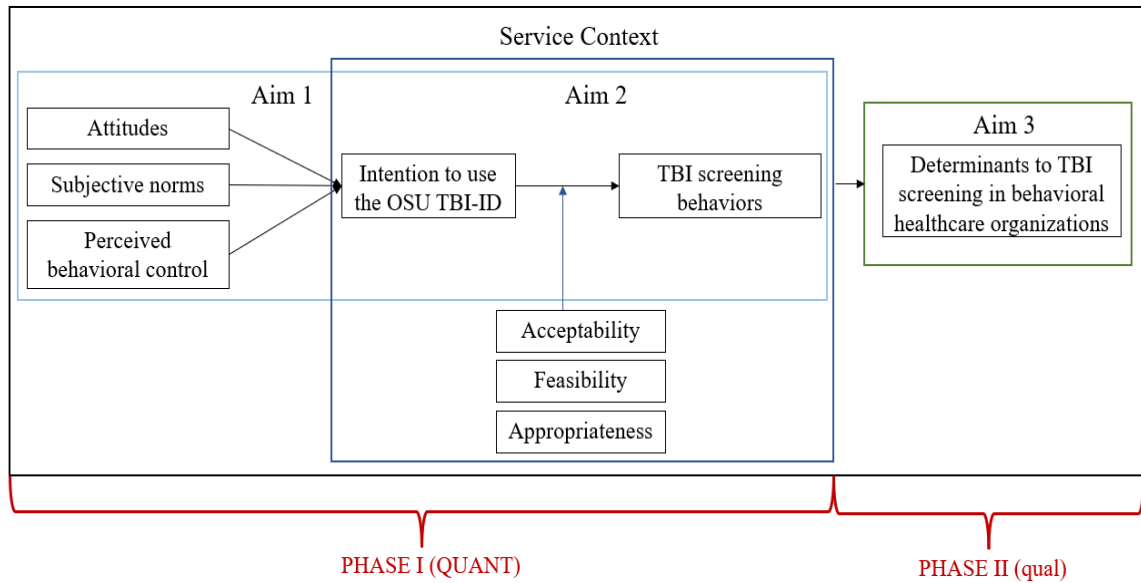
average, it takes approximately 17 years for only 14% of EBPs to eventually reach the service landscape and begin to be implemented in service settings (Balas & Boren, 2000). The first article written on the development, initial reliability, and validity of the OSU TBI-ID was published in 2007 (Corrigan & Bogner, 2007), which is approximately 15 years ago at the time of this writing. Despite its widespread use in some health settings, this TBI screening method has not been adopted, sustained, scaled-up, or scaled-out in behavioral health treatment contexts. This is particularly important given the utility of this screening method for populations who are at high-risk for sustaining a TBI or who may already have sustained a TBI that could be impacting their daily functioning and overall health. Research that is guided by public health behavioral theory (Ajzen, 1991; National Cancer Institute, 2005) and social sciences theory (Rogers, 2003) can offer insights into moving the research evidence into practice. Specifically, provider-level characteristics from the Theory of Planned Behavior (Ajzen, 1991) and innovation-level factors from Roger's Diffusion of Innovations Theory (Rogers, 1983, 2003) may be some of the most salient predictors to the adoption of the EBPs in these settings (Bartholomew et al., 2007; Damschroder et al., 2009; Hides et al., 2007; National Cancer Institute, 2005).

Therefore, this study draws on the Theory of Planned Behavior to better understand how characteristics of behavioral health providers, including attitudes, subjective norms, perceived behavioral control, and intentions affect TBI screening adoption in behavioral healthcare settings (Aim 1). This study also draws on Diffusion of Innovations Theory to understand how factors related to the OSU TBI-ID, specifically,

the acceptability, feasibility, and appropriateness, affect TBI screening adoption (Aim 2). Finally, additional factors within the service context may also affect TBI screening adoption beyond characteristics of providers and innovations and therefore, this study also qualitatively assesses additional determinants within the service context on TBI screening adoption (Aim 3). The following Conceptual model, published in Coxe-Hyzak et al. (2022), combines constructs from the Theory of Planned Behavior and Diffusion of Innovations Theory and specifies the direction of the relationships between the provider-level characteristics and innovation-level factors hypothesized to affect TBI screening adoption within the behavioral health services context (Coxe-Hyzak et al., 2022).

Figure 2.1.

Conceptual model, published in Coxe-Hyzak et al. (2022)



Theory of Planned Behavior

The Theory of Planned Behavior (TBP) posits that three independent determinants predict an individual's intention to perform a specified behavior (Ajzen, 1991, 2011). In this dissertation study, the behavior of interest is TBI screening. According to this theory, three conceptually distinct, individual-level characteristics that may predict intention to screen for TBI are attitudes, perceived behavioral control, and subjective norms. Understanding how these individual-level characteristics may affect provider's intentions to screen for TBI could provide valuable insights into the modifiable factors which can be targeted through implementation strategies. Specifically, strategies aimed at changing provider attitudes, changing the norms within the service context surrounding TBI screening implementation, and the degree to which providers believe that they have it within their power to screen for TBI could be targeted to increase intentions, and subsequently TBI screening adoption. As Aarons and colleagues (2009) point out, "the Theory of Planned Behavior has received substantial empirical support and overlaps with theoretical frameworks outlining the components needed for successful adoption and implementation of innovative behaviors within organizations by identifying attitudes as an influence in the adoption of and adherence to behavioral change" (Aarons et al., 2009, pg. 3).

Previous studies have used the TBP to examine providers' intentions to adopt virtual reality training for adult survivors of TBI in behavioral health contexts (Glegg et al., 2013) or concussion education and TBI reporting behaviors in other health or educational settings (Conaghan et al., 2020; Ernst & Kneavel, 2020; Kroshus et al., 2014;

Milroy et al., 2020; Register-Mihalik et al., 2013). The TBP has also been used to examine the effects of a stroke prevention training model with a group of first aide responders regarding their attitudes, norms, perceived behavioral control, and intentions to identify early signs of stroke (Tambi et al., 2019). However, to my knowledge, no studies have used the TBP to examine which, if any, of these provider characteristics might affect TBI screening intention and behaviors within the behavioral health service contexts where individuals with psychiatric comorbidities seek treatment.

Attitudes

The TBP posits that the more favorable one's attitude is toward a given behavior, the higher the perceived control that one has over their behavior, and the higher the perceived pressure to do a behavior, then the stronger the intention is to conduct that given behavior. Each of these constructs can work together or independently to predict intention to perform the behavior (Ajzen, 1991) (see Figure 2.1). First, attitude is defined as "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991, pg. 188) (See Table 3.1). In this dissertation study, provider attitudes toward screening for TBI may directly predict whether providers intend to adopt the OSU TBI-ID in practice. For example, providers who have favorable attitudes toward TBI screening using the OSU TBI-ID will likely demonstrate greater intentions to screen for TBI, and subsequently, be more likely to adopt TBI screening into their practice.

Subjective Norms

Second, subject norm refers to “the perceived social pressure to perform or not to perform the behavior” (Ajzen, 1991, pg. 188) (Table 3.1). Perceived social pressure may be internal to the organization and include perceived pressures to screen for TBI by other providers, clients, or organizational leadership. For example, if the perceived pressure is high from other providers within the organization to screen for TBI because the norm is to conduct TBI screening, then providers will be more likely to report greater screening intentions. In addition, perceived social pressures may be external to the organization, and may include perceived pressure from key stakeholders such as state-level funders), family members, or insurers. For example, if providers perceive that the pressure is greater from organizations who fund their programs, then their intentions to screen for TBI will be higher.

Perceived Behavioral Control

Third, perceived behavioral control is defined as “people’s perception of the ease or difficulty of performing the behavior of interest” which is often dependent on past experiences that contribute to this perception (Ajzen, 1991, pg. 183) (Table 3.1). Perceived behavioral control varies based on the individual and context, and is influenced by one’s confidence in their ability to perform a given behavior (Ajzen, 1991). Perceived behavioral control in behavioral health contexts could be influenced by time or other available resources, as well as self-efficacy to conduct TBI screening. For example, if the providers believe they do not have enough time to incorporate TBI screening into their assessments or treatment models, then they will likely report low perceived control over

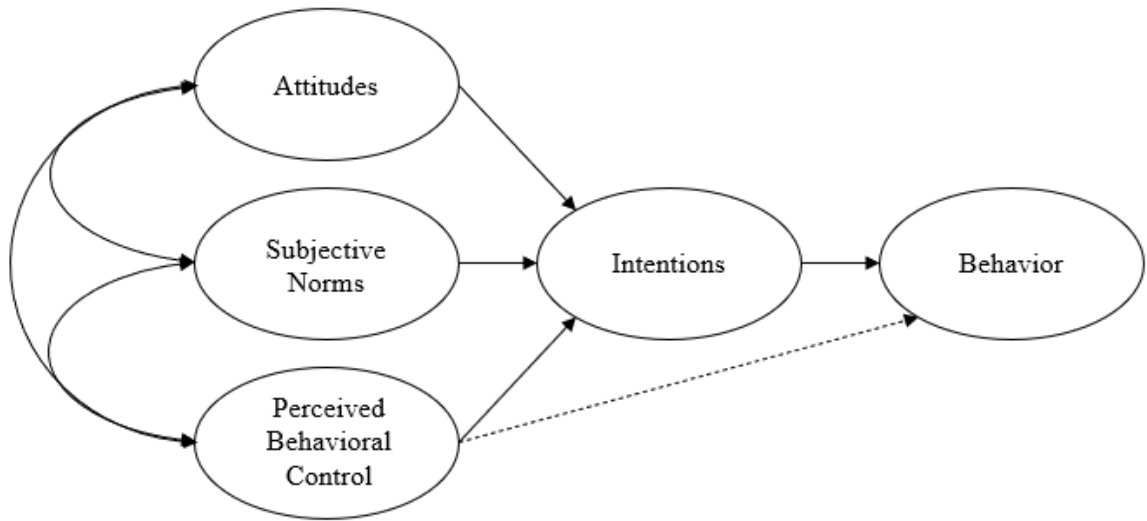
whether they can actually adopt TBI screening. As another example, if the providers believe that their work environment is not conducive to supporting TBI screening, then their intentions to screen will likely be lower, as will their behaviors. Perceived behavioral control can affect behaviors directly, or indirectly through intentions.

Intentions on TBI Screening Adoption

Finally, intentions are defined as the “perceived likelihood of performing behavior” (pg. 17) and is the most significant construct to the TBP (National Cancer Institute, 2005) because it serves as the mediating construct on the relationships between attitudes, perceived behavioral control, and subjective norms on behaviors. The TBP posits that attitudes, perceived behavioral control, and subjective norms precede and have a direct effect on one’s intentions to perform a behavior (Ajzen, 1991). Subsequently, having a greater likelihood of performing a behavior leads to actually performing that behavior. Specifically, Ajzen discusses that the underlying concept of intentions is the motivations – or how hard an individual is willing to try – to perform a behavior. Thus, motivations may be driven by one’s perceived ability to perform the behavior, opinions about the behavior, and external social pressures to perform the behavior. In this study, intentions therefore serve as the mediating construct between attitudes, subjective norms, and perceived behavioral control on TBI screening adoption. Figure 2.1 provides a visual depiction of the TBP, as seen in Ajzen (1991).

Figure 2.2

Theory of Planned Behavior as seen in Ajzen, 1991



Roger's Diffusion of Innovations Theory

Despite theoretical support for these individual-level characteristics in predicting intentions to perform a specified behavior, intention in itself may be a poor predictor of actual behaviors (Ajzen, 2011). Although attitudes, perceived behavioral control, and subjective norms may be predictive of intentionality, other moderating variables may influence the relationship between intention to perform a behavior and actual behavior change. Such potential moderating variables may include factors related to the innovation, particularly when the innovation is new to the implementation context. (Damschroder et al., 2009; Rogers, 2003).

Diffusion of Innovations Theory suggests that innovation-level factors, including the acceptability, feasibility, and appropriateness of the innovation, are key components to the adoption of the innovation within a particular context, such as in behavioral health treatment settings (Rogers, 1983). Diffusion is a type of social change that is defined as

the “process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1983, pg., 5) leading to the adoption or rejection of a new innovation. The four main elements of Diffusion of Innovations include: (1) the innovation; (2) communication about the innovation; and (3) channels by which information about the innovation is communicated, (4) over time (Rogers, 1983). According to Rogers (1983), communication is not necessarily linear by occurring interpersonally between two individuals, but rather cyclical and can occur through many different channels. For example, communication channels can include trainings, where one stakeholder communicates information about an innovation to a group of providers, or where providers within an organization communicate to each other about the innovation that is new to their context. These communication channels are meant to serve as the conduits by which information or knowledge is shared between individuals so that a mutual understanding is reached, with the ultimate goal of producing behavior change over time (Rogers, 1983).

Although the Diffusion of Innovations originally began with the diffusion of new technologies and technological advancements in different contexts, it has quickly spread to other disciplines, and is particularly useful within implementation science. More recently, implementation studies have used Diffusion of Innovations to inform pharmacists prescribing practices (Makowsky et al., 2013), the adoption of certain surgical procedures (Merkel et al., 2015), and the management of chronic health conditions in physician organizations (Miake-Lye et al., 2017). Within implementation science pertaining to TBI care innovations, Diffusion of Innovations has been used to

inform the development of interventions aimed to reduce variations in the management protocols for mild TBI in the emergency department (ED) (Tavender et al., 2015). In one study protocol published in *Implementation Science* by Tavendar and colleagues (2015), Diffusion of Innovations specifically informed the qualitative assessment of the feasibility and acceptability of the TBI management strategies (i.e., the innovation) within the ED. Specifically, several components of the care management innovation were found to not be feasible in the ED context, which were primarily due to lack of time and resources needed to deliver the innovation. Compatibility of the innovation to the ED context was also assessed qualitatively so that changes to the innovation could be made to ensure that the innovation was conducive to implementation within that particular context. Other studies have also examined the diffusion of the U.S. National TBI laws throughout states and high schools by identifying implementation processes and rates of adoption (i.e., early adopters, late adopters), although Diffusions of Innovations Theory was not explicitly discussed in any of these studies (Coxe et al., 2018; Harvey, 2013; Yang et al., 2017). Diffusions of Innovations Theory is relatively new to the TBI research landscape but could prove to be a very useful theoretical foundation as research in implementation science moves the TBI innovations from research to practice.

In this dissertation study, the innovation refers to TBI screening through the OSU TBI-ID; initial communication about this innovation is through the TBI training modules developed by TBI experts at The Ohio State Wexner Medical Center; the channels by which this information is communicated is through the survey for this study, where providers completed the TBI education modules. The pre-implementation nature of the

present study is aimed to capture early determinants to the adoption of TBI screening in behavioral health treatment settings and is foundational to subsequent studies looking at adoption patterns over time. In addition, diffusion of this TBI screening innovation were assessed initially and at a one-month follow-up.

Evidence suggests that providers employed in behavioral health settings have not adopted this TBI screening method, leaving questions about whether the innovation itself is deemed to be acceptable, feasible, and appropriate to implement within these specific contexts by these specific providers (Coxe et al., 2021). Where the innovation may be acceptable in one context by one provider, it may not be acceptable or feasible in another context or to other providers within that context (Rogers, 1983). Four main components important to the innovation are: (1) compatibility of the innovation to the context; (2) the complexity of the innovation; (3) trialability of the innovation; and (4) relative advantage of the innovation to other similar innovations (Damschroder et al., 2009; Proctor et al., 2011; Rogers, 1983). Each of these innovation components have been used as the theoretical basis to forming what are the key intermediate, proximal implementation outcomes in the implementation science literature (Proctor et al., 2011). These implementation outcomes are necessary for measuring the success of the implementation process, and ultimately, adoption of the innovation.

Acceptability

First, acceptability is one such implementation outcome directly derived from Diffusion of Innovation Theory's components of 'complexity' and 'relative advantage' (Proctor et al., 2011). Acceptability is defined as "the perception among implementation

stakeholders that a given treatment, service, practice, or innovation is agreeable, palatable, or satisfactory” (Proctor et al., 2011, pg. 67) (See Table 3.1). Rogers (1983) and Proctor et al. (2011) point to the importance of examining the acceptability of the innovation at the pre-adoption, or pre-implementation, stage of the research study (Proctor et al., 2011; Rogers, 1983). Acceptability should be measured on the degree to which providers perceive the complexity, content, or comfort with delivering the innovation, and can be measured through survey at the individual-level (Proctor et al., 2011).

Appropriateness

Second, appropriateness is directly derived from Diffusion of Innovation Theory’s ‘compatibility’ of the innovation (Proctor et al., 2011). Appropriateness is defined as “the perceived fit, relevance, or compatibility of the innovation or evidence-based practice for a given practice setting, provider, or consumer; and/or perceived fit of the innovation to address a particular issue or problem” (Proctor et al., 2011, pg. 69) (Table 3.1). Perceived appropriateness of a given innovation is the degree to which providers see the innovation as consistent with their set of skills, job expectations, and roles in that healthcare setting (Proctor et al., 2011). Rogers (1983) specifically discusses the appropriateness of innovations as a key factor in the diffusions of innovations process as the degree to which the innovation is considered compatible or relevant to the service context which could impact whether the innovation is ultimately adopted (Rogers, 1983). In this dissertation study, the degree to which the OSU TBI-ID is considered relevant to the service context, including the client population being served, could affect the adoption of this innovation

in behavioral health treatment settings. Appropriateness should be measured at the pre-implementation stage, and can be measured through survey at the individual-level (Proctor et al., 2011).

Feasibility

Third, feasibility is directly derived from Diffusion of Innovation Theory's 'trialability' of the innovation and is defined as "as the extent to which a new treatment, or an innovation, can be successfully used or carried out within a given agency or setting" (Proctor et al., 2011, pg. 69) (Table 3.1). Feasibility is often studied qualitatively (Aarts et al., 2011; Tavender et al., 2015); however, Proctor et al. (2011) argues that feasibility should be measured through quantitative survey, during the initial adoption stages when providers have had the opportunity to trial the innovation, and can be measured at the individual-level (Proctor et al., 2011).

While it is important to study these innovation-level factors as outcomes (Proctor et al., 2011), these factors could potentially be the moderators that bridge providers' intentions to screen for TBI to actual TBI screening behaviors. For example, the extent to which provider's perceive the OSU TBI-ID to be feasible and acceptable to implement, and relevant to their work, the more likely they may be to adopt this TBI screening method. The innovation-level factors are hypothesized to moderate the relationship between TBI screening intention to actual TBI screening behaviors. Therefore, this study is also significant for its potential to advance knowledge translation in dissemination and implementation science by identifying and testing intermediate outcomes bridging the gaps between proximal indicators (TBI screening intentions) to distal outcomes (actual

TBI screening behaviors). Subsequently, implementation strategies that directly target these moderators can be developed, tested, and used in behavioral health treatment settings where TBI innovation adoption is lacking.

The Importance of the Implementation Context

Assessing the contextual determinants to TBI screening is also vital to identifying implementation strategies aimed to increase the uptake, fidelity, and sustainment of TBI screening in behavioral health treatment settings (Hamilton & Finley, 2019).

Understanding the implementation context and environment under which a new innovation is used is necessary to connecting hypotheses and theorized mechanisms to behaviors (Hamilton & Finley, 2019). The service context in which a new innovation is implemented is one of the primary reasons why innovation adoption fails or has the chance to survive and thrive (Kaplan et al., 2010; Nilsen & Bernhardsson, 2019; Tomoaia-Cotisel et al., 2013). Assessing the service context adds depth and breadth to our understanding of how and why TBI screening is or is not adopted in behavioral health treatment settings (Palinkas et al., 2011), which cannot be ascertained through quantitative data alone. Based on the context, implementation strategies can be identified that harness a social environment that is supportive of the innovation (Powell et al., 2019).

Numerous studies have assessed behavioral health treatment contexts when implementing new innovations (Bartholomew et al., 2007; Hides et al., 2007; Pontin et al., 2009). However, TBI care is relatively new to these service contexts and to these types of professionals. This, in turn, presents unique challenges to implementing TBI

screening into these organizations and urges an in-depth assessment of the context from the perspective of the providers who are intended to deliver this innovation. Despite the clear association between TBI and behavioral health, and the vulnerability that TBI imposes on individuals, TBI screening has yet to be adopted into these service contexts and studies have yet to investigate how the context may affect TBI screening adoption. Therefore, this dissertation addresses the gaps in the literature regarding the factors affecting TBI screening adoption in behavioral healthcare settings through the following specific aims and hypotheses:

- (1) **Aim 1: Examine the relationships between behavioral health providers' attitudes, perceived behavioral control, and subjective norms as predictors to TBI screening intentions and examine whether intentions to adopt TBI screening mediate actual TBI screening behaviors at a one-month follow-up.**

H1: Providers who have more favorable attitudes, greater perceived behavioral control, and greater perceived social pressure within the organization to screen for TBI will demonstrate higher TBI screening adoption.

- (2) **Aim 2: Investigate whether the acceptability, feasibility, and appropriateness of the TBI screening innovation (OSU TBI-ID) moderates the relationship between TBI screening intentions and actual TBI screening behaviors.**

H2: Greater perceived acceptability, feasibility, and appropriateness of TBI screening using the OSU TBI-ID will strengthen the relationship between TBI screening intent and actual TBI screening behaviors.

- (3) **Aim 3: Assess the contextual determinants to TBI screening adoption to expand on the quantitative results.**

Determinants to TBI screening adoption were investigated through qualitative, semi-structured interviews with a subset of n = 20 behavioral health providers.

Innovation

This dissertation study is innovative in three specific ways. First, this study examines factors affecting the early adoption of the validated OSU TBI-ID screening

method with a novel group of behavioral health professionals. Because these professionals have yet to adopt this TBI screening method into routine care, they represent a novel group of individuals aimed to ultimately increase widespread TBI screening efforts in behavioral health treatment settings. This is innovative because behavioral health providers are a large segment of “untapped” professionals who could bridge gaps in service access by identifying individuals with co-occurring TBI, substance use disorders, and mental health comorbidities who may need additional services or adapted behavioral health treatment. Although the OSU TBI-ID can be used by these providers, it has not been systematically adopted. Engaging the behavioral health workforce to identify TBI among clients, as proposed by this study, addresses the National Institute of Neurological Disorders (NINDS) strategic development plan (Goal 3, Objective 3.1.1 and 3.3.2) by diversifying the workforce to deliver TBI innovations into routine care.

Second, this study combines multiple methods to investigate implementation of a TBI screening innovation in a complex health environment. Traditional TBI studies often utilize only quantitative or qualitative methods to study a particular phenomenon of interest, and which are often limited to physical health settings. The mixed methods approach utilized in this study will include comprehensive quantitative and qualitative data collection and advanced analytical techniques that go above and beyond the typical approaches to combine theory-driven hypotheses with in-depth assessments that explain the adoption of TBI screening in behavioral healthcare settings. Although TBI innovations exist for adults with behavioral health comorbidities, the behavioral health

treatment context is often excluded in many TBI studies (Bogner & Corrigan, 2013).

However, utilizing comprehensive data collection methods could help us understand the complex interplay of this environment with the innovation.

Third, this dissertation study examines theory-driven relationships between provider characteristics and innovation factors that capitalizes on two theory-driven hypotheses to bridge proximal (i.e., intention to screen) to distal outcomes (i.e., actual screening behavior). Although implementation science is often driven by large frameworks or models, many studies do not specify how constructs are related during pre-implementation phases that affect EBP adoption, and often do not clearly define mediating or moderating variables that could explain causal paths to the implementation of innovations (Kislov et al., 2019). Therefore, this study moves the field of implementation science forward by testing these proposed hypotheses and identifying mediators and moderators that potentially affect the diffusion of the TBI screening innovation throughout behavioral healthcare settings.

Chapter 3: Methods

Study Design and Rationale

This dissertation utilized an explanatory sequential mixed methods design with primary, prospective data collection to investigate the provider-level characteristics, innovation-level factors, and contextual determinants affecting the early adoption of the OSU TBI-ID method among licensed behavioral health providers employed in behavioral healthcare settings throughout the United States. This explanatory sequential mixed methods design consisted of two distinct consecutive phases, where an emphasis was placed on the quantitative phase, which was conducted first, followed by the qualitative phase which was conducted second and which was used to contextualize the quantitative results (QUANT → qual) (Creswell, 2015; Ivankova et al., 2006). The mixed methods approach used in this study included comprehensive data collection and advanced analytical techniques which combined theory-driven hypothesis-testing and in-depth interviews that explained factors affecting the early adoption of TBI screening in behavioral healthcare settings (Coxe-Hyzak et al., 2022). Four key integration features common to this type of mixed methods design that were used in this study included: 1) *building*, where participants from the quantitative phase were selected based on results from the quantitative phase; 2) *connecting*, where the quantitative results of for Phase I of this study were used to create the qualitative interview guide for Phase II; 3) *mixing*, where the quantitative and qualitative results were combined to form meta-inferences about the data as a whole, and 4) *weaving*, where the quantitative and qualitative results are intertwined in the text on a construct-by-construct basis (Creswell & Plano Clark, 2018; Fetters et al., 2013; Fetters, 2019).

Participants

Study participants were licensed behavioral health providers (N = 215) employed in various behavioral health treatment settings throughout the United States (e.g., private practices, community-based mental health and/or substance use treatment clinics, hospital-based outpatient clinics). Using convenience sampling, providers were identified through their participation in the Star Behavioral Health Providers Program (SBHP) of Ohio (Sample 1), Google searches and personal referrals (Sample 2), the Ohio State University College of Social Work Continuing Education listserv (OSU CE) (Sample 3), and membership in the National Association for Alcoholism and Drug Abuse Counselors (NADAAC) (Sample 4).

Study Eligibility

To be eligible for this study, participants had to be 18 years and older, English speaking, and currently employed as a licensed behavioral health provider in the United States (e.g., Licensed Psychologists, Social Workers, Professional Clinical Counselors, Professional Counselors, Marriage and Family Therapists, Chemical Dependency Counselors, Psychiatric Nurse Practitioners, etc.).

PHASE I (QUANT)

Aim 1: Examine the relationships between behavioral health providers' attitudes, perceived behavioral control, and subjective norms as predictors to TBI screening intentions and examine whether intentions to adopt TBI screening mediate actual TBI screening behaviors at a one-month follow-up.

Aim 2: Investigate whether the acceptability, feasibility, and appropriateness of the TBI screening innovation (OSU TBI-ID) moderates the relationship between TBI screening intentions and actual TBI screening behaviors.

Procedures

Recruitment and Data Collection

Phase I data collection consisted of two consecutive timepoints spaced one-month apart. All participants were recruited between November 2020 through January 2022. At Time 1, providers were emailed a detailed description of the study, the study inclusion criteria, and a Qualtrics survey link. Consent to participate in the study was included on the first page of the Qualtrics survey. Providers who were interested in participating in the study self-selected into the study by clicking the “Next” button at the bottom of their screen indicating informed consent to participate in the study, confirming that study eligibility were met, and agreeing to be contacted again for purposes of this study. Providers who did not wish to participate were directed to close the survey by clicking the ‘X’ located in the top right-hand corner of their screen.

Following informed consent, participants in Samples 2, 3, and 4 (Google search/personal referral, OSU CE, and NADAAC) were asked to first complete a 45-minute PowerPoint module used to raise awareness about the relevance of TBI screening to behavioral health treatment, introduce the OSU TBI-ID screening form, and demonstrate step-by-step procedures on how to administer the OSU TBI-ID screening method using video-based case exemplars. Providers in Sample 1 (SBHP) did not receive this module because they already completed a similar TBI education program as part of their training requirements to participate in the Star Behavioral Health Program (SBHP). SBHP is a program that provides training to civilian behavioral health providers to become competent in treating military service members, veterans, and their family

members, and includes education on the connection between TBI and behavioral health, and introduces the OSU TBI-ID as a TBI screening method. The goal of each type of training was to raise awareness about the OSU TBI-ID to behavioral health providers who participated in this study.

The rest of the Qualtrics survey, which was uniform across samples, included measures asking participants about their attitudes toward screening for TBI in their practice using the OSU TBI-ID, perceived social pressures to use the screening method, perceived control over using the screening method, and their intentions to use this screening method over the next month. The total time to complete the Time 1 survey measures was approximately 15 minutes.

At Time 2, providers were sent a second email one-month after completion of the Time 1 survey measures that included a Qualtrics link containing an abbreviated description of the study, informed consent, and survey measures assessing their perceptions of the acceptability, feasibility, and appropriateness of screening for TBI using the OSU TBI-ID screening method in practice after they had the chance to trial the intervention during that one-month period. To assess TBI screening behaviors, providers were also asked to report on the number of times they used the OSU TBI-ID to screen for TBI with their clients during the previous month (Aim 2). Total time to complete the second survey was estimated to take approximately 10 minutes.

Providers were asked to include their first name, last name, and email address at the end of both the Time 1 and Time 2 surveys, as well as a unique digital identifier (i.e.,

the last two digits of their phone numbers and their two-digit birth month) to link the Time 1 and Time 2 surveys.

Incentives for Time 1. Providers in Samples 2, 3, and 4 received a Certificate of Completion to submit to their respective state licensing boards for one free Continuing Education Credit for completing the TBI education module and were entered into a raffle for the chance to win a \$50 gift card from a list of university-approved vendors. A total of 60 winners from Time 1 were selected using a random number generator in Excel. Providers in Sample 1 were instructed they would not receive a gift card until after completion of the second survey. Funding constraints early in the study recruitment phase affected the different incentive structures for the samples, hence, why the incentives for Sample 1 differed from the other samples during early phases of recruitment for this study.

Incentives for Time 2. Providers in Sample 1 each received a \$15 gift card from a list of university-approved vendors for completing the Time 1 and Time 2 surveys. Providers in Samples 2, 3, and 4 were entered into a raffle for the chance to win a \$25 gift card from a list of university-approved vendors. A total of 20 winners were selected using a random number generator in Excel.

There were some differences in recruitment procedures at Time 1 between the four samples, which were due to restrictions to accessibility of each of the respective listservs. Specifically, recruitment emails were sent a maximum of two times for Samples 1 (SBHP), 3 (OSU CE) and 4 (NADAAC). However, participants in Sample 2 (Google search and referrals) received up to six contacts based on the established Dillman method

(Dillman et al., 2008), where a follow-up email was sent approximately one week after initial contact. Additional emails were sent again at 4-weeks and 7-weeks. After this, two more emails were sent at bi-weekly intervals, for up to six total contacts. Recruitment procedures for Time 2 were uniform across samples, with the same Dillman method applied. The response rate between Time 1 and Time 2 was 74.7%. All study procedures for this dissertation were approved by the Institutional Review Board at the Ohio State University.

Key Constructs and Measures

The following measures were used to investigate the constructs proposed by the Theory of Planned Behavior (i.e., attitudes about screening for TBI using the OSU TBI-ID, perceived behavioral control over TBI screening, subjective norms, intentions to screen for TBI, and TBI screening behaviors) (*Aim 1*), as well as the constructs proposed by Diffusions of Innovations Theory (i.e., acceptability, feasibility, and appropriateness of using the OSU TBI ID to screen for TBI) (*Aim 2*). See Table 3.1 for details on each construct and their measures.

Theory of Planned Behavior Constructs

The 28-item Theory of Planned Behavior Questionnaire for TBI (TPBQ-TBI) was used to measure provider attitudes, subjective norms, perceived behavioral control, and intentions to adopt the OSU TBI-ID. The TPBQ-TBI was adapted from a previously established TPBQ measure by tailoring the intervention in each item for purposes of this study (e.g., directing participants to refer to the OSU TBI-ID) (Glegg et al., 2013). Twenty-four items were retained from the Glegg and colleagues (2013) measure and four

items were added and adapted from another TPBQ measure to include additional items relevant to the present study (Davis & Rosenberg, 2013).

Attitudes. Thirteen items were used to assess provider attitudes toward using the OSU TBI-ID to screen for TBI. Three items assessed attitudes regarding compatibility of the intervention; three items assessed perceived ease of use of the intervention; four items assessed perceived usefulness of the intervention; and three items assessed overall attitudes toward the intervention. Each item was measured on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and averaged for a total score. Higher scores on the Attitudes subscale reflect more positive attitudes toward using the OSU TBI-ID to screen for TBI. The original TPBQ measure demonstrated high internal consistency reliability for attitudes ($\alpha = 0.94$) (Glegg et al., 2013).

Perceived behavioral control. Five items were used to measure perceived behavioral control over using the OSU TBI-ID. Items were measured on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and averaged for a total score. Higher scores on the Perceived Behavioral Control subscale equated to greater perceived control over TBI screening behaviors and self-efficacy. The original TPBQ measure demonstrated acceptable internal consistency reliability for perceived behavioral control ($\alpha = 0.77$) (Glegg et al., 2013).

Subjective norms. Five items were used to measure perceived social pressure to screen for TBI. Each item was measured on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and averaged for a total score. Higher scores on this subscale equated to more positive norms associated with TBI screening. The original

TPBQ measure demonstrated good internal consistency reliability for subjective norms ($\alpha = 0.87$) (Glegg et al., 2013).

Intentions. Three items were used to measure intentions to screen for TBI using the OSU TBI-ID over the following month. Items were measured on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and averaged for a total score. Higher scores equated to greater intentions to screen for TBI using the OSU TBI-ID. The original TPBQ measure demonstrated high internal consistency reliability for intentions ($\alpha = 0.92$) (Glegg et al., 2013).

TBI screening behaviors. TBI screening behaviors were measured as a continuous, individual-level variable using 4-items aimed to capture the total number of TBI screens conducted over the 1-month period. TBI screening behaviors were determined by the following questions: “Overall, how many *new* clients sought services from you over the last month?” “How many times did you screen for TBI using the OSU TBI-ID with *new* clients over the last month?” “Overall, how many *established* clients did you see over the last month?” “How many times did you screen for TBI using the OSU TBI-ID with *established* clients over the last month?” These questions were aimed to capture when screens were conducted to help inform the qualitative interview guide.

Diffusion of Innovations Theory Constructs

Acceptability. The Acceptability of the Intervention Measure (AIM) was used to measure acceptability of using the OSU TBI-ID in behavioral healthcare settings (Weiner et al., 2017). Each of the items was adapted to replace “intervention” with the intervention of interest for this study (e.g., OSU TBI-ID). This scale has 4-items

measured on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). Items were averaged for a total score, where higher scores indicate greater acceptability. The AIM has demonstrated high internal consistency ($\alpha = 0.85$) and test-retest reliability ($r = 0.80$).

Feasibility. The Feasibility of the Intervention Measure (FIM) was used to measure feasibility of using the OSU TBI-ID in behavioral healthcare settings (Weiner et al., 2017). Each item was adapted to replace “intervention” with intervention of interest for this study (e.g., OSU TBI-ID). This scale has 4-items measured on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). Items were averaged for a total score. Higher scores indicate greater feasibility. The FIM has demonstrated high internal consistency ($\alpha = 0.89$) and test-retest reliability ($r = 0.88$).

Appropriateness. The Intervention Appropriateness Measure (IAM) was used to measure appropriateness of TBI screening using the OSU TBI-ID (Weiner et al., 2017), and each item was adapted to replace “intervention” with the OSU TBI-ID intervention for this study. This scale has 4-items measured on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). Items were averaged for a total score. Higher scores indicate greater appropriateness. The IAM has demonstrated high internal consistency ($\alpha = 0.91$) and test-retest reliability ($r = 0.73$).

Table 3.1.

Measures and Key Constructs, and Definitions of Constructs

Construct	Definition	Aim	Measure	Timepoint	Theory	Variable
Attitudes	“The degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question” (Ajzen, 1991, p. 188).	1	TPBQ-TBI	1	TPB	Predictor
Perceived Behavioral Control	“Perception of the ease or difficulty of performing the behavior of interest” (Ajzen, 1991, p. 183).	1	TPBQ-TBI	1	TPB	Predictor
Subjective Norms	“The perceived social pressure to perform or not to perform the behavior” (Ajzen, 1991, p. 188).	1	TPBQ-TBI	1	TPB	Predictor
Adoption	“ <i>Intention</i> , initial decision, or <i>action</i> to try or employ an innovation or evidenced-based practice” (Proctor et al., 2011, p. 69) and is sometimes referred to as “uptake” of an EBP.	1,2	TPBQ-TBI, Proportion of TBI screens conducted	1,2	TPB, DOI	Intention: Mediator (Aim 1) Predictor (Aim 2) Behavior: Primary Outcome
Acceptability	“The perception among implementation stakeholders that a given treatment, service, practice, or innovation is agreeable, palatable, or satisfactory” (Proctor et al., 2011, p. 67).	2	AIM	2	DOI	Moderator

Table 3.1						
Feasibility	“The extent to which a new treatment, or an innovation, can be successfully used or carried out within a given agency or setting” (Proctor et al., 2011, p. 69).	2	FIM	2	DOI	Moderator
Appropriateness	“The perceived fit, relevance, or compatibility of the innovation or evidence based practice for a given practice setting, provider, or consumer; and/or perceived fit of the innovation to address a particular issue or problem” (Proctor et al., 2011, p. 69).	2	IAM	2	DOI	Moderator
Note: This table is published in Coxé-Hyzak, K. A., Bunger, A. C., Bogner, J., Davis, A. K., & Corrigan, J. D. (2022). Implementing traumatic brain injury screening in behavioral healthcare: Protocol for a prospective mixed methods study. <i>Implementation Science Communications</i> , 3(1), 17. https://doi.org/10.1186/s43058-022-00261-x						

Statistical Analyses

Data were first cleaned and analyzed using descriptive statistics in SPSS v.27 (IBM Corp, 2020). Demographic data from each of the four samples were compared using Pearson chi squared tests for categorical variables or Fisher's exact tests when cell sizes were smaller than five. Post-hoc analyses were conducted using Bonferroni corrections to determine where statistically significant differences occurred (Allen, 2017) and Phi correlation coefficients were used to determine the extent of the differences (Frey, 2018). Standard cut-offs were used to determine the size of the effect for the coefficients as small ($\Phi = 0.1 < 0.3$), medium ($\Phi = 0.3 < 0.5$), or large ($\Phi \geq 0.5$) (Allen, 2017). Continuous variables were compared using One-Way ANOVA, and post-hoc tests were conducted using Tukey-Kramer comparisons to account for unequal sample sizes between the four samples (Haynes, 2013). Eta-squared was used to measure the size of the effects using the standard cut-offs of small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) (Fritz et al., 2012). See Table A. in Appendix D for the sample characteristics of each of the four samples.

Descriptive statistics were also used to examine the means, standard deviations, and ranges for the main study constructs for the Theory of Planned Behavior Questionnaire for TBI (e.g., attitudes, perceived behavioral control, norms, intentions, and TBI screening behaviors), as well as the main constructs from AIM, FIM, and IAM (e.g., acceptability, feasibility, appropriateness). For the TBPQ-TBI constructs, response options were collapsed into six categories due to few cell counts on the lower scores, thereby re-setting the Likert scale for analysis from 1 (*strongly disagree/disagree*) to 6

(*strongly agree*). In addition, due to the highly right skewed nature of the TBI screening count data, with most providers reporting not having screened for TBI at all during the previous month, this variable was recoded as a binary variable, where 1 = yes (screened for TBI) and 0 = no (did not screen for TBI). Differences between each of the four samples were assessed among the main study constructs using One-way ANOVA. Post-hoc tests were conducted using Tukey-Kramer comparisons to account for unequal sample sizes between the four samples (Haynes, 2013). Eta-squared was used to measure the size of the effects using the standard cut-offs of small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) (Fritz et al., 2012). See Table B. in Appendix E and Table C. in Appendix F for detail on differences between the four samples on study constructs.

Descriptive statistics were also used to determine differences between demographic variables on the main study outcome (i.e., TBI screening behaviors) using Pearson chi squared tests for categorical variables or Fisher's exact tests when cell sizes were smaller than five. See Table 4.2. Post-hoc analyses were conducted using Bonferroni corrections to determine where statistically significant differences occurred (Allen, 2017) and Phi correlation coefficients were used to determine the extent of the differences (Frey, 2018) and interpretation using the standard cut-offs for the Phi value (Allen, 2017). Continuous variables were compared using One-Way ANOVA or Independent Samples *t*-tests, and post-hoc tests were conducted using Tukey-Kramer comparisons to account for unequal sample sizes between providers who screened for TBI compared to those who did not (Haynes, 2013). For One-way ANOVA, eta-squared was used to measure the size of the effects using the standard cut-offs of small ($\eta^2 =$

0.01), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) (Fritz et al., 2012). For *t*-tests, Cohen's *d* was used to measure the size of the effects using the standard cut-offs of small ($d = 0.01$), medium ($d = 0.06$), and large ($d = 0.14$).

Statistically significant results and effect sizes were used to guide selection of variables to control for in the advanced analyses. Because Sample 1 received a different educational program than the other three samples, a sensitivity analysis was conducted to determine if excluding this sample affected the main outcome; however, no differences were detected ($p > .05$) and therefore this sample was included in all analyses. Statistical significance for all cases was set to an $\alpha = .05$ (Fritz et al., 2012).

Statistical Analysis: Aim 1

Aim 1: Examine the relationships between behavioral health providers' attitudes, perceived behavioral control, and subjective norms as predictors to TBI screening intentions and examine whether intentions to adopt TBI screening mediate actual TBI screening behaviors at a one-month follow-up.

Structural equation modeling (SEM) was conducted in Mplus 8.5 (Muthen & Muthen, 2019). SEM enables the investigation of the direct and indirect effects of the latent constructs from the TBPQ-TBI on TBI screening behaviors, removes measurement error from the main constructs, and allows for precise handling of the ordinal nature of the data (Bowen & Guo, 2011). In the model for this study, 'Attitudes,' 'Perceived Behavioral Control (PBC),' and 'Subjective Norms' were the exogenous variables hypothesized to have direct effects on the endogenous variable, 'Intent,' and an indirect effect through 'Intent' on the endogenous variable, 'TBI screening behavior.' In addition, 'Attitudes,' 'PBC,' and 'Subjective Norms' were also tested for possible direct effects on TBI screening behaviors. Because the TPBQ-TBI items are measured using ordinal

response options, the robust Weighted Least Squares Mean and Variance (WLSMV) estimator was used (Bowen & Guo, 2011). Because TBI screening can be conducted by individuals and does not necessarily depend on organizational-level or team-level functioning, the data were not clustered within organizations, treatment teams, or any other entity.

Power calculation. Using the MacCallum et al. (1996) power and Root Mean Square Error of Approximation (RMSEA) specifications for determining sample sizes in SEM and the Preacher & Coffman (2004) sample size computation in R, a total of $N = 53$ participants were needed to sufficiently power the model with an alpha level of $p < .05$, $df = 408$, power level of .80, and $RMSEA_{\text{alternative}} = .06$ (MacCallum et al., 1996; Preacher & Coffman, 2006). The final sample for this study was $N = 215$, which exceeded the minimum requirements as well as the standard conventions for sample sizes in SEM (Wang & Wang, 2012).

Missing Data. A missing values analysis (MVA) was first conducted using Little's Missing Completely at Random (MCAR) test in SPSS v.27 to determine percentage and patterns of missing data (Little & Rubin, 1989). The MCAR test was not statistically significant ($\chi^2 = 301.69$, $df = 282$, $p = 0.20$) and missing data was less than 2% on variables with any missing data. This percentage of missing data is not likely to be statistically or clinically significant (Bowen & Wretman, 2014). Mplus uses full information maximum likelihood (FIML) for handling any missing data on the indicator variables of the latent factors, as well as observed variables and covariates pulled into the

model (Muthén & Muthén, 2019). Among the 215 cases used in this analysis, the minimum covariance coverage value of 0.100 was met (Geiser, 2012).

Measurement Model

Fit of the measurement model was determined prior to testing the general structural model (Anderson & Gerbing, 1988). A non-significant χ^2 value was sought, but not required, based on convention for confirmatory factor analysis (CFA) (West et al., 2012). Additionally, it is commonly considered as acceptable to have a non-significant p -value when assessing the measurement model in SEM, so long as the other fit indices are adequate (Bowen & Guo, 2011). Therefore, four other commonly used fit indices and cutoffs were used to assess model fit: the Comparative Fit Index (CFI, $> .95$), Tucker Lewis Index (TLI, $> .95$), Standardized Root Mean Square Residual (SRMR, $< .80$), and the point estimate and 90% CI of the RMSEA ($< .06$) (West et al., 2012).

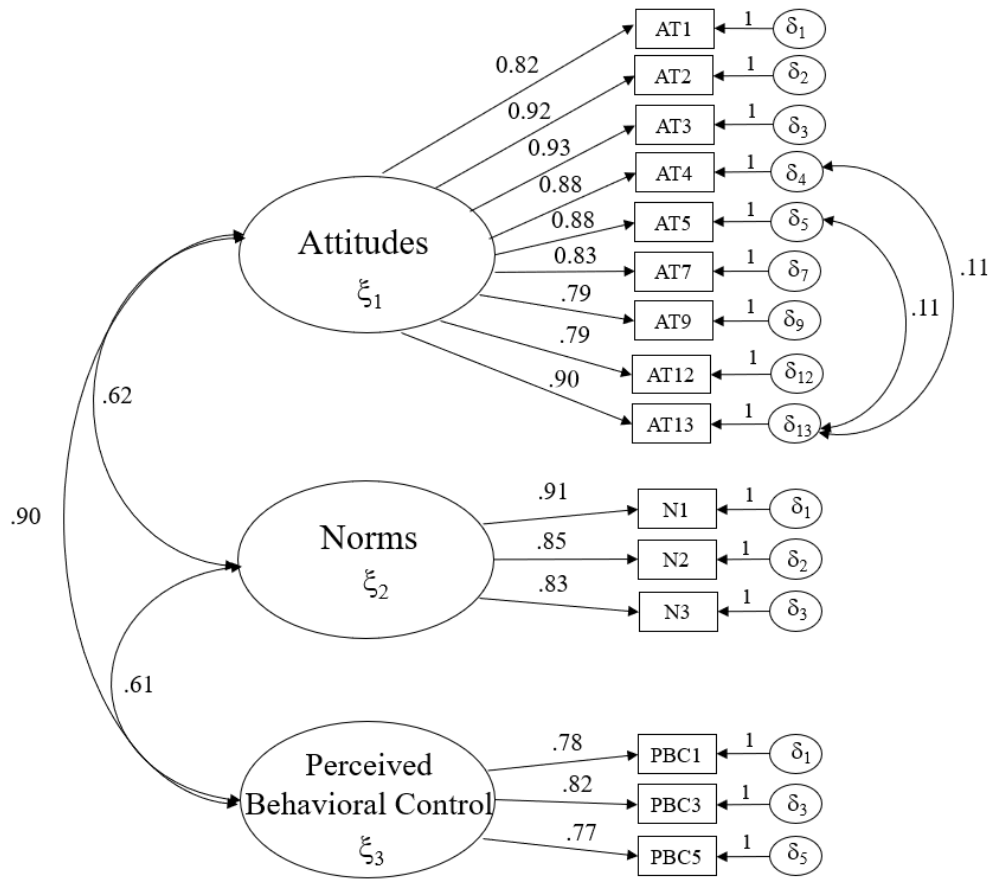
First, the measurement model was tested using all indicator variables that made up the main constructs loaded onto each of the latent factors: 13 indicator variables loaded onto ‘Attitudes,’ 5 indicators loaded onto ‘Subjective Norms,’ 5 indicators loaded onto ‘Perceived Behavioral Control,’ and 3 items loaded onto ‘Intent.’ The first model yielded inadequate fit statistics on most fit indices ($\chi^2 = 2516.61$; CFI = 0.65; TFL = 0.61; SRMR = 0.15; RMSEA = 0.17). In addition, two of the indicators on ‘Intent’ were highly correlated with each other ($r = 0.987$; “I intend to use the OSU TBI-ID in my practice with clients over the next month” and “Chances are that I will use the OSU TBI-ID in my practice with clients over the next month”). Removal of one of the indicators would have resulted in inadequate number of indicators loading onto the factor (Wang & Wang,

2012), and thus, the three indicators were computed as a mean value using the Mplus “DEFINE” command (Muthén & Muthén, 2019). ‘Intent’ was therefore measured as an observed variable and excluded from the measurement model. Next, using standard guidelines for rectifying the model (Bowen, 2018), indicator variables with poor factor loadings ($R\text{-square} < 0.30$) were removed and correlated error terms were added. These modifications were made one-by-one following Bowen et al. (2011) recommendations (Bowen & Guo, 2011).

The final measurement model yielded excellent fit incidences: ($\chi^2 = 303.63, p < 0.01$; CFI = 0.98; TLI = 0.98; SRMR = 0.04; RMSEA = 0.11; 90% CI = 0.10 – 0.12). Because the upper bound of the 90% confidence interval for the RMSEA exceeded 0.06, residual correlations were confirmed to be equal to or less than one (Bowen & Guo, 2011). The final measurement model had nine factors that loaded on to ‘Attitudes,’ three onto ‘Norms,’ and three onto ‘Perceived behavioral control.’ All the factor loadings of the measurement model presented in Figure 3.1 are statistically significant ($p < .001$).

Figure 3.1.

Fit of the Measurement Model with Standardized Estimates



Note: All factor loadings are significant at the $p < .001$ level.

Statistical Analysis: Aim 2

Aim 2: Investigate whether the acceptability, feasibility, and appropriateness of TBI screening using the OSU TBI-ID moderates the relationship between TBI screening intentions and actual TBI screening behaviors.

Unadjusted and adjusted binary logistic regression models were constructed and analyzed using STATA v.15 (StataCorp, 2017). Covariates for the model were chosen based on their significance on TBI screening behaviors. Specifically, the level of education (1 = masters/doctorate; 0 = associates/bachelors), and private practice setting (1 = yes; 0 = no) were found to be significant in the post-hoc tests described previously and were therefore selected as the covariates for these models. The primary independent variable (intentions to screen for TBI), and the moderators (acceptability, feasibility, and appropriateness) were used as continuous variables in the models. Interaction effects between intention x acceptability, intention x feasibility, and intention x appropriateness were used to determine whether each of these innovation-level factors moderated the relationships between TBI screening intentions and TBI screening behaviors. The binary outcome variable was TBI screening behaviors (1 = yes; 0 = no).

PHASE II (qual)

Aim 3: Assess the contextual determinants to TBI screening adoption through qualitative interviews with providers.

Procedures

Sample size and sampling strategy

A total of n = 20 providers who completed both Time 1 and Time 2 survey measures were purposively selected using non-random, maximum variation sampling

(Coyne, 1997). This sample size was determined *a priori* based on the phenomenological research approach utilized (Creswell, 2007).

Several decisions drove the selection of participants to be interviewed in this phase. The first decision was based on the survey responses to the main constructs from the TBP, as well as the AIM, FIM, and IAM. However, an emphasis was placed on TBI screening behaviors, which was aimed to capture greater detail regarding *why* TBI screens were or were not conducted within the treatment context. Second, because most providers in the sample were employed in private practice settings, providers employed in private practices took priority over other practice settings. However, to ensure variation in the sample, which aimed to capture differences in contextual determinants perceived to affect TBI screening adoption, providers from a variety of behavioral health settings and states were also selected. Ongoing assessment of the sample throughout the data collection process was conducted to confirm that participants and their responses corresponded to the quantitative survey data (Moseholm et al., 2017).

Providers were contacted directly by email using the emails they provided at the end of the surveys in Phase I. To account for the national sample and subsequent location variations of each provider, all interviews were conducted through Zoom videoconferencing software and audio-recorded with the participant's permission. Interviews lasted approximately 35 minutes. Participants who completed the interview received a \$30 gift card from the list of OSU-approved vendors.

Qualitative Interview Guide

A semi-structured interview guide was developed using the results from Phase I (Creswell & Plano Clark, 2018). A semi-structured interview approach creates consistency between interviews with a standardized set of questions while allowing for probing and follow-up questioning (Padgett, 2008). Specifically, the interview questions were structured according to each of the main study constructs to ensure linkage between the two phases (Fetters, 2019; Fetters et al., 2013). The interview guide aimed to corroborate and expand understanding of how the provider-level characteristics and factors related to the intervention affected TBI screening adoption within the treatment context (Fetters, 2019). See Table 3.2 demonstrating how the quantitative and qualitative questions were matched based on key constructs.

The interview guide consisted of nine primary and seven probing open-ended questions linked back to the main constructs from the Theory of Planned Behavior (e.g., attitudes, norms, perceived behavioral control, intentions, and TBI screening behaviors) and Diffusions of Innovations Theory (e.g., acceptability, feasibility, and appropriateness) (Fetters, 2019) (See Appendix C for the full interview guide). One additional question regarding barriers to TBI screening adoption was included based on the quantitative results which indicated low adoption of the OSU TBI-ID screening method across behavioral health settings (74.4% indicated they have not used the screening method at all) and to further elaborate on participant responses from a free-text item of the survey (e.g., “Please explain any of the barriers to using the OSU TBI-ID with your clients.”). This question was included to gain insight into contextual determinants to

TBI screening adoption that extend beyond individual-level characteristics and intervention-level factors.

Table 3.2

Example of Matched Quantitative and Qualitative Questions Situated by Theoretical Construct

Quantitative questions	Qualitative questions
1. Theory of Planned Behavior	
<i>Attitudes</i>	
3. Screening for TBI using the OSU TBI-ID fits with my practice preferences.	Regardless of whether or not you used the OSU TBI-ID in your work, what are your thoughts about screening for TBI using the OSU TBI-ID in your practice?
12. Using the OSU TBI-ID to screen for TBI will result in improved outcomes for my clients.	
<i>Subjective norms</i>	
1. Those whose opinions I value would prefer that I screen for TBI using the OSUTBI-ID with my clients.	What are the expectations in your practice setting or organization about implementing new interventions?
2. My colleagues think I should use the OSU TBI-ID to screen for TBI with my clients.	
<i>Perceived behavioral control</i>	
1. I am confident that I could screen for TBI using the OSU TBI-ID with new and/or established clients over the next month.	How easy or difficult was it to use the OSU TBI-ID to screen for TBI with your clients? Please explain.
5. I have access to the resources and opportunities I need to use the OSU TBI-ID.	
<i>Intentions</i>	
1. It is likely that I will use the OSU TBI-ID to screen for TBI in my practice with clients over the next month.	When you were first introduced to this TBI screening method, what were your plans to try to use this screening method with your clients to screen for TBI? Please explain.

Continued

2. Chances are that I will use the OSU TBI-ID in my practice with clients over the next month.

TBI screening behaviors

1. How many new clients did you screen for TBI using the OSU TBI-ID over the last month?
2. How many returning clients did you screen for TBI using the OSU TBI-ID over the last month?

[If participant *did not* screen for TBI]
What were some of the reasons why you did not use the OSU TBI-ID with your clients?

[If participant *did* screen for TBI]
What facilitated your use of the OSU TBI-ID in your work?

2. Diffusion of Innovations

Acceptability

1. Screening for TBI using the OSU TBI-ID meets my approval.
2. Screening for TBI using the OSU TBI-ID is appealing to me.

To what extent do you find the OSU TBI-ID to be acceptable to implement in your setting? Please explain.

Feasibility

1. The OSU TBI-ID seems fitting to my work
3. The OSU TBI-ID seems applicable to my work.

To what extent did you find this screening method feasible to implement?

Appropriateness

1. Screening for TBI using the OSU TBI-ID seems implementable.
 2. Screening for TBI using the OSU TBI-ID seems possible.
-

What is the extent to which you believe this screening method is appropriate to use with your clients? Please explain.

Qualitative Data Analysis

Interviews were transcribed verbatim immediately upon interview completion using a professional transcription service. Transcriptions were then cleaned and prepared for data analysis (Fetters, 2019). All interview data were managed and analyzed using NVivo 12.0 (QSR International Pty Ltd, 2020). Next, codes were generated deductively according to the five main constructs from the Theory of Planned Behavior and three main constructs from Diffusions of Innovations Theory (Nowell et al., 2017). The data were coded into these primary categories to allow for initial organization of the qualitative data and to frame the analysis according to the primary study purpose (Fetters, 2019). In addition, grouping the data according to the main constructs prepares the qualitative data to be mixed with the quantitative data during the mixed methods analysis stage (Fetters, 2019).

Next, two coders (P.I. and another doctoral-level student) independently familiarized themselves with the data by reading each transcript, taking notes, and creating additional codes within each main construct. Using an iterative process, the two coders met to discuss the initial set of codes and to discuss similarities and differences of each set of codes (Fetters, 2019). Coders then returned to the data to refine codes into main, overarching themes (Braun & Clarke, 2006; Nowell et al., 2017). Supportive quotes were selected to represent the essence of each theme and provide context to the themes (Nowell et al., 2017).

Next, because of the salience of the barriers discussed throughout interviews, these barriers were organized into primary categories using sensitizing concepts from the

Consolidated Framework for Implementation Research (CFIR) (Damschroder et al., 2009). This larger implementation framework was selected to 1) capture additional constructs not related to individuals or innovations, but that providers discussed as having a major, perceived impact on TBI screening adoption, and 2) to allow for additional implementation strategy selection that can be linked to these identified CFIR constructs. The two coders utilized the same approach as described above, but rather than generating overarching themes as was done in the thematic analysis of the data linked to the Theory of Planned Behavior and Diffusions of Innovations Theory, content analysis was used (Vaismoradi et al., 2013). Content analysis and thematic analysis use the same preparation, familiarizing, organizing, and code generation approach, but thematic analysis is used to identify overarching patterns in the data to create themes, and sometimes subthemes, representing the essence of the data, whereas content analysis is used to report on collective issues reported by participants during interviews (Braun & Clarke, 2006; Morse, 2008; Nowell et al., 2017; Vaismoradi et al., 2013). Therefore, barriers to TBI screening adoption were coded according to the main constructs under each of the five CFIR domains.

CFIR is a meta-theoretical framework that identifies and unites 37 unique constructs from 19 implementation science theories into one overarching framework (Damschroder et al., 2009). The barriers were organized and coded by these constructs situated within the five CFIR domains: 1) Intervention characteristics (complexity, design quality and packaging, trialability, adaptability, intervention source, evidence strength and quality, relative advantage, and cost); 2) Characteristics of the individual (knowledge

and beliefs about the intervention, self-efficacy, individual stage of change, individual identification with the organization, and other personal attributes); 3) Inner setting (structural characteristics, networks and communications, culture, implementation climate, learning climate, tension for change, compatibility, relative priority, organizational incentives and rewards, goals and feedback, readiness for implementation, leadership engagement, available resources, and access to knowledge and information); 4) Outer setting (patient needs and resources, cosmopolitanism, peer pressure, external policy and incentives); and 5) Process (planning, engaging, opinion leaders formally appointed internal implementation leaders, champions, change agents, executing, and reflecting and evaluating) (Damschroder et al., 2009). Together, these domains and constructs can help explain the barriers that inhibit adoption of TBI screening in behavioral healthcare settings as identified by participants in this study (Kirk et al., 2016).

Rigor. Co-coding, a detailed audit trail, and peer debriefing were used to ensure rigor and reproducibility of the results (Nowell et al., 2017).

Mixed Methods Data Integration and Analysis

In alignment with an explanatory sequential mixed methods study design, several points of data integration occurred (Fetters, 2019; Fetters et al., 2013; Onwuegbuzie & Johnson, 2006). First, *building* occurred during data collection in Phase II, where the results from Phase I were used to guide the selection of participants for recruitment for qualitative interviews (Fetters, 2019). Second, results from Phase I were *connected* to Phase II by using the quantitative results to develop the qualitative interview guide

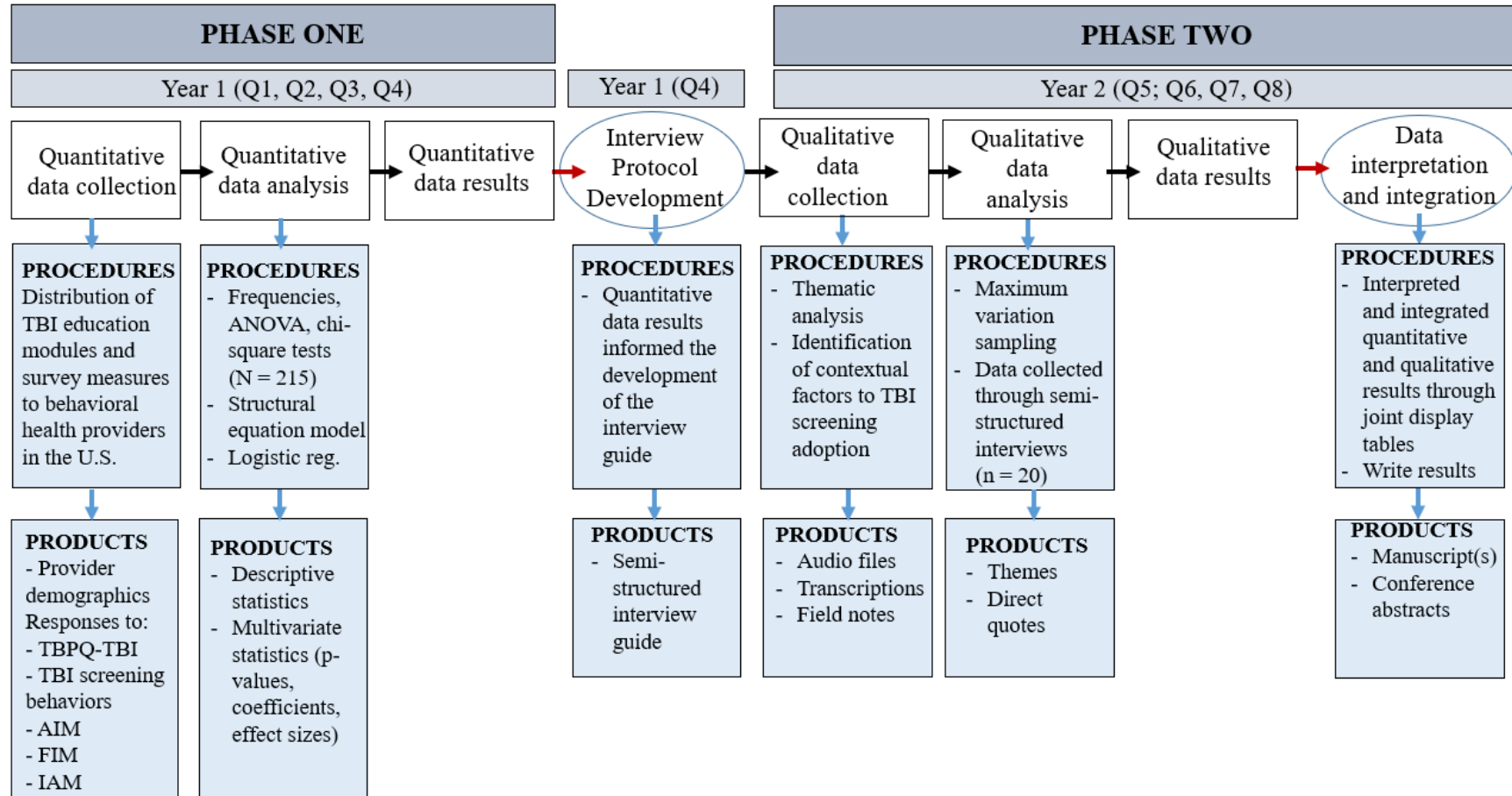
(Curry & Nunez-Smith, 2020). Third, results from the two Phases were *mixed* through meta-inferences, or insights, drawn from assessing the combination of both the quantitative and qualitative data together (Fetters, 2019). During the mixing stage, data were merged by examining both sets of data side-by-side to assess for confirmation, expansion, or discordance. Confirmation occurred when the quantitative and the qualitative results lead to the same conclusion and the data reinforced the other (Fetters, 2019). Expansion occurred when the quantitative and qualitative results had the same commonalities and conclusions, but additional, non-overlapping interpretations were made when qualitative data further explained the quantitative results (Fetters, 2019). Specifically, qualitative results sometimes expanded quantitative results by providing additional explanations to some of the constructs from the TBPQ-TBI surveys (Aim 1) and the acceptability, feasibility, and appropriateness measures (Aim 2). Discordance occurred when the quantitative and qualitative results did not match, leading to conflicting interpretations (Fetters, 2019).

Data integration also occurred at the reporting stage through *weaving*, where the quantitative results (Aims 1 and 2) and the qualitative results (Aim 3) are presented within the text side-by-side (Creswell & Plano Clark, 2018; Fetters, 2019; Fetters et al., 2013; Guetterman et al., 2015). Therefore, because Aim 3 was conducted to contextualize the quantitative results from Aim 1 and Aim 2, the qualitative results from Aim 3 are presented alongside these quantitative results within the text. Furthermore, joint displays were created for a visual depiction of the mixed results, presenting both quantitative and qualitative data together (Fetters, 2019; Fetters et al., 2013; Guetterman et al., 2015).

Specifically, the structural equation model diagram with odds ratios and p -values is presented alongside the main themes from the qualitative results that connect to the main constructs of the Theory of Planned Behavior, and meta-inferences are displayed to represent the mixed methods results (Aim 1 and Aim 3). Descriptive statistics (sum scores and standard deviations) are presented in a single table alongside the qualitative results that connect back to the constructs from Diffusion of Innovations Theory, and meta-inferences are displayed to represent the mixed methods results (Aim 2 and Aim 3). The odds ratios and p -values from the logistic regression models are presented in a separate table for clarity. The red arrows in Figure 3.2 represent points of data integration.

Figure 3.2.

Procedural diagram for the explanatory sequential mixed methods design



Chapter 4: Mixed Methods Results

Sample Characteristics of the Total Sample

Demographic characteristics for the entire sample and each subsample are provided in Table A in Appendix D. A total of $N = 215$ participants from 31 states participated in the surveys. The majority of participants were from Ohio (71.2%, $n = 153$), followed by Oregon ($n = 5$), North Carolina ($n = 5$), Washington ($n = 4$), Colorado ($n = 4$), and Michigan ($n = 4$). Most participants identified as female (85.5%), Caucasian or White (81.9%), and reported earning a masters or doctoral degree (78.3%). A significantly larger number of providers in Sample 3 reported being Caucasian or White compared with providers in Sample 4 (87.7% versus 68.1%, respectively); and more providers in Sample 4 reported being Hispanic or Latinx compared to providers in Sample 3 (8.5% versus 8%, respectively) ($p = 0.02$, $\Phi = 0.37$). Most respondents were licensed social workers ($N = 128$), followed by licensed counselors ($N = 43$), then licensed psychologists ($N = 6$). About one quarter of respondents reported being employed in private practice settings (26.5%, $N = 57$) or in community-based outpatient treatment clinics (25.6%, $N = 55$). Overall, participants were employed in their current organization for about seven years ($SD = 7.57$).

Sample Characteristics of Interview Participants

Of the 20 providers who participated in the qualitative interviews, the majority were female (90%), White (95%), and earned a masters or doctoral degree (85%). Most participants were employed in private practice settings (11/20; 55%), were licensed independent social workers or counselors with supervision distinction (50%), and reported being employed in their current place of work for an average of about four years

($SD = 4.09$). Characteristics of providers from the total sample and the qualitative interview sample are provided in Table 4.1.

Table 4.1

Characteristics of Participants in the Quantitative and Qualitative Phases

	Quantitative Phase: N = 215	Qualitative Phase: N = 20
	n (%)	n (%)
Age Group		
18 – 24	4 (1.9)	0
25 – 34	45 (21.2)	1 (5.0)
35 – 54	97 (45.8)	13 (65)
55 – 65	49 (23.1)	6 (30.0)
> 65	17 (8.0)	0
Gender		
Female	181 (85.4)	18 (90.0)
Male	30 (14.2)	2 (10.0)
Nonbinary	1 (0.5)	0
Race/Ethnicity		
Caucasian or White	176 (81.9)	19 (95.0)
African American or Black	16 (7.4)	1 (5.0)
Multi-Racial	11 (5.1)	0
Hispanic or Latinx	6 (2.8)	0
Asian or Pacific Islander	2 (0.9)	0
Other ^a	4 (1.8)	0
Highest Level of Education		
Masters or Doctorate	166 (78.3)	17 (85.0)
Associates or Bachelors	46 (21.7)	3 (15.0)
License Type		
LSW	58 (27.0)	3 (15.0)
LISW-S	47 (21.9)	5 (25.0)
LPC	24 (11.2)	4 (20.0)
LISW or LCSW	23 (10.7)	1 (5.0)
LICDC	22 (10.2)	3 (15.0)
LPCC or LPCC-S	20 (9.3)	5 (25.0)
LCDC-II or LCDC-III	16 (7.4)	2 (10.0)
CDCA	12 (5.6)	0
LP	6 (2.8)	0

Continued

LACDC	4 (1.9)	1 (5.0)
Other	22 (10.2) ^b	1 (5.0) ^c
Behavioral Health Setting		
Private practice	57 (26.5)	11 (55.0)
Community-based outpatient treatment clinic	55 (25.6)	3 (15.0)
Hospital-based outpatient services	26 (12.1)	2 (10.0)
Prison/jail	12 (5.6)	2 (10.0)
School-based behavioral health	11 (5.1)	0
Hospital-based inpatient services	9 (4.2)	0
Child welfare agency	9 (4.2)	0
Residential treatment facility	8 (3.7)	0
Senior services	5 (2.3)	1 (5.0)
Managed care organization	4 (1.9)	0
Developmental disability services	4 (1.9)	0
Public health agency	3 (1.4)	0
Domestic violence agency	2 (0.9)	1 (5.0)
Other ^d	10 (4.7)	0
Years worked as a behavioral health provider (M, SD)	14.13 (10.20)	9.88 (6.23)
Years worked at the current organization (M, SD)	7.09 (7.57)	3.72 (4.09)
^a Other Race = chose not to disclose or preferred not to answer.		
^b Other licenses included Licensed Marriage and Family Therapist, Licensed Independent Marriage and Family Therapist, Licensed Alcohol and Drug Counselor, Certified Addiction Counselor-III, National Certified Addiction Counselor-II, Substance Use Disorder Professional, Certified Independent Professional, Certified Addiction Specialist, Credentialed Alcoholism and Substance Abuse Counselor, Person-Centered Case Manager, Licensed Mental Health Counselor, Licensed Clinical Addiction Specialist, Licensed Addiction Specialist, Certified Brain Injury Specialist, Master Addiction Counselor, Licensed School Counselor, Registered Nurse, Certified Community Health Worker		
^c Other license was Substance Use Disorder Professional		
^d Other settings included primary care, military-based treatment setting, homeless shelter, community outreach and crisis center, affordable housing agency, employee assistance program, domestic violence shelter, local government authority, university academic medical institute, and professional ice hockey organization.		

Mixed Methods Results: Theory of Planned Behavior

Aim 1: Examine the relationships between behavioral health providers' attitudes, perceived behavioral control, and subjective norms as predictors to TBI screening intentions and examine whether intentions to adopt TBI screening mediate actual TBI screening behaviors at a one-month follow-up.

Hypothesis 1: Providers who have more favorable attitudes, greater perceived behavioral control, and greater perceived social pressure within the organization to screen for TBI will demonstrate higher TBI screening adoption at the one-month follow-up.

Aim 3: Assess the contextual determinants to TBI screening adoption through qualitative interviews with providers.

The following section presents the results from the structural equation model and the qualitative interviews weaved together in the text on a construct-by-construct basis aligned with the Theory of Planned Behavior (Fetters, 2019). Figure 4.1 presents the unstandardized model results for the final structural equation model, along with the main themes and subthemes from the qualitative results, and meta-inferences. Table 4.3 is a joint display of the main themes and subthemes, with additional direct quotes from participants. These quotes are presented alongside the mean scores and standard deviations from the TBPQ-TBI subscales, and the themes and subthemes from the qualitative results, on a construct-by-construct basis. For each quote, the type of behavioral health license, the providers' self-reported title at their place of employment, and behavioral health setting are included in parentheses for additional context.

Structural Model

First, the full unadjusted hypothesized structural model was tested. The model fit was excellent based on the predetermined fit statistics ($\chi^2 = 345.84$, $p < .001$; RMSEA = 0.099, 90% CI = 0.087 – 1.110; CFI = 0.98; TLI = 0.98; SRMR = 0.043). However, the

substantive path from perceived behavioral control leading to intentions was not statistically significant in the unstandardized ($p = 0.09$) or standardized estimates ($p = 0.09$). Next, to control for sample differences, Sample 1 was added as a covariate, where 1 = yes (Sample 1) and 0 = no (all other Samples). This second model yielded slightly better fit ($\chi^2 = 344.29$, $p < .001$; RMSEA = 0.091, 90% CI = 0.080 – 0.102; CFI = 0.98; TLI = 0.98; SRMR = 0.044). However, in this model, neither the paths leading from perceived behavioral control nor attitudes on intentions were significant in the unstandardized estimates or in the standardized estimates ($p = 0.14$ and $p = 0.27$, respectively). In cases where substantive paths are not statistically significant, not every path needs to be removed when it is theoretically justifiable (Bowen & Guo, 2011). Decisions to remove substantive paths from the model is left to the researcher to decide how to proceed so long as they are justifiable based on theory, however, alternative models should always be tested to determine the best model fit (Bowen & Guo, 2011).

Therefore, an alternative third model was tested with both attitudes and perceived behavioral control removed due to insignificance. However, this yielded poor fit statistics on at least one fit indicator (SRMR = 0.22), and norms was not significant on its own ($p = .93$). An alternative fourth model was tested with perceived behavioral control on its own (with attitudes and norms removed). Model fit was excellent ($\chi^2 = 346.48$, $p < .001$; RMSEA = 0.090, 90% CI = 0.079 – 0.102; CFI = 0.98; TLI = 0.98; SRMR = 0.045). Perceived behavioral control on its own was significant in the unstandardized and standardized estimates ($p < .001$). This model was compared to a fifth model with attitudes and norms included, but perceived behavioral control excluded. This model also

yielded excellent fit ($\chi^2 = 346.13$, $p < .001$; RMSEA = 0.091, 90% CI = 0.079 – 0.102; CFI = 0.98; TLI = 0.98; SRMR = 0.044). Attitudes and norms were both significant in the unstandardized ($p < .001$ and $p = .029$, respectively) and standardized estimates ($p < .001$ and $p = 0.014$, respectively).

Competing models should always be tested, and fit statistics should be used to determine the model with best fit (Bowen & Guo, 2011). When models are comparable, as is the case with these models (Model 4: perceived behavioral control only; Model 5: attitudes and norms only), the standardized residual should be assessed (Bowen & Guo, 2011). The SRMR was slightly better in Model 5 (SRMR = 0.044) compared with Model 4 (SRMR = 0.045), but still similar.

In this case, perceived behavioral control was chosen to be removed from the model because the standardized path estimate was also not significant in the previously tested unadjusted model. Despite differences between the four samples on some of the main constructs (see Table B, Appendix E), there is not a strong theoretical reason to justify why these differences exist. The type of education that the Samples engaged in is not enough to justify differences between samples and the main hypotheses do not rest on the type of education the participants received. Therefore, because of the lack of confidence in any true differences between samples, and to ensure greater confidence in selecting one of the two competing models, a sixth model was tested with private practice settings and level of provider education as the covariates because these were the only two variables that demonstrated statistically significant differences between samples on TBI screening behaviors (see Table 4.2). The model yielded excellent model fit ($\chi^2 = 371.68$,

$p < 0.01$; CFI = 0.98; TLI = 0.98; SRMR = 0.043; RMSEA = 0.09; 90% CI = 0.08 – 0.10), however, perceived behavioral control was again not significant in both the unstandardized and standardized estimates ($p = .14$ and $p = .14$).

Therefore, based on this path being insignificant in both adjusted and unadjusted models, the path leading from perceived behavioral control on intentions was removed, and attitudes and norms were retained. Sample 1 was selected as the only covariate to be used for the final model. The final model yielded excellent model fit according to the predetermined fit statistics ($\chi^2 = 346.13$, $p < 0.01$; CFI = 0.98; TLI = 0.98; SRMR = 0.04; RMSEA = 0.09; 90% CI = 0.08 – 0.10), and all remaining paths were statistically significant.

Attitudes

Results from the TBPQ-TBI subscale demonstrated favorable attitudes toward screening for TBI using the OSU TBI-ID ($M = 5.57$, $SD = 0.92$). (Table B, Appendix E). In the structural equation model, intentions to screen for TBI using the OSU TBI-ID fully mediated the relationship between attitudes and TBI screening behaviors. Specifically, providers who reported higher average scores on the attitude subscale demonstrated increased odds of screening for TBI at the Time 2 assessment (OR = 0.65, S.E. = 0.09, $p < .001$).

This finding was confirmed by the qualitative interviews, where interview participants reported favorable opinions toward and beliefs about the usefulness of the OSU TBI-ID. Specifically, providers reported that screening for TBI using this method would help them to differentiate mental health or substance use disorders from a TBI by

gaining additional insight into the client's clinical presentation and problems presented during the assessment. Providers reported that knowing that a client has a history of TBI could offer greater insight into differential diagnoses or possible sources of post-traumatic stress disorder (PTSD), attention-deficit hyperactivity disorder (ADHD), or identify changes to mood potentially due to the TBI. A provider explained, *"With trauma and with ADHD, processing can be affected by brain injury. So, knowing that may be a cause or part of what's going on as far as mental health diagnoses would be beneficial"* (Licensed Professional Counselor, Therapist, community-based outpatient treatment setting). This provider continued, *"Of course looking at the prefrontal cortex [and] things like that, when it comes to ADHD, we know that traumatic brain injury in that area can cause the same kind of symptomatology. So, it might mimic another diagnosis, so that's really powerful."*

Another provider explained:

"You're able to discern or differentiate between somebody's psychiatric issues. Somebody's relapse warning. I mean it adds a whole other layer, somebody's overall whole, the whole person approach and its primary factor on substance use issues. We're talking about mental health issues and substance use disorders. Traumatic brain injuries [are] another primary medical concern that is of significance when trying to treat somebody" (Licensed Professional Clinical Counselor, Director of Outpatient Services, community-based treatment setting).

Providers also explained that because of the utility of this screening method to differentiate possible symptoms of TBI from mental health or substance use disorders, that their intervention decisions could be better directed. They described that their treatment plans and/or referrals could be better tailored to their individual client.

Subjective Norms

The mean TBPQ-TBI subscale score for subjective norms was 2.99 out of 6 ($SD = 0.92$) (Table B, Appendix E). In the structural equation model, intentions to screen for TBI using the OSU TBI-ID fully mediated the relationship subjective norms and TBI screening behaviors. Specifically, providers who reported higher subjective norms demonstrated increased odds of screening for TBI ($OR = 0.12$, $S.E. = 0.06$, $p < .01$).

These quantitative results were discordant with the qualitative interviews, where the main theme was an overall lack of internal and/or external pressures to adopt TBI screening; however, this was highly context dependent. In private practice settings, providers discussed that pressures do not exist from any entity to adopt new screening methods because it is up to the individual provider to choose what interventions to adopt.

A provider explained:

“I mean, I definitely don't [screen for TBI] because I'm an independent contractor and yeah, definitely I guess it would be up to my own judgement... I mean, I'm in a private practice setting, so there would be other clinicians, but we all operate independently. So, it's a matter of like ... everyone does their own assessments in their own practice.” (Licensed Independent Social Worker, Therapist, private practice setting)

In group-based practice settings, however, the lack of pressures to adopt TBI screening were due to lack of awareness from colleagues about TBI and lack of pressures from colleagues to adopt this specific screening method. More specifically, providers reported that if other colleagues were also using the OSU TBI-ID, that they might be more willing to adopt the TBI screening method. A provider explained:

“If more of my colleagues were on board with it, to promote it in terms of it being useful to them as well, especially outside of integrated behavioral health...I wonder if the other providers would see the importance of it. Because, if you're in

this field already of integrated behavioral health, you can see that it would be worth happening. But if you're not inside this field they may raise questions; they want to know why do you want it or why do you need it.” (Licensed Chemical Dependency Counselor-II, Addiction Counselor, community-based outpatient treatment setting).

Also in group-based behavioral health settings, subjective norms were affected by the lack of leadership engagement needed to nudge providers to adopt TBI screening, as well as the lack of organizational-level and state-level mandates that would require TBI screening to be adopted. A provider explained:

“Where I see an issue and I think this is an issue with any type of change or any type of new program that comes in is that it's not mandated. Staff has a really hard time incorporating something that is outside of what their mandate is for ... I think the tool itself and the training method to do it, I mean, I think it was very clear. And the stuff that I went through to learn how to use it, I think it would be very easy for our staff who are all professionals. We have social workers and nurses, and I think it would be very easy for them to learn it. It's just, what their willingness would be, and what the pushback would be on incorporating it....Anything that comes down as ‘we must do this’ is based on a funder ... the norm is they grumble about it a little bit, and really ask questions about how the time [to incorporate the screening method] is going impact them, how long is this change going to happen, that kind of stuff” (Licensed Independent Social Worker with Supervision Distinction, Assessment Supervisor, senior services setting)

Although many participants explained that they have taken steps to discuss with their organization’s leader about this screening method, they reported that these leaders have not yet made any steps to increase widespread adoption, such as through offering training or continued education opportunities on TBI for providers employed within the organization.

Perceived Behavioral Control

The mean score on the perceived behavioral control subscale was 4.42 out of 6 ($SD = 1.17$) (Table B, Appendix E.) In the final structural model, neither the direct path

from perceived behavioral control on TBI screening behaviors, nor the indirect path through intentions on behaviors were found to be significant. Hence, this path was not included in the final model.

Interview participants, however, expanded on the mean subscale score for perceived behavioral control by explaining that once they had a chance to practice implementing the TBI screening, that their confidence also increased. However, the main theme demonstrated throughout interviews was that providers described the desire to obtain additional training, education, and direct observation to enhance their skills and confidence needed to adopt the TBI screening method. A participant explained, *“I think I would need a lot more training, and hands on learning observation, and supervision to learn and implement the system before I feel comfortable jumping in on mine. I don't feel that I'm sufficiently trained at this time to do it on my own”* (Licensed Social Worker Therapist, community-based outpatient treatment setting).

Interview participants discussed that although learning the screening method itself was relatively simple, more education on how TBI relates to behavioral health, as well as what to do following a positive TBI screen are necessary before they feel comfortable enough to adopt TBI screening. These qualitative results help to explain why perceived behavioral control may not have had a direct or indirect effect on TBI screening adoption in the structural model.

Intention

The mean score on the intention subscale of the TBPQ-TBI was 3.34 ($SD = 1.51$) (Table B, Appendix E.) In the structural equation model, providers who reported greater

intentions to screen for TBI had greater odds of adopting the OSU TBI-ID screening method ($OR = 0.30$, $S.E. = 0.10$, $p < .001$). Attitudes and subjective norms accounted for 54% of the variance in intentions ($R^2 = .54$).

Qualitative interview results expanded upon these quantitative results. Specifically, intentions to screen for TBI were based on intrinsic and client-driven motivations. Regarding intrinsic motivations, some interview participants reported simply wanting to practice conducting the intervention. These participants explained that they were curious about how this method worked in practice with clients, which drove their motivation to conduct the screening. Other participants explained that they had experienced a TBI themselves, which drove their intentions to use this screening method to identify TBI among clients.

Interview participants also explained that a primary motivation to conduct TBI screening stemmed from wanting to make more informed referrals or treatment plans, or to better understand a client with complex symptoms. A participant explained, *“For me, it was trying to better inform my treatments of them. And so, in some ways I felt curious or maybe start where I can understand why a client was struggling with a certain area”* (Licensed Professional Counselor, Director, private practice).

TBI Screening Adoption

Overall, approximately one-quarter of the sample (55/215) reported having screened for TBI during the one-month period between Time 1 and Time 2 (Range: 1 – 40, $M = 4.49$, $Mdn = 2.0$, $SD = 6.27$). See Table 4.2. Significant differences in TBI screening behaviors were observed between providers with a masters or doctoral degree

compared to providers with an associates or bachelors degree. Specifically, providers with masters or doctoral degrees were more likely to adopt TBI screening (89.1% versus 10.9%, respectively, $p = 0.02$), however, the effect size for these differences was small ($\Phi = 0.16$). In addition, significant differences were observed between private practice settings compared to other behavioral health settings on TBI screening adoption. Specifically, providers employed in private practices reported being significantly more likely to adopt TBI screening compared with providers employed in non-private practice settings, and the effect size was moderate ($p < 0.01$; $\Phi = 0.33$). In the structural equation model, intentions accounted for 17% of the variance in TBI screening behaviors ($R^2 = 0.17$).

Table 4.2

Differences Between Demographic Characteristics on TBI Screening Behaviors

	Screened N (%)	Did Not Screen N (%)	p -value ^a	Effect size
Total	55 (25.6)	160 (74.4)		
Dataset			0.05	0.04 ^b
OSU CE	25 (45.5)	105 (65.6)		
NADAAC	17 (30.9)	30 (18.8)		
BH Broad	9 (16.4)	14 (8.8)		
OH2019	4 (7.3)	11 (6.9)		
Age Group			0.99	0.00 ^b
18 – 24	1 (1.8)	3 (1.9)		
25 – 34	11 (20.0)	43 (26.9)		
35 – 54	25 (45.5)	72 (45.0)		
55 – 65	12 (21.8)	37 (23.2)		
> 65	5 (9.1)	12 (7.5)		
Gender			0.81	0.00 ^b
Female	47 (85.5)	134 (84.5)		
Male	7 (12.7)	23 (14.4)		
Nonbinary	0 (0.0)	1 (0.1)		
Race/Ethnicity			0.92	0.01 ^b

Caucasian or White	44 (80.0)	132 (82.5)		
African American or Black	5 (9.1)	11 (6.9)		
Multi-Racial	2 (3.6)	9 (5.6)		
Hispanic or Latinx	2 (3.6)	4 (2.5)		
Asian or Pacific Islander	1 (1.8)	1 (0.1)		
Other	1 (1.8)	3 (0.02)		
Highest Level of Education			0.02*	.16 ^b
Masters or Doctorate	49 (89.1)**	117 (73.1)**		
Associates or Bachelors	6 (10.9)**	40 (25.0)**		
Behavioral Health Setting			0.03*	0.33 ^b
Private practice	23 (41.8)**	34 (21.3)**		
Community-based outpatient treatment clinic	13 (23.6)	42 (26.3)		
Hospital-based outpatient services	9 (16.4)	16 (10.0)		
Residential treatment facility	4 (7.3)	4 (2.5)		
Prison/jail	2 (3.6)	10 (6.3)		
School-based behavioral health	1 (1.8)	10 (6.3)		
Senior services	1 (1.8)	4 (2.5)		
Hospital-based inpatient services	0 (0.0)	9 (5.6)		
Managed Care Organization	0 (0.0)	4 (2.5)		
Public Health Agency	0 (0.0)	3 (1.9)		
Child Welfare Agency	0 (0.0)	9 (5.6)		
Other ^d	2 (3.6)	11 (6.9)		
Years worked as a behavioral health provider (M, SD)	14.2 (10.4)	13.9 (9.6)	0.85	0.03 ^b
Years worked at the current organization (M, SD)	5.67 (6.3)	7.6 (7.9)	0.11	0.25 ^b

^a. Based on chi-square, One-way ANOVA, or independent samples t-test.
^b. Small effect. Note: Effect sizes are based on eta-squared, Phi, or Cohen's D and interpreted using standard cut-offs for the respective statistical test.
* Significant at the $p < .05$ level
** Post-hoc analyses demonstrated significant differences at the $p < .05$ level

Continued

^d. Other organizations include primary care, military-based treatment setting, homeless shelter, community outreach and crisis center, affordable housing agency, employee assistance program, domestic violence shelter, local government authority, university academic medical institute, and professional ice hockey organization. In this group, only one provider from a domestic violence agency and one provider from the professional ice hockey organization screened for TBI.

Providers who participated in the qualitative interviews expanded on the primary reason why they chose to adopt this screening method, which was trialability.

Specifically, providers who adopted the OSU TBI-ID chose to do so to assess for intervention fit within their current assessments. Providers discussed wanting to trial the intervention to see how it could be incorporated into their biopsychosocial assessment. A provider explained:

“Well, I mean, because I had done the training and I was like, I really wanted to see how successful I could make it in the assessment process and so it was really just kind of a trial for me, and I don't normally do assessments, like I supervise people who did their assessment, so I don't normally act myself. So I had to kind of like, I took this client, I'm gonna do this assessment, and this time I'm gonna incorporate it. So it was really a trial to see how easy it would be to incorporate it in, that's why I did that.” (Licensed Independent Social Worker with Supervision Distinction, Assessment Supervisor, senior services)

Providers who adopted the screening method also explained that because they suspected TBI among their clients, they wanted to trial the intervention to confirm their beliefs about the presence of lifetime history of TBI. One provider discussed the importance of using the screening intervention in her work with survivors of domestic violence:

I work for [a domestic violence shelter], and for me personally I think that it's very important. I actually approached my clinical director with this screening tool and the education part of things because our statistics do show, and from just the evidence of working with our clients, that 83% of our individuals that have experienced intimate partner violence do have at least one TBI. A lot of them are going unaddressed. It's very important, and for me that's extremely important as the crisis clinician here to be able to know whether that's something that we might

be working with them. So just in case there is something that we need to refer for some neurological things. Also, as far as what it looks like to me, I customize my interventions and things of that nature to them.” (Licensed Social Worker, Crisis Counselor, Domestic Violence Shelter)

Figure 4.1.

Joint Display Connecting the Structural Equation Model Results to the Qualitative Themes with Meta-inferences

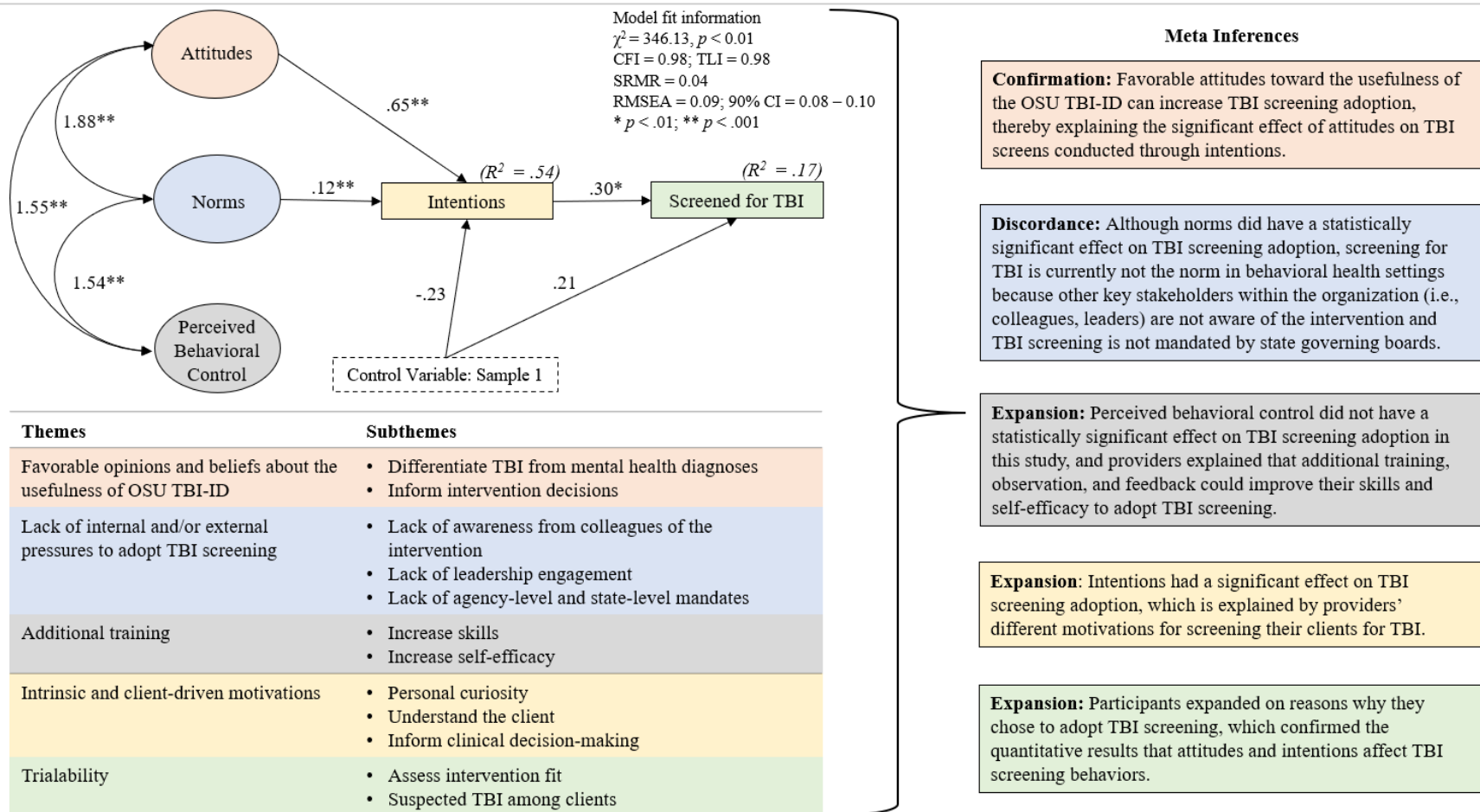


Table 4.3.

Joint Display of the Quantitative and Qualitative Results Connected to Constructs from the Theory of Planned Behavior (Aims 1 and 3)

TBP Constructs	Themes	Subthemes	Sample Quotes
TBPQ-TBI Means and standard deviations			
Attitudes 5.57 (0.92)	Favorable opinions and beliefs about the usefulness of OSU TBI-ID	<ul style="list-style-type: none"> - Differentiate TBI from mental health diagnoses - Inform intervention decisions 	<p><i>"I'm very positive about it. I certainly see the usefulness and it's great to be able to have guidelines to follow because I really do think that TBI is underreported and a huge part of some of the stuff that we could be doing better like identifying things like that. So having an actual screening tool is really helpful and kinda takes the guesswork out."</i> (Licensed Independent Social Worker with Supervision Distinction, Mitigation Specialist, prison setting)</p> <p><i>"I think it would be beneficial to give us more information and maybe help guide some of the diagnoses or assessments with clients. So, I definitely think it would be useful."</i> (Licensed Professional Counselor, Therapist, community-based outpatient treatment setting)</p>
Subjective Norms 2.99 (0.92)	Lack of internal and/or external pressures to adopt TBI screening	<ul style="list-style-type: none"> - Lack of awareness from colleagues of the intervention - Lack of leadership engagement - Lack of agency-level and state-level mandates 	<p><i>"I mean those [colleagues] who are [screening for TBI], I can think of one in my office who is aware of the effects of TBI. She does [screen for TBI], she is likely asking those questions. I don't know that anybody else is."</i> (Licensed Professional Counselor, Therapist, community-based outpatient treatment setting)</p>

Continued

Perceived Behavioural Control 4.42 (1.17)	Additional training needed to enhance skills and confidence	-	<p><i>“I mean, to me it sounds like a very valuable service and everything, that in terms of the likelihood of it being incorporated and utilized, that would be an upper management decision and call. I feel that it would be very beneficial, but I don't have any input or access to voice my opinion and so I don't know what actually aids the implementation of the program.”</i> (Licensed Social Worker, Therapist, community-based outpatient treatment setting)</p> <p><i>“I don't think there are any expectations other than what I present to my leadership as this should be an expectation. So, I don't really have any standards to abide by, I kind of make it up as I go along. But I do believe that they would trust me enough to know that they should look into this ... I know that they would be back.”</i> (Licensed Independent Social Worker with Supervision Distinction, Mitigation Specialist, prison setting)</p> <p><i>“This does take some finesse, I think. When you're asking some of these questions, it takes some finesse as you're doing it. So there's kind of a learning curve to it. I think that the video screening did really well. It's showing some kind of ways to interact with folks to get the information that you want. And my assessors are skilled in assessment in general, like know how to probe and know how to ask questions in a way that they can get [client] information....”</i></p>
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Intentions 3.34 (1.51)	Intrinsic and client-driven motivations	<ul style="list-style-type: none"> - Personal curiosity - Understand the client - Inform clinical decision-making 	<p><i>“I kind of come from a place of curiosity and wanting to help versus here's another screening you have to do, this is just part of our intake, just fill it out, there's a reason, there's a purpose for it... It's just I want to make sure that I'm treating them in the best way possible with the most tools that are gonna be the most effective for them. And if they've had a traumatic brain injury, that really is hampering their quality of life. I am not qualified to treat that, I am qualified to refer and really encourage them to get that additional assessment and potentially treatment.”</i> (Licensed Professional Counselor, Director, private practice)</p> <p><i>“It does give me a lot of guidance on if I need to ask, what I liked about it is that it gives me further guidance on what kind of questions I need to ask, where we're gonna look for referrals in order to get the client what they need.”</i> (Licensed Social Worker, Crisis Counselor, Domestic Violence Shelter)</p> <p><i>“I'm a big believer in just finding new information, new tools, new information for treatment, for groups or just more knowledge. I think that's really important that you have to train yourself.”</i> (Licensed Professional Counselor, Substance Use Disorder Professional, community-based outpatient treatment setting)</p>
TBI Screening Adoption 25.6% of the total sample	Trialability	<ul style="list-style-type: none"> - To assess intervention fit - Suspected TBI among clients 	<p><i>“I just I ran through it and then I actually end up having a program participant in my chair and so I've got to ask him the questions. He doesn't have a TBI. He has no history of that at all. But I was just kinda like, I don't want to practice, but it was just I had just gotten the thing and I was like, ‘Let's see how this works’. And so, you know, I sat down</i></p>

Continued

with him and pretended.” (Licensed Professional Chemical Dependency Counselor-II, Correctional Program Coordinator, prison setting)

“One of them is a death penalty client, and so I really wanted to cover all the mitigation bases because I feel like that it's life or death, right? Might as well do everything I certainly have available to me to either look into things or rule out things. And the other guy I'd been lost. I'd been absolutely lost on where to go with him ... to help me understand how I can best help him even in my mitigation, like okay, you're 30 years old and then you snapped. Well, that could have a lot to do with your mental health, but are there other things going on?” (Licensed Independent Social Worker with Supervision Distinction, Mitigation Specialist, prison setting)

Mixed Methods Results: Diffusions of Innovations Theory

Aim 2: Investigate whether the acceptability, feasibility, and appropriateness of TBI screening using the OSU TBI-ID moderates the relationship between TBI screening intentions and actual TBI screening behaviors.

Hypothesis 2: Greater perceived acceptability, feasibility, and appropriateness of TBI screening using the OSU TBI-ID will strengthen the relationship between TBI screening intent and actual TBI screening behaviors.

Aim 3: Assess the contextual determinants to TBI screening adoption through qualitative interviews with providers.

The following section presents the sum scores and standard deviations from the Acceptability of the Intervention Measure (AIM), Feasibility of the Intervention Measure (FIM), and Intervention Appropriateness Measure (IAM), the results from the logistic regression models, and the qualitative interviews weaved together in the text on a construct-by-construct basis corresponding to Diffusion of Innovations Theory (Fetters, 2019). Table 4.4 presents the quantitative model results from the logistic regressions including the unadjusted and adjusted odds ratios, 95% confidence intervals and *p*-values. Table 4.5 is a joint display presenting the sum scores and standard deviations from the AIM, FIM, and IAM measures, alongside the themes from the qualitative interview results, and mixed methods meta-inferences (Fetters, 2019; Guetterman et al., 2015; Moseholm et al., 2017). See Table C, Appendix F for descriptive statistics from the AIM, FIM, and IAM for each sub-sample.

Acceptability

The main hypothesis that the acceptability of screening for TBI would moderate the relationship between intentions and actual TBI screening behaviors was not supported in the unadjusted or adjusted logistic regression models. In other words, no interaction effects were found between provider intentions to screen for TBI and their perceptions

about the acceptability using the OSU TBI-ID to screen for TBI ($OR = 0.92$, 95% CI = $0.80 - 1.05$, $p = .19$). See Table 4.4. When the adjusted model was tested without interaction effects, providers who reported higher acceptability of the OSU TBI-ID demonstrated greater odds of adopting TBI screening, however, this was finding also was not significant ($OR = 1.04$, 95% CI = $0.86 - 1.25$, $p = .71$). Although the main hypothesis was not supported, participants rated their perceptions of the acceptability of the OSU TBI-ID as relatively high, where the overall average score on the AIM was 16.50 out of 20 ($SD = 2.50$, $Mdn = 16.00$, Range = 9 – 20).

The qualitative interview results expanded upon the high average score on the AIM. Overall, participants reported that using the OSU TBI-ID to screen for TBI would be highly acceptable to adopt in their current behavioral health settings. Specifically, providers discussed that the OSU TBI-ID would be a welcomed tool to guide clinical decision-making because it provides clinicians a more complete understanding of the client and could help to differentiate diagnoses. A provider explained, *“That actually gives me a really good full picture of what the client might be experiencing mental health, and things like that, if it's part of the TBI. And that gives me a really good idea of what I can recommend for resources, long term counseling, and things like that. But it also gives me, really good picture of what I can pull to try to educate them on what might be going on with them”* (Licensed Social Worker, Crisis Counselor, domestic violence shelter).

In addition, providers described that the OSU TBI-ID would be an acceptable screening method that could be added to their current clinical assessment because of their experiences with adopting other screeners and diagnostic assessments. Specifically, they explained that adding screeners to assess clients for various conditions is common

practice. Providers discussed that adding the OSU TBI-ID would be welcomed, although it would add time onto their already lengthy assessment. A provider explained, *“I mean it's just like any other assessment that I might pass along, in our screening for level of anxiety or level of depression or ACEs (Adverse Childhood Experiences), past trauma and things like that. People are grateful to be screened for a variety of things and I think they may feel very protected if something like this was used, that I'm trying to look at the whole person”* (Licensed Professional Clinical Counselor/Owner, private practice).

Feasibility

The main hypothesis that feasibility of screening for TBI would moderate the relationship between intentions and actual TBI screening behaviors was not supported in the unadjusted or adjusted logistic regression models. See Table 4.4. Specifically, there was no interaction between provider intentions to screen for TBI and their perceptions of the feasibility using of the OSU TBI-ID on TBI screening adoption ($OR = 1.07$, 95% CI = 0.93 – 1.23, $p = .36$). When the adjusted model was tested without interaction effects, providers who reported greater perceptions of the feasibility of using the OSU TBI-ID demonstrated greater odds of TBI screening adoption, however, this was effect not significant ($OR = 1.07$, 95% CI = 0.88 - 1.30, $p = .48$). Although no interaction effects were observed between intent and feasibility, the average score on the FIM subscale was relatively high, at 16.07 ($SD = 2.48$, $Mdn = 16.00$, Range = 10 – 20).

The qualitative results confirmed the FIM sum score, where interview participants reported high feasibility in adopting the OSU TBI-ID in behavioral health practice settings. Specifically, providers reported that the screening method was feasible to adopt due to the relative simplicity of the method and minimal learning curve needed to

understand how to conduct this screening method. Notably, the step-by-step layout and straightforwardness of this intervention contributed to their perceptions of feasibility.

One provider commented on the intuitiveness of the screening method: *“I haven't had a problem implementing it. I think it's pretty intuitive, it's pretty easy. It's easy for me”*

(Licensed Professional Counselor, Director, private practice). Another provider stated, *“I liked the way it was streamlined and straightforward with the questions. Very user friendly as far as the steps and everything. It was really self-explanatory, the simplicity of it”* (Licensed Social Worker, Crisis Counselor, domestic violence shelter).

In addition, interview participants reported that integrating this intervention into current workflows would be a relatively easy process, as long as leadership or higher-level decision-makers approved. A provider expanded, *“I think it would definitely be doable. I don't think it would be a difficult thing to implement given the right backing... Just by talking to the clinical director about it, rather than just me [deciding]”* (Licensed Independent Social Worker with Supervision Distinction, Therapist, private practice).

Providers also discussed how easily this screening method could be incorporated into their current workflows due to the short length and minimal amount of time needed to implement it. One provider explained:

“I don't see why it wouldn't fit in ... like once you get familiar with it, it's five minutes. You can take five minutes and figure out if there's going to be more of a need for different services just by the screening. It's five minutes, it's not a long screen. It should be quick and then you're like, ‘okay, well, maybe this needs some extra attention. Or maybe we need to look at this,’ as opposed to just passing them along.” (Licensed Professional Chemical Dependency Counselor-II, Correctional Program Coordinator, prison setting)

When discussing where this screening method would fit into current workflows, providers explained that this would most likely fit within the trauma section of the biopsychosocial

assessments. A provider reported, *“The violence trauma piece, in my opinion is probably right about this area. And I don't know if it needs to be at the beginning of the assessment or at the end or just situational. I have to trust my skills to understand if it's five minutes to go in my session I'm not gonna just open the violence trauma piece”* (Licensed Professional Clinical Counselor, Outpatient Therapist, community-based outpatient treatment and private practice settings).

Appropriateness

The main hypothesis that the perceived appropriateness of screening for TBI would moderate the relationship between intentions and actual TBI screening behaviors was not supported in the unadjusted or adjusted logistic regression models. See Table 4.4. Specifically, there was no interaction between provider intentions to screen for TBI and the perceived appropriateness of the OSU TBI-ID on TBI screening adoption ($OR = 0.97$, $95\% CI = 0.87 - 1.09$, $p = .65$). When the adjusted model was tested without interaction effects, providers who reported higher perceptions of the appropriateness of the OSU TBI-ID demonstrated greater odds of TBI screening adoption, however, this was not significant ($OR = 1.09$, $95\% CI = 0.94 - 1.28$, $p = .26$). In the descriptive analyses, the sum score on the IAM subscale was 14.78 out of 20 ($SD = 3.56$, $Mdn = 16.00$, $Range = 4 - 20$).

The qualitative results expanded upon the sum score for the appropriateness subscale. Specifically, overall, the interview participants explained that they believed screening for TBI was appropriate for their clients due to the amount of violence and trauma most of their clients have experienced, which would likely result in TBI. Providers explained that many of their clients are survivors of domestic violence or have

survived childhood physical abuse, are perpetrators of physical abuse, or are combat veterans and therefore they have likely experienced a TBI. These interview participants stressed that screening for TBI would therefore be highly appropriate to their client-base and an appropriate tool to use when deciding what next steps to take for their care. One provider explained:

“I think it is very appropriate because a lot of my clients and probably a lot of my peers and colleagues don't necessarily know what counts as contributing to a possible TBI. So like for domestic violence survivors, they don't even think of that. It's like a possible scenario that would contribute to TBI ... Like there's a lot of domestic violence in my clients' backgrounds and that could be victimization, that could be perpetration, that could be both, right? And so I think that domestic violence is like a very under reported area when it comes to TBI or even under asked or even under anything, but also the kids that I work with. There's a lot of aggravated robberies and aggravated robbery can include carjackings, and there's loud car crashes. I have one kid over at the jail right now doing some back flipping and hitting his head, like just kind of like the risk taking that some of the teenagers do. Like he's been to the hospital numerous times, because of just like hitting his head... I think that the kids [in prison settings] just take more risks. The adults have a lot of trauma. Well, the kids and adults have a lot of trauma in their background which can include domestic violence. Substance use is also another one that I think is just really under examined because like with drinking you could black out, hit your head or you might be in a compromising situation that could also sustain a blow to your head. It's so risky and you're not able to really control yourself as you would sober. Yeah, I mean people getting in fights. So there's a lot of risky behavior, high risk behavior. Whether it's intentional or unintentional, that I think that could really up the rate of blows to the head.” (Licensed Independent Social Worker with Supervision Distinction, Mitigation Specialist, prison setting)

In addition to the strong perceptions of intervention fit to the clients, interview participants also discussed the relevance of the screening method to their clinical care practices. Participants explained that this TBI screening method would be valuable for gaining insight into the client, to guide intervention decisions such as referrals to physician specialists, occupational therapy and/or physical therapy, as well as to guide mental health treatment plans. One interview participant explained, *“I think it could be*

valuable because, with a treatment plan, the more you know about a patient, you're able to help them. The mindset, the way they process information, or cognitively ... I think it's quite important" (Licensed Professional Counselor, Substance Use Disorder Professional, community-based outpatient treatment setting). Another interview participant explained that TBI screening adoption among behavioral health providers could bridge gaps in medical and mental health services, however, there is lack of role clarity on who should be conducting the screening:

"To be perfectly honest, in domestic violence situations, a lot of them are not receiving medical treatment and they sure as hell aren't saying, 'Yeah, I just got thrown through a wall, I just got hit in the back of the head with something.' So it seems like everybody's kind of just waiting for somebody else to determine that it's there. So, yeah, I feel like it's an area that it impacts so much but we just don't know what to do with it. And when I saw this, I was pretty excited about it because we don't even know the questions to ask. Because from a clinician standpoint, we're like, this is really a medical type of thing, but we deal with the aftermath of it. So if we don't know what we're looking for, we can't say 'hey, you might need to see a medical doctor about it just to make sure that this hasn't accelerated to any point. Or we need to address the fact that this has happened to you and it can cause everything from memory loss to anything like that. Yeah, it's definitely stuff that comes up, it seems like nobody really knows what to do with it or who's responsible for doing it.'" (Licensed Professional Clinical Counselor, Therapist, private practice setting)

Some participants, however, reported the belief that TBI screening is outside of their scope of practice. These interview participants explained that they believed that TBI is a medical issue, and therefore that medical providers should be the ones conducting the screening. One interview participant stated, *"This is probably a medical workflow, and I think you were targeting social workers. I think it's equally as appropriate to target medical staff. Traumatic brain injuries are typically medical, right? They're typically medically focused. And so, I think with the way that clients are viewed, I believe that it's equally as important for this to be part of medical evaluation"* (Licensed Professional

Clinical Counselor, Director of Outpatient Services, community-based treatment setting).

Another interview participant explained, “*If I was able to use it within the scope of my profession, it would be very helpful because a lot of them (clients) do have [TBI]*”

(Licensed Professional Chemical Dependency Counselor-II, Correctional Program Coordinator, prison setting).

The combination of interview participants who reported high relevance of TBI screening to their clients and to their clinical practice along with participants who reported that they believed TBI screening is outside of their scope of practice helps to explain the slightly lower Appropriateness of the Intervention score demonstrated in the quantitative surveys.

Table 4.4.

Logistic Regression Analysis Examining Characteristics of the Intervention on TBI Screening Behaviors

	OR (95% CI)	AOR (95% CI)
Level of Education		
Masters or Doctorate	ref	ref
Associates or Bachelors	0.36* (0.14 – 0.89)	0.41 (0.15 - 1.12)
Behavioral Health Setting		
Private practice (Yes)	2.66* (1.38 – 5.13)	1.70 (0.81 – 3.6)
Private practice (No)	ref	ref
Intention to screen for TBI	1.65* (1.31 – 2.09)	2.92 (0.44 – 19.49)
Characteristics of the Intervention		
Acceptability	1.23* (1.08 - 1.40)	1.43 (0.76 - 2.69)
Appropriateness	1.23* (1.10 - 1.36)	1.19 (0.83 - 1.70)
Feasibility	1.23* (1.08 - 1.41)	0.89 (0.50 – 1.45)
Interaction Effects		
Intent x Acceptability	0.95 (0.86 - 1.05)	0.92 (0.80 - 1.05)
Intent x Appropriateness	0.98 (0.91 - 1.05)	0.97 (0.87 - 1.09)
Intent x Feasibility	1.00 (0.91 - 1.09)	1.07 (0.93 - 1.23)

* Significant at the $p < .05$ level

^a Other organizations include primary care, military-based treatment setting, homeless shelter, community outreach and crisis center, affordable housing agency, employee assistance program, domestic violence shelter, local government authority, university academic medical institute, and professional ice hockey organization.

Table 4.5

Joint Display of the Quantitative, Qualitative, and Meta-inferences of the Acceptability, Feasibility, and Appropriateness of the OSU TBI-ID (Aims 2 and 3)

Constructs from DOI	Quantitative Findings	Qualitative Findings	Mixed Methods Meta-Inferences
	Mean (SD)	Themes and supportive quotes	
Acceptability	16.50 (2.50)	<p><i>1. Helpful in guiding clinical decisions</i></p> <p>“I say fully acceptable. I think that it's a valuable tool. It's been valuable to me and to my clients. And I think that is an easy way to say, here's something else that can help us again understand what's going on within your life. Within the context of the certain things, memory or processing input of memory or trying to go between getting the words out... It would be another really excellent tool in our toolkit to work with our clients.” (Licensed Professional Counselor/Director, private practice)</p> <p>“So, we live in a pretty rural area, and to be honest, TBI's are not uncommon, from accidents different things like that. We have a lot of teenagers on four wheelers, dirt bikes and you know, accidents, things like that. So, I think that knowing our population and knowing that some of the things that we run into, being able to screen for TBI would help us, again, and in some of those diagnoses or treatment methods.” (Licensed Professional Counselor/Therapist, community-based outpatient treatment setting)</p> <p><i>2. Familiar with screeners</i></p> <p>“Before they are accepted into our program, they're also screened for substance use. So, we do a lot of screenings and if that was one of the beginning screens that we did, it would be totally fine. It's just part of like, their recovery services chart, it would be fine. Do the</p>	<p><i>Expansion:</i> The qualitative results expanded upon the high sum scores on the AIM, where providers explained in-depth reasons for why the OSU TBI-ID was highly acceptable.</p>

Continued

		TCU (Texas Christian University screener) and then do a TBI [screener]. So, it wouldn't be that big of an issue, I think.” (Licensed Professional Chemical Dependency Counselor-II/Correctional Program Coordinator, prison setting)	
Feasibility	16.07 (2.48)	<p><i>1. Easy to use</i></p> <p>“It's just very simple, I mean the line of questioning is very non-threatening, very simple for them to complete quick to assess and pretty much easy to score.” (Licensed Professional Clinical Counselor/Owner, private practice)</p> <p>“I thought that the way that your questionnaire was broken down was very simple to understand. So it was easy for me to follow it.” (Licensed Professional Chemical Dependency Counselor-II/Correctional Program Coordinator, prison setting)</p> <p><i>2. Easy to integrate</i></p> <p>“I think it would be very easy to do even with our site. I mean we can't we don't add things to the digital platform for people to fill out. There's a like a preset bundle that clients are added to another department in our agency is managing that. Like, we just facilitate it. So if yeah, if they were to be on board and think yeah this would be great and they could have that buy-in, then absolutely. I think it would be pretty simple. I think if this was something that our leadership was approached with and that they were accepting of I think it would be very simple for us to include this in our process wherever they need it that's effective.” (Licensed Professional Counselor/Therapist, community-based outpatient treatment setting)</p>	<p><i>Confirmation:</i></p> <p>Qualitative results confirmed the FIM sum scores, that the OSU TBI-ID is feasible to adopt within behavioral healthcare settings.</p>

		<p>“I don't think it's too lengthy. That's actually very, very handy. I think the amount of questions that it is, is perfect, because it covers important subject areas, but they don't lose interest, essentially. I think if it was too much longer, they could potentially lose interest in the questions.” (Licensed Professional Clinical Counselor/Counselor, community-based treatment setting)</p>	
Appropriateness	14.78 (3.56)	<p><i>1. Relevant to clients</i></p> <p>“I mean, we have Veterans, we have car accident people, we have lots of, I mean it's the brain, we have a lot of issues that have been affected. ... Most of the individuals that we work with have been abused. They have lived violent lives, so whether it's they're being the perpetrator or the victim, there's definitely a need to understand because ... they were like, the problem kids, they were the problem. They weren't traditional adolescents, 90% of them. I've done a lot of biopsychosocial [assessments]. So very few of them would have what [my colleague] and I would probably call a typical childhood. Their childhoods were filled with poverty. Lots and lots of abuse, lots of things like that so, within the need of the population that I serve, yes, it is a very big need” (Licensed Professional Chemical Dependency Counselor-II/Correctional Program Coordinator, prison setting)</p> <p>“Well, as I said, I haven't had to use it yet, but it seems like a well-established system from what I'm aware of and I think it's very appropriate and necessary for, there are a lot of industry and so forth in construction in this area. And people who suffer from those traumatic brain injuries need to be assessed as quickly as possible and referred and treated and so forth.” (Licensed Social Worker/Therapist, community-based outpatient treatment setting)</p>	<p><i>Expansion:</i></p> <p>Qualitative results expanded upon the appropriateness sum score by explaining that the TBI screening method is relevant to both client population and clinical practice.</p>

Continued

2. Relevant to clinical practice

“I think it fits very well, it's an excellent fit. Because again its client focused, it's strengths-based and it's a way for us again to just gain new insight into our clients and build that rapport with them. And it also allows us to bring in the team approach that we already use with our MAT personnel. (Licensed Professional Counselor/Director, private practice)

“I think it's highly appropriate. I think it's essential. I mean, I think it would be valuable if it could be implemented across the board for all clinicians to use it. I think we need additional tools to help tease out what is going on. If I were talking, when I do my bio psychosocial spiritual assessment, I want to know if someone has had acquired brain injury if they have some sort of loss maybe they've had concussions or been involved with sports. Maybe they don't even understand how the concussion where they were treated and released and went back. I mean, maybe they went back to play the rest of the game. But they may not have a full understanding of how the brain, if it's impaired, injured, impaired, insulted and they don't understand the full extent of the injury, then they don't know, or this would help them gain some self-awareness. And I'm probably I'm probably over thinking it, but I think it needs to be a screening tool. There needs to be questions about brain injury.” (Licensed Professional Clinical Counselor/Outpatient Therapist, community-based outpatient treatment and private practice settings)

Barriers to Traumatic Brain Injury Screening Adoption across Behavioral Health Settings

Although the structural equation model confirmed that provider-level characteristics affect early TBI screening adoption, and that provider perceptions of the acceptability, feasibility, and appropriateness were rated as relatively high, about three-quarters of the sample (74.4%, 160/215) reported not adopting the TBI screening method at all during the one-month period between Time 1 and Time 2. Interview participants reported numerous barriers affecting widespread TBI screening adoption that extended beyond provider attitudes, subjective norms, and intervention-level factors. The barriers gleaned from these qualitative interviews provide additional context to the low proportion of TBI screening adoption across behavioral health settings in this study.

The following section presents the barriers discussed by interview participants, which are matched to domains and constructs from the CFIR (Damschroder et al., 2009). Table 4.6 outlines each of these main barriers and codes from the qualitative interviews, matched to the CFIR domains and constructs. Specifically, 10 CFIR constructs were identified within four CFIR domains: Inner-Setting, Outer-Setting, Characteristics of Individuals, and Process.

Inner-Setting

The majority of the barriers to the adoption of TBI screening in behavioral health treatment settings related to the inner-setting context. Specifically, four constructs within the inner setting domain were identified: Available resources, leadership engagement, relative priority, and organizational incentives & rewards.

Available Resources. First, the most common barrier reported during interviews was limited organizational resources needed to deliver the intervention. Specifically, interview participants reported lack of time needed to implement the OSU TBI-ID, noting that adding an additional screening method would add more time to their already lengthy assessment which often consists of other screeners mandated by their state funding boards. Participants described feeling additional burden of having to add an additional screening tool to their workload. One participant commented, *“They would need to reduce our caseloads and hire more people and pay us more and reduce our stupid documentation”* (Licensed Social Worker, Therapist, community-based outpatient treatment setting).

Also reported was the lack of personnel needed to deliver the TBI screening intervention, where providers discussed that their organizations experienced strains on staff retention during the COVID-19 pandemic, which they reported affects the number of clinicians available to adopt TBI screening. A participant explained, *“We have a high turnover rate where you have a lot of people that have left the organization, and so we're trying to hire on a lot more clinicians here. And so, their level of expertise in the TBI, I don't know what that would be. So, it would be interesting to know if they are familiar with that, and their thoughts on if they would want to implement it in their everyday practice”* (Licensed Chemical Dependency Counselor-II, Addiction Counselor, community-based outpatient treatment setting). Another participant commented, *“We don't have staff to facilitate being able to screen all the prisons that I work with alone. There are over 2,000 inmates, so we wouldn't be able to screen all of them”* (Licensed

Professional Chemical Dependency Counselor-II, Correctional Program Coordinator, prison setting).

Other participants reported a lack of a private, designated space where they could go through each of the questions on the OSU TBI-ID, which are sometimes sensitive in nature because they ask about violent assaults or drug and alcohol use that might have led to a TBI. Specifically, providers employed in prison settings are not allocated a private space away from security guards to discuss these sensitive topics, and they reported that the inmates are less willing to share their personal experiences in front of the guards or other inmates for fear of being stigmatized.

Leadership Engagement. Although many of the providers reported having discussed the OSU TBI-ID with at least one leader within their organization, and that the feedback from the leadership was generally positive, providers noted that organizational leaders have not taken any steps to increase widespread adoption throughout the organization, beginning with education and training. Providers also discussed needing to obtain leadership buy-in and permission to feel comfortable adopting the intervention. A provider explained the need to raise awareness about TBI to leaders in her behavioral health setting in order to increase adoption:

“I guess if more people at a higher level, higher power level within behavioral health knew about it, I think that that would make a difference. Where I mean, I pretty much do what they tell me in a sense. But in terms of it being used for more people, whether that was the agency deciding everyone's gonna do it, or just more clinicians knowing about it, I think that it would have to be targeting upper level, someone in a leadership position, whether that's finding supervisors in behavioral health agencies and informing them of the tool, or I don't even know, talking to the executives...I think targeting those upper levels, then it would maybe it would sort of trickle-down I guess.” (Licensed Social Worker/Therapist, Licensed

Professional Clinical Counselor, Outpatient Therapist, community-based outpatient treatment setting)

Interview participants in community-based settings discussed feeling like they do not have any say as to what interventions can be adopted, or do not have the self-agency to adopt interventions without leadership approval. A provider commented, *“I mean, to me it sounds like a very valuable service and everything, but in terms of the likelihood of it being incorporated and utilized, that would be an upper management decision and call. I feel that it would be very beneficial, but I don't have any input or access to voice my opinion.”* (Licensed Social Worker, Therapist, community-based outpatient treatment setting). Another provider explained:

“I hope it's coming soon. I just I'm not part of any of those decisions. But I am a voice... My gut tells me it's a good thing; it's a necessary thing. I also don't know what type of screening tools are used with the brain injury program. So, I don't know, I just kind of was like, I'm a little gun. I don't know if I'm just a little timid right now because I've offered at least two or three other system-wide potential programs and they went nowhere” (Licensed Professional Clinical Counselor, Outpatient Therapist, community-based outpatient treatment and private practice settings).

Relative priority. Another barrier to the adoption of TBI screening in these behavioral health settings is that TBI screening is a relatively low priority compared to their perceptions of more pressing concerns, such as client crises, sustaining behavioral health accreditation, or maintaining daily operations affected by the COVID-19 pandemic. Some providers discussed the new challenges with conducting their current work due to COVID safety concerns and that incorporating new interventions is not important right now. One provider explained:

“It's much more difficult right now to actually implement any new changes because of COVID, and the fact that they're really not doing visits in person. So

the people that they're acting with currently are on the phone and it's dehumanizing in some respects. I think they still see people as people. I'm not saying that they don't see other people. But it's so much easier to have really deeper interactions and really understand how and what they're doing actually impacts the person that they're seeing on a long-term basis as opposed to just talking to someone on the phone and trying to fill out their assessment.” Licensed Independent Social Worker with Supervision Distinction, Assessment Supervisor, senior services)

Organizational Incentives & Rewards. Finally, participants discussed that there are no motivations to conduct screenings due to lack of incentives to screen for TBI. Specifically, when providers were asked if financial incentives would help to improve screening adoption, providers denied the desire for financial incentives and instead explained that an incentive could be to reduce other screenings that are required to conduct and/or to allow TBI screening to be a billable service because they perceived it would make screening more worth their time.

Outer Setting

Additional barriers to the adoption of TBI screening in behavioral health treatment settings related to the outer setting context. Specifically, lack of external policies and incentives were identified as main barriers to screening adoption.

External policies and incentives. Lack of state-level mandates requiring TBI screening within behavioral health organizations was a main barrier that participants reported as needed in order to increase TBI screening adoption. Specifically, interview participants reported that without mandates or policies that would require TBI screening to be adopted, the OSU TBI-ID would not become a widespread screening method used in these organizations. Participants also reported that the OSU TBI-ID is currently not

billable, which reduces their likelihood of wanting to adopt the innovation. A participant stated, *“If it was billable and mandatory, I think there would be full support. If SAMSHA said, ‘hey, we want this is our emphasis, this is our point of emphasis, and we want you all to do this, it's required,’ then we would do it overnight”* (Licensed Professional Clinical Counselor/Director of Outpatient Services, community-based treatment setting).

Characteristics of Individuals

Although provider attitudes toward adopting TBI screening were favorable, additional characteristics of the individuals were identified as barriers to TBI screening adoption. These included: Knowledge and beliefs about the intervention, self-efficacy, and individual stage of change.

Knowledge and beliefs about the intervention. Although providers received a brief training introducing the OSU TBI-ID intervention and the relationship between TBI and behavioral health, many interview participants still lack the level of knowledge necessary to deliver the intervention and to deliver it with fidelity. Specifically, in terms of fidelity, participants often discussed either not fully completing the screening method or wishing clients could complete the screening method on their own without the clinical interview component. Providers also discussed not knowing what to do following a TBI screen, describing that they would not know how to address the needs of the client within behavioral health treatment. A provider explained, *“Having some guidance because my specialty is not in traumatic brain injury, and in the hospital, it really would have been a referral out. So maybe some guidance if these are positive then what do you do next. Or, what's the recommendation?”* (Licensed Independent Social Worker, Therapist, private

practice setting). Another participant stated, *“What do you do in the next session? And more of applying what you've learned through doing this screening in your future work with them, and how to really support people, because again, it's just not an area that I am seeing a lot of CEs (continuing education) on. And it's not something that was covered in grad school. Yeah, I mean, I don't think there's enough info on it”* (Licensed Social Worker, Therapist, Licensed Professional Clinical Counselor/Outpatient Therapist, community-based outpatient treatment and private practice settings).

Other providers demonstrated lack of understanding about why the OSU TBI-ID is better at identifying a lifetime history of TBI over asking if clients have ever experienced a TBI as a ‘yes’ or ‘no’ question. Several participants also reported that if there was a single question asking whether or not the client has experienced a TBI, and that the client marked ‘yes,’ that this would initiate the provider to then conduct the full OSU TBI-ID.

Finally, participants demonstrated lack of in-depth understanding about the connection between TBI and behavioral health. One participant stated, *“Cognitively they seem to be functioning okay. And they don't complain of headaches or memory loss or any of those types of things. It's more or less people come to me talking about life circumstances that are affecting them negatively right now. But they're able to communicate, they're able to process and none of those symptoms seem to be appearing ... I never really thought to myself, somebody if that comes in depressed, my first thought is never traumatic brain injury”* (Licensed Professional Clinical Counselor, Owner, private practice).

Self-efficacy. Several participants reported needing additional training and education to obtain the skills necessary to implement the intervention. They reported that having this additional training would increase their confidence in conducting the screening. A participant explained, *“Some of the barriers would be a lack of education a lack of information around it ... I think that would be the opportunity if I had more training to administer that, so I can get more of information ... and then I can share it with my colleague”* (Licensed Chemical Dependency Counselor-II, Addiction Counselor, community-based outpatient treatment setting).

Individual Stage of Change. The third barrier within the Characteristics of Individuals domain is that the majority of the providers interviewed demonstrated falling within the pre-contemplation stage of change, where providers lacked buy-in to fully adopt TBI screening. Providers expressed caution about adopting TBI screening because they do not always see the benefit of adding TBI screening to their assessments. A provider commented, *“We have social workers and nurses. I think it would be very easy for them to learn it. It's just what their willingness would be and what the pushback would be on incorporating it. And I think we they would really need to see what the real use of it was, how helpful is this”* (Licensed Independent Social Worker with Supervision Distinction, Assessment Supervisor, senior services). Participants also discussed a lack of buy-in to adopt TBI screening because they believe TBI is not common among their clients. A provider explained, *“There's actually a brief question in our suicide risk assessment about, ‘do you have a TBI?’ And I don't know. Again, I guess it's just kind of, there's so much other stuff that unless it were to come up more strongly, I feel like it*

would be hard to say, okay. We're gonna do this whole assessment” (Licensed Social Worker, Therapist, Licensed Professional Clinical Counselor/Outpatient Therapist, community-based outpatient treatment and private practice settings).

Process

The final barrier identified to affecting TBI screening adoption was overall lack of engaging the leadership of the organization, providers, and state-level funders or boards who are all critical key stakeholders to the early adoption process. Providers explained that their colleagues and leaders are generally unaware of TBI because they have likely not been engaged in educational initiatives. Similarly, state-level funders or licensing boards have yet to be engaged in educational initiatives that would help to increase awareness and training efforts needed to improve adoption.

Table 4.6

Barriers to TBI Screening Adoption Organized by Constructs from the Consolidated Framework for Implementation Research

CFIR Construct	Barriers	Codes
<i>Inner-Setting</i>		
Available Resources	Limited organizational resources	<ul style="list-style-type: none"> - Time - Personnel - Funding - Designated space
Leadership Engagement	Lack of leadership engagement needed to nudge behavior change	<ul style="list-style-type: none"> - Poor awareness of TBI - Poor awareness of the TBI screening intervention
Relative Priority	Low priority relative to other pressing needs	<ul style="list-style-type: none"> - Changes in workflows due to COVID - Accreditation - Client-crises

Continued

Organizational Incentives & Rewards	Lack of incentives to promote TBI screening adoption	<ul style="list-style-type: none"> - Lack of ability to bill for innovation - Too many other screening forms
<i>Outer-Setting</i>		
External Policies	Lack of state-level mandates	<ul style="list-style-type: none"> - Not required by the state behavioural health governing body - No policies requiring agencies to adopt screening when agency is publicly funded
Incentives	Lack of incentives	<ul style="list-style-type: none"> - Insurance billing - Reduction of other screens needed to incorporate TBI screening
<i>Individual-Characteristics</i>		
Knowledge & Beliefs about the Intervention	Lack of knowledge and skills needed to adopt screening	<ul style="list-style-type: none"> - Poor understanding of the connection between TBI and behavioural health - Early evidence of low fidelity to OSU TBI-ID method
Self-efficacy	Low self-efficacy to conduct screening	<ul style="list-style-type: none"> - Lack of self-reported confidence in conducting TBI screening
Individual Stage of Change	Precontemplation stage in the individual stages of change	<ul style="list-style-type: none"> - Lack of willingness to screen - Perceived lack of client willingness to be screened
<i>Process</i>		
Engaging	Lack of key-personnel engagement within the organization and external to the organization	<ul style="list-style-type: none"> - Organizational leaders - Providers - State-level funders

Chapter 5: Discussion

Overview of the Study and Implications

This study is the first to examine determinants affecting the adoption of the OSU TBI-ID in behavioral healthcare settings. Specifically, this study utilized theory-driven hypotheses to investigate individual characteristics of behavioral health providers and factors related to the OSU TBI-ID on TBI screening adoption, as well as qualitatively assessed contextual factors affecting TBI screening adoption in behavioral health settings. This study offers a unique contribution to the implementation science literature through its utilization of theory-driven hypotheses, rather than broad implementation frameworks or models, to specify and describe causal pathways among constructs that affect early adoption of this screening method in complex healthcare contexts (Grol et al., 2007; Lewis et al., 2018, 2021). Subsequently, results from this study can be used to guide the selection of implementation strategies that are aimed to improve adoption, reach, fidelity, scale-up, and sustainment of this EBP within these health settings (Fernandez et al., 2019). This study is also unique in its contribution to implementation science through the use of theory-driven hypotheses that bridge proximal indicators (i.e., attitudes, behavioral control, norms, and intention to screen for TBI), to distal outcomes (i.e., TBI screening behaviors) through specification of potential moderators (acceptability, feasibility, and appropriateness) and mediators (i.e., intentions) (Coxe-Hyzak et al., 2022; Lewis et al., 2018, 2020). Clear specification and testing of potential mediators and moderators, as well as clearly separating where along the implementation cascade these implementation outcomes occur, are necessary to selecting and prioritizing implementation strategies within the behavioral health service context (Lewis et al.,

2018). Implementation science is advanced through hypothesis testing to better explain under what conditions a phenomenon occurred and build stronger models of prediction to the outcome of interest (Glanz & Bishop, 2010; Lewis et al., 2018). Behavioral science theories in particular are advantageous to investigating characteristics of providers affecting the early stages of adoption during the pre-implementation stages (Damschroder et al., 2009), because these individuals often carry the overarching cultural and professional norms, attitudes, and concerns of the organization as a whole, are sometimes the first to experiment with new EBPs, communicate the EBP, and can influence the spread of the EBP (Greenhalgh et al., 2004). Therefore, examining these foundations to early TBI screening adoption within the service context can set the stage for future implementation studies that investigate other multi-level influences (e.g., outer-setting or inner-setting factors) to TBI screening adoption and subsequent studies that test which specific implementation strategies are most likely to increase EBP uptake (Damschroder et al., 2009).

Furthermore, the mixed methods approach used in this study provides a deeper and more nuanced explanation about *how* and *why* characteristics of individuals and factors related to the OSU TBI-ID affected TBI screening adoption observed in this study. While the quantitative phase of this study tested theorized mediators, moderators, and relationships between constructs on EBP adoption, these results are contextualized with the addition of the qualitative component (Curry & Nunez-Smith, 2020; Hamilton & Finley, 2019). The qualitative results in this study provide depth that would not have otherwise been achieved through the quantitative results alone (Palinkas et al., 2011).

Additionally, the quantitative results are limited to the study of only provider and innovation constructs, however, the qualitative results in this study demonstrated a broader range of constructs operating with the service context affecting TBI screening adoption. These additional constructs provide a theoretical base for building future models that situate these constructs as mediators, moderators, and mechanisms to test in future studies (Lewis et al., 2018). Furthermore, strategies can be selected beyond those that map back to individuals and innovations and which extend to outer setting and inner setting factors to stage implementation scale-up.

This study is also the first to use an implementation science lens as applied to TBI screening adoption in behavioral health settings which advances the TBI literature by moving beyond classical TBI intervention effectiveness studies or TBI epidemiological studies toward translating EBPs into clinical practice. The barriers identified in this study are unique to this intervention within this context, which can be used to guide implementation strategy selection to effectuate practice and policy change.

Characteristics of Individuals on TBI Screening Adoption

Attitudes

Results from this study demonstrated that provider attitudes toward screening for TBI using the OSU TBI-ID were generally positive and that these attitudes had an indirect effect on TBI screening adoption through intentions. The quantitative results confirmed the Theory of Planned Behavior regarding the importance of attitudes on behavior change (Ajzen, 1991) as applied to TBI screening adoption. Specifically, attitudes may be shaped by beliefs about how the target behavior can inform client-level

outcomes (National Cancer Institute, 2005). Attitudes about an innovation that is new to the service context are critical to the early adoption stages in the implementation process (Ajzen, 1991; Benjamin Wolk et al., 2015; Damschroder et al., 2009; Fernandez et al., 2019; Rogers, 2003). In this study, providers demonstrated positive attitudes toward adopting the OSU TBI-ID as demonstrated in the quantitative results and explained in the qualitative interviews that their attitudes toward TBI screening were shaped around their beliefs regarding how useful the OSU TBI-ID would be in facilitating assessments by better identifying and delineating mental health problems from a TBI. Furthermore, providers' beliefs were also shaped around the perceived benefits to their intervention decisions, which included bridging gaps in services by driving referral or treatment planning that takes into account their clients' memory problems or ability to process information, which are common areas of need for providing accommodations for individuals with TBI in behavioral health (Corrigan & Bogner, n.d.; Lewandowski et al., 2007).

Furthermore, it is important to note that providers in this study who were employed in prison-based behavioral health settings explained that they believed clients could potentially benefit from TBI screening because this screening method could provide better insight into potential causes of criminal behaviors of their clients that may have been driven by problems related to the TBI. Studies demonstrate that damage to the frontal lobes resulting in executive dysfunction that often occur with TBI may lead to impulsivity, aggression, and personality changes that not only predispose these individuals to risk-taking behaviors, but also predispose some individuals to misuse

substances, thereby increasing threat of imprisonment following this injury (Fishbein et al., 2016; Williams et al., 2018). Studies have demonstrated increased risks for mental health problems and behavior dysregulation among prisoners who have both a TBI and substance use disorder, thereby increasing risk for incarceration (Walker et al., 2003). The prevalence of TBI and substance use disorders among individuals in the prison system range between 5.69% up to 84.4% (Barnfield & Leathem, 1998; Bogner & Corrigan, 2009a; Colantonio et al., 2014; Fishbein et al., 2016; Kavanagh et al., 2010; Perkes et al., 2011; Pitman et al., 2015; Schofield et al., 2006; Shiroma et al., 2010). Therefore, the identification of lifetime history of TBI among individuals involved in the criminal justice system may be particularly important in driving decisions of the courts or could guide policies to increase behavioral health treatment in prison-based settings.

Perceived Behavioral Control

Perceived behavioral control (PBC) did not demonstrate a direct effect on adoption or indirect effect through intentions on TBI screening adoption in the structural equation model. However, providers explained in the qualitative interviews that this lack of perceived control was due to not having sufficient knowledge, skills, or self-efficacy to conduct the OSU TBI-ID with clients. Specifically, providers reported lacking in-depth knowledge about the relationship between TBI and behavioral health. Most of the providers who participated in the qualitative interviews believed that TBI is a medical issue and were unable to articulate the connection between TBI, mental health, and substance use disorders, as well as their role in TBI identification. Therefore, more comprehensive education on the connection between TBI, mental health, substance use

disorders, and providers' roles in intervening with these clients might be necessary for improving adoption. The qualitative results also demonstrated that providers lacked self-efficacy to deliver the OSU TBI-ID to their clients and they reported the desire to receive additional training and education about how to deliver the EBP. Notably, however, was that providers who reported having more knowledge about TBI due to their personal experiences or who reported seeking out additional education about TBI on their own demonstrated greater understanding about why TBI is relevant to their clients in these contexts. This demonstrates that more comprehensive education and skills-based training could possibly improve knowledge and self-efficacy to adopt TBI screening in the future.

Providers also reported that they lacked knowledge about what to do following a positive TBI screen. While most providers reported that identifying a TBI could guide decisions to refer clients to specialty treatments, providers did not know where specifically to provide the referral. Furthermore, providers who participated in this study reported not knowing what specific adaptations could be made for these clients, which affected their willingness to adopt the screening. This is consistent with previous research demonstrating that behavioral health providers generally lack knowledge about TBI among clients with behavioral health problems, and lack confidence in how to intervene for these clients (Conrick et al., 2022; Coxe et al., 2021). Future work is needed to improve widespread dissemination of education on TBI to behavioral health providers.

Subjective Norms

Results from this study demonstrated that greater perceived social pressures to screen for TBI indirectly increased TBI screening adoption through intentions. However,

the qualitative results demonstrated an overall lack of social pressures to adopt TBI screening in behavioral healthcare settings. Namely, although the quantitative results confirmed the Theory of Planned Behavior as applied to this study that subjective norms can directly predict intentions to perform TBI screening, and indirectly predict TBI screening through intent (Ajzen, 1991; Glegg et al., 2013), providers employed across the various types of behavioral health contexts in this study explained that there are no internal pressures to adopt TBI screening, which they explained was primarily due to lack of awareness from leaders within the organization or because other colleagues are not implementing TBI screening. Providers who were specifically employed in group-based public practice settings also reported that there are no external pressures to adopt TBI screening due to lack of policies by state-level funders who are often responsible for mandating what EBPs providers are required to adopt within these settings. It is therefore possible that there are no motivations nudging TBI screening adoption because other's opinions and beliefs, as well as policies mandating TBI screening are non-existent (National Cancer Institute, 2005).

Discordant results between the quantitative and qualitative data in mixed methods is common and should not be considered a limitation of the implications of the study or refute the credibility of the study results (Wagner et al., 2012). Rather, incongruent results provide a more nuanced investigation of the complex social phenomenon being studied and can offer deeper insights into the phenomenon (Wagner et al., 2012). Several possible explanations exist for the discordance between the quantitative and qualitative results found in this study regarding the phenomenon of subjective norms. In this study,

although norms did significantly predict TBI screening adoption in the structural model, providers' overall ratings on the subjective norms subscale was relatively low, with an overall mean score of 2.99 out of 6. When using only descriptive statistics, the providers' explanations of the lack of subjective norms do align with the quantitative results. It is possible that with the level of heterogeneity of behavioral health settings in this study that subjective norms also varied widely, hence affecting this mean score. Specifically, providers were employed in 21 unique types of behavioral health settings, with the most common being private practice settings and community-based outpatient treatment clinics. Inevitably, these contexts differ, and variations exist in how EPBs are spread when providers are influenced by external policies or through interorganizational pressures by leaders or colleagues. The same level of pressures may not exist in private practices that exist in publicly funded practices; specifically, private practitioners may not experience pressures at all if other colleagues are not implementing TBI screening and because they may not have the same type of top-down leadership affecting when, how, and what types of EBPs are implemented. Future research is needed to better explain this phenomenon among practice settings that are more similar in nature, such as private versus publicly funded settings. Previous studies have examined the role of provider attitudes on EBP adoption, comparing public versus private practice settings (Aarons et al., 2009), however, much less attention has been paid to the role of norms. Interorganizational norms, or the collective norms of colleagues, can filter down to affect individual's perception of the expectation of what EBPs should be adopted and is a fundamental mechanism to the spread of the EBP (Greenhalgh et al., 2004). However,

how these mechanisms work when providers practice individually, such as in private practices, remains unclear.

It is also possible that the way in which ‘subjective norms’ are defined, operationalized, and measured based on the Theory of Planned Behavior does not fully capture the nuance of this construct. As currently defined in this theory, subjective norms are the “perceived social pressure to perform or not to perform the behavior” (Ajzen, 1991, p. 188), which was the way in which norms were operationalized and believed to have been measured in this study. However, research demonstrates that this construct may actually be broken down to a finer level, consisting of injunctive and descriptive norms (Baumeister & Vohs, 2007). Descriptive norms are defined as what the majority of individuals *think or do*, whereas injunctive norms are defined as what the individuals in the group *approve of* (Baumeister & Vohs, 2007). The way in which norms was quantitatively measured in this study referred to injunctive norms which was meant to match the overarching definition of ‘subjective norms’ used in this study. However, it is possible that providers may have conceptualized what their colleagues are actually doing (which is not adopting TBI screening) when answering these questions. This implies the need for better measurement and specification of norms to delineate the nuance of this construct, and the multiple levels that this construct could be operating at to affect behavior (i.e., individual, organizational, or policy-levels) through implementation strategy testing and refinement (Lewis et al., 2018).

Despite how core the Theory of Planned Behavior is to social science research, a single, robust measure of the constructs in this theory does not exist. Therefore the

measure created for this study was completed based on existing research (Davis & Rosenberg, 2013; Glegg et al., 2013). Although the CFA confirmed the high factor loadings on the items used to measure constructs in the final structural model, many of these items were pared down from the original survey. It is therefore possible that results may have differed had a more robust measure been available to use. This has implications for future research that is needed to develop a measure for the Theory of Planned Behavior that can be used across different types of behaviors and individuals in future work.

Taken together, these individual-level determinants may explain why only one quarter of the sample in this study adopted TBI screening during the study period. It is likely that the educational module introducing the OSU TBI-ID did not provide enough in-depth information about the connection between TBI and behavioral health. The goal of including the educational module in this study was to raise awareness about the OSU TBI-ID and only included a brief explanation about why screening for TBI is important in behavioral health contexts. Raising awareness about the EBP is a first step in the early adoption of the EBP (Fernandez et al., 2019), but a one-time training is often insufficient to increasing the uptake of the EBP (Beidas et al., 2012). Comprehensive education about the relationships between TBI and behavioral health, as well as additional training on how to administer the OSU TBI-ID are implementation strategies that could increase knowledge, change beliefs, and improve providers' confidence in adopting the OSU TBI-ID, and will also improve fidelity during implementation (Beidas & Kendall, 2010; Conrick et al., 2022; Herschell et al., 2010; Kirchner et al., 2020; Powell et al., 2015).

Furthermore, strategies that target social norms could also help to improve TBI screening adoption in these contexts.

Characteristics of Innovations on TBI Screening Adoption

The second hypothesis in this study which investigated the moderating effects between intentions and the acceptability, feasibility, and appropriateness of the OSU TBI-ID on TBI screening adoption was not supported. This hypothesis was built on robust theories (Ajzen, 1991; Rogers, 2003) and on implementation science literature, where acceptability, appropriateness, and feasibility are thought to affect adoption (Mettert et al., 2020; Proctor et al., 2011). While it is possible that interactions between intentions and these innovation-level factors actually do not exist, it is also likely that issues related to measurement and conceptual clarity of the constructs impacted the study results.

First, although the AIM, FIM, and IAM selected for this study were psychometrically sound (Weiner et al., 2017), questions remain as to whether these measures fully capture providers' appraisals of the acceptability, feasibility, and appropriateness of an EBP. These measures include 4-items to capture these constructs, however, it is possible that more items are needed to improve the validity of these measures (Bishop & Herron, 2015; Simms et al., 2019). The items used to measure these constructs are therefore possibly limited in scope and may ultimately have affected the average scores. Furthermore, there are no cut-offs to determine whether the acceptability, feasibility, or appropriateness are considered 'high,' 'moderate', or 'low,' leaving it to the researcher to interpret these levels. In this study, the average scores were considered to be

relatively high overall on each of these measures, however, this is currently not empirically supported due to the lack of guidance how to interpret the scores. This dissertation is one of the first to utilize these measures. There is a paucity of published literature where these specific measures have been used. However, this study illuminates the shortcomings of implementation science outcome measures and reiterates the need for more psychometrically sound measures in implementation science (Lewis et al., 2015, 2020; Mettert et al., 2020).

Second, and which affects the measurement, is that there may be a lack of conceptual distinction between the constructs of acceptability and appropriateness, which could have affected the outcomes of this study (Lewis et al., 2015; Mettert et al., 2020; Sekhon et al., 2017). Several prior reviews of studies examining these constructs and measures of these constructs, have pointed to lack of clear definitions and distinction between these constructs (Lewis et al., 2015; Mettert et al., 2020; Proctor et al., 2011). Therefore, the measures used in this study may be assessing the same construct, but which were tested as distinct constructs in the logistic regression models in this study. The lack of conceptual clarity has important implications for implementation science outcomes, where these outcomes may need to be updated, redefined, or refined into a construct that captures these nuances.

Nonetheless, participants in this study rated their overall appraisal of the acceptability, feasibility, and appropriateness of the OSU TBI-ID in the quantitative measures and the qualitative interviews as relatively high, which is encouraging for TBI screening adoption. Specifically, participants reported that the OSU TBI-ID was easy to

use and easy to integrate into current practices, which indicates high feasibility of the EBP itself and the EBP adoption process. Participants also reported that they found the OSU TBI-ID to be useful in helping them to understand their client better, and to delineate and clarify diagnoses, which indicates high acceptability of the EBP. Furthermore, because providers are already expected to learn and adopt other screeners into their work, providers in this study indicated that learning and adopting this screening method would be a familiar practice. However, one of the main barriers providers reported was lack of time to add another screener into their already exhaustive list of screening tools and methods. This may be one reason why the majority of providers did not adopt TBI screening as observed in this study. Participants discussed at length that lack of resources, including time, designated space, and manpower were ultimately barriers perceived to affect adoption. However, participants who were interviewed reported they would be more willing to adopt the OSU TBI-ID if other screeners were eliminated. At the time participants were interviewed, several reported that their state governing boards required other screenings centered around the social determinants of health to be included into all assessments, and these providers therefore reported that this takes priority, and time, away from adding other screeners. De-implementing EBPs that are not evidenced-based or are of low value in providing benefits to clients could be eliminated and replaced with EBPs that could improve client outcomes, such as the OSU TBI-ID (Augustsson et al., 2021; Nilsen et al., 2020; Prasad & Ioannidis, 2014).

This study demonstrated that providers found TBI screening to be appropriate for clients overall, however this was highly context dependent and highly dependent upon

providers' understanding of the relationship between TBI to behavioral health treatment. Specifically, providers who were employed in domestic violence settings, prison settings, or who work with individuals with previous traumas resulting from childhood physical abuse or military involvement were more likely to describe the OSU TBI-ID as appropriate for their client population. However, many providers still reported that they believed that TBI is a medical issue and therefore outside of their scope of practice. This indicates lack of understanding about TBI and how it can impact substance use and mental health conditions, as well as behavioral health providers' roles in providing care for these clients, which was a barrier to TBI screening adoption. These results are consistent with previous research demonstrating that social workers generally lack knowledge about TBI and their roles in providing care to these clients (Conrick et al., 2022; Coxe et al., 2021). These results also add to existing the evidence demonstrating the need for building workforce capacity to increase access to care that could be achieved through the integration of TBI and behavioral health (Coxe et al., 2021).

Finally, providers also discussed the lack of engagement from leaders as an inner-setting barrier and state-level funders as an outer setting barrier that affects their willingness and comfort with adopting TBI screening. Previous research has demonstrated that leaders and funding structures have an effect on EBP adoption (Aarons et al., 2015; Aarons & Sommerfeld, 2012; Green & Aarons, 2011; Williams et al., 2020). Future research is needed to better understand how both of these inner- and outer-setting factors can be harnessed together synergistically to effectuate behavioral change at the individual-level (Green & Aarons, 2011; Rapp et al., 2010).

Implications for Theory

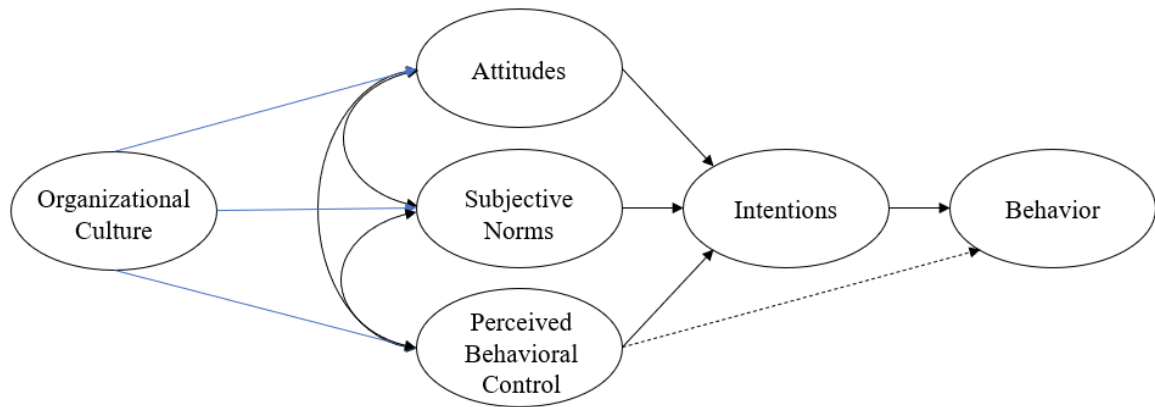
Results from this study draw important implications for theory development that expand our traditional ways of thinking about individual-level behavior theories and organizational theories. Specifically, most theories in social and behavior sciences tend to focus on factors situated within one level of influence from a socioecological perspective (National Cancer Institute, 2005). For example, the Theory of Planned Behavior, which was one of the primary theories guiding this study, is focused on intrapersonal characteristics of individuals (i.e., the attitudes, norms, perceived behavioral control, intentions, and behaviors of individuals). Other theories focus on constructs situated solely within broader ecological levels, such as organizational factors which include organizational structures, cultures, or capacities. However, situating theory neatly within one level alone negates the importance of how these constructs operate together within the environment and influence each other, which obstructs or limits our understanding of the complex processes affecting EBP uptake. Specifically, when the focus is solely on one level of influence, we may fail to see how change processes are driven by factors at other levels.

To illustrate this point, the results of this study found a discrepancy between the quantitative and qualitative results regarding the roles of subjective norms on TBI screening adoption (i.e., the quantitative results demonstrated that norms significantly affected TBI screening adoption, but providers explained norms around TBI screening are lacking with their respective organizations). When diving deeper into possible explanations for this discrepancy, norms may, in fact, be affected by broader

organizational factors that influence provider perceptions of the social pressures to perform TBI screening. ‘Social’ pressures suggest that perceptions are externally influenced from the larger group and therefore understanding how external factors affect the individuals’ perceptions of ‘subject’ norms warrants extension of the Theory of Planned Behavior to include additional constructs drawn from other theories. This is confirmed through the results of this study, where in the qualitative interviews, providers discussed that other colleagues within their organization are not aware of TBI screening, nor do they conduct TBI screening, and therefore they perceive that there are no social pressures to conduct TBI screening. This then draws attention to the cross-level effects of organizational culture on individual-level norms and behaviors (Glisson et al., 2007). In Organizational Culture Theory, Glisson and colleagues (2007) describe culture as “how the work is done in the organization and is measured as the behavioral expectations reported by members of the organization” (Glisson et al., 2007, pg. 100). This implies that culture of the organization (i.e., expectations of providers) may be affecting individual’s perceptions of expectations derived from the large group, thus creating a cross-over effect of organizational-level factors on individual-level characteristics. Therefore, drawing on organizational theory, the Theory of Planned Behavior could be extended as illustrated in the following model:

Figure 5.1.

Extended Theory of Planned Behavior



Note: Blue arrows denote cross-over effects from the organizational level to the individual level.

By extending this theory beyond individual-level constructs to also include the organizational-level construct of culture, theory-guided selection of implementation strategies situated at each of these levels can then be identified and tested to better understand the implementation adoption cascade. Multilevel strategies selected based on the results of this study are described in greater detail in the following section. Future work is warranted to test this extended theory, as well as how implementation strategies that mirror these cross-over effects can better explain the adoption process.

Implications for Practice and Policy

This study has several implications for practice and policy that could improve how behavioral health treatment is delivered to improve outcomes for individuals with

TBI, substance use, and mental health comorbidities. By first beginning with TBI screening to identify clients with TBI in behavioral health settings, intervention decisions can be more precisely guided and individualized to these clients. First, intervention decisions may include referrals to specialized medical care (i.e., psychiatry or neurology) for medication management to address prolonged symptoms associated with TBI, which often include headaches, fatigue, dizziness, insomnia, memory problems, and reduced alcohol tolerance (Quinn et al., 2018). In addition, because TBI may result in long-term disability, but these individuals may not be receiving disability supports, referrals and application assistance could be completed for Home and Community-Based Service (HCBS) waivers. These waivers are issued through state Medicaid departments, and have expanded to serve individuals with TBI which have been adopted by all 50 states and the District of Columbia, beginning with Kansas in the mid-1980s (Kaiser Family Foundation, 2022; Vaughn, 2018). Other referrals could be made to state specific TBI resources or to national educational resources, such as the Brain Injury Association of America. In addition to referrals, behavioral health providers are well-positioned to not only screen for TBI, but to then provide psychosocial interventions adapted for these clients. Cognitive behavioral therapy and problem-solving therapy are recommended treatment modalities for individuals with TBI and psychiatric comorbidities (Quinn et al., 2018), but many other therapies exist and may be employed instead for individuals with TBI. Furthermore, adaptations to treatment to accommodate problems post-TBI, such as attentional deficits, task initiation, or learning and memory problems, could include group-based therapy with fewer clients (Harrison et al., 2013), slowing down instructions

to allow the person time to process the information (Lewandowski et al., 2007), or allowing clients to use notebooks or planners to remember tasks (McDonald et al., 2011). However, understanding which interventions are needed first requires that providers are familiar enough with TBI and are able to conduct and interpret TBI screening with fidelity.

It is also important to note how the characteristics of the providers in this sample may have impacted the outcomes of the study, which has important implications for the reach of clients who are living in rural geographical areas where healthcare resources are scarce, as well as the reach of minoritized clients who already face barriers to accessing behavioral health and TBI care. Specifically, the majority of providers who participated in this study identified as Caucasian or White (81.9%), while a combined 18.1% identified as African American or Black, Multi-Racial, Native American, Hispanic, Asian or Pacific Islander, and other races. As a result, this leaves out the perspectives of these providers who may be treating clients of similar race and ethnicity and who may also be more knowledgeable on how to deliver culturally responsive treatment (Berger et al., 2014; Steinfeldt et al., 2020).

Another possible explanation for why few providers of color participated in this study could be due to time constraints or burden associated with client treatment. Specifically, research has demonstrated that clients of color seeking treatment in behavioral health care have greater race-related stressors affecting mental health (Williams, 2018), which in turn requires more time and resources spent providing care for these clients. Similarly, research has demonstrated that older African American adults

have greater odds of sustaining a TBI than individuals who are white (Kisser et al., 2017), that individuals of color have higher functional disability following TBI (Hart et al., 2007), and that mental health outcomes among individuals of color with TBI tend to be worse over the course of the first two years post-injury (Perrin et al., 2014). Taken together, this burden could cause higher levels of stress and burnout among providers of color, leaving little room for additional work not required by their place of employment, such as research study participation. This therefore leaves out perspectives of these providers in terms of how they may be identifying clients with TBI and providing care for these clients. Future research is needed to better understand TBI identification and care practices of providers from more diverse samples.

In addition, although this study did not examine any of the characteristics of clients who were screened for TBI, it is possible that disparities exist between which clients were or were not screened. Individuals who have sustained a TBI often have multiple intersecting vulnerabilities and are more likely to be homeless (Young & Hughes, 2020), have experienced domestic violence (Costello & Greenwald, 2022), be involved with the criminal justice system (Brandel et al., 2017), and experience psychiatric conditions (Whelan-Goodinson et al., 2010). Women, individuals of color, individuals who identify as gay, lesbian, bisexual, transgender, and gender non-conforming, and with lower socioeconomic status who have sustained a TBI often have greater challenges and poorer outcomes following TBI (Gary et al., 2009; Kucukboyaci et al., 2018). Therefore, future research should examine not only the *adoption* of TBI screening among behavioral health providers, but also the *reach* of TBI screening in

terms of client-level demographics so that inequities in TBI identification and subsequent care can be reduced or eliminated.

Implications for Implementation Strategy Identification

Results from this study have important implications for selecting multilevel implementation strategies that are tailored to the determinants demonstrated to affect TBI screening adoption in these contexts. Implementation strategies are *deliberate* efforts aimed to increase the adoption, reach, fidelity, and scale-up of interventions in health contexts (Proctor et al., 2013). Currently, 73 implementation strategies exist, making it challenging to select which discrete strategy or bundle of strategies would be the best and most cost-effective in effectuating practice and policy changes within behavioral health contexts with this specific EBP (Powell et al., 2015). However, using a data-driven approach where determinants to EBP adoption are mapped to implementation strategies, and how mechanisms of action might occur with these strategies, can lead to more precise and accurate selection of strategies that may effectuate the greatest practice and policy changes (Lewis et al., 2021; Powell et al., 2019).

Implementation Strategy Recommendations

Based on the results from this study, 13 implementation strategies have been selected to inform policy and practice changes, which are intended to close the research-to-practice gap and increase TBI screening adoption efforts in behavioral healthcare contexts. The selection of these implementation strategies was completed using a systematic approach to implementation strategy selection guided by the CFIR and the Expert Recommendations for Implementing Change (ERIC) query tool (Damschroder et

al., 2009; Powell et al., 2015). These strategies are specified below and situated by CFIR domains and constructs as they related back to the results from this dissertation study. Hypothesized mechanisms of action for each of these strategies and implementation outcomes are also specified below and outlined in Table 5.1 (Lewis et al., 2021).

Outer-Setting

Implementation strategies that target larger systems that mandate, oversee, and enforce changes within behavioral health settings could help to change the norms within the organization, and to increase motivations, intentions, and ultimately TBI screening adoption in behavioral healthcare settings (Lewis et al., 2021). Specifically, given the size and complex nature of these systems, implementation strategies could be bundled together to develop stakeholder interrelationships needed to promote changes to motivations and norms at the individual-level, which are affected by broader policy-level changes (Brownson et al., 2012; Powell et al., 2015).

Involve executive boards. First, this bundle could include involving executive boards by obtaining buy-in from leaders at the state governing boards (i.e., medical directors and clinical directors of state mental health departments) (Powell et al., 2015). These leaders can be educated on why TBI and behavioral health are so important to client outcomes and buy-in could be established to include these leaders on efforts to incorporate TBI screening into assessment forms.

Obtain formal commitments. Second, these state directors could provide a written, formal commitment regarding what they will do to help implement TBI screening in behavioral health (Powell et al., 2015). Ultimately, this would ensure that

these state leaders are committed to these changes and hold them accountable on their promises.

Mandate changes. A third strategy within this bundle that is aimed at policy-level efforts could be for state-level funders to mandate changes, where the OSU TBI-ID is a required component of biopsychosocial assessments (Powell et al., 2015). This effort also ensures that TBI screening is a priority at higher levels of leadership, which would in turn help to effectuate expectations and norms at the individual level.

Inner-Setting

Change physical structure and equipment. Some of the barriers that providers discussed were lack of available resources needed to facilitate TBI screening adoption. Specifically, some providers discussed a lack of designated space to deliver TBI screening, and that clients might therefore be less likely to want to disclose TBI. Therefore, changing the physical structure of the organization that allows for a private space to screen for TBI privately could facilitate TBI screening adoption and feasibility.

Revise professional roles. The majority of the providers reported not having enough time or designated personnel to deliver the EBP. Therefore, one implementation strategy could be to revise the professional roles of some of the providers within the organization who would be designated to conduct TBI screens. These providers could also be the same team to provide adapted behavioral health treatments for clients who are identified to have a TBI and who need adapted treatment. This could not only reduce the burden of training and education among providers within the organization but could also

ensure designated stakeholders are ready and knowledgeable to treat clients with these complex comorbidities.

Inform local opinion leaders. Another implementation strategy that could influence norms/social pressures is to involve influential opinion leaders. These opinion leaders could be the clinical directors within the organization as well as one direct practice provider who has social influence on colleagues. Involving these leaders could help to improve knowledge and awareness about the OSU TBI-ID and influence norms/social pressures needed to motivate their colleagues to adopt this TBI screening method (Powell et al., 2015; Rogers, 2003).

Conduct local consensus discussions. Two of the barriers to TBI screening adoption were lack of priority of implementing TBI screening, as well as lack of leadership engagement. These two barriers map to conducting local consensus discussions as an implementation strategy that can address both of these determinants by raising knowledge and awareness about TBI screening (Powell et al., 2015). These discussions could involve the providers and leaders in the organization to discuss the extent to which they perceive TBI to be a problem among clients, and to provide education about how common TBI is among clients within these types of healthcare settings. These discussions would serve to improve knowledge of the problem, create tension for change, and build buy-in.

Fund and contract for the innovation. In addition, allowing providers to bill for TBI screening could help to motivate these providers to adopt this EBP and have a more direct effect on implementation (Damschroder et al., 2009; Powell et al., 2015, 2016).

Providers reported that if the OSU TBI-ID was mandated and billable, that this could improve motivations, and subsequently adoption of the EBP.

Characteristics of Individuals

Although providers in this study have received some education on TBI screening, additional education may be needed to further increase their knowledge on the relationships between TBI and behavioral health, as well as on implementing the OSU TBI-ID. Increasing provider knowledge and self-efficacy could be the mechanisms that facilitate how acceptable they believe this EBP would be to implement, ensure fidelity to the EBP, and increase EBP adoption and sustainment over time (Lewis et al., 2021).

Conduct educational meetings. First, more in-depth education about how TBI can affect behavioral health is one implementation strategy that could be used (Powell et al., 2015). The educational meetings could involve greater detail than what was provided for purposes of this study. A series of five web-based training modules have already been created through the Ohio Valley Center for Brain Injury Prevention and Rehabilitation at the Ohio State University Wexner Medical Center. Topics include the incidence and prevalence of TBI, neurobehavioral impairments, impact of TBI on the lives of individuals and their caregivers, how to identify and accommodate symptoms of TBI within behavioral health, and how to use the OSU TBI-ID (Ohio State Brain Injury Prevention & Rehabilitation, 2022). These educational meetings could address providers' current lack of knowledge about the EBP, change beliefs about why TBI screening is important, and increase intentions to screen by improving their awareness.

Distribute educational materials. Along with these meetings, written guidelines about each of the three components of the OSU TBI-ID could be included as a supplement for providers to refer back to as they start to deliver the screening. In addition, several providers reported in the interviews as well as in the open-text fields of the quantitative survey that they desired more information about how injury severity (i.e., mild, moderate, or severe) might affect next steps for clients. It might therefore be useful to include a bundled intervention including the OSU TBI-ID plus referral options within the state and/or accommodations together so that providers have a clearer process map for implementation.

Shadow other experts. To increase provider's self-efficacy with delivering the OSU TBI-ID, additional opportunities to shadow experts on during screening sessions, as well as obtain feedback on their own screenings could improve feasibility, adoption, and fidelity of the EBP.

Conduct ongoing training. Sustaining implementation of the OSU TBI-ID within behavioral healthcare is one of the long-term goals of this line of research. Therefore, one implementation strategy could be to incorporate standardized trainings for onboarding clinicians as well as consultation on TBI screening, how to address complex TBI cases, and offer new information as TBI research continues to advance.

Process

Identify and prepare champions. At the outset of the implementation process is the identification and preparation of champions who are willing pioneer the EBP within the organization (Damschroder et al., 2009). In the early adoption stages, identification of

these champions is a first step to increasing the adoption and reach of the intervention. Specifically, these champions are key stakeholders within the organization (i.e., social workers, counselors, psychologists) who are enthusiastic and dedicated to supporting and driving EBP implementation within that organization, and who can serve as role models and change makers (Damschroder et al., 2009; Powell et al., 2015). These champions are individuals who motivate colleagues by overcoming barriers and resistances to the practice change and are distinguished from key opinion leaders in their active and dedicated engagement in the implementation process (Damschroder et al., 2009). Without a champion, it is likely that there will be a voltage drop and the EBP will fail to launch.

Table 5.1.

Recommendations for Implementation Strategies Linked to Determinants, Mechanisms, and Implementation Outcomes for TBI Screening in Behavioral Healthcare

CFIR Domains and Determinants	Implementation Strategy	Mechanism	Implementation Outcome
<i>Outer-Setting</i>			
Determinant: Lack of external policies & incentives	<ul style="list-style-type: none"> ✓ Involve executive boards ✓ Obtain formal commitments ✓ Mandate changes 	Norms/social pressures	Adoption, Acceptability
<i>Inner-Setting</i>			
Determinant: Lack of Available Resources	<ul style="list-style-type: none"> ✓ Change physical structure and equipment ✓ Revise professional roles 	Designated space; time; motivation	Feasibility, Adoption
Determinant: Poor Leadership Engagement	<ul style="list-style-type: none"> ✓ Inform local opinion leaders ✓ Conduct local consensus discussions 	Knowledge, awareness; norms/social pressures	Adoption, Acceptability, Appropriateness
Determinant: Low Relative Priority	<ul style="list-style-type: none"> ✓ Conduct local consensus discussions 	Knowledge, awareness	Acceptability, Appropriateness
Determinant: Lack of Organizational Incentives & Rewards	<ul style="list-style-type: none"> ✓ Fund and contract for the clinical innovation 	Motivations	Feasibility, Adoption, Sustainment

Continued

<i>Individual-Characteristics</i>			
Determinant: Knowledge & Beliefs about the Intervention	<ul style="list-style-type: none"> ✓ Conduct educational meetings ✓ Distribute educational materials 	Knowledge	Appropriateness, Acceptability, Feasibility, Adoption, Fidelity
Determinant: Self-efficacy	<ul style="list-style-type: none"> ✓ Shadow other experts ✓ Conduct ongoing training 	Self-efficacy/perceived behavioral control	Feasibility, Adoption, Fidelity
Determinant: Pre-contemplation Stage of Change	<ul style="list-style-type: none"> ✓ Conduct educational meetings 	Knowledge	Acceptability
<i>Process</i>			
Determinant: Lack of stakeholder engagement	<ul style="list-style-type: none"> ✓ Identify and prepare champions 	Norms/social pressures	Adoption

Study Strengths

This study has several strengths. This is the first study to examine determinants affecting TBI screening adoption in behavioral healthcare settings using implementation research and science. The TBI research landscape is in its infancy regarding integrating implementation science, which has resulted in a research-to-practice gap where many of the innovations have not been widely implemented in the healthcare settings for which they are intended. Although the OSU TBI-ID was developed approximately 15 years ago at the time of this writing (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007), consistency of adoption and reach of TBI screening has not been investigated, and there has been no evidence of systematic adoption across behavioral health practice in the U.S. By using implementation science, we now have a better understanding about *why* this screening method has failed to be adopted in these settings since its initial development. Second, this study used prospective, primary data collection methods, which allowed for novel research questions to be investigated that could not have been investigated with any existing datasets. The breadth and depth of the data collected throughout this dissertation allows for future research questions to be investigated to build upon the work done in this dissertation. Third, this study used a combination of quantitative and qualitative data in an explanatory sequential mixed methods design, which permitted a much deeper understanding of the complex phenomena affecting early TBI screening adoption in behavioral healthcare. If only quantitative data were collected, our understanding about determinants would have been limited to constructs from the Theory of Planned Behavior and Diffusions of Innovations Theory. The qualitative interview data generated a much

deeper picture of other factors within the service landscape that affect TBI screening adoption. Alternatively, if only qualitative data were used, this study would have been limited in scope by providing the viewpoints of only a few individuals and would not allow for testing hypotheses to draw inferences. Rather, this dissertation capitalized on two theory-driven hypotheses to test relationships between constructs associated with providers and the OSU TBI-ID innovation using mediation and moderation analyses. This is a strength for several reasons. First, theories, rather than broad frameworks or models, are not often used in implementation science and theory is rarely used in TBI research. Using the theories in this study brought us beyond epidemiological research to explain complex phenomena within the treatment environment, and also clarified directions of the relationships between constructs that make up the broader frameworks and models. In turn, the combination of the theories used in this study can help us to build stronger interventions (i.e., implementation strategies) for integrating TBI screening into these settings (National Cancer Institute, 2005). The use of these theories to bridge proximal to distal outcomes is also a strength of this study because the results clarified the *why* (intentions) and the *how* (behaviors) of the causal process leading to TBI screening adoption (Lewis et al., 2018). Furthermore, although the results from Aim 2 did not demonstrate a significant effects between implementation outcomes (i.e., acceptability, feasibility, and appropriateness on adoption), this study is one of the first to test possible relationships between implementation outcomes, which leads us one step closer to distinguishing between these outcomes and determining if these outcomes are conceptually distinct or should be combined (Proctor et al., 2011).

Another strength of this dissertation was the use of structural equation modelling (SEM). SEM allows for multiple regressions to be tested together, removes measurement error, and allows for testing of latent constructs. The study would have been limited had path analysis been used, which can only test manifest variables rather than latent constructs. It also would have been limited had a basic multiple regression been used because causal paths between constructs cannot be ascertained. Finally, the heterogeneity of the sample of behavioral health providers (i.e., social worker, counselors, and psychologists) and behavioral health contexts allows for broader perspectives about attitudes, beliefs, and barriers to TBI screening adoption, which allows for generalizability of the results.

Study Limitations

This study has several limitations. First, although the heterogeneity of the sample is a strength, it can also limit our understanding about determinants affecting adoption within specific types of behavioral health settings. First, the actions (i.e., roles and responsibilities) and actors (i.e., leaders, providers, clients) within private practice settings inherently differ from domestic violence settings, prison settings, or community-based clinic settings, for example, which may affect the extent to which TBI screening is adopted (Presseau et al., 2019). In addition, the barriers to TBI screening adoption, as well as the attitudes, norms, and perceived behavioral control are likely to also differ between contexts. This may have been one reason why attitudes and norms had a significant effect on adoption, but perceived behavioral control did not. It is possible that all three may have had an effect in one type of setting, but not in another. Therefore,

future research could investigate differences in determinants across settings. This is significant because the implementation strategies used to increase the uptake of TBI screening may therefore be more effective in one context over another. Another limitation was the sampling frame, which required that four different data sources be used to collect enough data to reach sufficient power for statistical modelling. With the different samples, the descriptive analyses did demonstrate significant differences between provider characteristics, and on some of the main study constructs. Again, the heterogeneity of the types of providers and behavioral health settings that make up these contexts could be one reason for these differences, or the fact that some samples consisted of providers primarily from Ohio versus providers from across the United States where attitudes, norms, and beliefs may be affected by other factors not controlled for in this study. A larger sample of providers from throughout the United States may have generated different outcomes, and therefore future studies should replicate these findings with a broader sample. Another limitation is voluntary response bias. It is possible that providers who elected to participate in this study already had an interest in TBI which negates perspectives of providers with no vested interest, or it could leave out providers who are already implementing the OSU TBI-ID and their perspectives on why they chose to adopt the screening. Similarly, the self-report nature of the study, where providers were asked to recall the number of TBI screens conducted over the previous month between the Time 1 and Time 2 surveys, could have resulted in under or overestimation of the actual number of TBI screens conducted. Future research should prospectively track the number of TBI screens conducted in real time to gain a more

accurate picture of behaviors. A limitation also existed with regards to attrition bias. Specifically, some statistically significant differences existed on certain demographic characteristics between participants who completed only the Time 1 survey compared with participants who completed both the Time 1 and Time 2 surveys. Specifically, differences were observed on the number of Licensed Professional Counselors who participated in both surveys, as well as differences between providers employed in private practice settings, hospital-based inpatient settings, and managed care organizations. It is possible that these providers self-selected out of the study at the second time point because they believed that TBI screening is not relevant to their clients or practice settings. See Appendix D.

Another possible limitation is desirability bias, which could have explained why providers generally rated their responses on the TBPQ-TBI, AIM, IAM, and FIM as relatively high. This could have also explained some of the discrepancy in provider's qualitative appraisal of the TBI screening, which was positive overall, and the low adoption rates demonstrated in the study. Furthermore, although the structural model demonstrated that intentions did predict behaviors, providers explained having little actual intentions to conduct screening.

Another limitation is that the TBPQ-TBI measure had to be created from previous measures in the literature, which were also created for their respective studies. Because a standardized measure does not exist for the Theory of Planned Behavior (Ajzen, 2019), the items used for this study had to be generated independently. However, the CFA did help to establish a strong measurement model prior to testing the full SEM. Nonetheless,

future studies could begin to establish a more common measure to be used in research applying this theory. Similarly, the AIM, IAM, and FIM may not have fully capture participants perspectives. Currently, the rating scale of 1 to 5 may limit perspectives to a stricter range, and the lack of a cut-point differentiating possible ‘low,’ ‘moderate,’ or ‘high’ levels of acceptability, feasibility, and appropriateness leaves interpretation of these levels open to the individual researcher. Furthermore, when looking at the specific items on these measures as well as synonyms for acceptability (one of which is appropriateness), questions still exist as to how conceptually distinct these two constructs are from each other. Questions also exist as to how conceptually distinct attitudes are from these constructs. Although a simple multiple regression demonstrates no multicollinearity exists between attitudes, acceptability, feasibility, the way in which these constructs are operationalized and conceptualized may be unclear across studies. Therefore, future measurement development should be done to help improve the delineation between these constructs.

Directions for Future Research

Several areas for future research can build upon the results, implications, and limitations of this study. First, additional research is needed to investigate how contextual factors may differ between specific types of behavioral health organizations on the adoption of TBI screening. Previous research has demonstrated differences in contextual factors within and between organizational settings (Glisson et al., 2007; Li et al., 2018; Weiner et al., 2011). Therefore, the way in which contexts differ between domestic violence agencies, prisons, and community-based substance use treatment organizations,

for example, will also differ and likely affect the uptake of TBI screening. While this study investigated characteristics of providers and the TBI screening innovation across a range of behavioral health organizations, which helped to generate an base of initial evidence, future research is needed to understand how these characteristics differ between the types of organizations. Similarly, the barriers identified were collected and analyzed across organizations, however, barriers to TBI screening adoption clearly differed based on the type of behavioral health organization (i.e., public versus private), which warrants the need for deeper investigations of the barriers within each type of organization. This, in turn, will help to guide more precise selection of implementation strategies tailored to these contexts. Second, the implementation strategies selected based on the results of this study, as well as the hypothesized mechanisms and implementation outcomes should also be tested to determine which strategy is most effective and in which context. Testing the effectiveness of implementation strategies and their mechanisms of action is still in its infancy (Lewis et al., 2021; Powell et al., 2019). Testing these strategies and mechanisms is critically needed to advance the field of implementation science to improve strategy generalizability across settings and EBPS, cost-effectiveness of strategies, and sustainment of both the strategy and the EBP. Future research is also needed to improve upon the current measures available in implementation science and behavior theory research. Although approximately 150 measures exist to study implementation outcomes, many of these measures are either not easily adaptable across EBPs or their psychometric properties are inadequate (Metttert et al., 2020). Furthermore, despite the common use of the Theory of Planned Behavior in social work and other social sciences research, a

single, adaptable, psychometrically sound measure does not exist, thereby leaving it to the researcher to develop a measure for each new study as it applies to the behavior in question. In turn, this likely has an effect on the study outcomes. Future research is sorely needed to improve both implementation science measures and measures guided by theory-based constructs.

Conclusions

This is the first study to investigate implementation of TBI screening in behavioral healthcare settings, which represents a critical shift in the way in which traditional TBI research has been conducted. Specifically, this study helps to translate the EBPs that currently exist for TBI by closing the research-to-practice gap using implementation science. This study also represents the first step in advancing an overall implementation science research agenda by testing theory-driven constructs as mediators and moderators on implementation outcomes (Lewis et al., 2021). The results from this study lay a critical foundation in the identification of implementation strategies that span Characteristics of Individuals, Outer-Setting, Inner-Setting, and Process domains which can be used in practice and policy efforts, as well as tested in future research that will build upon this work.

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**Appendix A: Theory of Planned Behavior Questionnaire for Traumatic Brain
Injury Screening (TBPQ-TBI)**

Theory of Planned Behavior Questionnaire for Traumatic Brain Injury Screening (TBPQ-TBI)

Response Scale: 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neither agree nor disagree, 5 = Somewhat agree, 6 = Agree, 7 = Strongly agree

Items are averaged for a total score.

* Denotes item was removed in the confirmatory factor analysis due to poor factor loading.

[Description provided to participants]

Please rate how much you agree or disagree with the following statements. Some questions may sound redundant; this is intentional.

I. Attitudes (Higher scores = more favorable attitudes)

1. Screening for TBI using the OSU TBI-ID is within my scope of practice.
2. Using the OSU TBI-ID fits with the way I work.
3. Screening for TBI using the OSU TBI-ID fits with my practice preferences.
4. Using the OSU TBI-ID in assessments or treatment sessions with my clients is a good idea.
5. I would enjoy using the OSU TBI-ID in my practice.
6. *Screening for TBI using the OSU TBI-ID with my clients would require minimal mental effort on my part.
7. It is easy for me to become skillful in using the OSU TBI-ID.
8. *I find the OSU TBI-ID easy to use.
9. Screening for TBI using the OSU TBI-ID is worth the effort.
10. *Screening for TBI using the OSU TBI-ID adds something beyond what my conventional assessment, diagnosis, or treatment approach could offer my clients.
11. *Screening for TBI using the OSU TBI-ID is necessary in my practice.
12. Using the OSU TBI-ID to screen for TBI will result in improved outcomes for my clients.
13. I like the idea of using the OSU TBI-ID with my clients.

II. Subjective Norms (Higher scores = more positive norms)

1. Those whose opinions I value would prefer that I screen for TBI using the OSUTBI-ID with my clients.
2. My colleagues think I should use the OSU TBI-ID to screen for TBI with my clients.
3. I feel that I am keeping up with my colleagues by using the OSU TBI-ID with my clients.
4. *My supervisor thinks I should use the OSU TBI-ID with my clients.
5. *I will have to use the OSU TBI-ID in my practice because my supervisor requires it.

III. Perceived Behavioral Control (Higher scores = greater perceived behavioral control)

1. I am confident that I could screen for TBI using the OSU TBI-ID with new and/or established clients over the next month.
2. I have the knowledge to make use of the OSU TBI-ID in my assessments or treatment sessions.
3. I can screen for TBI using the OSU TBI-ID with my clients if I choose to.
4. *I have a lot of control in my daily practice over whether I use the OSU TBI-ID with my clients.
5. *I have access to the resources and opportunities I need to use the OSU TBI-ID.

IV. Intentions (Higher scores = greater intentions)

1. It is likely that I will use the OSU TBI-ID to screen for TBI in my practice with clients over the next month.
2. I intend to use the OSU TBI-ID in my practice with clients over the next month.
3. Chances are that I will use the OSU TBI-ID in my practice with clients over the next month.

VI. Behaviors

1. How many new clients sought services from you over the last month?
2. How many new clients did you screen for TBI using the OSU TBI-ID over the last month?
3. How many returning clients sought services from you over the last month?
4. How many returning clients did you screen for TBI using the OSU TBI-ID over the last month?

Appendix B: Acceptability of Intervention Measure (AIM), Feasibility of Intervention Measure (FIM), and Intervention Appropriateness Measure (IAM)

Acceptability of Intervention Measure (AIM), Feasibility of Intervention Measure (FIM), and Intervention Appropriateness Measure (IAM)

Response Scale: 1 = Completely disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Completely agree
Items are summed for a total score.

[Description to participants]

Please rate how much you agree or disagree with the following statements. Some questions may sound redundant; this is intentional.

I. Appropriateness of the OSU TBI-ID

1. Screening for TBI using the OSU TBI-ID meets my approval.
2. Screening for TBI using the OSU TBI-ID is appealing to me.
3. I like the OSU TBI-ID screening method.
4. I welcome the OSU TBI-ID screening method.

II. Feasibility of the OSU TBI-ID

1. Screening for TBI using the OSU TBI-ID seems implementable.
2. Screening for TBI using the OSU TBI-ID seems possible.
3. Screening for TBI using the OSU TBI-ID seems doable.
4. The OSU TBI-ID seems easy to use.

III. OSU TBI-ID Appropriateness

1. The OSU TBI-ID seems fitting to my work.
2. The OSU TBI-ID seems suitable to my work.
3. The OSU TBI-ID seems applicable to my work.
4. The OSU TBI-ID seems like a good match to my work.

Appendix C: Qualitative Interview Guide

Qualitative Interview Guide

[Opening script]

Thank you for participating in today's interview. We are here today to better understand the processes, barriers, and facilitators to implementing traumatic brain injury (TBI) screening in behavioral health treatment settings, and particularly within your organization or setting. Specifically, we are interested in understanding your thoughts and beliefs about implementing the Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID) in your setting. By gathering this information, we hope to develop strategies to improve TBI screening within behavioral healthcare. This interview is anticipated to take about one hour to complete. There are no right or wrong answers. We are interested in your personal experiences. Do you have any questions before I begin?

I would like to audio-record this interview with your permission. Do you agree to participate in this audio recorded interview? Participant will agree or deny. If participant agrees say, "Great! I am going to turn on the recorder. [Turn recorder on and begin the interview]. If participant does not want to be audio-recorded say, "Ok, I will not turn on the recorder." [Proceed to the first interview question.]

[Interview start]

The first set of questions I am going to ask you are related to your personal beliefs and opinions about screening for TBI using the OSU TBI-ID.

I. Characteristics of Individuals (Theory of Planned Behavior Constructs)

1. Attitudes:

- a. Regardless of whether or not you used the OSU TBI-ID in your work, what are your thoughts about screening for TBI using the OSU TBI-identification method in your practice?

2. Perceived behavioral control:

- a. How confident were you in using the OSU TBI-ID screening method to screen for TBI with your clients following the video module?
- b. How easy or difficult was it to use the OSU TBI-ID to screen for TBI with your clients? Please explain.

- i. **Probe:** If you did not use the OSU TBI-ID, what were some of the reasons why you did not use it? Please explain.
- c. What would help to support you in implementing the OSU TBI-ID in your work?

3. Norms:

- a. What are the expectations in your practice setting or organization about implementing new interventions?
 - i. **Probe:** How do you think the OSU TBI-ID would fit into these expectations?
 - ii. **Probe:** Do you think this screening method is something that your colleagues or agency leaders would like to see implemented? Why or why

4. Intentions

- a. When you were first introduced to this TBI screening method, what were your plans to try to use this screening method with your clients to screen for TBI? Please explain.

II. Appropriateness, Acceptability, and Feasibility (Diffusions of Innovations Theory)

- a. Please describe the types of clients you work with.
- b. What is the extent to which you believe this screening method is appropriate to use with your clients? Please explain.
 - i. **Probe:** Would you find any advantages to using this intervention with your clients? Please explain.
 - ii. **Probe:** To what extent do you believe screening for TBI using this method would improve your treatment or intervention decisions with clients?
- c. To what extent do you find the OSU TBI-ID to be acceptable to implement in your setting? Please explain.
 - i. **Probe:** Do you believe *clients* would find it acceptable to be screened for TBI? Why or why not?

- d. [If the participant *DID* screen for TBI]: To what extent did you find this screening method feasible to implement?
 - i. **Probe:** What facilitated your use of the OSU TBI-ID in your work?
- e. [If the participant *DID NOT* use the screening method]: Would you find this to be a feasible method for screening for TBI in your practice? Please explain.

III. Closing

What were the barriers you faced to implementing the OSU TBI-ID in your practice?

Are there any other questions that we did not ask that we should have asked?

Is there anything else you would like to discuss about TBI screening or the OSU TBI-ID that we did not already discuss?

Thank you for your time and participation!!!!

Appendix D: Sample Characteristics of Participants from Phase I

Table D.1.

Participant Characteristics for Each Sub-Sample

	Total (N = 215)	Sample 1 (n = 15)	Sample 2 (n = 23)	Sample 3 (n = 130)	Sample 4 (n = 47)	Range	<i>p</i> ^a	Effect size ^b
	N	n (%)	n (%)	n (%)	n (%)			
Age Group							0.18	0.28
18 – 24	4 (1.9)	0 (0.0)	0 (0.0)	4 (3.1)	0 (0.0)			
25 – 34	45 (21.2)	2 (13.3)	4 (18.2)	33 (25.6)	6 (13.0)			
35 – 54	97 (45.8)	6 (40.0)	15 (68.2)	57 (44.2)	19 (41.3)			
55 – 65	49 (23.1)	5 (33.3)	3 (13.6)	25 (19.4)	16 (34.8)			
> 65	17 (8.0)	2 (13.3)	0 (0.0)	10 (7.8)	5 (10.9)			
Gender							0.89	0.10 ^f
Female	181 (85.4)	13 (86.7)	20 (90.9)	111 (86.0)	37 (80.4)			
Male	30 (14.2)	2 (13.3)	2 (9.1)	17 (13.2)	9 (19.6)			
Nonbinary	1 (0.5)	0 (0.0)	0 (0.0)	1 (0.8)	0 (0.0)			
Race/Ethnicity							0.02*	0.37 ^g
Caucasian or White	176 (81.9)	12 (80.0)	18 (78.3)	114 (87.7)**	32 (68.1)**			
African American or Black	16 (7.4)	3 (20.0)	1 (4.3)	8 (6.2)	4 (8.5)			
Multi-Racial	11 (5.1)	0 (0.0)	1 (4.3)	4 (3.1)	6 (12.8)			
Hispanic or Latinx	6 (2.8)	0 (0.0)	1 (4.3)	1 (0.8)**	4 (8.5)**			
Asian or Pacific Islander	2 (0.9)	0 (0.0)	0 (0.0)	2 (1.5)	0 (0.0)			
Other ^c	4 (1.8)	0 (0.0)	2 (9.5)	1 (0.8)	1 (2.2)			
Highest Level of Education							0.09	0.17 ^f
Masters or Doctorate	166 (78.3)	14 (93.3)	21 (91.3)	99 (77.3)	32 (69.6)			
Associates or Bachelors	46 (21.7)	1 (6.7)	2 (8.7)	29 (22.7)	14 (30.4)			

Continued

License Type							
LSW	58 (27.0)	4 (2.7)	3 (13.6)	48 (36.9)**	3 (6.4)**	< .01	0.30 ^g
LISW-S	47 (21.9)	4 (2.7)	2 (9.5)	35 (26.9)	6 (12.8)	0.08	0.18 ^f
LPC	24 (11.2)	1 (6.7)	7 (30.4)**	4 (3.1)**	12 (25.5)	< .01	0.36 ^g
LISW or LCSW	23 (10.7)	3 (20.0)	2 (9.5)	15 (11.5)	3 (6.4)	0.48	0.12 ^f
LICDC	22 (10.2)	2 (13.3)	1 (4.3)	14 (10.8)	5 (10.6)	0.78	0.07 ^f
LPCC or LPCC-S	19 (8.8)	1 (6.7)	4 (21.1)	13 (10.0)	1 (2.1)	0.17	0.15 ^f
LCDC-II or LCDC-III	16 (7.4)	1 (6.7)	2 (9.5)	3 (2.3)**	10 (21.2)**	< .01	0.29 ^f
CDCA	12 (5.6)	1 (6.7)	0 (0.0)	6 (4.6)	5 (10.6)	0.27	0.14 ^f
LP	6 (2.8)	1 (6.7)	4 (18.2)**	0 (0.0)**	1 (2.1)	< .01	0.33 ^g
LACDC	4 (1.9)	0 (0.0)	0 (0.0)	0 (0.0)	4 (8.5)	< .01	0.26 ^f
Other ^d	27 (12.6)	1 (6.7)	0 (0.0)	5 (3.8)**	15 (31.9)**	< .01	0.42 ^g
Behavioral Health Setting						0.02*	0.51 ^h
Private practice	57 (26.5)	7 (46.7)**	14 (60.9)	22 (16.9)**	14 (29.8)		
Community-based outpatient treatment clinic	55 (25.6)	2 (13.3)	4 (17.4)	36 (27.7)	13 (27.7)		
Hospital-based outpatient services	26 (12.1)	3 (20.0)	2 (8.7)	14 (10.8)	7 (14.9)		
Prison/jail	12 (5.6)	1 (6.7)	0 (0.0)	9 (6.9)	2 (4.3)		
School-based behavioral health	11 (5.1)	0 (0.0)	0 (0.0)	11 (8.5)	0 (0.0)		
Hospital-based inpatient services	9 (4.2)	0 (0.0)	0 (0.0)	8 (6.2)	1 (2.1)		
Child welfare agency	9 (4.2)	0 (0.0)	0 (0.0)	9 (6.9)	0 (0.0)		
Residential treatment facility	8 (3.7)	0 (0.0)	1 (4.3)	3 (2.3)	4 (8.5)		
Senior services	5 (2.3)	1 (6.7)	0 (0.0)	4 (3.1)	0 (0.0)		
Managed care organization	4 (1.9)	0 (0.0)	0 (0.0)	3 (2.3)	1 (2.1)		
Developmental disability services	4 (1.9)	0 (0.0)	0 (0.0)	4 (3.1)	0 (0.0)		
Public health agency	3 (1.4)	0 (0.0)	0 (0.0)	3 (2.3)	0 (0.0)		

Other ^e	12 (5.6)	1 (6.7)	2 (8.7)	4 (3.1)	5 (10.6)			
Years worked as a behavioral health provider (M, SD)	14.13 (10.20)	14.93 (11.15)	12.80 (7.41)	14.21 (11.07)	14.30 (8.66)	< 1 – 45	0.92	0.002 ^f
Years worked at the current organization (M, SD)	7.09 (7.57)	7.43 (9.46)	6.24 (4.89)	7.40 (8.07)	6.53 (6.61)	< 1 – 40	0.85	0.004 ^f

^a P-values are based on χ^2 tests or Fisher's exact test for categorical variables or One-way ANOVA for continuous variables.

^b Effect sizes are based on Phi values for categorical variables or eta-squared for continuous variables.

^c Other Race = chose not to disclose or preferred not to answer.

^d Other license includes Licensed Marriage and Family Therapist, Licensed Independent Marriage and Family Therapist, Licensed Alcohol and Drug Counselor, Certified Addiction Counselor-III, National Certified Addiction Counselor-II, Substance Use Disorder Professional, Certified Independent Professional, Certified Addiction Specialist, Credentialed Alcoholism and Substance Abuse Counselor, Person-Centered Case Manager, Licensed Mental Health Counselor, Licensed Clinical Addiction Specialist, Licensed Addiction Specialist, Certified Brain Injury Specialist, Master Addiction Counselor, Licensed School Counselor, Registered Nurse, Certified Community Health Worker.

^e Other organizations include primary care, military-based treatment setting, homeless shelter, community outreach and crisis center, affordable housing agency, employee assistance program, domestic violence shelter, local government authority, university academic medical institute, and professional ice hockey organization.

^f Small effects

^g medium effect

^h large effect

* Significant at the $p < .05$ level

** Post-hoc analyses demonstrated significant differences at the $p < .05$ level

**Appendix E: Descriptive Statistics of the Constructs from the Theory of Planned
Behavior by Sub-Sample**

Table E.1.

Descriptive Statistics of the Constructs from the Theory of Planned Behavior by Sub-Sample

	Total (N = 215)	Sample 1 (n = 15)	Sample 2 (n = 23)	Sample 3 (n = 130)	Sample 4 (n = 47)	<i>p</i>	Effect size
	M (SD) ^a	M (SD)	M (SD)	M (SD)	M (SD)		
Attitudes	5.57 (0.92)	5.15 (0.71)**	5.86 (0.90)	5.47 (0.91)	5.85 (0.93)**	0.01*	0.05 ^b
Subjective norms	2.99 (0.92)	2.71 (0.81)	3.06 (0.81)	2.95 (0.91)	3.18 (1.01)	0.29	0.02 ^b
Perceived behavioral control	4.42 (1.17)	3.67 (1.26)**	5.03 (0.76)**	4.23 (1.16)**	4.81 (1.11)**	< .001*	0.09 ^c
Intentions	3.34 (1.51)	2.80 (1.55)**	4.22 (1.08)**	3.08 (1.52)**	3.82 (1.38)**	< .001*	0.09 ^c

^a Scores range from 1 – 6.

^b Small effect.

^c Moderate effect.

Note: Effect sizes are based on eta-squared for One-way ANOVA.

* $p < .05$

** Denotes where differences occurred.

**Appendix F: Descriptive Statistics of the Constructs from Diffusions of Innovations
Theory by Sub-Sample**

Table F.1.

Descriptive Statistics of the Constructs from Diffusion of Innovations Theory

	Total (N = 215)	Sample 1 (n = 15)	Sample 2 (n = 23)	Sample 3 (n = 130)	Sample 4 (n = 47)	<i>p</i>	Effect size
	Sum (SD) ^a	Sum (SD)	Sum (SD)	Sum (SD)	Sum (SD)		
Acceptability ^a	16.50 (2.50)	15.67 (2.29)	16.65 (2.89)	16.53 (2.91)	16.62 (2.91)	0.60	0.01 ^d
Feasibility ^b	16.07 (2.48)	15.93 (2.37)	16.09 (2.84)	15.96 (2.42)	16.38 (2.54)	0.79	0.01 ^d
Appropriateness ^c	14.78 (3.56)	13.87 (3.98)**	15.61 (3.49)	14.25 (3.51)	16.09 (3.22)**	0.01	0.05 ^d

^a Scores range from 9 – 20.

^b Scores range from 10 – 20.

^c Scores range from 4 – 20.

^d Small effect.

Note: Effect sizes are based on eta-squared for One-way ANOVA.

* $p < .05$

** Denotes where differences occurred.

Appendix G: Test of Attrition Bias Between the Time 1 Only Sample and the Final Analytical Sample

Appendix G.1.

Differences in Demographics Between the Analytic Sample and the Time 1 Only Sample

	Time 1 only (N = 288)	Time 1 + 2 (N = 215)	p^a	Effect size ^b
	N (%)	N (%)		
Age Group			0.91	0.06
18 – 24	6 (2.0)	4 (1.9)		
25 – 34	63 (21.9)	45 (21.2)		
35 – 54	131 (45.5)	97 (45.8)		
55 – 65	64 (22.2)	49 (23.1)		
> 65	21 (7.3)	17 (8.0)		
Gender				
Female	243 (84.4)	181 (85.4)	0.69	0.05
Male	39 (13.5)	30 (14.2)		
Nonbinary	2 (0.6)	1 (0.5)		
Race/Ethnicity			0.53	0.13
Caucasian or White	236 (81.9)	176 (81.9)		
African American or Black	22 (7.6)	16 (7.4)		
Multi-Racial	1 (0.3)	11 (5.1)		
Native American	1 (0.3)	0 (0.0)		
Hispanic or Latinx	8 (2.8)	6 (2.8)		
Asian or Pacific Islander	3 (1.0)	2 (0.9)		
Other	6 (2.0)	4 (1.8)		
Highest Level of Education			0.65	0.03
Masters or Doctorate	219 (76.0)	166 (78.3)		
Associates or Bachelors	63 (21.9)	46 (21.7)		
License Type				
LSW	76 (26.4)	58 (27.0)	0.70	0.02
LISW-S	58 (20.1)	47 (21.9)	0.21	0.07
LPC	26 (9.0)	24 (11.2)	0.03*	0.13
LISW or LCSW	30 (10.4)	23 (10.7)	0.79	0.02
LICDC	25 (8.7)	22 (10.2)	0.12	0.09
LPCC or LPCC-S	27 (9.4)	20 (9.3)	0.94	0.00
LCDC-II or LCDC-III	20 (6.9)	16 (7.4)	0.57	0.03
CDCA	14 (4.9)	12 (5.6)	0.33	0.06
LP	9 (3.1)	6 (2.8)	0.58	0.03
LACDC	6 (2.0)	4 (1.9)	0.64	0.03

Continued

Other	33 (11.5)	22 (10.2)	0.26	0.07
Behavioral Health Setting			0.01*	0.31
Private practice	68* (23.6)	57 (26.5)*		
Community-based outpatient treatment clinic	74 (25.7)	55 (25.6)		
Hospital-based outpatient services	34 (11.8)	26 (12.1)		
Prison/jail	16 (5.6)	12 (5.6)		
School-based behavioral health	13 (4.5)	11 (5.1)		
Hospital-based inpatient services	19 (6.7)*	9 (4.2)*		
Child welfare agency	9 (3.1)	9 (4.2)		
Residential treatment facility	14 (4.9)	8 (3.7)		
Senior services	5 (1.7)	5 (2.3)		
Managed care organization	9 (3.1)*	4 (1.9)*		
Developmental disability services	7 (2.4)	4 (1.9)		
Public health agency	3 (1.0)	3 (1.4)		
Other	16 (5.6)	12 (5.6)		
Years worked as a behavioral health provider (M, SD)	13.97 (10.25)	14.13 (10.20)	0.66	.06
Years worked at the current organization (M, SD)	7.10 (7.47)	7.09 (7.57)	0.98	0.00