Using Digital Technologies to Support Populations with Trauma: Building a Case for Healing-Centered Engagement Online

By

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Abstract

Over 50 million individuals in the U.S. struggle with mental illness, with the burden being higher among marginalized groups, such as those with substance use disorders, elders and racial and ethnic minorities. Scholars are investigating information-communication technologies (ICT) to reduce mental health disparities. However, many of these groups also suffer a high trauma burden and ICTs don't often account for the impact this trauma may have on engagement with the intervention and intervention effects. This dissertation aims to build the case for utilizing trauma-informed and healing-centered practices in ICTs for marginalized populations with trauma history and mental health morbidity. Study 1 and study 2 demonstrate potential adverse outcomes of ICT use on three marginalized populations, depressed elders, socially isolated elders and individuals with opioid use disorder. Healing-centered and trauma-informed care can help guide interventions for these groups and reduce the potential harms. However, no current model or best-practice exists on how to design or implement trauma-informed practices online. Thus, study 3 proposes a model for healing-centered engagement online. It also applies this model to online messaging on an ICT for opioid use disorder and investigates its association with online engagement. Moderator messages on the ICT were only somewhat healing-centered and some healing-centered principles were related to increased engagement while others were associated with decreased engagement. Future directions and implications are discussed. The final chapter provides examples of healing-centered messages from a social media intervention to improve COVID-19 information for Black, LatinX, and Native American populations and provides key principles for the design and implementation of trauma-informed and healing-centered digital interventions. In order to design equitable interventions, public health practitioners and health communication scholars should incorporate more trauma-informed and healing-centered approaches.

Dedication

I would like to dedicate this dissertation to my support system - my husband and children, parents, siblings, extended family, church family, community family, and research family. They encouraged me, pushed me, stayed awake with me, prayed for me, brainstormed with me, never allowed me to give up, and helped pave a path for me through the unforgettable challenges of this journey.

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Chapter 1

Using Digital Technologies to Support Marginalized Populations with Trauma:

Building a Case for Healing-Centered Engagement Online

Introduction

Almost one in five U.S. adults (51.5 million Americans) live with mental illness (Substance Abuse and Mental Health Services Administration, 2019). In 2019, American Indian and Alaskan Natives reported the second highest prevalence of a serious mental health illness and in 2015, suicide rates among this group were reported as 21.5 per 100,000 people (Leavitt, 2018; Substance Abuse and Mental Health Services Administration, 2019). According to the National Institute of Mental Health, the prevalence of mental health illness is highest among adults reporting two or more races (SAMHSA, 2019). Further, in 2019, 16.3 million adults over 50 reported having a mental health illness in the past year, and 9.5 million Americans had both a mental health illness and a substance use disorder (Substance Abuse and Mental Health Services Administration, 2019). This data was taken before the COVID-19 pandemic, which led to over 382,892 deaths in 2020 and forced the global population into isolation, drastically increasing the number of children and adults experiencing these and other traumatic events known to be associated with mental illness (CDC, 2021; Friis-Healy et al., 2021; Mukhtar, 2020; Rauschenberg et al., 2021). In addition, racial and ethnic minority groups and elders were more likely to contract severe COVID-19 and suffered higher incidences of COVID-19-associated mortality (Berg-Weger & Morley, 2020; Tai et al., 2021).

The burden for mental health morbidity is only increasing, as are suicide rates and serious mental health illnesses (Leavitt, 2018; SAMHSA, 2019; Substance Abuse and Mental Health Services Administration,

2019). In 2019, 43.8% of adults that had a mental health illness and believed they needed services, did not receive mental health services (Substance Abuse and Mental Health Services Administration, 2019). Further, vulnerable and marginalized populations, such as racial and ethnic minorities, adults over 65, those with substance use disorders and those with mental health illness, disproportionately suffer higher incidences of lifetime traumatic stressors, like financial strain, racism, extreme poverty and social stigma and are more likely to have a history of adverse childhood experiences, all known to increase mental health morbidity and mortality (Y. Kim et al., 2021; Larkin et al., 2017; Rhee et al., 2019a; Sacks & Murphey, 2018). These groups are some of the least likely to utilize mental health services(Barnett et al., 2018; Maura & Weisman de Mamani, 2017; Sagar-Ouriaghli et al., n.d.; Substance Abuse and Mental Health Services Administration, 2019).

Based on the DSM and prior work, lifetime traumatic stressors (also referred to as traumatic events) are defined as events or circumstances involving "actual or threatened death or serious injury or a threat to the physical integrity of self or others" (Dailey et al., 2011; Dennis et al., 2009). These circumstances can occur at any point in one's lifetime. This includes events experienced directly or indirectly, through witnessing or learning after the fact, and can consist of various events, such as violent crimes, sexual abuse, divorce, and disasters (Dailey et al., 2011). SAMHSA indicates that trauma results from an event, series of events, or set of circumstances experienced as physically harmful, emotionally harmful, or threatening that has adverse effects on an individual's functioning, physical well-being, social and emotional well-being, or spiritual well-being (SAMHSA, 2014).

Scholars are looking to innovative technologies, such as information communication technologies (ICTs) and other digital technologies as a means to address the health disparities and mental health burden among these groups (Ralston et al., 2019; Schueller et al., 2019). However, technology interventions

seeking to improve health in these groups don't often account for the impact trauma and poor mental health has on changing health behavior and/or the ability to interact with an intervention (Schueller et al., 2019). Further, the theoretical frameworks and models that guide health communication interventions for these groups largely ignore trauma as an instrumental factor and if included, may only view trauma as an individual, clinical experience rather than a collective experience, as is the case among many populations, especially racial and ethnic minorities.

These groups with a higher mental health burden may not experience communication technologies in the same way as other groups and may use the different affordances of these technologies in ways that have differential implications for health. In today's era, marginalized groups have been using media and technology as a means of empowerment for the group to construct a collective identity in ways that may have meaningful effects on individual mental health, as in the case of Black Twitter and the recent #metoo movement (T. A. Hunt, 2017; Williams, 2017) . Despite multiple positive examples of the ways in which marginalized groups can derive benefits from the use of technology for health, studies also point to potential negative implications of social media and other digital tools for vulnerable populations, such as youth with depression or eating disorders (Basterfield et al., 2018; Ralston et al., 2019; Satici & Uysal, 2015; Stowell et al., 2018). Additional research is needed to understand the ways in which technology systems may be impacting individual mental health among populations that are more vulnerable and/or suffer a higher mental health burden as a way to start building guiding principles and standards for the design and implementation of health technologies for these groups.

Given that marginalized populations suffer a higher trauma burden and mental health morbidity than other groups, I propose in this dissertation that as we design equitable interventions to improve health disparities, scholars should include some form of trauma-informed and/or healing-centered practice in

intervention design and implementation. Trauma-informed and healing-centered approaches are strength-based approaches that focus on promoting healing from prior trauma, an awareness of the systematic impact of individual and collective trauma and opportunities to re-build control and capacity individually and within a group (Bath, n.d.; J. Bulanda & Byro Johnson, 2016; Ginwright, 2021; Reeves, 2015). Very few, if any, communication technology interventions systematically apply trauma-informed practice to their approach, despite racial and ethnic minorities and other marginalized groups being at high risk for stressful life experiences.

Therefore, this dissertation's overarching goals are to build a case for the use of trauma-informed, healing-centered approaches in communication technology interventions targeting populations with high trauma or mental health burden and to provide prevention scientists and public health practitioners with practical examples of design interventions with a healing-centered approach. This dissertation will also present a model for utilizing healing-centered engagement in online communication interventions aimed at populations with a higher mental health burden.

I will accomplish the goals of this dissertation utilizing three studies. In the next section of this chapter, I will briefly review the literature surrounding the health communication theories and affordances that guide information-communication technology interventions to promote well-being, focusing on the factors to consider when engaging with marginalized populations and those with high trauma. I will touch on both research regarding positive and negative effects of communication technology on these populations. This will help guide our understanding of the ways in which we can design interventions to maximize benefit and minimize harm among populations with high trauma. Chapter 2 and 3 will further demonstrate need for this area of research by pointing to the potential adverse effects of two communication technology interventions. In Chapter 2, I will present study 1 investigating the effects of

Elder Tree, an ICT designed to improve the quality of life among older adults, on some of the most vulnerable elders, those who are clinically depressed and socially isolated. This chapter calls for more research regarding ways in which we can use digital affordances to reduce negative effects and increase support for vulnerable populations with high mental health burden.

Chapter 3 presents the results of study 2, which investigates the impact of message content and the moderator role on engagement among another marginalized population, those with opioid use disorder utilizing an ICT intervention. This study also demonstrates a need to improve support facilitation online among this highly stigmatized group. Chapter 4 starts this work by introducing a model for healing-centered engagement online and investigates (study 3) how healing-centered messages by moderators on the ICT for opioid use disorder may be impacting engagement online. I wrap up with overarching conclusions from all three studies and provide additional examples of healing-centered engagement from a case study, a COVID-19 social media intervention to reach three populations at higher risk for both trauma and COVID-19 morbidity and mortality (African Americans, Native Americans and LatinX). In this final chapter, I also present next steps for future research.

Literature Review

Theories of media, communication and public health have not been traditionally well=integrated to address the multiple ways in which media has and can impact mental and physical health. Traditionally, health communication and other media interventions have focused on physical health. However, with the rise of digital communication and differing ways in which online media has provided a refuge for those suffering from mental health issues, scholars have directed attention towards how media is affecting this stigmatized population (Clarke et al., 2015; Doherty et al., 2010; Schueller et al., 2019).

Adding to this, digital communication has given rise to new ways to combat the shortage of mental health providers and mental health services able to reach underserved and traditionally marginalized populations, such as racial and ethnic minority groups (Clarke & Yarborough, 2013). This has garnered much interest from public health professionals and other health systems practitioners in developing digital communication interventions for mental health. Digital communication interventions for public health, also referred to as digital health interventions or digital behavior change interventions, are interventions that utilize information and communication technologies to change health behavior and/or support health (Yeager & Benight, 2018). These technologies include behavioral intervention technologies, which typically refer to traditional behavioral and psychological interventions administered through technology. It also includes computer-mediated support systems, also referred to as information-communication technologies, administered via web-based applications (electronic Health/e-Health) or on mobile devices and other internet of things (IoT), mHealth (Mohr et al., 2013; Wright, 2015). mHealth interventions are defined as health interventions that utilize mobile devices, including smartphone and non-smartphone applications, such as SMS and voice interventions.

Despite this rise in scholarly interest, many digital communication interventions for public health still lack theoretically grounded communication (Mohr, Burns, Schueller, Clarke, & Klinkman, 2013) and media effects principles. Often interventions merely utilize online media as a platform to administer therapy without keen attention to the impact of the different affordances of said platform and how these may change well-being effects (Mohr et al., 2013; Mohr, Carmody, Erickson, Jin, & Leader, 2011; Wright, 2015). In fact, in a meta-analysis of mHealth interventions for vulnerable populations, out of the 83 papers studied, 55.42% did not report a theory grounding the intervention. The most commonly used theories included the Health Belief Model and the Transtheoretical Model (Stowell et al., 2018), common

public health models rather than media and communication models. Before we can fully understand and harness the impact of digital communication tools for the improvement of mental well-being, sharp attention needs to be placed on the theoretical underpinnings guiding possible effects so as to interrogate the ways we understand media effects in communication, sociology and public health.

Lanigan's socio-technological model proposes that technology shapes individuals and individuals shape technology (Lanigan, 2009). It stipulates that the different affordances and features of technology (e.g. accessibility, scope and obtrusiveness) impact our individual characteristics (e.g. goals, attitudes, etc.) and drive how we interact, communicate and form relationships, while our individual characteristics (e.g. demographics, personality etc.) affect what, how and why we use technology in the way we do (Lanigan, 2009). Our influence over technology, and its influence over us affect our relationships in our family and community, and this is all situated in the greater ecological framework of work, culture and other external factors.

Marginalized populations have unique characteristics and circumstances practitioners should account for when designing and implementing technologies. Many of these groups are traditionally stigmatized offline and experience high individual levels of self-stigma and low self-esteem (Lawlor & Kirakowski, 2014). The different affordances of technology (e.g. anonymity) make digital technologies more *accessible to* and *accessed by* these stigmatized populations compared to in-person well-being programs (Lawlor & Kirakowski, 2014). Further, these populations face both increased *individual* and *collective* trauma; technology provides a supportive space for these populations with higher levels of trauma (Carlson et al., 2017). However, as we situate this in the greater ecological framework of community and culture, not all groups have access or use digital technology and these spaces can also harmfully facilitate re-traumatization among these populations (Basterfield et al., 2018).

A. ICTs are Accessible to some but not all Marginalized Populations

Before we start designing technologies to support populations with trauma, practitioners should first assess how accessible the ICT intervention will be to the target population. In January 2019, there were over 4.4 billion internet users globally. However this equates to only a 57% internet penetration rate (We Are Social Inc. & Hootsuite, 2019). While some regions, such as North America, had an internet penetration rate of 95%, other regions such as Western Asia, the Caribbean and Middle Africa reported only 66%, 51% and 12% internet penetration rates respectively (We Are Social Inc. & Hootsuite, 2019). Thus there are still stark disparities that exist globally and one could argue some of the populations that need access the most are the ones in these regions lacking the infrastructure to facilitate increased penetration.

In the U.S., where the penetration rate is over 90% for some groups, internet access is still lower for non-Whites, those with lower education and income and those living in rural areas (Perrin & Duggan, 2015; Pew Research Center, 2019). Despite the internet being generally low cost, infrastructure prevents the internet from being accessible in many homes. For example, many Native American communities still lack the infrastructure to support widespread internet use (Du, 2017). In addition, an AARP study in 2010 on loneliness in older adults reported that 29% of individuals felt lonely because they do not have a computer in their home (AARP Research, 2010). Older adults also report some of the lowest internet usage rates with only 73% of older adults using the internet compared to 100% of 18-29 year olds (Seo et al., 2020).

According to PEW Research Center, African Americans are less likely to have home broadband access but they report high mobile phone usage (Smith, 2014a). For multiple marginalized populations, internet is

accessed via mobile phones and other platforms (Du, 2017; Pew Research Center, 2019). Therefore, practitioners should not only assess internet access but internet usage based on preferred platform (mobile app, desktop, tablet, web-based, video game, social media etc.) as different groups have different utilization rates (Pew Research Center, 2019). Other studies also report that Native Americans are more likely to utilize mobile phones to access the internet and are likely to use social media for connection and information access (Du, 2017; Wilson et al., 2017). For some groups, utilization rates are low across multiple platforms. For example, low-income Americans report lower usage of smartphones, desktops, laptops, home broadband or tablets than other groups (Anderson et al., 2019). Tablet use was the lowest with only 36% of those with an income of less than $30,000 having a tablet (Anderson et al., 2019). Other studies of low income African Americans also report low utilization of the internet and low use for health (Song et al., 2015). Intersectionality also exacerbates low utilization rates; low-income African American adults who are older with education levels less than high school report the least internet utilization rates (Seo et al., 2020).

It should be noted that having access to the internet does not mean that a population has high utilization rates. Utilization varies based on multiple factors including the affordances of the technology, the motivations of its users and individual level characteristics, such as literacy (Ramos & Chavira, 2019). Multiple studies report low eHealth and e-literacy among low-income African Americans, Native Americans and low-income African American older adults (Birru & Steinman, 2004; Du, 2017; Seo et al., 2020). Language can also be a barrier for other groups, such as Hispanics (Schueller et al., 2019). Doherty and colleagues point out the importance of literacy difficulties when designing mental health interventions. They report studies indicating problems interacting with the technology intervention

because of low literacy among participants, who were, in that case, adolescents with mental health issues (Doherty et al., 2010).

Further, in a study examining mobile phone literacy among 282 underserved patients, Kumar and colleagues found that about a quarter to a third of individuals switched phone numbers in the prior year, lost cell-phone service for a period or did not have an unlimited cell phone plan (Kumar et al., n.d.). Also, one third of participants did not use their phones for text messaging, a common proposed mHealth intervention for marginalized populations (Kumar et al., n.d.). Among this low-income population, the scholars attributed low mobile literacy as the reason for limited use of the phones beyond calling and texting. Despite having a smartphone, many individuals did not know how to use many of the aspects of their phones, such as apps and the internet. As expected, mobile literacy increased with higher education and decreased with older age. Participants also reported not being willing to subscribe to health text messages depending on the cost and their value (Kumar et al., n.d.). Consistent with other reports of health technology interventions in low-income, marginalized populations, these scholars cautioned against the risk of excluding highly underserved populations and exacerbating disparities when utilizing mobile phones as a health intervention tool (Kumar et al., n.d.; Song et al., 2015) .

Accessibility as an Affordance

Toma and colleagues examined how the use of social sharing for emotional well-being varied based on the affordances of media (Choi & Toma, 2014). In their study, they looked at accessibility as not only the cost of access and whether the internet is available but also the portability of the media and whether content can be accessed without the internet, so as to facilitate use when individuals need it most (i.e. real time and just-in-time access) (Choi & Toma, 2014). They argued for events that were particularly

triggering, such as traumatic experiences, individuals will want to share and interact with others close to when the event occurred; thus, the accessibility of the media as an affordance is critical (Choi & Toma, 2014). Text-based platforms, Twitter and cell-phones were the most accessible, since they do not require an internet connection, and blogs, Facebook and video-chat were the least accessible since they required internet and sometimes a desktop, at that time (Choi & Toma, 2014). Other affordances that impacted use of media for social sharing were the intrusiveness of the media, meaning whether a participant's daily activity is interrupted by the media in order to attend to it (intrusive media being phone calling and non-intrusive being Twitter or Facebook posts) or the richness of the media/availability of non-verbal cues (face to face being most rich, then phone calls, and lastly texting, Twitter etc.). Choi & Toma demonstrated that individuals experiencing a positive event preferred to share on accessible, non-intrusive media, such text or Twitter, and those experiencing a negative event preferred more intrusive and rich media, such as phone calling (Choi & Toma, 2014).

Given the accessibility of mobile phones, it is not surprising that multiple marginalized populations with a high trauma burden are more likely to utilize this medium to access the internet and social share, such as African Americans, Native Americans, refugee populations and even some studies of individuals with substance use disorders report 100% of the participants using smartphones to access the internet (Almohamed et al., n.d.; Baroni et al., 2019; Dekker et al., 2018; Du, 2017; Smith, 2014a). Other studies report that African Americans are more likely to utilize Twitter than other groups (Smith, 2014a). Though we can now access video-chat, Facebook and blogs via smartphones, usage requires high broadband internet speeds, thus they are still not as accessible to marginalized populations as other media.

Researchers are now examining disparities as they relate to high speed broadband internet access as certain features and affordances of digital technology, such as video chat, are not accessible to low

broadband internet users, no home broadband users or smartphones with limited capabilities (Anderson & Pew Research Center, 2018; Kalichman et al., 2002; Pew Research Center, 2019). One study of online health information seeking among 147 individuals living with HIV/AIDS who have access and use the internet, found that those individuals with no access to broad-band at home were not enrolled in any computer-mediated self-help groups. They also found that internet utilization was lowest among those with lower income and low education (Kalichman et al., 2002). Internet access at home was associated with higher email use, more HIV-related internet searches and computer-mediated self-help groups (Kalichman et al., 2002).

Since accessibility and use of high-speed internet among marginalized populations is still lower than other groups, scholars targeting these populations should look to interventions utilizing low-band or requiring no internet to function (Pew Research Center, 2019; Song et al., 2015). In a systematic review of 83 mHealth interventions for vulnerable populations, Stowell and colleagues found the device most commonly used was a cell-phone without internet access (Stowell et al., 2018). Further, multiple studies reviewed cited use of technology unfamiliar to the participants as a barrier to intervention implementation. Others reported lack of access to the technology outside the research setting as another barrier (Stowell et al., 2018). Participants also reported the prohibitive cost of cell phone plans and anxiety around operating the technology (Stowell et al., 2018). The most commonly reported facilitator for the success of the mHealth interventions was using technology participants were already familiar with (Stowell et al., 2018). Despite technology yielding many affordances, such as portability, ease of use and low cost, that make it accessible to many, for many marginalized populations, some technologies are still inaccessible. Thus, utilizing ICTs marginalized populations already access, afford and are comfortable with, will yield a higher possibility for success (Doherty et al., 2010). Understanding what affordances

make technology more likely to be accessed by marginalized populations is key in designing interventions with a greater chance of utilization by these groups.

B. Certain affordances increase ICT use by some Marginalized Populations and decrease use by others

Less than half of individuals with any mental health illness accessed mental health services in 2015 (American Psychiatric Association, 2017). Among racial and ethnic minorities, this was even lower with usage rates of 31% or less (American Psychiatric Association, 2017). Stigma was and is consistently reported as one of the barriers to receiving mental health care and is reportedly worse among minority communities (American Psychiatric Association, 2017; Lawlor & Kirakowski, 2014; McFarling et al., 2011). However, multiple marginalized populations report using ICTs to support their mental well-being and studies report preference for online support groups compared to in-person groups (Lawlor & Kirakowski, 2014; Yeshua-Katz et al., 2019). The affordances of ICTs have been critical in helping to lower the barrier to entry for marginalized populations and combat stigma (Lawlor & Kirakowski, 2014; Tanis, 2009).

Marginalized populations are defined here as groups of individuals that experience a state of disadvantage or are in a position of lower power as a result of being deemed different from others on some dimension of identity (Schueller et al., 2019). That dimension ranks them as an "outsider" or "outlier," as in the case of racial and ethnic minorities, sexual minorities or those with a mental illness (Schueller et al., 2019; Tanis, 2009). Marginalized populations often experience social stigma and/or oppression by the mainstream identity or dominant social group. This leads to these groups sharing stigmatized identities that can be categorized either as a conspicuous stigmatized identity, referring to an identity that cannot be hidden, such as gender, race, age or physical disability, or a concealable identity, referring to identities that cannot be easily identified (Tanis, 2009; Yeshua-Katz et al., 2019).

Since they can be hidden, concealable stigmatized identities are not revealed unless disclosed, like some mental health illnesses, sexual abuse history, trauma history, HIV/AIDS status, substance use, sexual minority status, political orientation and religious orientation (Andalibi et al., 2016; Tanis, 2009; Yeshua-Katz et al., 2019). Individuals with concealable identities are less likely to find others with a similar identity offline, especially since they are more likely to conceal their identity in offline interactions to prevent stigma (Tanis, 2009; Yeshua-Katz et al., 2019). These individuals are more likely to experience social isolation and reduced social support compared to individuals with conspicuous stigmatized identities (Yeshua-Katz et al., 2019). Though those with conspicuous stigma are more likely to find similar others offline, because their identity cannot be hidden, they face greater levels of outward discrimination, oppression and social exclusion and the associated psychological implications. They are also affected by the systemic results of that social exclusion in communities, organizations and policies (Yeshua-Katz et al., 2019).

Conspicuous Stigmatized Identities and Digital Affordances that Promote Engagement

Walther's Hyperpersonal model of computer-mediated communication postulates that individuals use the various features of digital tools to manage the impressions of others and promote desirable relationships (Walther, 1992, 2007). Walther argues that users take advantage of the interface and channel characteristics of computer mediated communication to selectively promote positive self-representations and reduce negative impressions (Walther, 2007). Populations with conspicuous identities tend to favor technologies, such as text-based virtual spaces, with the affordances of *distribution* (i.e. co-presence is not required) and *reduced visual cues*. Both are able to help the user conceal their stigmatized identity and are important in helping to reduce stigmatization on the basis of that identity (i.e. they should face less social stigma) (Tanis, 2009).

Users of such technologies tend to feel liberated and are less likely to question the impact of their written contributions based on their physical characteristics (Tanis, 2009). The more stigmatized and marginalized the physical identity, the more important these affordances would be. For example, those with physical disabilities or skin mutilations may find these very important as compared to individuals without these identities. Walther writes that the affordance of distribution also allows senders to "not exude their natural physical features and non-deliberate actions into the receiver's realm of perception," thereby inhibiting unwanted nonverbal cues that can leak in other interactions, such as face-face interactions (Walther, 2007).

In addition to distributed and reduced visual cues, the affordances of editability and asynchronicity also provide ample benefits to those with conspicuous stigmatized identities. E*ditability* allows the user to alter their self-presentation any number of times before releasing their message and *asynchronicity* allows almost unlimited time to edit and customize the message and features of that self-presentation to promote the desirable characteristics and reduce stigmatized characteristics (Walther, 2007). Digital technologies yield multiple ways in which identity and self-presentation can be constructed online through audio, text and images.

One digital tool not often utilized in ICT interventions but common in gaming interventions is the use of virtual avatars for self-presentation (M. V. Birk et al., 2016; Wrzesien et al., 2015). Avatars offer individuals with conspicuous identities a means to assume a different, non-stigmatized visual identity online. Designers can choose to have users select from pre-made visual representations or utilize editability and asynchronicity to allow the user to create and customize their own avatar. Multiple studies demonstrate that users do select and customize avatars that look like them, however many of these studies are done with small sizes, with predominantly white individuals and do not do sub-group analyses

(Hooi & Cho, 2014; Messinger et al., 1970; Vasalou et al., 2007). Thus, they do not segment based on stigmatization offline.

Note that some of these studies do demonstrate that while individuals might choose an avatar that looks similar, the avatar tends to be a more "attractive" version of self, indicating that those who might see themselves as "less attractive" or might face discrimination based on their own physical features (i.e. experience conspicuous stigma), may choose to de-emphasize those features in their virtual avatars (Messinger et al., 1970). This includes both visible and invisible features as similarity can also include similarity in terms of personality and not merely appearance. Studies show that avatar preference towards dissimilarity is more likely to occur among users with dissatisfaction in their offline lives and others show that less extroverted users tend to be more extraverted online when they select to use more attractive avatars (Messinger et al., 1970; Trepte & Reinecke, 2010).

Dunn & Guadagno provide some indication of the utility of avatars for those with conspicuous identities. In their study of avatar selection, they found that participants who were non-white were more likely to select avatars with lighter skin tones. In another study, Lee found that White participants were not influenced by avatar-diversity in the gaming environment but Black participants were in fact influenced (Dunn & Guadagno, 2019; J.-E. R. Lee, 2014). Lee demonstrated that Black participants tended to choose avatars that were whiter looking to represent themselves when the diversity among the avatars in the game was low. But when the diversity was higher, they chose avatars that were less white looking, potentially more comfortable representing their offline selves (J.-E. R. Lee, 2014). This study shows that the stigmatization of being black offline will and can negatively influence willingness to represent one's true self online. They did also separately test willingness to reveal true racial identity and showed that Black participants were less willing to reveal their conspicuous identity in the low diversity online

environment and more willing to reveal it in the high diversity online environment (J.-E. R. Lee, 2014). For white participants, they saw no difference in willingness to reveal their offline racial identity (J.-E. R. Lee, 2014).

With advancements in technology beyond text, photo and video, virtual avatars and virtual communities provide a particularly unique, interactive and salient way of allowing those with conspicuous identities to access and experience online communities and information-communication technology interventions. However, given the complexity of the different ways we can be "similar" to an online character, designers of ICT interventions for these groups need to be careful not to replicate the environments online (e.g. low diversity spaces) that perpetuate stigmatization of individuals offline, as it will only lead to re-stigmatization of these already marginalized groups. Thus, it is important to be mindful of the psychological implications of virtual selves and implement strategies to reduce harm to these groups. Further, there is more research in the field regarding online spaces and concealable stigmatized identities than there is for conspicuous identities. Much work still needs to be done in this area, especially regarding online spaces and other conspicuous identities beyond racial and ethnic minorities, such as those with different physical disabilities or skin mutilations, etc.

Concealable Stigmatized Identities and Digital Affordances that Promote Engagement

Recall that those with concealable stigmatized identities find it difficult to find similar others with their shared identity offline and they are reluctant to share their stigmatized identity with others, including often family and friends, for fear of worsened stigma (Tanis, 2009; Yeshua-Katz et al., 2019). Thus, those with concealable stigmatized identities experience greater social isolation and tend to be at high risk for self-stigma and low self-esteem (Lawlor & Kirakowski, 2014; Tanis, 2009; Yeshua-Katz et al., 2019). Self-

stigma is the internalization of society's negative perceptions as "true" to one's sense of self (Lawlor & Kirakowski, 2014). This can be detrimental to mental health as it serves to prevent individuals from seeking social support and increases social avoidance (Lawlor & Kirakowski, 2014). Offline supportive groups tend to combat self-stigma (Lawlor & Kirakowski, 2014). However, this is difficult for individuals as the self-stigma prevents them from engaging in supportive groups and prevents them from approaching others because of risk of accidental disclosure (Lawlor & Kirakowski, 2014).

The internet affordances of *accessibility* and *searchability* make it much easier for individuals with concealable stigmatized identities to find similar others online (Tanis, 2009). Groups with specialized interests and identities are readily found online (McKenna & Green, 2002; Tanis, 2009). Research has demonstrated that individuals with mental illnesses, substance use disorders, HIV/AIDS status, sexual minority status, body dysmorphic disorders, and sexual abuse trauma are among the many identities using online communities to find support and help combat self-stigma (Andalibi et al., 2016; Blackwell et al., 2016; Coursaris, n.d.; Craig et al., 2015; Fisher, n.d.; Gustafson et al., 2016; Lawlor & Kirakowski, 2014). Further, the affordances of portability and distribution also makes it accessible whenever they need it.

Affordances for those with Social Anxiety

For those with social anxiety disorders or higher social anxiety, affordances such as *asynchronicity*, *editability* and *anonymity* reduces anxiety-inducing circumstances that occur during face to face interactions (McKenna et al., 2002). Anonymity reduces the anxiety associated with having to talk with someone face to face. Asynchronicity reduces the anxiety from having to respond immediately, i.e. the in-the-moment response that normally occurs during a face-to-face encounter is eliminated, and editability

in conjunction with asynchronicity, allows the individual to make as many edits while taking as much time as needed to respond (McKenna & Green, 2002). In a study of social anxiety and online environments, Mckenna and colleagues found that those who scored high in anxiety offline reported lower scores when in an online environment. Scores were similar to the ones from individuals who scored low in anxiety offline (i.e. the digital space levelled the playing field for socially anxious individuals) (McKenna et al., 2002; McKenna & Green, 2002).

Furthermore, the reduced cues in the online environment facilitates greater liking of individuals that interact for the first time in an online environment compared to in-person, which then facilitates more positive responses to individuals with concealable stigmatized identities (McKenna & Green, 2002; Tanis, 2009). Studies do report that individuals with social anxiety and loneliness prefer interacting in online spaces vs. in-person groups (McKenna & Green, 2002) and are more liked (Lim et al., 2019). In a pilot study of an mHealth intervention to combat loneliness, Lim and colleagues found that those with social anxiety disorders had double the attrition rate compared to those without the disorder (Lim et al., 2019).

The editable nature of online spaces allows individuals with mental illness and other concealable stigmatized identities to manage their self-presentation online, similar to those with conspicuous identities. As mentioned above, this can have different impacts on well-being. Individuals can choose to represent their true, authentic selves or utilize a strategic self-presentation that emphasizes positive attributes (Walther, 2007). Given that those with concealable stigmatized identities tend to have higher rates of self-stigma and associated low-self-esteem, these groups, as with conspicuous identities, may tend to utilize inauthentic versions of themselves, especially if they see themselves as negative compared to the dominant group. Twomey & O'Reily's analysis of 21 studies on Facebook and self-presentation indicated that inauthentic self-presentation tends to be associated with users high in social anxiety and

low in self-esteem. It is also associated with traits, such as neuroticism and narcissism (Twomey & O'Reilly, 2017). Multiple studies report relationships between true self-presentation and positive well-being indicators but only for those with more positive determinants of well-being, such as high self-esteem or high mindfulness (Jang et al., 2018; Yang et al., 2017; Yang & Bradford Brown, 2016). However, other studies indicate that usage of strategic self-presentations, not true representations, was associated with more self-reported happiness among users with both low and high self-esteem (Jang et al., 2018). Thus, utilizing more strategic self-presentation may be more beneficial for those with stigmatized identities.

Anonymity and Concealable Stigmatized Identities

Probably the most salient affordance that attracts individuals with concealable stigmatized identities to the online space is anonymity. *Anonymity* means that an individual's identity cannot be revealed based on any of the seven dimensions of identity knowledge, such as name, location, behavior patterns or identifying personal characteristics including pseudonyms that are connected to these dimensions (Andalibi et al., 2016). Anonymity in ICTs can be accomplished in multiple ways, by intentionally masking these identifying features and dimensions with specific measures, such as the use of aliases, fictitious identifying information and avatars instead of profile pictures. It can also be facilitated through deindividuation and reduced feelings of self-awareness and attention on any one individual as a result of being submerged within a group. Anonymity in digital environments can serve two main purposes to those with concealable identities. First, it facilitates an environment of perceived safety and reduced fear and second, it facilitates disinhibition, which helps to promote self-disclosure and social sharing (Andalibi et al., 2016; Warner et al., 2011).

Reducing Fear

Because individuals with concealable identities often experience self-stigma, and fear of disclosing their identities, anonymity affords these individuals an opportunity to engage with others, form relationships and experience support without ever having to reveal this aspect of their true self. Further, anonymity helps to assure these individuals that their offline identity will not be linked to their online identity, reducing the incidences of accidental disclosure of the stigmatized identity (Tanis, 2009). This makes it easier to approach others to inquire about shared concealable stigmatized identity and thus, makes it easier to find others with that shared identity (Tanis, 2009). The fear of accidental disclosure and link back to offline identity is very important for those with concealable stigmatized identities, e.g. LGBTQ, previously incarcerated, etc., as this can lead to embarrassment, severing of relationships, and further exacerbation of stigma offline (Craig et al., 2015). For some individuals, such as those in abusive situations, such as domestic violence victims, this can also lead to additional abuse and physically harmful circumstances. Thus, anonymity is critical for facilitating safety and promoting well-being for these individuals. Craig and colleagues' study of sexual minority youth and young adults reported that these individuals felt significantly safer in their online communities (Craig et al., 2015). Multiple individuals reported experiencing more bullying and other stigmatizing events offline than they did online and reported that they experience less fear and anxiety online.

For marginalized individuals with risk of physical harm, and others who find their identity to be highly stigmatizing, they may prefer to use platforms with an added layer of anonymity, such as temporality. In an analysis of Reddit users posting about sexual abuse, Andalibi and colleagues found that male users were more likely than female users to use anonymous throwaway accounts when disclosing sexual abuse and seeking support (Andalibi et al., 2016). Throw-away accounts are temporary accounts formed on

Reddit, typically disposed of after use. This is not surprising as male gender norms stigmatize help seeking and victimization via sexual assault (Andalibi et al., 2016). In addition, the ephemeral nature of media platforms like Snapchat may also prove very attractive to individuals who prefer their online content to be short-lived and who have increased fear associated with disclosure (Bayer et al., 2016).

Promoting Self-Disclosure and Social Sharing

For groups whose voices are often marginalized offline or whose experiences are stigmatized, the act of disclosure and sharing can be empowering and beneficial to self-esteem, self-stigma and well-being (Choi & Toma, 2014; Lawlor & Kirakowski, 2014). Studies examining online supportive communities and ICTs have found that self-disclosure is one of the main activities exhibited on these systems (Andalibi et al., 2016; Balani & De Choudhury, 2015; Blackwell et al., 2016; Fisher, n.d.; Hollenbaugh & Everett, 2013; McKiernan et al., 2017). As a consequence of deindividuation effects, the anonymity of online spaces reduces inhibition and helps to facilitate self-disclosure and social sharing among these groups. Multiple scholars have reported that the act of self-disclosure and self-expression improves mental well-being (Choi & Toma, 2014; Han et al., 2011; Smyth & Helm(Weinstein & Hodgins, 2009), 2003). In fact, Chaudoir and Fisher proposed the disclosure processes model, a framework under which to examine how disclosures promote well-being for those with concealable stigmatized identities (Chaudoir & Fisher, 2010). They indicated that alleviation of inhibition, social support and changes in social information mediates the effects of disclosure on multiple outcomes, including well-being (Chaudoir & Fisher, 2010).

Furthermore, social sharing theory stipulates that people engage in social sharing to cope with emotions elicited by a triggering event (Choi & Toma, 2014). Dealing with the emotion satisfies psychological needs of personal expression, like verbalizing thoughts and feelings and obtaining feedback (Choi & Toma,

2014). Smyth & Helm also report that focused expressive writing of traumatic experiences improves health and well-being. Han et al reports that expression of empathy among patients in an online cancer support group (in addition to receiving empathy) improves well-being (Han et al., 2011; Smyth & Helm, 2003). Social sharing, self-disclosure and expression on new media platforms can result in psychological processes that improve well-being (Choi & Toma, 2014). Choi & Toma investigated this phenomenon and found that respondents experienced positive affect after sharing positive events and negative affect after sharing negative, triggering events (Choi & Toma, 2014). Multiple other studies also indicate that the expression of support and disclosure contributes to positive well-being and positive coping strategies in online support systems (Namkoong et al., n.d.; Yoo et al., n.d.).

Interestingly, it is not merely the anonymity of the users that facilitates disclosure but also the anonymity of the audience. In the latter case, the affordance of distribution and social distance of the audience facilitates disclosure. Multiple studies demonstrate that individuals with concealable identities, such as intimate partner violence, are more likely to disclose to computers versus to a person in face-to-face interaction (Butler et al., 2009; Gratch et al., 2014; Rhodes et al., 2002, 2002) and that disclosure is more likely when the audience behind the computer is anonymous (Lucas et al., 2014). Also, individuals are more likely to share positive events with more public audiences and negative events with more private audiences (Choi & Toma, 2014). Note that Ma and colleagues did find that regardless of audience type (social ties or people nearby), anonymity of the user facilitated both intimate and non-intimate disclosures of negative valence (Ma et al., 2016). This is an important finding since the emotional expression of negative events is an important part of the healing process from traumatic and stressful events. Thus, the ability to disclose anonymously may be a critical element in ICTs to promote mental health for those with stigmatized identities.

Affordances that Decrease ICT Use by those with Stigmatized Identities

Despite multiple studies indicating the affordances of digital environments make them more attractive to groups with concealable and conspicuous identities, some of these same affordances can also be a deterrent. Qualitative and quantitative research into what factors motivate social media and ICT avoidance among marginalized groups is sparse. However, there are some studies that can provide insight to help guide the design of ICTs to reduce disengagement for these groups. For example, for those individuals with highly stigmatized identities or those at high risk for physical harm, the *recordability* and *permanence* of certain online spaces may deter these individuals from utilizing these spaces or disclosing on these platforms (Basterfield et al., 2018). One study on childlessness in Israel, a highly stigmatized issue in that culture, indicated that the male perspective (a highly stigmatized group for self-help) was significantly under-represented in their study of two online forums for Israeli infertility (Andalibi et al., 2016; Parent et al., 2018; Yeshua-Katz, 2018).

Another study of social media use among Hispanic and African American youth in socio-economically marginalized neighborhoods reported both the permanence, *lack of privacy* and *message visibility* of Facebook were deterrents for use (Stevens et al., 2017). The researchers emphasized that Facebook tended to echo and amplify the harsh social realities existent offline for these youth. Conflict also consistently emerged on that space and was publicly showcased. Youth preferred platforms, such as Instagram and Twitter, where there are *reduced cues* and more perceived *anonymity* and *privacy* (Stevens et al., 2017). In addition, deception and lack of trust can often inhibit disclosure on online spaces. Hancock et al's study of communication spaces and deception found that deception is just as likely to occur face-to-face as it is via instant messaging and that spaces that are *recordless*, *synchronous* and *distributed* promote the most deception among individuals (Hancock et al., 2004). In addition, other

studies indicate that trust is more likely to form in virtual spaces using more rich media like audio and video versus text-only chats (Bos et al., 2002). Issues of privacy, trust and permanence can be important factors to facilitate the use of ICTs by those with stigmatized identities.

Avoiding Re-traumatizing and Re-stigmatizing Content

Another factor that contributes to avoidance for these groups is the valence and content of messages online. Studies report that individuals in certain groups prefer to read more positive stories and want to avoid the negative content or negative stories that may often be told on online support spaces (Basterfield et al., 2018; Guyer & Vaughan-Johnston, 2018). Furthermore, some report wanting to avoid harmful content, i.e. content that is triggering. In one study investigating the use of online spaces for eating disorders, the participants reported that the *accessibility* of information on the internet that promote eating disorder symptoms was a barrier to receiving support (Basterfield et al., 2018; Santarossa & Woodruff, 2017). They reported needing to disengage from technology because of the easy availability of social media and other tools, such as calorie counters, that facilitated relapse. They also said that information on the internet about eating and nutrition is so readily available that they find it difficult to avoid this triggering content (Basterfield et al., 2018). In fact, they even report that recovery and supportive spaces created for people with eating disorders often still contained triggering content and can cause re-traumatization, so they tend to avoid those spaces as well (Basterfield et al., 2018).

Other groups have reported avoiding online spaces that were not diverse or inclusive in their content because of re-stigmatization (J.-E. R. Lee, 2014; Steinke et al., 2017). Steinke's examination of 92 sexual and gender minority youths experience with ICTs revealed that youth frequently reported resources, including ones targeting the health of SGM youth on various platforms (Youtube, Tumblr, health

interventions), lacking diversity in the expressions of gender, race/ethnicity, socio-economic status, sexuality and age (Steinke et al., 2017). The youth felt their experience was undervalued, unaddressed and felt further alienated by the content they encountered (Steinke et al., 2017). This can be particularly damaging as it leads to further stigmatization of a population that already reports greater feelings of isolation and stigma offline compared to other groups (Craig et al., 2015; Steinke et al., 2017). While information communication technologies can provide unique ways of reaching marginalized groups and provide access to groups unable to find supportive and accepting environments offline, scholars should be mindful of the ways in which these same technologies can perpetuate stereotypes, cause re-traumatization and further stigmatize these groups.

C. Providing Support with Online Support Groups and ICTs for Individual-level Trauma

Decades of research indicate that online communities can provide empowerment and foster supportive spaces for individuals with stigmatized identities (Anderson-Lewis et al., 2018a; Barak et al., 2008; Gustafson et al., 2011; Tanis, 2009). They can also provide healing and emotional support for individual trauma and stressful life events (Andalibi et al., 2016; Yoo et al., n.d.). Multiple studies have shown that these communities can have meaningful impacts on individual well-being, with much of the research on online support groups and mental health relying on social support and social capital theory as a guiding theory for impacts on well-being (Best et al., 2014; Tanis, 2009; Wright, 2015). Social capital is the actual or perceived resources gained from social interactions and connections to those in one's network (Bourdieu, 2002). This could include psychological resources, such as emotional support, or it could include other resources, such as information and knowledge regarding a health issue, referred to as informational support. It could also include tangible resources, such as goods, services or practical assistance with daily living, referred to as instrumental support (Tanis, 2009; Yip, 2018).

The premise is that individuals who are stigmatized or oppressed, such as racial and ethnic minority groups, or those with mental health issues, seek online groups for support processes with similar others not readily available offline (Tanis, 2009; Wright, 2015). Those with anxiety, social isolation or lived trauma benefit from online support groups as a low threatening space to seek emotional support and access instrumental and informational capital (Tannis, 2009). Social capital has been categorized into two groups: bridging capital, which are the loose ties between individuals that have been associated with information diffusion, and bonding capital, which are stronger ties individuals form, associated with emotional support and improved well-being (Ellison et al., 2007; W. Pan et al., 2020a; Tanis, 2009). Bridging and bonding capital have been associated with different communication patterns, platforms and different well-being measures (Ellison et al., 2007; W. Pan et al., 2020a; Tanis, 2009). For example, Ellison et al found that Facebook use was associated with utilizing bridging capital, rather than bonding capital, and that this association was stronger for those with low self-esteem or low life-satisfaction, such as those with mental health issues or marginalized identities (Ellison et al., 2007).

Online support groups have the capacity to make, break and expand social ties. Thus, research has investigated whether the social ties themselves and ones location in the network is associated with well-being (Hopfer et al., 2014; H.-J. Kim et al., 2017; Oster et al., 2013; Valente, 2010; Yeshua-Katz et al., 2019). In addition, online networks now include tools of feedback to participants that facilitate the creation and maintenance of those social ties. The access to similar others and the expansion of one's network has been categorized as another form of support, called network support or, in some studies, socializing support (Lu et al., 2021; Yeshua-Katz, 2018; Yeshua-Katz et al., 2019). Those in online support spaces with similar others are more likely to express and provide more positive feedback to participants, which leads to increases in self-esteem and subsequent increases in well-being (Crone & Konijn, 2018;

Firth et al., 2019; McKenna & Green, 2002). This feedback helps provide validation, understanding and an increase in self-worth, often categorized as esteem support (Yeshua-Katz, 2018; Yeshua-Katz et al., 2019).

Multiple studies find evidence for these different types of support being exhibited in online spaces for those with concealable identities, such as those with depression or cancer, victims of sexual abuse and those struggling with infertility (Andalibi et al., 2016; Han et al., 2011; Lu et al., 2021; Yeshua-Katz, 2018; Yip, 2018). A meta-analysis of online forums offering various types of support for stigmatized identities found that studies targeting individuals with concealable stigmatized identities were more associated with higher prevalence of emotional, network and instrumental support and lower prevalence of information and esteem support (Yeshua-Katz et al., 2019). Whereas forums targeting those with conspicuous identities had the opposite, a higher prevalence of information and esteem support and lower prevalence of emotional network and instrumental support (Yeshua-Katz et al., 2019). Their findings confirm what we know about stigmatization among the various identities. Those with conspicuous identities have a greater need for validation and bolstering of self-worth, often met by esteem and informational support, and those with concealable identities having a greater need for finding similar others to provide emotional and tangible support (Yeshua-Katz et al., 2019).

Providing Support on Mobile Apps and Social Media

Social media and mobile apps can provide rich ways of providing ongoing support to marginalized populations. Different affordances, such as interactivity, allow participants to engage in the community in ways that are self-guided, can be tailored to their preferences and can be ongoing (Tanis, 2009; Wright, 2015). Mobile apps allow on-the-go support, including at times when individuals need immediate attention and where providers are unavailable (e.g. late night). GPS and other features allow those in

recovery from substance use disorders to avoid triggering locations while also providing social support features (Gustafson et al., 2011). The versatility and possibility of digital communication to support well-being is only increasing with the increasing availability of different features and sensors. However, findings have been mixed regarding their supportiveness and effectiveness in marginalized populations (Cole et al., 2017; Eysenbach et al., 2004; Nesvåg & McKay, 2018; Rauschenberg et al., 2021).

In a review of 26 digital interventions to support substance use disorder, they found that 57% of the interventions were found to be efficacious and rates of sustained use were relatively high. However, in another review of self-guided digital interventions for suicide prevention, they reported poor adherence rates to the interventions; almost two thirds of participants did not complete the treatment module. They did however find small but significant effects on suicide ideation (Nesvåg & McKay, 2018; Torok et al., 2020). Similarly, a review of 14 mobile apps and online interventions found positive effects on suicide ideation, but no effect of these supportive interventions on self-harm and attempted suicide (Witt et al., 2017).

Further, multiple studies have found associations between the use of social media platforms, like Facebook, and worsened depression, anxiety, eating disorders, alcohol addiction, life satisfaction, happiness and vitality (Ahmad et al., 2018; Dhir et al., 2018a; Frost & Rickwood, 2017; Satici & Uysal, 2015; Vannucci & McCauley Ohannessian, 2019). Meanwhile, others report decreases in loneliness and depression. In Forchuk et al's study, they found that Facebook reassurance via likes or comments led to greater decreases in depression for those higher in attachment anxiety (Forchuk et al., 2020; Frost & Rickwood, 2017). However, Hunt et al in their study demonstrated that limiting social media use improved mental well-being; they showed reduced social media use daily decreased loneliness, fear of missing out and anxiety over a three week period (M. G. Hunt et al., 2018).

Fostering Unsupportive Online Communities for Individuals with Trauma

Though many online communities fosters support for individuals with stigmatized identities, multiple affordances on these spaces can also facilitate unsupportive environments. For example, anonymity can lead to deindividuation that facilitates reduced inhibition regarding harmful behaviors online. Deindividuation can cause a reduced sense of responsibility, a lowering of restraints and lowered pressure to conform to offline social norms that govern behavior (Lapidot-Lefler & Barak, 2012). Under this context, behaviors like flaming, bullying, trolling and other behaviors harmful to certain groups, such as oversexualizing of gender minorities or adolescents, can occur (Cho & Kwon, 2015). Flaming is the use of hostile language and expressions towards an individual online, such as derogatory language, threats and sexually inappropriate content. Trolling is the use of various strategies to intentionally upset, provoke and antagonize others online (Griffiths, 2014; Lapidot-Lefler & Barak, 2012). In 2017, 41% of internet users reported experiencing some form of online harassment (27% experienced name calling, 10% experienced physical threats and 22% experienced trolling) (Pew Research Center, 2017). In a global survey of cyberbullying in teens in 11 countries, conducted by Vodafone Foundation, 43% of teens reported that they believed cyberbullying is a bigger issue than drug abuse (VodaFone Foundation, 2015). Of those who experienced cyberbullying, 41% said it made them feel hopeless or depressed and 18% had suicidal thoughts (VodaFone Foundation, 2015). Further, social media and other networking apps are some of the most common spaces for online harassment. In a 2017 Pew study, 58% of those who experienced online harassment said that social media were the sites of their most recent online harassment incident (Pew Research Center, 2017).

A study of the affordances of anonymity, lack of eye contact, invisibility in deindividuation and flaming behaviors found that lack of eye contact is the core contributory factor to deindividuation (Lapidot-Lefler

& Barak, 2012). In addition, deindividuation can also promote the Social Identity Model of Deindividuation Effects (SIDE). SIDE stipulates that under conditions of deindividuation (e.g. perceived anonymity in large online groups), individuals will prefer accepted group norms over individual normative behavior (Tang & Fox, 2016). For example, under anonymous conditions, when gender norms are established, individuals will tend to act in more gender stereotypical ways compared to non-anonymous conditions (Tang & Fox, 2016). The result is that individuals not conforming to these group norms, such as those with stigmatized identities, may be excluded, which can lead to further stigmatization.

Coyle cautions against the damaging effects of individuals being blocked from telling their story and the negative emotional impacts from individuals feeling their story does not fit with the accepted norm (Coyle et al., 2012). Further neurobiological studies show that similar regions of the brain are activated when one feels acceptance and rejection online as they do offline, indicating the salience and detrimental effects of online social rejection (Crone & Konijn, 2018; Firth et al., 2019). The potential negative effects for groups already stigmatized to experience negative feedback on social media can be detrimental to self-stigma and their well-being (Tanis, 2009). Designers should work to find a less-problematic means of providing feedback and mitigate harmful behaviors like cyberbullying and trolling.

Online Communities and Harm to Well-Being

In addition to these affordances that help others to promote unsupportive environments in online communities, scholars are finding that the ways those with stigmatized identities may be experiencing these environments also seem to be harmful to their well-being. The adverse effects of ICTs and other online spaces seem to be linked to how users utilize these spaces and the motivations and psychological drivers of this utilization (Ahmad et al., 2018; Bessière et al., 2010). Multiple studies are finding that

worsened negative impacts of online spaces on well-being occur among those who rely on these spaces for their primary social network and emotional connection and exhibit social avoidance. Those also detrimentally affected are people who fear missing out, those who draw social comparisons in these spaces and those exhibiting problematic internet usage behaviors (Dhir et al., 2018a; Frost & Rickwood, 2017; Lawlor & Kirakowski, 2014; Satici & Uysal, 2015; Tandoc et al., 2015).

Lu et al's study of 15 online discussion boards for depression found that information and emotional support was associated with positive effects on depression while socializing support was associated with negative effects on depression (Lu et al., 2021). Similarly, Bekalu et al in their study found that using social media for emotional connection was associated with poor social well-being and mental health while routine use of social media was associated with positive well-being (Bekalu et al., 2019). In addition, Lawlor et al found that individuals with high usage of online mental disorder support groups had decreased recovery from self-stigma while others had increased recovery (Lawlor & Kirakowski, 2014). They proposed that these high users may be compromising offline relationships for online relationship (i.e. engaging in more socializing support), leading to greater social avoidance and greater salience of their stigmatized identity (Lawlor & Kirakowski, 2014). Others find connections between increased depressive symptoms and both those who use the internet to escape life's problems and those who fear "missing out" when not on social media (Dhir et al., 2018a; Wegmann et al., 2017).

Given the ability of social media to draw social comparisons and enable individuals to feel accepted or rejected, studies have looked at social comparison theory and have found that individuals more likely to exhibit envy from social media are more likely to exhibit depressive symptoms (Tandoc et al., 2015). Others show that appearance-related comparisons on Instagram are linked to body dissatisfaction and drive for thinness (Hendrickse et al., 2017). Social comparison theory may provide some insight into these

findings. This theory stipulates that individuals often make comparisons with others to promote their well-being; they will make an upward comparison to focus on similarities with someone better than themselves and downward comparisons to emphasize differences with people worse-off (Guyer & Vaughan-Johnston, 2018). Vogel et al found that individuals who use Facebook more frequently are more likely to draw upward social comparisons and this comparison mediates the impact on well-being, i.e. leads to lower self-esteem and self-evaluations (Vogel et al., 2014). In addition, other studies found a relationship between upward social comparisons and Facebook envy and that the relationship between upward social comparison and depression (also found in the Vogel study) was mediated by Facebook envy.

Similarly, Tandoc et al in their study, showed that Facebook envy also mediated the relationship between Facebook use for surveillance (behavior that can facilitate upward social comparisons) and depression (Tandoc et al., 2015). Their study indicated that when individuals did not exhibit envy, Facebook use led to a decrease in depression (Tandoc et al., 2015). To unpack the directionality of these effects, Scherr et al showed that envy and Facebook surveillance did not lead to depression but rather it was depression that led to Facebook envy and this envy led to exhibiting surveillance-type behaviors (Scherr et al., 2018). Therefore, if one is able to mitigate Facebook envy among those with depression, they may be able to reduce the harmful behaviors associated with Facebook surveillance and help improve well-being.

Lastly, multiple studies indicate that problematic internet usage behaviors are linked to negative well-being (Akanni & Adayonfo, 2020; Faghani et al., 2020a; Satici & Uysal, 2015). Problematic internet usage behaviors include time spent online, addictions to social media, social withdrawal, loss of control, addiction to pornography, abstraction from reality and ludopathy (Baroni et al., 2019). Problematic internet use and high frequency of social media use has been associated with social avoidance, panic

disorders, anxiety symptoms, depressive symptoms and substance use disorders (Akanni & Adayonfo, 2020; Baroni et al., 2019; Primack et al., 2017; Satici & Uysal, 2015; Vannucci & McCauley Ohannessian, 2019), and other studies link problematic usage, such as lurking, with lower body image and eating disorder symptoms (Santarossa & Woodruff, 2017).

Unfortunately, utilizing ICTs and social media in these problematic ways is more likely to occur among individuals already at a disadvantage, such as those with low self-esteem and those with poor emotional regulation, both not uncommon among individuals with concealable stigmatized identities (e.g. substance use disorders, social anxiety disorders and emotional disorders) (Appel et al., 2015; Bekalu et al., 2019; Faghani et al., 2020a). Studies of emotional regulation indicate that difficulties in emotional regulation are linked to increased problematic internet use, but it is mediated by experiential avoidance, a self-regulatory strategy used to control or escape from negative and stressful stimuli (Faghani et al., 2020a). Individuals likely to utilize experiential avoidance include individuals with social anxiety disorders, emotional disorders and substance use disorders (Faghani et al., 2020a).

Further exacerbating disparities, multiple studies indicate that while those with high emotional regulation abilities experience increased positive effects of ICTs and social media on well-being, those with poor regulation abilities experience worsened effects on well-being (Charoensukmongkol, 2016; Finkelstein-Fox et al., 2018; Yoo et al., n.d.). Yoo et al in their study found that the positive effects of emotional support on psychological quality of life were higher for those with high emotional communication competence (the ability to send, receive and regulate emotional messages) and lower for those with low emotional communication competence. Other studies suggests that high mindfulness, which aids emotional regulation, decreases social media burnout while low mindfulness increases burnout (Charoensukmongkol, 2016; Finkelstein-Fox et al., 2018; Yoo et al., n.d.).

Individuals with stigmatized identities are at risk for poor mental health and lower well-being. Online communities can prove to be supportive for those with increased mental health burden but affordances on these spaces can also further stigmatize and traumatize those identities. In addition, as a result of co-morbid psychological states, such as low self-esteem and poor regulation, scholars are finding that those with stigmatized identities may use digital spaces in different ways that may be harmful for well-being (Appel et al., 2015; Scherr et al., 2018). Additional care should be taken in the design and support of marginalized individuals utilizing ICTs to reduce any further stigmatization or harm.

D. Providing Supportive Spaces for Collective Trauma

Online communities have been shown to foster feelings of shared identity and trust among communities with concealable identities, producing positive effects on depression (Craig et al., 2015; Lu et al., 2021). They can also be a powerful avenue for those with conspicuous identities, such as racial and ethnic minorities, to heal from collective trauma (Florini, 2017). Turner's Social Identity Model proposes that subjective togetherness and belongingness drives group formation. Thus the "group" is defined as a result of that shared "psychological" identity rather than by the physical make-up of the group (McKenna & Green, 2002). In addition, the Elaboration Social Identity Model proposes that collective action in solidarity with a group leads individuals to believe their action is effective and impacts their empowerment (Foster, 2015). Uden-Kraan et al defines empowerment as an "individual's own personal sense of efficacy, esteem or personal competence" (van Uden-Kraan, Drossaert, Taal, Shaw, et al., 2008). Groups traditionally stigmatized in the offline space, such as those with mental health illnesses, substance use or racially and ethnically diverse communities have found empowerment in digital spaces (e.g. Black Twitter) and other social-support spaces (Lawlor & Kirakowski, 2014; V. V. Patel et al., 2018; Schuschke &

Tynes, 2016; Sweet et al., 2015). Empowerment has been associated with an increased ability to navigate one's health and an increased self-efficacy and better health (Barak et al., 2008).

As social media becomes more pervasive among communities that are underserved, the potential for digital platforms to provide a space for healing, collective action and empowerment becomes more apparent. Affordances, such as text-based, synchronicity and accessibility allow large groups to form on Twitter, facilitating greater anonymity and deindividuation (see above) that, in the right environment, promotes disclosures that can lead to collective healing and collective action. The research on collective trauma and healing on social media is sparse. Few studies investigate this space for collective healing and even fewer studies investigate how this healing transcends to individual improvements in well-being and collective action in local communities (M. E. Brown et al., 2021).

Collective action is defined as an action that works to empower or benefit the group, versus the individual, including individual behaviors for collective impact (Foster, 2015). Foster's study investigating the impact of tweeting about sexism found that public tweets demonstrated both collective intent and collective action and that these public tweets improved individual well-being and reduced negative affect (Foster, 2015). In addition, emerging studies indicate that, during times of collective oppression and trauma spurned by offline events, such as police shootings of Black individuals or accusations of sexual assault among celebrities, social media and other online spaces can become avenues for widespread disclosure, discourse and healing.

Collective trauma here is defined as a traumatic event for which the impact is felt by an entire group, whether that group is defined by a non-geographically bound community, such as by social identity or defined by physical geography. Three studies demonstrate that social media has the potential to generate

discourse and healing among both geographically bound and non-geographically bound communities. First, Carlson et al writes, on collective trauma and Indigenous social media, that among indigenous Australians online, "the collective experience of trauma emanates from a "shared recognition" of the continuity of colonial practices" (Carlson et al., 2017). They argue that social media platforms and hashtags like, #IndigenousDads, that emerged in response to racist depictions of indigenous peoples online, serve as a means of shared recognition and linked fate (Carlson et al., 2017). Individuals used the hashtag to mobilize resistance and counteract racist depictions with pictures of shared pride for Indigenous dads. Social media served as a space to recognize and discuss the cause of collective trauma, as well as a space in which to take collective action to counteract stereotypes (Carlson et al., 2017). By doing so, the movement promoted empowerment and healing among the indigenous community.

In contrast to #IndigenousDads, the second study by Brown and colleagues analyzed the Twitter discourse 30 days following the 2016 police shooting of a Black man in Baton Rouge, Alon Sterling (M. E. Brown et al., 2021). According to the study, a homeless man felt "threatened" while soliciting money from Sterling and called the police. Sterling was killed by the police officers responding to the call (M. E. Brown et al., 2021). The study found that the discourse from the community in Baton Rouge was dominated by messages of fear, anger and unrest, despite Twitter's potential to mobilize information about healing and social justice, as in the case of #IndigenousDads. Few messages about the Sterling killing were about peaceful protests or were pro-protesting (M. E. Brown et al., 2021). In addition, multiple messages and pictures from the local community surrounding the events were re-traumatizing and triggering (M. E. Brown et al., 2021). Furthermore, messages and tweets by the local authorities, politicians and community leaders were absent from the discourse. In fact, tweets by local community members highlighted this silence and called for more response from the local authorities (M. E. Brown et

al., 2021). The authors proposed that the local advocates and authorities infusing messages of healing, support and collective action on Twitter could have proved powerful in helping the community to feel heard and supported (M. E. Brown et al., 2021). Despite their community members being present on this social media space, local authorities missed the opportunity to meet their community where they were, and facilitate a space of collective healing from trauma. The third study provides another example of what this may look like utilizing digital media spaces.

Following the acquittal of George Zimmerman, the police officer accused in the killing of the unarmed teenager, Trayvon Martin, the podcast, This Week in Blackness aired a live stream version of their show. In her analysis of the podcast, Florini explained how the affordance of synchronicity was used to facilitate collective healing among Black listeners. Individuals were able to call into the podcast, share their stories live, while also participating in a live chatroom and Twitter conversation (Florini, 2017). On multiple spaces, members of his 20,000 followers and more, shared about their experiences of discrimination and how the community "needed this right now" (Florini, 2017). Individuals expressed gratitude and solidarity, and talked about needing to find others who understood how they felt and shared their experiences (Florini, 2017). They talked about historical trauma and the challenges of this injustice across the globe with listeners from Germany and Korea among the audience (Florini, 2017). Using a variety of online spaces and media, This Week in Blackness was able to demonstrate how practitioners can use online spaces to transcend geographical and physical boundaries to facilitate collective healing and togetherness, and help group members help make sense of the systematic injustices the collective face. Other studies also demonstrate the use of synchronicity and Black Twitter to facilitate community and collective identity (Williams, 2017).

Perceived anonymity and deindividuation effects have also motivated other individuals with stigmatized identities to use Twitter as a mobilization tool for social justice. A good example is the #metoo movement, which facilitated detailed self-disclosures on social media of incidences of sexual assault, abuse and harassment in multiple settings, work, home, the restaurant industry, Hollywood, government and across the globe, #MoiAussi, #WoYeShi, #BalanceTonPorc (Deal et al., 2020; Loney-Howes et al., 2021). The movement shed a dramatic light on the pervasiveness of sexual assault. It highlighted the systemic, institutional and political determinants that created this silent, widespread issue and raised awareness of the need for collective action.

Fostering Unsupportive Online Communities for Groups with Collective Trauma

Though deindividuation and anonymity can motivate socially powerful disclosures of trauma and stigma on social media, they can also create hostile and unsupportive environments in those same spaces for groups with stigmatized identities. Groups can be discriminated against through racist and oppressive messaging on social media (Bliuc et al., 2018). For geographically-bound groups, this can also spill over into the offline space. Multiple scholars report that cyber-racism and online hostility is yielding harmful effects offline (Bliuc et al., 2018; Carlson et al., 2017; Stevens et al., 2017). Carlson et al accounts an incident of a woman posting online about an Aboriginal youth breaking into a vehicle. The comments that followed included a call to hunt down the “sub human mutts” and “run them off the road” (Carlson et al., 2017). A few days later, there was an incident of a 14-year old Aboriginal youth being hit by a truck. This incident was then followed by comments online in support of the incident (Carlson et al., 2017). Though circumstantial, it illustrates the potential for online communities to also become spaces of hatred that reinforce existing detrimental social divides and structures offline. Other researchers argue that neglecting to infuse positive messages into spaces where a community has faced trauma may reinforce

existing negative schemas surrounding oppression and facilitate communal re-traumatization, therefore negatively impacting mental well-being (M. E. Brown et al., 2021).

Scholars who seek to utilize social media and online spaces for collective trauma should understand how these spaces can work to facilitate healing and collective action but also how they can promote negative valence messages and harm both online and offline. When groups are already facing immediate and historical trauma, it remains critical to utilize measures to mitigate risks to these groups. Utilizing a trauma-informed lens or a healing-centered approach when designing and implementing interventions for these groups facing both collective and individual trauma, historically and in their everyday lives, can be a starting point in helping to mitigate harm to these groups. However, it is not clear how health technologies and information communication spaces should account for trauma-informed practices. Research is also still new and emerging regarding the ways in which these spaces affect marginalized populations with various stigmatized identities, such as racial and ethnic minorities, those with substance use disorder and elders. For instance, more research is needed on conspicuous identities and online spaces and much more study on the ways in which social media and other ICTs can either cause further collective trauma or help heal from said trauma.

Research Gap and Dissertation Aims

During the COVID-19 pandemic, social distancing forced multiple communities and industries, such as education, business, health and many others into the online space, out of necessity. For many, the virtual space has been the only arena in which to interact and stay connected with family, friends and the "offline" social world. Further, multiple studies indicate that some groups with stigmatized identities are at a higher mental health burden due to COVID and face COVID-19-associated trauma, such as elders and

racial and ethnic minorities (Banerjee, 2020; Berg-Weger & Morley, 2020; Fernández-Aranda et al., 2020; Rauschenberg et al., 2021, 2021; Tai et al., 2021). Few rules and models exist that serve as guides for how to engage in this new space with populations experiencing high trauma and higher mental health burden. In fact, to my knowledge, there does not exist a model for engaging with high trauma communities in the digital space. Given the ubiquity of internet use in almost every industry during this pandemic, the high trauma burden due to COVID and the high internet usage rates among traditionally stigmatized groups, a framework for engagement in the digital sphere building on existing expertise in the trauma-informed space is needed for health intervention and communication practice.

Thus, this dissertation aims to fill this gap by proposing a model for online engagement with high trauma populations. This model builds on Ginwright's healing-centered engagement framework, an extension of the trauma-informed framework that attempts to fill some of the gaps and limitations of trauma-informed care (Ginwright, 2021; Watts, n.d.; Wilson & Richardson, 2020). The model proposes the following five principles to guide the practice of applying healing-centered engagement online (see Chapter 3 for additional details and examples):

- *Healing is Political* – Trauma and healing should be viewed more from a political lens and less from a clinical lens. Engagement with participants online should include strategies to promote a critical reflection and/or collective action towards the greater social, economic and environmental factors that facilitate trauma and inhibit the promotion of well-being. This shift focuses more on collective determinants rather than individual determinants of trauma and well-being.

- *Focus on Building Capacity / Be Strengths-Based* – Online engagement strategies should build on the assets of the online community and aim to increase capital. Strategies should also build on the strengths of the person engaging with the community (practitioner) as well.
- *Healing is Cultural and Spiritual* – Online engagement and health promotion should include strategies rooted in culture and spirituality.
- *Promote Healing and Mitigate Harm* – Engagement strategies should include an element to promote healing from trauma and reduce harm. Strategies can promote hope, empathy and well-being of the online community as well as the practitioner.
- *Responsive and Rebuild Control* – Online engagement should provide target users with opportunities to give input on community needs and practitioners should be responsive to those needs (i.e. their individual and collective voices are being heard and strategies are empowering).

To reiterate, the aims of my dissertation are as follows:

1. To propose ways in which communication and technology tools can be used to engage populations with high trauma or high mental health burden for health promotion.
2. To build evidence and devise a model for healing-centered engagement online.

Methods and Analysis

In order to fulfill the aims of my dissertations and demonstrate the need and application of healing-centeredness across contexts, I examine communication technology interventions in two different marginalized populations with high mental health burden: elders and individuals with opioid use disorder.

In addition, I also provide examples of healing-centeredness among two different types of communication technology interventions, a social media intervention and a mobile health app.

First, I establish the need for healing-centered engagement practices online utilizing two studies. Study 1 explores the impact of an online support system, called Elder Tree, on mental well-being among a population with a high mental health burden, a population of depressed and socially isolated elders (see Chapter 2). Elder Tree is a web-based intervention that includes information about healthy aging as well as discussion forums and private messaging. Regression analysis was used to assess whether depression and social isolation moderate the impact of the Elder Tree randomized clinical trial on mental well-being of these elders (390 Wisconsin elders). Given that depressed and socially isolated elders experience both conspicuous and concealable stigmatized identities, this group was chosen to examine the effectiveness of communication technology interventions and whether there may be a greater need for a healing-centered approach when engaging with this group online.

Study 2 utilizes data from a different type of communication technology intervention to demonstrate need for healing-centered engagement in another context - a mobile app for recovery from opioid use disorder (see Chapter 3). Individuals with opioid use disorder experience a concealable stigmatized identity and experience a higher mental health burden (Larkin et al., 2017; Substance Abuse and Mental Health Services Administration, 2019). Two hundred and twelve patients with opioids use disorder were recruited to receive both MAT (methadone, injectable naltrexone, or buprenorphine) and A-CHESS treatment to improve recovery (Gustafson et al., 2016). A-CHESS is a smartphone intervention with difference affordances and features to support recovery, including an online forum, GPS tracker and motivational messages. Using qualitative content analysis and regression analysis, the study explored the type of content posted on this ICT for opioid use disorder and investigates whether content types is

associated with the author type (moderator (n=1,128) or participants (n=2,790)) and associated with engagement by the participants. Supportive and unsupportive engagements are often managed by moderators on online community spaces. Individuals with opioid use disorder experience large levels of stigma and trauma (McFarling et al., 2011; Stein et al., 2017). They may be particularly reluctant to disclose in these communities. The moderator is vital in helping to promote social sharing and reduce re-stigmatization following disclosures. Thus, this sample and approach was chosen to help elucidate the type of content that drives engagement and the need for a healing-centered approach by moderators among this heavily stigmatized group.

Lastly, I review the literature regarding trauma-informed engagement and healing-centered practices and propose a model for healing-centered-engagement online (see Chapter 4). Using this model, messages by moderators (n=186) in the A-CHESS forum for opioid use disorder were coded for healing-centered engagement. Regression analysis was used to assess the impact of healing-centeredness on engagement in the forum (views, view time, response rate and # of comments). Further, to demonstrate application of this model across contexts, I also provided examples of healing-centered messages using a case study social media intervention for COVID-19. The case study was taken from a current project to promote accurate COVID-19 information on social media among three marginalized groups with conspicuous stigma, Madison, Wisconsin's African American population, its LatinX population and the Oneida Nation in Green Bay, WI. Examples from their social media posts (between 40 and 150 posts since January 2020) were included to illustrate the use of healing-centered engagement online. These three communities traditionally face a higher mental health burden, lifetime stressors, COVID-19 trauma and adverse childhood experiences and thus are appropriate for the use of a healing-centered framework (Sacks & Murphey, 2018; Tai et al., 2021, p. 19).

Chapter 2

Elders, Depression, and Social Connectedness:

Understanding Who Benefits the Most from an Online Social Support System

Abstract - Approximately 15-20% of Americans over 65 have experienced depression. Some studies report up to 43% of elders feeling socially isolated. Both depression and loneliness worsen chronic conditions prevalent among the elderly, such as heart disease and stroke. Thus, development of interventions to support the mental well-being of the elderly and reduce isolation and depression are an urgent priority. Meanwhile, the COVID-19 pandemic has significantly increased the number of socially isolated elders and there is growing concern regarding the impact of social distancing on this group. Computer technologies that foster social connection had been investigated pre-pandemic as a possible solution to support active aging and are often now the only means by which elders remain connected. This study investigates whether depressed and socially isolated elders benefit the most from online support systems and whether comfort with social media moderates these relationships. Using data from the Elder Tree Clinical Trial among 390 Wisconsin elders, we found that depression, but not social isolation, moderates the effect of the Elder Tree support system on 12-month mental well-being ($F= 5.617$, $p=0.076$). Those in the clinical trial condition, who were depressed at baseline, reported slower change in mental well-being at 12 months compared to the control group. Further, our study revealed that the most vulnerable elders, the most isolated and depressed who were most comfortable with social media, had lower mental well-being when they used Elder Tree compared to control. Online support systems are designed to increase social support and subsequently improve users' mental well-being. However, we find here that among

elders on Elder Tree, those with the least socio-emotional support and social engagement offline received no additional mental well-being benefits, and other sub-groups had an adverse effect.

Background

Among adults over 65, 18.4% have experienced symptoms of depression, yet depressive symptoms are often discounted or under-treated among elders (Centers for Disease Control and Prevention & National Association of Chronic Disease Directors, 2009; Corcoran et al., 2013a; Villarroel & Terlizzi, 2020). Further, in 2019, 4.7% of adults over 50 reported having a major depressive episode in the past year (SAMHSA, 2019). Depression worsens chronic conditions prevalent among the elderly, such as heart diseases and stroke (Centers for Disease Control and Prevention & National Association of Chronic Disease Directors, 2008; Frederick et al., 2007). It is associated with functional impairment, higher medical care costs, cognitive impairment and mortality (Aldrich, n.d.; Centers for Disease Control and Prevention & National Association of Chronic Disease Directors, 2008; Frederick et al., 2007; Katon et al., 2003; Kok & Reynolds, 2017). In an analysis of 455 patients with a mental health illness, Sauleviciute and Rybakova found that patients reported that since diagnosis, they experienced decreases in daily life activities and communication with their friends and family, and a higher prevalence of social isolation (Sauleviciute & Rybakova, 2016). Perceived social isolation and loneliness is a known risk factor for depression and it is often assessed in screenings for depressive symptoms (Wilby, 2011). Roughly 13.8 million elders in 2017 report living alone (National Institute on Aging, 2019). Given that the number of older American adults is expected to double to 98 million in 2060, the impact of social isolation, loneliness and depression are of particular concern to those working with elderly populations (Administration on Aging, 2018; Centers for Disease Control and Prevention & National Association of Chronic Disease Directors, 2008, 2009)).

Between 7-24% of elders report being socially isolated (Y.-R. R. Chen & Schulz, 2016). Those who are depressed may experience feelings, such as self-stigma or low self-esteem, that inhibit engagement in social activities and promote social isolation (Chaudoir & Quinn, 2016; Lawlor & Kirakowski, 2014; Sauleviciute & Rybakova, 2016). Studies of depressed elders have demonstrated that both engagement in social activities and the capacity to obtain social support is important for alleviating depressive symptoms (Corcoran et al., 2013b; Wilby, 2011). However, in addition to the existing causes of social isolation among the elderly, the COVID-19 pandemic has halted engagement in social activities (Berg-Weger & Morley, 2020), further exacerbating social isolation (Armitage & Nellums, 2020; Berg-Weger & Morley, 2020). Liu and colleagues found that COVID-19 disease progression and mortality is three times higher among elderly populations and elders therefore have largely been instructed to self-isolate (Banerjee, 2020; Conroy et al., 2020). This has significantly increased the number of elders being objectively isolated and some studies are reporting increases in loneliness among the elderly (Berg-Weger & Morley, 2020; Conroy et al., 2020).

Social distancing, a method recommended to reduce viral spread, has only added further subjective disconnectedness and multiple scholars have pointed to the damaging short and long terms effects of social distancing on morbidity and mortality for the elderly (Armitage & Nellums, 2020; Berg-Weger & Morley, 2020; Conroy et al., 2020; S. S. Patel & Clark-Ginsberg, 2020). In addition, COVID-19 is being linked with multiple traumatic events, such as the death of loved ones, financial strain, job loss, recession and extreme fear (Banerjee, 2020; Ho et al., 2020; Zhou et al., 2020). Both the mental health morbidity associated with socially isolating elders and the COVID-19-associated trauma present significant psychological burden (Banerjee, 2020; Berg-Weger & Morley, 2020; Ho et al., 2020). The development of

interventions that support the mental health and well-being of elderly populations and further, those experiencing a higher mental health burden, is an urgent priority.

Current studies have looked to social media and information communication technology (ICT) systems as intervention tools to strengthen and expand the social networks of the elderly and help combat social isolation (Y.-R. R. Chen & Schulz, 2016; Conroy et al., 2020; Cornejo et al., 2013; Gustafson et al., 2015). For many friends and family, including elders who are social distancing, the virtual space has become the only way to maintain interaction with others and stay connected (Conroy et al., 2020). However, elders are the least adept at using digital technology and studies report low utility of internet usage and social networks among the elderly (Pew Research Center, 2019, 2021c; Smith, 2014b). A systematic review of social isolation, mental health and ICTs among the elderly revealed the research is inconclusive regarding the benefits of such systems on mental health and social isolation, with some reports of positive, negative and no effects (Y.-R. R. Chen & Schulz, 2016). The authors suggest these systems may be beneficial to some elders but not others (Y.-R. R. Chen & Schulz, 2016). Additional research is needed to understand the relationship between social isolation, mental well-being and the impact of online support systems in different groups of elders. Understanding the impact on specific groups will help us to design and customize social networking systems to provide the maximum impact on well-being.

Given that those with higher mental health morbidity, including depression, are at higher risk for social isolation (Sauleviciute & Rybakova, 2016), coupled with the increased social isolation of elders, this study aims to address these gaps by investigating the impact of an online support system called Elder Tree on two sub-group populations – elders with depression and elders with perceived social isolation or low social support. We aim to provide clarity to the literature regarding who benefits the most from such

online support systems and add to the body of knowledge regarding the potential implications of online support systems among those with a higher mental health burden.

Social Isolation and the Elderly

Social isolation is often defined in the psychological literature as a *subjective measure of one's connectedness*, feelings of support, loneliness and sense of belonging (E. Y. Cornwell & Waite, 2009; Masi et al., 2011; Perissinotto CM et al., 2012; Steptoe et al., 2013). Multiple studies have found that perceived loneliness is associated with higher health care utilization, depression, functional decline, decreases in daily activities, physical and mental morbidity and mortality (E. Y. Cornwell & Waite, 2009; Gerst-Emerson & Jayawardhana, 2015; Perissinotto CM et al., 2012; Rico et al., 2018). In a longitudinal study of 1,604 older adults, Perissinotto et al found that 43% of older adults perceived themselves as lonely; only 18% lived alone (Perissinotto CM et al., 2012). Perceptions of social isolation and loneliness may not reflect actual connectedness and social engagement. Thus, other scholars often use more objective measures of social isolation. Social isolation is seen as a function of your social network, a lack of social relationships and low *engagement in social activities* (B. Cornwell et al., 2008; E. Y. Cornwell & Waite, 2009; Krueger et al., 2009; Masi et al., 2011; Steptoe et al., 2013). These measures often focus on contact with family and friends and participation in social groups (E. Y. Cornwell & Waite, 2009; Steptoe et al., 2013). This form of social isolation is also linked to physical and mental morbidity, mortality and depression (B. Cornwell et al., 2008; Golden et al., 2009; Krueger et al., 2009; Steptoe et al., 2013). In addition, different measures of social engagement or objective isolation can have different impacts on well-being (Golden et al., 2009; Krueger et al., 2009). For example, higher social engagement, but not larger network size, has been associated with better cognitive functioning in older adults (Krueger et al., 2009). Further, the quality of

the engagement can also impact health, with some studies finding negative interactions associated with cognitive functioning and other physical and mental health issues (Rook, 2015; Sneed & Cohen, 2014).

Studies attempting to understand the interplay between these two measures of social isolation and health among older adults have found that both measures may be independently associated with physical health, but the impact of *social engagement* on mental health may be moderated by *perceived social isolation* (E. Y. Cornwell & Waite, 2009). Others have found social engagement rather than perceived social isolation to be more relevant for all-cause mortality among older adults (Steptoe et al., 2013). Though both perceived isolation and social engagement were linked to higher mortality, the effect of perceived social isolation (but not social engagement) was attenuated with demographics and other health problems added to the model (Steptoe et al., 2013). These studies demonstrate the importance of examining multiple dimensions of social isolation when examining impact on health.

Older adults face many barriers, actual and perceived, to social connectedness in the offline space. For example, older adults are more likely to experience co-morbid health conditions, multiple of which create both functional and cognitive decline (Aldrich, n.d.; Centers for Disease Control and Prevention & National Association of Chronic Disease Directors, 2008; National Institute on Aging, 2019; Perissinotto CM et al., 2012). Cognitive decline can often impair communication, and limitations in communication are significantly associated with higher level of loneliness and social participation (Palmer et al., 2016). Adding to this, for those elders with additional functional decline, these limitations may inhibit engagement in social activities and loss of social roles (B. Cornwell et al., 2008; E. Y. Cornwell & Waite, 2009; Frederick et al., 2007; Gerst-Emerson & Jayawardhana, 2015; Kok & Reynolds, 2017; Perissinotto CM et al., 2012). Furthermore, loss of social roles can also occur as a result of retirement and bereavement, more common amongst older adults (B. Cornwell et al., 2008; E. Y. Cornwell & Waite, 2009).

In an AARP study, a majority of elders reported that they felt isolated because of factors related to a lack of engagement with friends and family. In the study, 48% of elders reported that friends and family are too far away and 42% reported that they were too busy (AARP Research, 2012). Further, functional limitations exacerbated the problem, with 12% reporting feeling isolated because of physical limitations, 17% because they are no longer able to drive or don't have a car and 10% reporting no access to public transportation (AARP Research, 2012). Further, other studies report that elders feel isolated from family and friends because a significant portion of social interactions have moved to the online space (Y.-R. R. Chen & Schulz, 2016; Cornejo et al., 2013). With family and friends being further away, this presents few other alternatives to connect. In the AARP study, 29% of elders report that lack of access to the internet at home is the primary reason they feel isolated (AARP Research, 2012). Therefore, increasing access to online support systems and networks may provide a viable means of increasing social connectedness and social engagement for elderly populations.

Online computer support systems can not only provide new social connections to buffer the effects of loneliness and isolation, but the discussions generated on these spaces can also provide both informational and emotional resources that otherwise may not be accessed by individuals who are disconnected from others offline. A few studies have found that social network systems can strengthen older adult's social network and serve to complement traditional social interactions (Cornejo et al., 2013). A meta-analysis of 25 studies investigating the role of information communication technologies among the elderly found that, in general, ICTs tend to improve social isolation in four ways: 1. by connecting elders to the offline world, 2. increasing their social support, 3. increasing their self-confidence and 4. improving their engagement in activities of their interest (Y.-R. R. Chen & Schulz, 2016). However, this analysis found that not all elders received benefits (Y.-R. R. Chen & Schulz, 2016). We propose that not all

older adults need these online support systems and inconsistent study results could be due, in part, to lack of segmentation based on support needed or social engagement offline.

Theoretical Framework: Online Communities Increase Social Capital

We suggest here that online support groups provide access to social capital that may either be inaccessible to some elders or have been reduced as a result of disengagement in social roles in the offline space (Hartnett et al., 2013). Disengagement can be caused by any of the factors discussed above, such as, functional decline, cognitive decline, loneliness etc. Social capital is "the aggregate of the actual or potential resources, which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition" (Bourdieu, 2002). Multiple studies have linked social capital to increased mental and physical well-being among various populations, see Chapter 1 (Landstedt, Almquist, Eriksson, & Hammarström, 2016). As indicated above, online communities provide a means for elders to access social capital (informational and emotional resources) that may not be readily available offline (Hartnett et al., 2013; W. Pan et al., 2020b; Rains et al., 2015; Tanis, 2009). In fact, studies seeking to understand the use of online support groups have found that individuals preferred to use online groups when they felt dissatisfied by offline support (Chung, 2013).

Elders who are not satisfied with offline support and perceive themselves as socially isolated or who experience the lowest social engagement offline are the least able to access offline social capital and social support. These elders are at the highest risk for decreases in mental well-being and mortality over time. Thus, we propose that these elders are the most likely to benefit from an online computer support system that fosters social connection.

Our first hypotheses stipulate:

H1: Social isolation should moderate the effect of online support systems on mental well-being.

H1-A: - Among those elders who are more socially isolated at baseline, those who use an online support system for 12 months should experience increased mental well-being compared to those who do not use the system.

Some studies do report that social participation and engagement in volunteer work increases with age, as older adults have more access to free time after retirement (B. Cornwell et al., 2008). In addition, other studies have shown that older adults tend to strengthen relationships within their networks as their non-kin relationships decline; some report high levels of perceived social support (E. Y. Cornwell & Waite, 2009; Lang & Carstensen, 1994; Wilby, 2011). Therefore, there are groups of elders that do report higher social engagement and are less likely to perceive themselves as socially isolated. These elders are able to access meaningful social capital offline. For these elders, reporting higher levels of social support and engaging in social activities and roles offline, we expect limited effects of an online support system.

Thus, H1-B stipulates: For those elders with less isolation, no statistically significant difference in mental well-being is expected between those who use the system after 12 months and those who do not.

According to socio-emotional selectivity theory, older adults with real and perceived limitations on future time may be more focused on emotionally meaningful goals, such as relationships with family and friends, compared to those without time constraints (Wilby, 2011). Thus, age-related adjustments in expectations may also result in older adults' perceiving lower social isolation and higher satisfaction with social relationships regardless of the actual size of their social network and connectedness (E. Y. Cornwell & Waite, 2009).

Online support systems could increase actual connectedness and social network size, adding the social engagement needed to combat the perceived social disconnectedness and loneliness faced by many older adults, leading to marked improvements in mental health. The relationship between such systems, well-being, and connectedness, actual or perceived, is still unclear. Thus, our study will explore the relationship with social isolation as a function of both elders' perceived social and emotional support as well as their engagement in social activities (operationalized here as participation in social groups offline).

Reducing Stigma and Promoting Empowerment

Both depression and old age are stigmatized identities, so elders who are also depressed suffer the intersection of both of these stigmatized identities on self-esteem and social engagement (see Chapter 1). Self-stigma is associated with hopelessness, low self-esteem, lower quality of life, depression, anxiety, lower social integration and decreased empowerment (Birtel et al., 2017a; Corrigan et al., 2009; Lawlor & Kirakowski, 2014; Livingston & Boyd, 2010). As a result, elders who are also depressed may perceive even greater social isolation compared to their non-depressed counterparts. They may also face multiple functional limitations that prevent engagement in social activities and in-person groups, as depression is also linked to functional decline. Studies have shown that online support groups can reduce self-stigma, reduce depression and promote empowerment (Breuer & Barker, 2015; Lawlor & Kirakowski, 2014). Empowerment is an individual's perceived sense of esteem, competence and efficacy and it has been associated with improved self-efficacy and better health (Barak et al., 2008; van Uden-Kraan, Drossaert, Taal, Shaw, et al., 2008). Online communities can serve as a means of empowerment and increased social connection for depressed elders, as they gather social capital, informational resources and support needed to navigate their daily lives. Further, studies show that individuals with social stigma, such as elders with mental illnesses, prefer to use online groups, as opposed to in-person groups, and greater

reports of social stigma were associated with higher likelihood of utilizing online support groups compared to in-person or traditional treatment (Chung, 2013; DeAndrea, 2015).

For these reasons, we propose that depressed elders are another group with reduced social capital offline who stand to benefit the most from increased empowerment and engagement in online communities. In addition, elders who meet the criteria for Major Depressive Disorder suffer from higher levels of depression and may be the most at risk for perceived social isolation and lack of social engagement (Kok & Reynolds, 2017). These elders may be the least able to access social capital offline and may benefit the most from accessing social capital and social support online. Those who are not clinically depressed may be able to access sufficient capital offline and thus may not benefit from an online support system.

Thus, we hypothesize that:

> H2: Clinical depression should moderate the effect of online support systems on mental well-being.
>
> H2-A: Elders who are clinically depressed at baseline who use an online support system should experience greater improvements in mental well-being after 12 months of use compared to those who are not and don't use the system.
>
> H2-B: Among those who were not clinically depressed at baseline, no statistically significant difference is expected in well-being after 12 months of system use between those who used the system and those who did not.

It should be noted that not all elders who are depressed suffer from social isolation or are unable to access social capital offline (Wilby, 2011). In fact, one study seeking to understand the link between

depression and social isolation found that elders who were depressed were more likely to socially engage with family and friends and equally likely to engage in volunteer activities compared to those who were not depressed (Wilby, 2011). Other studies show that older adults who perceive greater emotional togetherness in social interactions are less likely to be depressed and those who had a partner or perceived less loneliness and isolation experience reduced negative effects of chronic diseases on depression (Bisschop et al., 2004; Tiikkainen & Heikkinen, 2005). However, some of these studies did not distinguish between those who were clinically depressed and those who were not, nor did they assess perceived social isolation. Thus, we add clarity to the literature regarding the impact of online support systems on well-being among those experiencing objective and subjective social isolation.

Lastly, 25% of older adults over 65 report never going online (Pew Research Center, 2021a). Adults over 65 are the least likely to have home broadband of any other age group, with only 59% of older adults having home broadband and 53% owning a smartphone in 2019 (Pew Research Center, 2019). Further, only 45% of older adults report using at least one social media platform in 2021, up from 2% in 2008 (Pew Research Center, 2021c). Though internet use has dramatically increased among older adults, usage of social support systems and social media platforms is still low compared to other groups (Pew Research Center, 2019). Given that ICTs and online social support or social networking systems have unique affordances that change the way we experience social connection and social connectedness, one's comfort level with such systems may impact the benefits one receives. Meaning, an individual who is more familiar and comfortable with social networking sites, with their affordances and features and are more comfortable with such systems may be better able to navigate a similarly functioning ICT system and subsequently receive greater benefits from interacting with such a system. Further, multiple studies indicate that individuals who are depressed or socially anxious may utilize social networking sites in

different ways that have differential effects on well-being (Appel et al., 2015; Forchuk et al., 2020; Satici & Uysal, 2015; Scherr et al., 2018). For these reasons, we propose that comfort level with social networking sites, like Facebook, may moderate the benefits received by different sub-groups on well-being and that those who are more comfortable will receive greater benefits to well-being when using a similarly functioning ICT.

We hypothesize that:

H3: Comfort level with Facebook should moderate the effect of online support systems on mental well-being

H3-A: Comfort level with Facebook should moderate the effect of online support systems and social isolation on mental well-being.

H3-A2: Those who are more comfortable with Facebook, in the Trial condition and are socially-isolated should see greater improvements in well-being at 12-months compared to those who are not isolated and not comfortable with Facebook. This group should have the greatest improvements in well-being, with those who are not isolated, not comfortable with Facebook and in the control having the least improvements in well-being.

H3-B: Comfort level with Facebook should moderate the effect of online support systems and clinical depression on mental well-being.

H3-B2: Those who are more comfortable with Facebook, in Trial condition and are clinically-depressed should see greater improvements in well-being at 12-months, compared to those who are clinically depressed and not comfortable with Facebook. This group should have the greatest

improvements in well-being, with those who are not depressed, not comfortable with Facebook and in the control having the least improvements in well-being.

This is a timely area of research as the COVID-19 pandemic has forced us all our social interaction online. Populations are reporting record levels of social isolation, with social distancing predicted to only globally exacerbate the prevalence of mental illnesses like depression (Armitage & Nellums, 2020; Bavel et al., 2020; Berg-Weger & Morley, 2020). The need for research that seeks to understand the relationship between online systems, mental health and stigmatized and high mental health burden populations is an urgent priority.

Methods

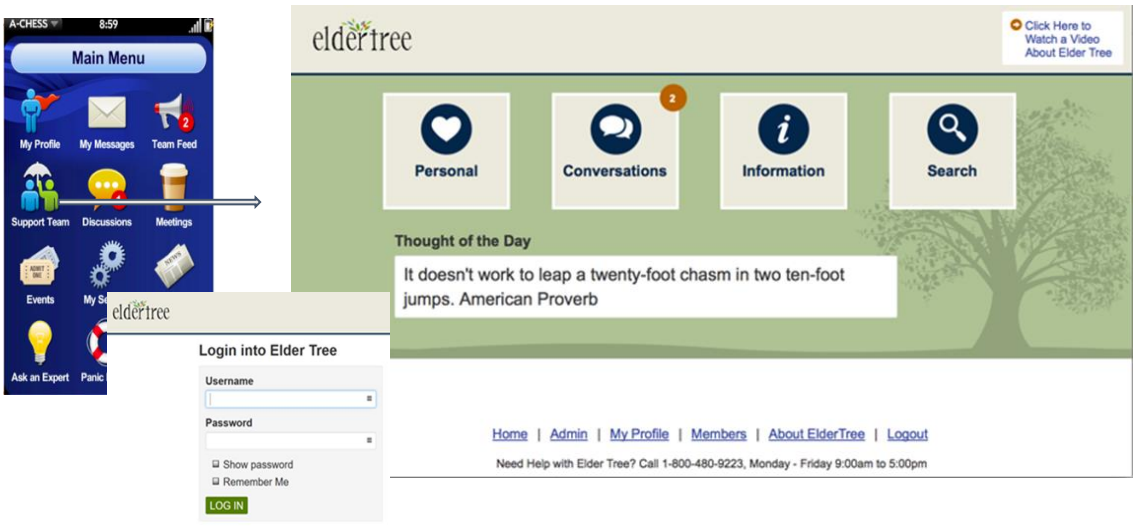
Program Background

Elder Tree is a web-based intervention that includes information about healthy aging as well as discussion forums and private messaging. It was designed to improve the quality of life and maintain the independence of older adults and their caregivers. Elder Tree was developed by the UW-Madison Center for Health Enhancement Systems Studies in collaboration with older adults, content experts, caregivers, and community and state partners, such as the Aging and Disability Resource Centers and the Wisconsin Bureau of Aging. The services in Elder Tree involved informational resources regarding tips for health conditions, training for the site and videos for exercise and fall prevention. It also involved photo sharing, communication with coaches, bulletin boards, discussion groups for your friends and family, route planners, health tracker, links to games and a to-do list. Elder Tree included nine discussion boards with content-specific topics: Just Chatting, Health & Wellness, Religion/Spirituality, Social Games, Preventing a

Fall, Politics, Milwaukee County and Elder Tree Help, Caregiving Support. See study protocol for additional details (Gustafson et al., 2015).

The data for this study was collected from an un-blinded randomized, longitudinal controlled trial of Elder Tree to test its effectiveness and cost. From November 2013 to May 2015, participants over 65 who were at risk of losing their independence were recruited and randomized to a control group, (N=193) which continued to use their usual sources of information and communication, and an intervention group (N= 197) that received access to Elder Tree, along with their usual sources of information and communication (Gustafson et al., 2015). Elders with severely limited mobility, experiencing homelessness or living in hospice were excluded from the study. Elders were recruited from three Wisconsin counties: Urban Milwaukee County, suburban Waukesha County, and rural Richland Counties. Participants were trained on how to use Elder Tree in their homes and were aided in setting up a profile. Resources were tailored to the participants' specific health need (diabetic participants received diabetic tips). To assess the above hypotheses, we primarily used data from surveys collected at baseline and at 12 months.

A.



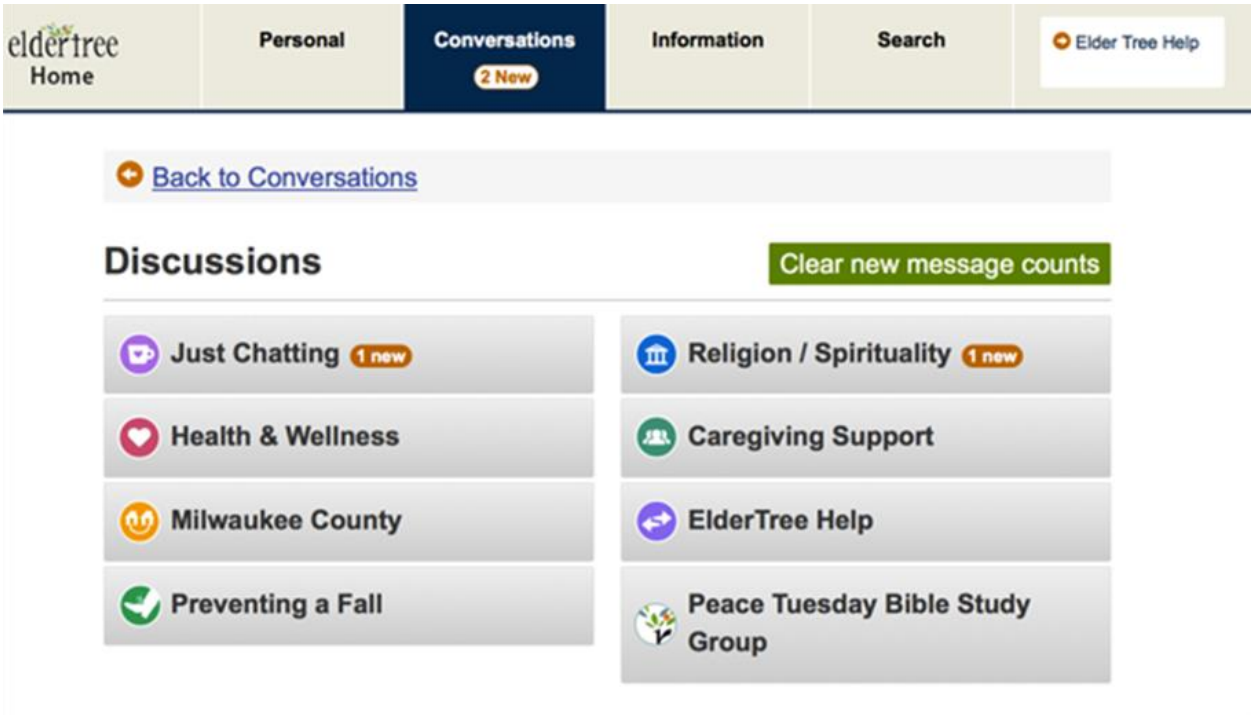


Figure 1. Showing Screenshots of the Elder Tree Online System and Discussion Board Page.

Measures

Dependent Variable: Mental Well-Being was assessed using the Global Mental Health component (Global02, Global04, Global05, and Global10rescored) of the PROMIS Global Health short form (10 item survey). The PROMIS global health form was administered at baseline, 6 months and 12 months. The four questions (2, 4 ,5, 10) assessing emotional problems, satisfaction with social engagement, mental health and quality of life on a scale of 1 to 5 were used. Consistent with prior studies and the PROMIS Global Health Scoring Manual, items were recoded so that a higher score indicates better health (Allen et al., 2018). A summary score for global health was derived using the Health Measures Scoring Service (https://www.assessmentcenter.net/ac_scoringservice). The score is calibrated to the general U.S. population and a T-score is generated for each participant, so a score of 50 represented the mean in the

U.S. general population, with a standard deviation of 10 (Allen et al., 2018). A score above 50 indicates better health and scores below indicate more poor mental health. A score was derived at baseline, 6 months and 12-months.

Independent Variable: Control Trial Condition was assessed as a dichotomous variable that reflected whether you received the Elder Tree intervention or were in the control group (1=Tx, 0=Control).

Moderators: The participants' level of depression was assessed at baseline by summing responses to the Personal Health Questionnaire Depression Scale (PHQ-8) (M=4.36, SD=4.60). *Baseline Clinical Depression Status* was determined as those participants who scored 10 or greater on PHQ-8 at baseline. They were tagged (1=Yes, 0=No) as meeting the criteria for major depressive disorder (clinically depressed).

Social isolation was measured in two ways:

1. Perceived *Socio-emotional Support*: Socio-emotional support (M=3.65, SD = 0.95) was assessed by averaging, from a set of 13 items, nine items that measured how often respondents felt emotionally supported in various scenarios at baseline. The questions asked if participants, for example, "have someone to count on to listen when they need to talk" or "...share your most private worries and fears?" The items were rated on a scale of 1=Never, 2=Seldom, 3=Sometimes, 4 = Most of the time and 5 = Often (See Appendix A for list of questions). A trinomial variable for Socio-emotional support (2=Low, 1=Moderate, 0=High) was created from this mean. Those with a mean of 2 or less were coded as 2 indicated the least socio-emotional support (respondents with means in this range report "Never" or "Seldom" feeling emotionally supported in all 9 scenarios). Those with a mean of between 2.01-3.44 indicated moderate socio-emotional support (respondents with means in this range report "Never" having support in some scenarios and

"Always" having support in others). Those with a mean of 3.45 or higher indicated moderate to high socio-emotional support (Respondents with means in this range report "Mostly" or "Often" having support in majority of the scenarios). Socio-emotional support here is intended to reflect the subjective measure of social isolation, i.e. support and connectedness, consistent with prior studies (E. Y. Cornwell & Waite, 2009; Perissinotto CM et al., 2012; Steptoe et al., 2013).

Note: As a sensitivity analysis, we also created a second socio-emotional variable with a cut off of 2.8, a binomial variable (1=Yes, 0=No) to reflect social isolation as those individuals in the lowest quintile, consistent with prior studies of older adults and social isolation (Steptoe et al., 2013). 2.8 is the cut off at which 19.5% of the sample was deemed "low socio emotional support" (1) and the rest of the sample (80.5% of the sample), meaning those with a score of greater than 2.8, were deemed "medium-high socioemotional support" (0). We did this to assess whether the results will remain the same at different cut points.

2. Social Engagement Offline: *A. Social Group Activity:* indicating participation in-person in a social club/group (i.e., book club, recreation, sports league) or a faith/based group. This was assessed by summing the responses to two questions: one asking if they participated, in-person, in a social club/group (1=Yes, 0=No) and another asking if they participated in a faith/based group in-person (1=Yes, 0=No). Prior studies on a U.S. national sample of older adults have grouped these two activities and found that they loaded on a common factor (J.-H. Chen et al., 2016). A trinomial variable was created to indicate social group participation, those being in both groups (2), those in one group (1), 0= No participation in any groups. A binomial variable was also created (1=Yes, 0=No) to facilitate easier understanding of the estimates. "Yes" was indicated if the respondent participated in at least 1 group in-person, (faith or social) and "No" was indicated if respondents

participated in neither, in person. This measure is consistent with prior studies assessing the objective measure of social isolation or social engagement (Carpiano & Kimbro, 2012; Erving & Hills, 2019; K.-L. Lee et al., 2015; Steptoe et al., 2013).

Health/Wellness Group Activity: indicating participation in person, in a 'health/medical-related support group' or a 'caregiving support group. This was assessed by summing the responses to two questions: one asking if they have participated in person in a health support group (1=Yes, 0=No) and another asking if they have participated in a care-giving support group, in-person (1=Yes, 0=No). A trinomial variable was created to indicate health group participation, 2=Yes in both groups, 1=Yes in one group (health or caregiving), 0= No participation in any groups. A binomial variable was also created (1=Yes, 0=No). "Yes" was indicated if the respondent participated in at least 1 group (health or caregiving) and "No" was indicated if respondents participated in neither in-person.

Comfort level with online social network systems was assessed using the variable, *Social network comfort level*, rated as their level of comfort with Facebook at baseline (1= very uncomfortable, 2 = somewhat uncomfortable, 3 = neither comfortable nor uncomfortable, 4= somewhat comfortable, 5 = very comfortable, 0 = never used). A variable of general comfort with computers was not statistically significant in any of the models, nor did it improve model fit, so it was not included in the model.

Control variables: Age was assessed as exact values of age, *gender* (1=male, 2=female), *education*, assessed as the highest grade of level of education completed (1 = less than high school, 2 = some high school, 3 = high school graduate, 4 = some college or post-high school, 5 = college graduate, 6 = Other), *race/ethnicity* assessed as indication of White or Caucasian race/ethnicity (1 = White, 0 =Non-white). We also controlled for whether the participant was from one of three Wisconsin counties, Richland,

Waukesha or Milwaukee County, utilizing a variable for asking the zip code of where the individual lives. See Table 1 and 2 for full list of descriptive statistics.

Data Analysis

To test our hypotheses, eight linear mixed models were used to predict mental well-being over the first 12 months of the study, controlling for age, gender, education, race, social network comfort and zip code. An unconditional mean model was used to test the intra-class correlation coefficient to assess whether the linear mixed model is necessary over traditional ANOVA in estimating fixed effects and the ICC was 0.69 (Shek & Ma, 2011). Generally, one would not utilize this model method if ICC is lower than 0.25. In this case, 69% of the total variation in Global Mental health is due to inter-individual differences (Shek & Ma, 2011). Model 1 included low socio-emotional support, clinical trial condition and their interaction terms as independent variables. Model 2 included health group engagement, clinical trial condition and their interaction term as independent variables. Model 3 included social group engagement, clinical trial condition and their interaction term as independent variables and model 4 included clinical depression status, clinical trial condition and their interaction term as independent variables. Model 5-8 were the same as Model 1-4 except that social network comfort was included as a moderator and its accompanying interaction terms in each other 4 models. All models included time (coded as 0, 0.5 and 1 for baseline, 6 months and 12months, according to methods utilized in prior studies (Shek & Ma, 2011)) as an independent variable and as an interaction with the other variables to determine change over time. Linear mixed models have been suggested as a more robust alternative for assessing longitudinal data to overcome some of the statistical errors and assumptions in traditional regression analysis (e.g. GLM) and we also applied this method. (Shek & Ma, 2011). All statistical tests were ran using SPSS Statistics 27

according to the methodology outlined in Shek & Ma, 2011 (Shek & Ma, 2011). Plots of relevant interaction terms were generated using R.

Table 1 of Descriptive Statistics for the all the variables included in the models.

Variable	N	Minimum	Maximum	Mean	SD
Controls					
Age	390	65	100	76.5	7.4
Gender	390	1	2	1.7	0.4
Race/Ethnicity	390	0	1	0.9	0.3
Education	389	1	6	3.8	1.0
Moderators					
Social Network Comfort	388	0	5	1.5	1.9
Socio-Emotional Trinomial Score	388	0	2	0.5	0.6
[a]Socio-Emotional 9-item Mean	388	1	5	3.7	0.9
Social Group Activity	390	0	2	1.0	0.8
Health Group Activity	390	0	2	0.2	0.5
[a]Depression Score (PHQ-8)	374	0	24	4.4	4.6
Clinical Depression Status	374	0	1	0.1	0.3
Dependent Variables					
Baseline Mental Well-Being	390	21.3	67.6	46.8	8.6
6 months Mental Well-Being	351	21.3	67.6	47.4	8.5
12 months Mental Well-Being	308	21.3	67.6	47.5	8.2

a. continuous version of the variable

Results

Twelve percent of the elders met the criteria for major depressive disorder and 4.1% of the elders perceived low socio-emotional support at baseline (see Table 2). Forty-one percent of elders perceived moderate socio-emotional support and 54.9% perceived high socio-emotional support. Almost 20% of the elders had never used a laptop or computer and 53.9% reported the lowest level of comfort with social networks. Fourteen percent of the elders reported the highest level of social network comfort. About 40% of the sample had a high school education or less. There was a higher percentage of social group

engagement reported than engagement in health and wellness clubs or caregiving support groups. About a third of the participants engaged in at least one social group or faith based group, such as church. Thirty-two percent engaged in both and 36.7% engaged in neither. Only 14.1% of the participants engaged in at least 1 health/wellness group. Over 80% did not engage in this kind of group activity (Table 2). No significant difference found on chi squared tests between Trial and Control on any of the baseline demographic and moderating variables. Lastly, the mean mental well-being at baseline was 46.8.

Table 2 Frequency Table showing characteristics of the sample based on the variables in the models.

	Control (n=193)		Elder Tree (n=197)		Total (n=390)	
Variables	n	%[a]	n	%[a]	n	%[a]
Age						
65-75	87	45.1	101	51.3	188	48.2
76-85	76	39.4	70	35.5	146	37.4
85+	30	15.5	26	13.2	56	14.4
Gender						
Male	46	23.8	52	26.4	98	25.1
Female	147	76.2	145	73.6	292	74.9
Race/Ethnicity						
Non-White	27	14.0	21	10.7	48	12.3
White	166	86.0	176	89.3	342	87.7
Education						
Less than high school	7	3.6	0	0.0	7	1.8
Some high school	12	6.3	9	4.6	21	5.4
High school graduate	58	30.2	65	33.0	123	31.6
Some college or post-high school education	71	37.0	65	33.0	136	35.0
College graduate	40	20.8	51	25.9	91	23.4
Other	4	2.1	7	3.6	11	2.8
Social Network Comfort						
Never used	108	56.5	101	51.3	209	53.9
Very uncomfortable	19	9.9	13	6.6	32	8.2
Somewhat uncomfortable	14	7.3	16	8.1	30	7.7
Neither comfortable or uncomfortable	11	5.8	14	7.1	25	6.4

Somewhat comfortable	13	6.8	25	12.7	38	9.8
Very comfortable	26	13.6	28	14.2	54	13.9
Socio-Emotional Support						
Low Support (Most Isolated)	8	4.1	8	4.1	16	4.1
Moderate Support	86	44.6	73	37.4	159	41.0
High Support (Least Isolated)	99	51.3	114	58.5	213	54.9
Social Group Activity						
Low Group Participation (in No Groups)	67	34.7	76	38.6	143	36.7
Moderate Participation (in 1 Group)	58	30.1	63	32.0	121	31.0
High Participation (In Both Groups)	69	35.2	58	29.4	126	32.3
Health Group Activity						
Low Participation (in No Groups)	161	83.4	156	79.2	317	81.3
Moderate Participation (in 1 Group)	24	12.4	31	15.7	55	14.1
High Participation (In Both Groups)	8	4.1	10	5.1	18	4.6
Depression Status						
Clinically Depressed	22	12.0	25	13.2	47	12.6
Not Depressed	162	88.0	165	86.8	327	87.4

Social Isolation (Perceived Loneliness & Social Disengagement) as a Moderator

Controlling for demographics and baseline social network comfort, the linear mixed model predicting mental well-being change revealed that socio-emotional support did not moderate the effect of clinical trial condition on linear change in mental well-being (β= 0.98, SE=1.291, p=0.448). The results remained the same for all measures of socio-emotional support. Age, social network comfort and socio-emotional support were significantly associated with mental well-being in all the models. Race/ethnicity was marginally significantly associated with linear change in well-being. Thus, hypothesis 1, 1A-B was not supported for socio-emotional support. Among those who reported low socio-emotional support, no statistically significant difference was found between those who received Elder Tree and those who did not.

Table 3. Linear Mixed Model Results for Socio-Emotional Support and Trial Condition on Mental Well-Being

Parameter	β	Std. Error	df	t	Sig.	95% CI Lower Bound	95% CI Upper Bound
Intercept	-56.623	58.321	374.154	-0.971	0.332	-171.300	58.054
Time	0.211	54.671	328.637	0.004	0.997	-107.339	107.760
Trial Condition	-0.599	1.030	374.946	-0.581	0.561	-2.624	1.427
Gender	-1.650	0.956	373.711	-1.727	0.085	-3.530	0.229
Age	0.147	0.058	375.767	2.536	0.012	0.033	0.261
Education	0.510	0.410	374.606	1.245	0.214	-0.296	1.316
Race/Ethnicity	1.633	1.276	372.054	1.279	0.202	-0.877	4.143
Zip Code	0.002	0.001	374.238	1.560	0.120	0.000	0.004
Social Network Comfort Level	0.590	0.217	373.084	2.718	0.007	0.163	1.017
[a.] Socio-emotional Support	-2.258	0.684	374.558	-3.299	0.001	-3.603	-0.912
Trial Condition * Socio-emotional Support	-1.358	1.026	375.085	-1.323	0.187	-3.376	0.660
Time * Gender	0.453	0.898	331.969	0.504	0.614	-1.313	2.218
Time * Age	-0.037	0.057	356.037	-0.640	0.523	-0.149	0.076
Time * Education	0.029	0.392	338.795	0.074	0.941	-0.743	0.801
Time * Race/Ethnicity*	-1.947	1.176	326.806	-1.656	0.099	-4.260	0.366
Time * Zip Code	0.000	0.001	329.166	0.076	0.940	-0.002	0.002
Time * Social Network Comfort	0.136	0.203	334.420	0.670	0.503	-0.263	0.535
Time * Trial Condition	0.087	0.978	334.960	0.089	0.929	-1.836	2.011
Time * Socioemotional Support	0.659	0.658	343.171	1.001	0.318	-0.636	1.954
Time * Trial Condition * Socio-emotional Support	0.033	0.976	335.681	0.034	0.973	-1.888	1.953

*a. Binomial version (Quintile cut-off) of variable used here in model. *p<0.1, **p<0.05, ***p<0.01*

Controlling for demographics and baseline social network comfort, the linear mixed model predicting change in mental well-being revealed that neither social group activity (β= 1.379, SE=1.604, p=0.390) nor health group activity (β=-1.880, SE=1.951, p=0.336) moderated the effect of clinical trial condition on

linear change in mental well-being. Therefore, hypotheses 1, 1A-B was not supported for social engagement**.** Among those who reported low social engagement, no statistically significant difference was found between those who received Elder Tree and those who did not. Age, social group and health group activity and social network comfort level was statistically significantly associated with mental well-being. Race/ethnicity was marginally significantly associated with linear change in well-being in both models. Zip code was marginally associated with well-being in the social group activity model and education was marginally associated with well-being in the health group activity model.

Table 4. Linear Mixed Model Results for Social Group Activity and Trial Condition on Mental Well-Being

Parameter	β	Std. Error	df	t	Sig.	95% CI Lower Bound	95% CI Upper Bound
Intercept	-69.733	59.831	376.729	-1.165	0.245	-187.378	47.912
Time	1.070	54.802	333.312	0.020	0.984	-106.732	108.872
Trial Condition	1.095	1.384	376.608	0.791	0.429	-1.626	3.817
Gender	-1.429	0.979	376.113	-1.460	0.145	-3.354	0.496
Age***	0.164	0.059	377.963	2.778	*0.006*	0.048	0.280
Education	0.339	0.426	377.134	0.796	0.426	-0.498	1.176
Race/Ethnicity	1.758	1.312	374.614	1.340	0.181	-0.822	4.337
Zip Code*	0.002	0.001	376.812	1.705	0.089	0.000	0.004
Social Network Comfort Level**	0.551	0.222	375.615	2.476	*0.014*	0.113	0.988
[a]Social Group Activity***	3.604	1.277	376.112	2.821	*0.005*	1.092	6.116
Trial Condition x Social Group Activity	-0.561	1.731	376.179	-0.324	0.746	-3.965	2.843
Time x Gender	0.388	0.897	336.410	0.433	0.665	-1.377	2.153
Time x Age	-0.043	0.057	359.839	-0.755	0.451	-0.155	0.069
Time x Education	0.076	0.400	344.447	0.190	0.849	-0.710	0.862
Time x Race/Ethnicity*	-1.994	1.180	331.169	-1.691	0.092	-4.315	0.326

Time x Zip Code	0.000	0.001	333.746	0.079	0.937	-0.002	0.002
Time x Social Network Comfort	0.153	0.203	339.037	0.754	0.452	-0.246	0.552
Time x Trial Condition	-1.017	1.297	347.782	-0.784	0.434	-3.567	1.534
Time x Social Group Activity	-1.425	1.206	353.165	-1.182	0.238	-3.797	0.947
Time x Trial Condition x Social Group Activity	1.379	1.604	343.978	0.860	0.390	-1.775	4.533

*a. Binomial version of social group activity used in this model, where 1=participation in at least 1 social group and 0 is no participation in any groups. *p<0.1, **p<0.05, ***p<0.01*

Table 5. Linear Mixed Model Results for Health Group Activity and Trial Condition on Mental Well-Being

						95% CI	
Parameter	β	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	-52.475	60.618	376.692	-0.866	0.387	-171.666	66.716
Time	3.032	54.762	332.867	0.055	0.956	-104.691	110.755
Trial Condition	-0.040	0.938	376.047	-0.042	0.966	-1.884	1.805
Gender	-1.155	0.983	376.153	-1.176	0.240	-3.088	0.777
Age**	0.145	0.060	378.036	2.411	*0.016*	0.027	0.263
Education*	0.724	0.428	377.094	1.690	0.092	-0.118	1.566
Race/Ethnicity	1.268	1.327	374.718	0.956	0.340	-1.341	3.877
Zip Code	0.002	0.001	376.772	1.440	0.151	-0.001	0.004
Social Network Comfort Level***	0.612	0.225	375.522	2.717	*0.007*	0.169	1.055
[a]Health Group Activity**	-3.269	1.633	374.536	-2.002	*0.046*	-6.480	-0.058
Trial Condition x Health Group Activity	3.193	2.189	374.679	1.459	0.145	-1.111	7.498
Time x Gender	0.261	0.890	336.912	0.293	0.769	-1.490	2.012
Time x Age	-0.037	0.057	358.825	-0.648	0.517	-0.149	0.075
Time x Education	-0.038	0.395	342.199	-0.097	0.923	-0.816	0.739
Time x Race/Ethnicity*	-1.987	1.178	331.390	-1.687	0.093	-4.304	0.330
Time x Zip Code	0.000	0.001	333.378	0.026	0.979	-0.002	0.002
Time x Social Network Comfort	0.141	0.203	338.447	0.697	0.487	-0.257	0.539
Time x Trial Condition	0.282	0.849	337.618	0.332	0.740	-1.389	1.952
Time x Health Group Activity	1.025	1.468	343.139	0.699	0.485	-1.861	3.912

Time x Trial Condition x Health Group Activity	-1.880	1.951	335.831	-0.963	0.336	-5.718	1.958

*a. Binomial version of health group activity used in this model, where 1=participation in at least 1 health group and 0 is no participation in any groups. *p<0.1, **p<0.05, ***p<0.01*

Clinical Depression Status as a Moderator

Controlling for demographics and baseline social network comfort, the linear mixed model predicting change in mental well-being revealed that depression (β=-0.286, SE=0.125, p=0.023) was significantly positively associated with change in mental well-being, with those who are more depressed indicating a faster change in mental well-being. Further, depression as a moderator was marginally significant (β=-0.297, SE=0.167, p=0.076), indicating some support for depression moderating the effect of clinical trial condition on linear change in mental well-being. Higher depression with Elder Tree use was associated with slower change in mental well-being. Thus, hypothesis 2, 2A-B was somewhat supported. However, this model was not statistically significant when the variable for clinical depression status (β=-3.398, SE=2.325, p=0.145) was included in the model. Among the clinically depressed, no statistically significant difference was found between those who received Elder Tree and those who did not.

Table 6. Linear Mixed Model Results for Depression and Trial Condition on Mental Well-Being

						95% CI	
Parameter	β	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	79.423	51.367	363.329	1.546	0.123	-21.591	180.438
Time	-14.367	56.010	326.041	-0.257	0.798	-124.554	95.820
Trial Condition	0.561	0.974	362.095	0.576	0.565	-1.354	2.476
Gender	-0.197	0.846	361.931	-0.233	0.816	-1.860	1.467
Age	0.053	0.052	365.293	1.022	0.308	-0.049	0.156
Education	0.207	0.362	363.799	0.571	0.569	-0.506	0.919
Race/Ethnicity	1.744	1.093	360.826	1.596	0.111	-0.405	3.894
Zip Code	-0.001	0.001	363.506	-0.690	0.490	-0.003	0.001
Social Network Comfort Level*	0.347	0.188	362.119	1.847	0.066	-0.022	0.717
[a]Depression***	-1.091	0.115	359.980	-9.509	0.000	-1.316	-0.865

Trial Condition * Depression	0.069	0.154	361.119	0.447	0.655	-0.233	0.371
Time x Gender	0.136	0.919	328.176	0.148	0.883	-1.673	1.944
Time x Age	-0.022	0.059	348.889	-0.364	0.716	-0.139	0.095
Time x Education	0.042	0.403	335.039	0.105	0.917	-0.750	0.834
Time x Race/Ethnicity*	-2.150	1.176	324.540	-1.828	0.068	-4.463	0.163
Time x Zip Code	0.000	0.001	326.691	0.299	0.765	-0.002	0.002
Time x Social Network Comfort	0.208	0.205	331.681	1.015	0.311	-0.195	0.611
Time x Trial Condition	1.261	1.061	329.969	1.188	0.236	-0.827	3.349
Time x Depression**	0.286	0.125	336.120	2.276	*0.023*	0.039	0.532
Time x Trial Condition * Depression*	-0.297	0.167	329.864	-1.781	*0.076*	-0.625	0.031

*a Depression as a continuous variable used in this model. *p<0.1, **p<0.05, ***p<0.01*

Social Network Comfort Level and Social Isolation (Perceived Loneliness & Social Disengagement) as Moderators

Controlling for demographics and baseline social network comfort, the linear mixed model predicting mental well-being revealed that social network comfort level did not moderate the effect of clinical trial condition and perceived socio-emotional support on change in mental well-being (β = -0.380, SE= 0.430, p=0.377). Thus, hypothesis 3A, 3A2 was not supported for perceived socio-emotional support (see Appendix B). The effect of socio-emotional support and social network comfort on the relationship between clinical trial condition and well-being (not the change in well-being, Time was not significant) was marginally significant (β = 0.804, SE= 0.463, p=0.083) in the model utilizing the 20% cut off for socio-emotional support and as a continuous predictor (Appendix B).

Controlling for demographics and baseline social network comfort, the linear mixed model predicting mental well-being revealed that social network comfort level did not moderate the effect of clinical trial condition and health group activity on change in mental well-being (p=0.959). Thus, hypothesis 3A, 3A2

was not supported for engagement in health group activity (see Appendix C). However, for social group activity, though social network comfort level did not moderate (p=0.171) the effect on change in mental well-being (i.e. interaction with Time), it did moderate the effect of clinical trial condition and social group activity (β =2.845, SE= 0.909, p=0.002) on the average mental well-being over the course of the study (Table 7). Thus, the hypothesis was not supported for the effect of the ET intervention over time. In addition, both social network comfort (β =-2.313, SE= 0.746, p=0.002) and social group activity (β =-4.318, SE= 2.117, p=0.042) moderated the association between trial condition and mental well-being. The independent effect of social group activity and social network comfort level, age and trial condition were all statistically significant in the model. Race/Ethnicity was not marginally significant in this model. However, the interaction between social group activity and social network comfort was marginally significant (p=0.079).

Table 7 Showing the Interaction of Trial Condition, Social Network Comfort and Social Group Activity on Change in Mental Well-Being.

						95% CI	
Parameter	β	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	-53.029	59.178	376.914	-0.896	0.371	-169.390	63.332
Time	-11.568	54.419	331.823	-0.213	0.832	-118.617	95.481
Trial Condition**	3.929	1.634	376.411	2.404	0.017	0.716	7.142
Gender	-1.431	0.965	376.299	-1.482	0.139	-3.328	0.467
Age**	0.144	0.059	378.039	2.451	0.015	0.028	0.259
Education	0.262	0.420	377.364	0.623	0.533	-0.565	1.089
Race/Ethnicity	1.639	1.296	374.889	1.265	0.207	-0.910	4.188
Social Network Comfort Level***	1.543	0.548	374.380	2.815	0.005	0.465	2.621
Zip Code	0.002	0.001	376.999	1.453	0.147	-0.001	0.004
[a]Social Group Activity***	4.909	1.502	376.464	3.269	0.001	1.956	7.861

Social Network Comfort x Social Group Activity*	-1.163	0.661	374.618	-1.759	0.079	-2.464	0.137
Trial Condition x Social Network Comfort***	-2.313	0.746	376.234	-3.100	0.002	-3.780	-0.846
Trial Condition x Social Group Activity**	-4.318	2.117	376.306	-2.040	0.042	-8.481	-0.156
Trial Condition x Social Network Comfort x Social Group Activity***	2.845	0.909	375.972	3.131	0.002	1.058	4.632
Time x Gender	0.403	0.889	335.823	0.453	0.651	-1.346	2.153
Time x Age	-0.027	0.057	357.470	-0.481	0.631	-0.138	0.084
Time x Education	0.087	0.396	342.901	0.220	0.826	-0.692	0.867
Time x Race/Ethnicity	-1.689	1.171	329.707	-1.442	0.150	-3.992	0.614
Time x Zip Code	0.000	0.001	332.233	0.283	0.777	-0.002	0.002
Time x Trial Condition	-2.344	1.528	344.262	-1.534	0.126	-5.350	0.661
Time x Social Network Comfort	0.298	0.505	343.788	0.590	0.555	-0.695	1.292
Time x Social Group Activity	-0.762	1.426	352.010	-0.535	0.593	-3.568	2.043
Time x Social Network Comfort x Social Group Activity	-0.410	0.601	336.387	-0.681	0.496	-1.593	0.773
Time x Trial Condition x Social Network Comfort	1.058	0.695	346.084	1.521	0.129	-0.310	2.425
Time x Trial Condition x Social Group Activity	2.952	1.964	341.424	1.503	0.134	-0.912	6.816
Time x Trial Condition x Social Network Comfort x Social Group Activity	-1.150	0.838	341.475	-1.371	0.171	-2.799	0.499

*a. Binomial version of social group activity used in this model, where 1=participation in at least 1 social group and 0 is no participation in any groups. *p<0.1, **p<0.05, ***p<0.01*

The plot (done in R) of the interaction effect with social group activity and social network comfort, revealed that elders who reported no social group involvement and were the most comfortable with Facebook reported the second lowest mental well-being at 12 months (Figure 2). Among these isolated elders, those in the control group who were more comfortable with Facebook had higher mental well-being than those in the trial condition. Thus, hypothesis 3A2 was not supported. Further, among those who were the least comfortable with Facebook and reported no social group involvement, elders who

received Elder Tree had higher mental well-being than the control group. Among those who participate in some social groups and are most engaged offline, well-being increases with increasing comfort level with Facebook, with those in trial condition reporting greater increases in well-being (figure 1). Also, in this model, Facebook comfort level and trial condition were statistically significant; higher mental well-being was reported by those with greater comfort with Facebook who used Elder Tree compared to those in Control (p=0.002), thus hypothesis 3 was supported.

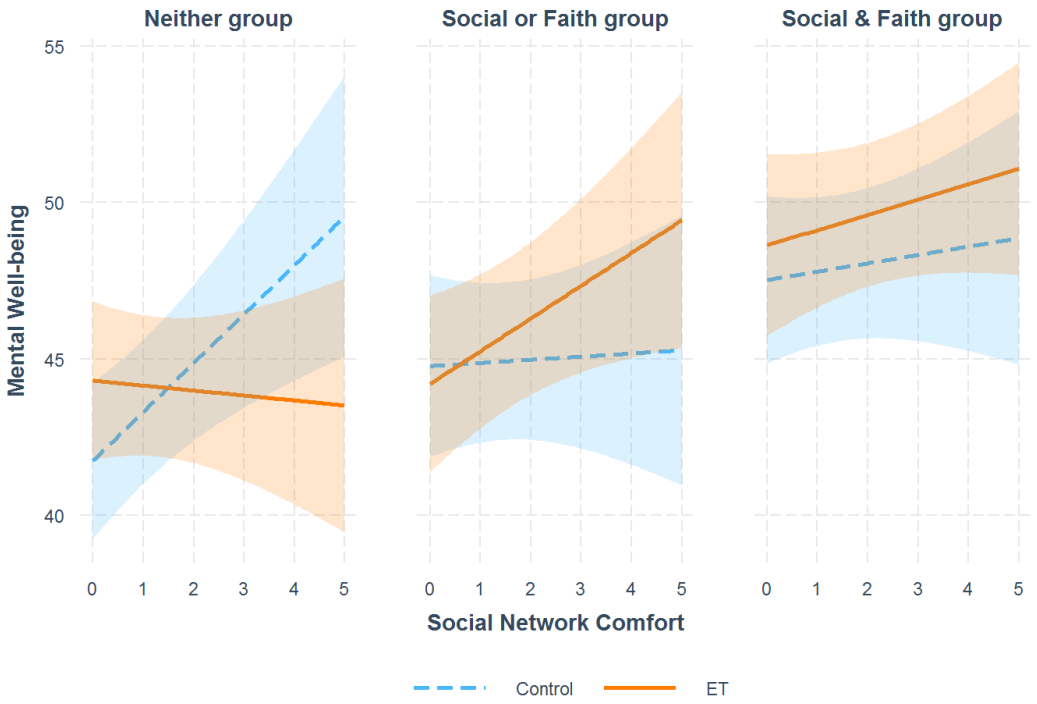


Figure 2. Plot of Interaction Among Trial Condition, Social Network Comfort and Social Group Activity

Trinomial version of the social group variable was used in R to make the plot, 2 – participation in both groups (faith and social), 1 is participation in 1 group (faith or social) and 0 is participation in no groups.

Controlling for demographics and baseline social network comfort, the linear mixed model predicting mental well-being revealed that social network comfort level did not moderate (p=0.842) the effect of clinical trial condition and clinical depression status on change in mental well-being (i.e. interaction with Time). However, it did moderate the effect of clinical trial condition and clinical depression status (β =-2.540, SE= 1.259, p=0.044) on the average mental well-being over the course of the study. Thus, hypothesis was not supported for the effect of the ET intervention over time. Both age (p=0.051) and

clinical depression status ($p<0.01$) were also significantly associated with well-being, including the interaction between social network comfort and clinical depression status ($p=0.004$). Race/Ethnicity was marginally negatively associated with change in mental well-being ($p=0.084$). Thus, hypothesis 3B was supported (see Table 8).

A plot in R of the interaction among social network comfort, clinical depression status and trial condition revealed those who received Elder Tree and were both clinically depressed at baseline and most comfortable with Facebook reported lower mental well-being than those who were in the control group (figure 3). Thus, hypothesis 3B2 was not supported. A plot of the interaction effect revealed that, among depressed elders, those least comfortable with Facebook who received Elder Tree reported higher mental well-being than those in the control group. Among those who were not depressed, there was little difference between trial and control condition at the varying levels of comfort with Facebook (figure 3). Those with the most comfort with Facebook had generally higher mental well-being than those with the least comfort (figure 3). In this model, Facebook comfort level and trial condition were also statistically significant, indicating those with Elder Tree access and greater comfort with Facebook reported higher mental well-being compared to those in Control ($p=0.028$), thus hypothesis 3 was supported.

Table 8 Showing the Interaction of Social Network Comfort, Clinical Depression Status and Clinical Trial Condition on Change in Mental Well-Being.

						95% CI	
	β	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	33.845	56.713	362.152	0.597	0.551	-77.684	145.374
Time	-5.689	56.004	324.273	-0.102	0.919	-115.865	104.488
Trial Condition	1.141	1.062	362.063	1.075	0.283	-0.947	3.228
Gender	-1.018	0.938	361.485	-1.086	0.278	-2.863	0.826
Age**	0.112	0.057	363.956	1.959	0.051	0.000	0.224

Education	0.006	0.406	362.685	0.014	0.989	-0.793	0.805
Race/Ethnicity	1.864	1.215	360.334	1.534	0.126	-0.526	4.253
Social Network Comfort Level	0.475	0.317	361.738	1.499	0.135	-0.148	1.098
Zip Code	0.000	0.001	362.306	0.085	0.932	-0.002	0.002
[a]Clinical Depression Status***	-12.559	2.053	359.274	-6.118	0.000	-16.596	-8.522
Social Network Comfort x Clinical Depression Status***	2.589	0.904	357.310	2.864	0.004	0.811	4.367
Trial Condition x Social Network Comfort	-0.108	0.426	361.437	-0.254	0.800	-0.947	0.730
Trial Condition x Clinical Depression Status	2.160	3.049	360.380	0.708	0.479	-3.836	8.155
Trial Condition x Social Network Comfort x Clinical Depression Status**	-2.540	1.259	361.824	-2.018	0.044	-5.015	-0.065
Time x Gender	0.291	0.927	328.009	0.313	0.754	-1.533	2.114
Time x Age	-0.031	0.059	347.869	-0.529	0.597	-0.148	0.085
Time x Education	0.073	0.409	332.478	0.178	0.859	-0.732	0.877
Time x Race/Ethnicity*	-2.053	1.185	323.070	-1.733	0.084	-4.383	0.278
Time x Zip Code	0.000	0.001	324.787	0.169	0.866	-0.002	0.002
Time x Trial Condition	-0.057	1.058	330.224	-0.054	0.957	-2.138	2.024
Time x Social Network Comfort	-0.032	0.314	330.001	-0.101	0.920	-0.650	0.587
Time x Clinical Depression Status	2.071	2.042	338.383	1.014	0.311	-1.947	6.088
Time x Social Network Comfort x Clinical Depression Status	0.276	0.850	312.901	0.325	0.745	-1.397	1.949
Time x Trial Condition x Social Network Comfort	0.290	0.421	329.141	0.690	0.491	-0.537	1.118
Time x Trial Condition x Clinical Depression Status	-3.784	3.011	330.840	-1.257	0.210	-9.706	2.139
Time x Trial Condition x Social Network Comfort x Clinical Depression Status	0.245	1.231	327.443	0.199	0.842	-2.177	2.668

*a. Clinical Depression Status (binomial) used in this model, where 1=participation in at least 1 social group and 0 is no participation in any groups. *p<0.1, **p<0.05, ***p<0.01*

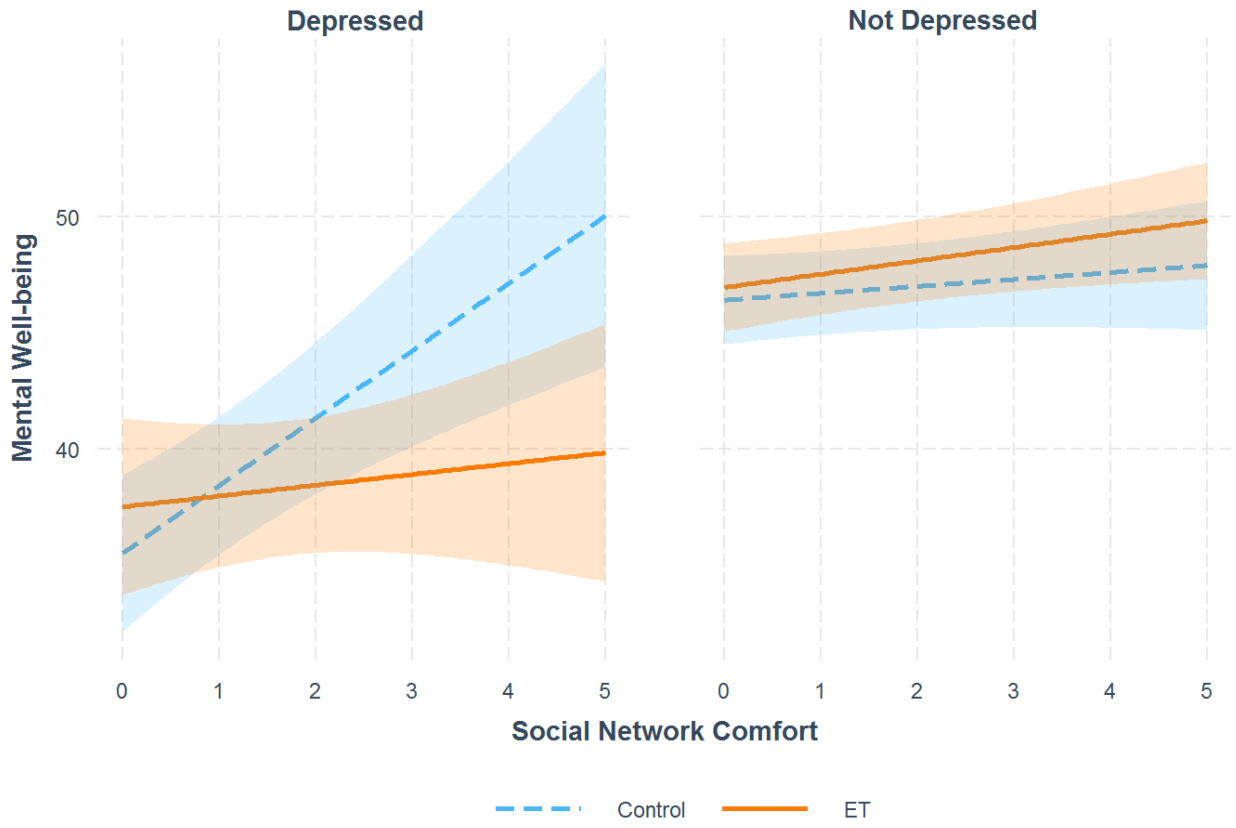


Figure 3. Linear Mixed Model Plot of Interaction Between Trial Condition, Social Network Comfort and Clinical Depression Status

Discussion

Various scholars have investigated information communication technologies as a means to promote social support, increase mental and physical well-being and decrease loneliness among the elderly population (Y.-R. R. Chen & Schulz, 2016; Cornejo et al., 2013; Slegers et al., 2008). However, results indicating effectiveness with mental well-being have been inconsistent (Y.-R. R. Chen & Schulz, 2016). Prior work shows that possible contradictions in the literature may be due in part to specificity in ascertaining which elders stand to benefit the most from these online support systems (Y.-R. R. Chen & Schulz, 2016). The mechanism of action on mental well-being, from these systems may be through

improving social support and social capital among elders. We propose that those elders who are already gaining enough social capital in offline environments may not need such systems. Despite this theoretical implication, multiple ICT interventions are deployed among all groups of elders, regardless of measured need for social support offline. Our study demonstrates some of the challenges of such practice as we show here that different sub-groups of elders, while expected to have greater social capital offline, receive little additional benefit from such systems. Further, for some sub-groups of elders, such interventions may be potentially harmful.

For Socially Isolated Elders

In our study, we found little evidence to suggest that social isolation (perceived and objective) moderated the impact of the online support system, Elder Tree, on mental well-being. After 12 months of using the Elder Tree system we found that elders who were the most socially isolated, reporting the lowest levels of perceived socioemotional support and social engagement at baseline, reported no greater increases in mental well-being compared to those who did not use the system. This suggests that this support system did not improve overall mental well-being for those individuals who stand to benefit greatly from such systems. Socially isolated in our study are those who reported never or seldom having social or emotional support when needed and those with no participation in social groups or clubs. These elders would be least likely to report receiving social capital offline and consequently have the greatest need for an online support system that aims to improve social capital. Despite this, our hypothesis was not supported in this sample.

Online support systems have been promoted as intervention tools to improve social capital and social support among multiple groups, especially vulnerable and stigmatized populations, such as the elderly

and specifically the elderly who are socially isolated (Y.-R. R. Chen & Schulz, 2016; Chung, 2013; McKenna & Green, 2002; W. Pan et al., 2020b; Tanis, 2009). Online support systems have been shown to provide social capital, such as informational resources, emotional resources and socializing support that can help to improve social connection, reduce feelings of loneliness and isolation and improve well-being among stigmatized groups, such as those who are elderly and isolated (Y.-R. R. Chen & Schulz, 2016; Lu et al., 2021; Tanis, 2009; Yeshua-Katz, 2018; Yeshua-Katz et al., 2019). In a systematic review of online support systems and elderly populations, Chen & Schulz urged scholars to include both subjective and objective measure of isolation in assessing ICT effects as both have different impacts on well-being and online systems may differentially impact these measures (Y.-R. R. Chen & Schulz, 2016). We add to the literature by testing both subjective and objective measures of social isolation on well-being. Our study finds that both measures are associated with mental well-being. However, we were not able to demonstrate intervention effects on in well-being, despite testing for both measure of social isolation in the model.

One possible reason for such findings is that the use of online support systems may be contingent on other factors, such as individual ability to use such systems. That is, computer support systems may be technically challenging for some elders to navigate as internet use is still not ubiquitous among elderly populations. Only 75% of elders over 65 report using the internet in 2021, compared to over 96% in all other age groups (Pew Research Center, 2021b). Therefore, the user friendliness and functionality of such systems may affect whether an elder can consume the ICT in the way intended. Additionally, the affordances of social support systems online and social media-like systems present new ways of communicating and forming connections that elders may not be familiar or comfortable with. Thus, confounders, such as comfort level, may impact the degree to which an elder may benefit from such a system. Elders more familiar with social media and other support systems may benefit more from utilizing

ICT interventions. Our hypothesis to test this theory was somewhat supported as social network comfort level moderated the relationship between Elder Tree and average well-being, but not change in well-being over time. That is, for those who were most socially engaged, there was little difference between trial condition and control in mental well-being, regardless of the elders' comfort level with Facebook (figure 2). This indicates that those elders already very engaged offline had access to social capital and thus, Elder Tree had little impact for these groups. Furthermore, established comfort with social networks had little impact as an indicator of their greater ability to utilize Elder Tree because they had little need for an additional social networking system.

However, for individuals less engaged in the other two groups (only engaged in 1 type of group or not engaged at all), social network comfort did have an effect on the impact of Elder Tree on well-being. Supporting our hypothesis, for those engaged in 1 type of group, Elder Tree added to their well-being with those with the highest social network comfort doing the best. But contrary to our hypothesis, for those engaged in no groups, Elder Tree had an adverse effect on well-being (figure 2). For those individuals who are most isolated, i.e. report greatest need, those assigned to Elder Tree reported lower well-being compared to those assigned to the control group, with the greatest difference seen among those with highest social network comfort. In general, the most isolated Elder Tree group reported the lowest mental well-being of all the groups.

Contrary to our hypothesis, social network comfort did not improve the effectiveness of Elder Tree for all groups. For some groups, greater comfort led to lower well-being. This finding is consistent with research reporting adverse effects of social media and other ICTs on mental well-being (Ahmad et al., 2018; Bessière et al., 2010; Y.-R. R. Chen & Schulz, 2016; Dhir et al., 2018; Frost & Rickwood, 2017; Revenson et al., 1991). Multiple studies find associations between online social networks, increased depression and

anxiety and decreased life satisfaction (Frost & Rickwood, 2017; Jang et al., 2018; Satici & Uysal, 2015; W. Wang et al., 2020). Our assessment of social network comfort here is via comfort level with Facebook. Scholars have found that behaviors, such as Facebook surveillance, envy and upward social comparisons, are associated with decreases in self-esteem, mental well-being and increased Facebook use (Appel et al., 2015; Chow & Wan, 2017; Li, 2018; Scherr et al., 2018; Tandoc et al., 2015). Individuals who are more vulnerable and tend to have stigmatized identities are also more likely to utilize Facebook and the internet in these harmful ways (Bekalu et al., 2019; Faghani et al., 2020a; Lawlor & Kirakowski, 2014; Santarossa & Woodruff, 2017; Tandoc et al., 2015). Perceived and objective social isolation have been associated with depression, social avoidance, anxiety and low self-esteem and these are all associated with problematic internet use (Akanni & Adayonfo, 2020; B. Cornwell et al., 2008; CORNWELL & WAITE, 2009; Faghani et al., 2020a; Santarossa & Woodruff, 2017; Sauleviciute & Rybakova, 2016; Tiikkainen & Heikkinen, 2005).

Few studies have elucidated the reason why individuals who tend to be the most vulnerable are also most likely to use the internet in problematic ways, which then lead to harmful effects of the internet on their well-being. One study has shown that problematic internet use is linked to experiential avoidance, a self-regulatory strategy for coping with negative stimuli, and that this mediates the relationship between difficulties in emotional regulation and problematic internet use (Faghani et al., 2020a). Vulnerable Individuals, such as those with social anxiety, emotional disorders and substance use disorder, tend to utilize experiential avoidance (Faghani et al., 2020a). Multiple studies examining problematic use utilize younger samples and do not include older adults as a sub-population. Additional research regarding the psychological drivers of this usage among older adults is urgently needed.

For depressed elders

Our second hypothesis proposed that elders who were clinically depressed should benefit the most from such systems, as a result of reduced offline capital and the need for empowerment online; surprisingly, we found the opposite in this population. We find here a similar trend for clinical depression status and baseline depression level. Depression level was marginally significant for moderating the effect of Elder Tree on change in mental well-being. Depression was associated with slower increases in well-being for those who used Elder Tree compared to the control. This relationship was not statistically significant at the 5% level but is at the 10% level, which indicates it is approaching significance. The control group had more improved well-being over time. As expected, the interaction between time and depression was significant at the 5% level. Thus, depression was associated with change in mental well-being over time. Consistent with a number of emerging studies pointing to potential adverse effects of social networks on depression, those with Elder Tree seemed to be trending towards worsened well-being over time, compared to the control groups (Bessière et al., 2010; Li, 2018). As mentioned above this could be connected to problematic internet usage behaviors or the psychological use of social networking systems. Despite public health practitioners developing ICTs to help improve social connection for the elderly, studies indicate that individuals who use social networking systems primarily for emotional connection, maybe as their primary source for social interaction and engagement, suffer more harmful effects of ICTs (Bekalu et al., 2019; Lawlor & Kirakowski, 2014). Those with worsened depression or clinical depression are at greatest risk for social isolation and stigmatization offline (Lawlor & Kirakowski, 2014; Sauleviciute & Rybakova, 2016). Therefore, these individuals may be more likely to use ICTs for this purpose, to obtain meaningful social ties and less stigmatizing social engagement.

Further research is needed to assess how these sub-groups of older adults may be using interventions like Elder Tree. It is possible that this already vulnerable population may be experiencing the deleterious

effects of online support systems rather than the benefits, either due to the way they process such systems because of their prior psychological state, or as a result of how they engage with the system. Are there certain forums they tend to engage with or do they tend to process support in different ways? Are there negative environments on these spaces that are potentially more harmful to those who are already experiencing self-stigma and at high risk for low self-esteem? Do they process lack of comments, likes and lack of social engagement with their posts differently? Studies of adolescents indicate that social rejection and acceptance via media excites similar brain activity as social rejection and acceptance offline and that this relationship is stronger for those with lower self-esteem (Crone & Konijn, 2018; Firth et al., 2019). Other studies indicate a potentially beneficial effect on depressive symptoms for those with attachment anxiety in seeking reassurance via Facebook (Forchuk et al., 2020). Additional research is needed to understand why older adults who are clinically depressed may be experiencing lower mental well-being after system use compared to those who did not use the system

We also assessed whether those more comfortable with Facebook would receive differential effects of the intervention. As hypothesized, for those who are not depressed, there was little difference between trial and control among participants with varying levels of Facebook comfort (figure 3). Among the depressed elders, for those with the lowest level of social network comfort, little difference between Elder Tree and Control is found, as these individuals may find Elder Tree most difficult to use and obtain reduced benefit from using the system. However, for those depressed elders with the highest level of comfort, similar to social isolation, the greatest difference between Elder Tree and control was found, with lower well-being among those who were assigned to the Elder Tree group compared to control. We suggest here that this adverse impact on well-being may be for the same reasons as indicated above. Elders who are depressed may be repeating harmful behaviors they normally utilize on Facebook on the

Elder Tree system, as multiple studies indicate that mental health illness and depression is associated with problematic internet use and harmful effects of Facebook use (Li, 2018; Tandoc et al., 2015). Scherr and colleagues found that Facebook use did not predict depression over time but rather, that depression predicted Facebook envy and that led to surveillance use of Facebook over time, which is associated with decreased well-being (Scherr et al., 2018). Other studies show that only those with envy had decreased mental well-being (Appel et al., 2015; Tandoc et al., 2015). Those without envy had improvement in well-being after social network use (Tandoc et al., 2015). Further, other studies show that depending on your online social comparison orientation, Facebook may have negative or positive effects on mental well-being (Park & Baek, 2018). It is possible that here, those who are depressed may be using Elder Tree or experiencing Elder Tree in ways that mimic other social networking platforms and thus, this may be adversely impacting well-being for these sub-groups that scholars most typically find to be negatively impacted by these platforms.

Main Intervention Effects

We did not find effects of the intervention or the moderators on change in mental well-being (interaction with time), which may indicate that the intervention did not have an impact on mental well-being. However, given for clinical depression we found marginally significant results in the direction of potentially adverse effects, I would caution against making that claim. It is possible that a longer time point is needed in order to see effects of ICTs on this elderly population. This may not be surprising as for some elders, this was their introduction to computer use and social networks. Twenty percent of this population had never used a computer or laptop before the study and 54% reported the lowest level of comfort with social networks. Further, change in mental well-being may be moderated by the type of engagement with the system. For example, those more able to engage with the system may receive

greater benefits on well-being as hypothesized with social network comfort; we see some support for this here. Differences in how elders are engaging with the system may also be a confounder here. Though elders were using the system, they may have spent more time messaging clinicians or consuming informational and instrumental resources about health rather than posting and engaging on the discussion forums. Prior studies show that expression (and not just reception) of support in online forums is important for positive effects (Han et al., 2011; Namkoong et al., n.d.). Further changes in well-being may also be related to the quality of the social interactions on Elder Tree. Prior work indicates that negative and positive social interactions can have different impacts on depression among older adults, and that this effect varies depending on the interaction source (Okun & Keith, 1998). It is unclear whether this applies to online social interactions. We did not assess quality of the social interaction in this study.

In addition, it is possible that some measures of social isolation are more impacted by ICTs than others. For example, ICTs can increase your social network size and increase your available social support, but it is less likely to increase participation in offline social groups or with family, if family are not on the ICT platform. Elder Tree affords the ability to connect with family and friends online. If utilized, Elder Tree could increase social engagement with existing social networks and potentially increase social support perceived over time. Thus, it is possible that changes in engagement with existing friends and family over time may predict changes in well-being over time. Future research should assess this in order to further elucidate the mechanism by which ICTs may be impacting social engagement and improving social capital over time. The importance of this should not be underscored as it is critical we design, tailor and deploy such systems for health improvement. Understanding the affordance that drive social isolation can help us to customize a system tailored to specifically critical areas of need (i.e. designing a system for increasing social network size (for e.g. Facebook 1.0, Instagram) vs. a support system tailored towards

mainly providing emotional or informational support (e.g. forums, such as Reddit or Twitter). It is possible that only certain sub-groups need the latter vs. the former. It's also possible that others may not benefit, possibly wasting valuable resources utilized to develop such systems, or they may even be potentially harmed.

Limitations

Our study furthers research regarding the relationship between social isolation, mental well-being and ICTs in older adults. We add to the body of literature by assessing multiple dimensions of social isolation, perceived social isolation and objective social isolation. We utilized socio-emotional support for perceived social isolation. However, assessing loneliness in addition to socio-emotional support may have yielded a more comprehensive assessment of perceived social isolation. Loneliness was not assessed at baseline in the ET survey. Consistent with prior studies, our results indicate that social participation in groups, on its own, has an impact on well-being in older adults (K.-L. Lee et al., 2015). However, including additional measures of objective social isolation, such as contact with family and friends, quality of interactions with social network members or social network size would produce a more comprehensive measure of social isolation and may have also produced different results regarding isolation as a moderator. Further, we were not able to assess frequency of engagement in social activities or examine specific social engagement activities, such as meetings or churches. Different activities may have varying effects as well.

Further, we sought to assess whether those who were most isolated and most depressed may benefit from online support systems. However, we were not able to truly assess the impact of the most vulnerable due to a small size for these groups. Only 47 individuals in our sample met the criteria for Major Depressive Disorder and only 16 participants in our sample responded that they never or rarely

have someone to turn to in the nine different scenarios for social and emotional support. A larger sample size would yield a more robust assessment of the impact of ICTs on these stigmatized groups. Similarly, as we argue above, some depressed elders are not isolated, yet depression and social isolation are associated; thus, an interaction examining depressed elders who are also socially isolated may point to the group that is most likely to benefit from ICT interventions or the group most harmed. A large sample size is truly needed to assess these sub-group differences.

Lastly, it may be that ICTs among older adults require a longer time period in order to see intervention effects and thus examining additional time points may help to ascertain the mechanisms driving these effects. Further, it is also possible the effects in the first six months may be different from the effects in the last six months and therefore, assessing these different time points is an area for future research. Prior studies indicate that ICTs seem to have an impact in the first few months and then less impact as time elapses with multiple studies reporting effects at three months (Y.-R. R. Chen & Schulz, 2016; Tsai et al., 2010; Tsai & Tsai, 2011). However, we did not assess outcomes at three months. Future studies should employ shorter time durations to evoke a more accurate assessment of when the intervention may be impacting well-being and how. Lastly, this group of elders are all from Wisconsin counties and thus these results may not be generalizable to elderly populations in other geographical locations. Despite these limitations, strengths of this study include the randomized design and the relatively high retention rate (90% at 6months and 88% at 12months (78% overall)). This analysis also assessed multiple measures of social isolation, both perceived and objective social isolation and is one of few studies to investigate these effects among those with major depressive disorder.

Practical Implications

Internet use and online support systems have been investigated as a means to supplement social interactions for the elderly. Some elders may have reduced social engagement as a result of functional and cognitive decline. Others may have reduced engagement because much of the social interaction in today's world exists digitally and they may not be online. Elder Tree is an ICT that was provided to elders in three Wisconsin counties to help aid social isolation and promote mental and physical health. We found here that the elders that needed this system the most, those most isolated based on perceived isolation and a more objective social engagement measure, did not receive the greatest benefits. In fact, those elders who started out with a higher level of comfort with Facebook and were most isolated and depressed experienced lower well-being when on Elder Tree compared to the control group. This points to the need for scholars and practitioners, before implementation, to further evaluate which groups of elders are the most in-need of their online system, and which are most likely to benefit. Research indicates that certain behaviors online by some of these stigmatized groups may further exacerbate mental health issues and thus, before deploying such systems among these groups, efforts should be made to reduce harm to these already vulnerable populations.

Mitigating Harmful Effects of ICTs and Social Media

Our study adds to the growing number of studies indicating that some older adults may receive no benefits or negative effects from ICTs and social media platforms. Given this finding, additional and urgent research is needed to assess how we can design systems that will maximize the social capital and support benefits of ICTs while also minimizing harm. Attention should be given to how these elders are socializing and internalizing the affordances of online systems and the interactions that are encountered in the online space. Due to deindividuation and other affordances, such as accessibility, multiple studies indicate that re-stigmatization and negative interactions can occur on online spaces, including those

designed for stigmatized groups, such as those with social anxiety, loneliness or depression (Basterfield et al., 2018; Cho & Acquisti, 2013; Lawlor & Kirakowski, 2014; Santarossa & Woodruff, 2017; Stevens et al., 2017; Tang & Fox, 2016). Other studies indicate a preference for certain affordances that allow for the disclosure of negative events versus positive events, and that affordances that help users manipulate self-presentations can potentially lead to harmful manipulations for certain groups (Choi & Toma, 2014; Noll et al., 2009; Twomey & O'Reilly, 2017; Yang & Bradford Brown, 2016). Further study should assess how we can design messages and foster environments that reduce negative interactions, foster empowerment and reduce re-stigmatization. Given that older adults with stigma and high mental health burden are more susceptible to these negative interactions and potentially traumatizing spaces, additional research is needed to address how we can design online spaces that reduce trauma, promote mental health and reduce harm (Newsom et al., 2005; Twomey & O'Reilly, 2017). Researchers and practitioners should aim to design spaces on ICTs that are more trauma-informed and healing-centered to reduce the likelihood of these spaces exacerbating harmful behaviors online and to increase positive interactions (Ginwright, 2021; Substance Abuse and Mental Health Services Administration, 2014). I will discuss in Chapter 4 and 5, how we can design online systems and engage with participants online in a trauma-informed and healing-centered way to promote mental health and reduce harm.

Conclusion

In 2017, Almost 5.5 million adults 65 and older had a mental health illness and 1.4 million had experienced a major depressive episode in the prior year (SAMHSA, 2017). Furthermore the number of elders who live alone is projected to increase (Benson, n.d.; CDC, n.d.; Centers for Disease Control and Prevention & National Association of Chronic Disease Directors, 2008). According to the CDC's Audience Insights on the baby boomer generation, only 11% of baby boomers plan to stop working entirely after

retirement age and there is a shift towards leading more independent, active lives among these individuals (CDC, n.d.). In fact, the share of elderly in the workforce has been increasing steadily since the 2000s and in 2015, 19% of Americans 65 and older were in the labor force (working or actively seeking work) (ARP PUBLIC POLICY INSTITUTE, 2020; CDC, n.d.). Since loneliness and depression are both associated with increases in mortality and morbidity among the elderly, understanding the specific needs of these individuals will help to support their quality of life. Online support systems that decrease loneliness and social isolation are critical in supporting elderly well-being. We add to the body of literature suggesting that the mental health benefits from these systems may be limited. We found no improvement in mental well-being for some of the most vulnerable elders, namely those reporting the highest perceived and actual social isolation. Additionally, in our population of depressed elders, we found potentially harmful effects. Comfort level with social media platforms like Facebook further exacerbated this effect. Social media use by older adults is increasing. Future research is needed to understand how sub-groups of elders may be using online support systems and how, as practitioners, we can support their elderly mental well-being through these systems (and recommend use of others) while minimizing harm.

Chapter 3

Fostering Supportive Environments in Online Support Systems for Opioid Use

Abstract

Mobile health solutions that supplement traditional treatment for addiction recovery have demonstrated positive effects. It is unclear whether the supportive systems and strategies, such as trauma-informed care, used in offline recovery programs translate well into the virtual space. Few models exist guiding the moderation and facilitation of engagement in the online space for opioid use disorder. Given that multiple studies indicate that forum engagement drives the beneficial impacts of online support systems, this is a critical area of research needed for thoughtful and effective digital interventions targeting substance use disorders. This study aims to address this by investigating what types of supportive content drive engagement on the online discussion board of the A-CHESS app, a smartphone-based intervention adapted for opioid use disorder, and whether moderators or community managers moderate this relationship. We coded 3,918 messages posted on the A-CHESS discussion boards by participants and moderators between March 31, 2016 to April 24, 2018 for 10 content types, coding categories related to support, stigma and methadone perceptions. Regression analysis (ANCOVA) was used to assess the impact of content type and author type on engagement (number of comments, views, view time and response time). We found that moderators posted more supportive messages and less messages related to stigma. Threads containing informational support received less views ($F=13.13$, $p<0.001$), less comments ($F=23.52$, $p<0.001$) and had slower response time ($F=5.99$, $p=0.015$). Threads with stigma and threat received more views and comments. Author type (peers or moderators) moderated the relationship between different types of content and different measures of engagement. Moderators play

a critical role in facilitating views, comments and support in this online space. Practical implications on the role of moderators in facilitating health promoting and de-stigmatizing engagement is discussed.

Background

Opioid use disorder is a chronic disease that can cause life-threatening health, social and economic problems (Strang, 2020). The majority of health-related institutions recognize opioid use disorder as a growing public health problem in the United States, and are making greater efforts to reduce the mortality rate and the costs of economic burden caused by this disorder (Florence et al., 2016). Globally, in 2016, 26.8 million people were living with opioid use disorder and there are over 100,000 overdoses annually (Strang, 2020). Traditional, acute treatment for substance use disorders is limited in timing of the treatment (typically 3-6 months), despite these disorders being chronic conditions requiring continuing care (Nesvåg & McKay, 2018). Scholars have looked towards ICTs and mobile health interventions to help promote more long term supportive social networks, improved coping responses and engagements that increase self-esteem and self-worth, all factors that contribute to relapse prevention (Nesvåg & McKay, 2018). Through affordances, such as accessibility, asynchronicity and portability, mHealth solutions can provide potentially sustainable on-the-go, real-time support that could reduce relapse and promote healthy behaviors (Gustafson et al., 2011; Hochstatter et al., 2021; Nesvåg & McKay, 2018).

However, in a systematic review of 28 digital interventions for substance use disorders, Nesvåg & McKay concluded that though some interventions showed positive effects on some recovery outcomes, such as risky drinking days, overall these interventions had limited efficacy; more research is needed to understand how to increase effectiveness of such interventions among these groups (Nesvåg & McKay, 2018). Further, very few of these interventions were for users of opioids, with the vast majority focusing

on alcohol use. More research is needed to understand how individuals with opioid use disorder may benefit from ICTs and online support systems for recovery. Prior research indicates that solely consuming content through viewing messages on an online system can have a different impact on well-being, compared to actively engaging with the content through posting and commenting (Han et al., 2014). Understanding how to motivate users to engage in different ways can help increase the likelihood of benefits received from these interventions. However, most of the research on online support systems and engagement has largely been descriptive and few studies pay additional attention to the role of moderators or community managers in facilitating user engagement compared to peers. In addition, almost none of these studies examined online systems for opioid use disorder, a heavily stigmatized illness that may make facilitating engagement even more challenging. Here, we present the findings of a quantitative analysis of the content that drives engagement on the online discussion board of the mobile health app, A-CHESS, adapted for patients in recovery from opioid use disorder.

Opioid Use Disorder and Stigma

Individuals struggling with opioid use disorder often face higher levels of self-stigma and societal stigma that can present significant barriers to continued engagement in treatments and interventions for recovery (Corrigan, 2020; McCradden et al., 2019; Olsen & Sharfstein, 2014). Perceived stigma among patients with opioid use disorder has been associated with lower physical, psychological and environmental quality of life, along with lower self-esteem, depression, anxiety and poor sleep (Birtel et al., 2017b; Singh et al., 2018). McCradden et al found the stigma associated with opioid use disorder is complex and multi-faceted. Individuals experience internalizing stigma or self-stigma, stigma within the clinical encounter, stigma related to using opioids for pain management and interpersonal or structural

stigma related to opioid replacement therapy or medication-assisted therapy (McCradden et al., 2019). They also found that the stigma is systemic; it exists among the general public, among clinicians, among other patients struggling with opioid use disorder and among institutions like the justice system (McCradden et al., 2019). One individual with opioid use disorder, in a study by Gunn and Guarino, expressed that among her community, she believes individuals with substance use disorders are seen as "nothing, not human, they are dead already" (Gunn & Guarino, 2016). Further, in a study of 1,169 U.S. residents, Perry and colleagues found that 76% of participants would not work with an individual with opioid use disorder and participants were more likely to label those with opioid use disorder as lower in competence compared to individuals with alcohol use disorder (B. L. Perry et al., 2020).

Understanding the power of stigma in the context of opioid use disorders is a vital step in facilitating the recovery process. Individuals with opioid use disorder have concealable stigma. As explained in Chapter 1, this type of stigma is not easily identifiable and has to be self-disclosed. The discouragement, shame and guilt associated with this stigma often prevents disclosure, reduces the likelihood of pursuing necessary recovery resources and makes it difficult to find others who share this stigmatized identity (Lawlor & Kirakowski, 2014; McCradden et al., 2019; Tanis, 2009). These individuals may hesitate to share treatment information or may be less motivated to change their behaviors because of the self-stigmatizing "why try" belief (Corrigan, 2020). Online support systems can provide a new way for individuals with opioid use disorder to find similar others and access informational and emotional support. They have been associated with decreasing self-stigma and can serve as a means of boosting self-confidence and personal empowerment (Barak et al., 2008; Lawlor & Kirakowski, 2014; van Uden-Kraan, Drossaert, Taal, Seydel, et al., 2008). Very few studies have investigated how individuals with

opioid use disorder obtain support online. One study of this phenomena did find that individuals used Reddit to seek advice, emotional support and a space to share personal experiences (D'Agostino et al., 2017). They also found that very few individuals talked about seeking treatment from medical professionals and cited stigma as a potential contributory factor (D'Agostino et al., 2017).

Research Questions

Given few studies furthering our understanding of the types of content posted by individuals with opioid use disorder, this study assesses the type of content posted in an online forum or discussion board for opioid use disorder and includes codes specific to the opioid use disorder context, such as different types of stigma and methadone perceptions. We seek to first answer the following set of research questions:

- RQ1: What types of content are posted on an online forum for opioid use recovery?
- RQ2: Do users of an opioid use recovery space post about stigma?

The high degree of stigma experienced by this group may lead to higher mistrust that could present as a barrier to engagement, even in online support systems. However, because of the safe environment that anonymity and asynchronicity affords, online users show higher levels of self-disclosure and emotional expression compared to in-person interactions (Lawlor & Kirakowski, 2014). D'Agostino et al. emphasized the affordance of anonymity in throwaway accounts on Reddit, potentially deemed this space more attractive to those with opioid use disorder (D'Agostino et al., 2017). In the absence of anonymity, individuals with opioid use disorder may be less likely to engage on these forums and may only participate through viewing others' messages. Since studies indicate that benefits received from online support

systems are driven by forum engagement, this is a key avenue needed for research to develop thoughtful and effective digital interventions targeting opioid use disorder.

Individuals can engage with online forums through expressions, posting and commenting on forums, or by consuming other individuals' posts, i.e. reception. Both types of engagement have been linked to improved well-being and coping (Han et al., 2011; Namkoong et al., n.d.). Some studies indicate that expression, rather than reception, is linked to receiving the benefits of emotional support in online forums (Namkoong et al., n.d.). While others indicate that in some cases, reception provides benefits over expression in the first few months of engagement (Han et al., 2014). In another study examining engagement in online health groups, they found that both types of engagement led to empowerment of participants, i.e. feelings of confidence, optimism and self-esteem, but only posting led to improved social well-being (van Uden-Kraan, Drossaert, Taal, Seydel, et al., 2008).

It should be noted that in other studies participants reported that consuming messages, rather than posting, helped them feel more comfortable with the space and that this practice is often utilized in the beginning until individuals feel comfortable enough to post (van Uden-Kraan, Drossaert, Taal, Seydel, et al., 2008). In fact, in a study of health-related discussion lists, 45.5% of individuals only viewed messages and did not comment (Nonnecke & Preece, 2000; van Uden-Kraan, Drossaert, Taal, Seydel, et al., 2008). It is possible that only viewing (otherwise known as lurking) may be a critical practice for individuals with stigmatized identities, such as those with opioid use disorders who may be apprehensive of personal disclosure in these spaces, may be more reluctant to engage with others and may distrust clinician

moderators. Additional research is needed to understand how individuals with opioid use disorder may use online support systems and what sorts of factors impact the different types of engagement. Given the relative importance of expression in addition to reception in facilitating the maximum benefits received, this study aims to fill these gaps in research by answering the overarching research question: *What types of content drive forum engagement (viewing and commenting) among users with opioid use disorder?*

We examine engagement on the forum in two ways: reception (i.e. views) and expression (i.e. comments). We also investigate two dimensions within these two types of engagement (speed and quantity). Thus, we study the number of views and how quickly messages were viewed in addition to the number of comments generated and how quickly a comment was made. Our next set of research questions are:

- RQ3: Do certain types of content generate more views (total and unique views)?
- RQ4: Are message threads with a certain type of content viewed more quickly than message threads without this type of content?
- RQ5: Do certain types of content generate more comments?
- RQ6: Do message threads with a certain type of content receive more rapid responses than message threads without this type of content?

Moderators on Online Forums

Multiple studies point to the utility of moderators or community managers in helping to drive engagement on online forums and in helping to mitigate harm (Male et al., 2017; O'Grady et al., 2010;

Young, 2013). Given that those with opioid use disorders are already marginalized and pose a high risk for stigmatization, including moderators or community managers on the forum space to facilitate emotional support and reduce re-stigmatization may be a critical feature of such a system. However, the role of moderators on online support systems for opioid use disorder has not yet been studied. Prior studies of the feasibility of a mobile application for alcohol use disorder found their system moderators, operated by staff, played instrumental roles in the online network. (Johnson et al., 2016). Network analysis revealed that without the moderators, many of the individuals in the network would have been isolated, and moderators were found to be central to the network (Johnson et al., 2016). Similar findings regarding centrality of moderators in the network were found in other studies (Fronzetti Colladon & Vagaggini, 2017). Further, in another study of moderators on online health communities, the researchers found that users viewed moderators as critical to the forum space and in some cases, users were emotionally attached to the moderators (Huh et al., 2016). Thus, it is possible that moderators could be a key actor in a forum space for opioid use disorder. This remains to be empirically tested.

System moderators may play important roles in these systems as they not only provide expert information and emotional support to users but also encourage communication and dialogue on the system (Smedley & Coulson, 2017). Providing both informational and emotional support has been linked to increased physical and mental health among online support system participants as well as relapse prevention among substance use disorder populations (Namkoong et al., 2010).

Moreover, system moderators may provide a critical role in preventing hostility, reducing stigma and guarding against re-victimization. The number and speed of response from moderators or peer members in online support systems may impact patients' perception of support and benefits received and could play a part in relapse prevention. System moderators can manage these activities by themselves or encourage peer members to participate. Thus, understanding how moderators are providing these supportive structures to such systems will help maximize benefits by participants in these groups.

Moderators may post different types of content on these spaces compared to the type of content posted by peers. Prior research suggests that individuals look to experts for evidence-based information regarding illnesses and treatment and to clinician moderators for informational resources. Alternatively, they look to peers for experience-based information (Atanasova et al., 2018; Vennik et al., 2014). Other studies indicate that messages designed by expert moderators compared to those designed by peers can be more or less motivating depending on the stage of behavior change of the user consuming the message. Therefore, moderator messages may contain different content compared to peer messages, with varying impacts. A majority of the studies done on moderators versus peer-led forums have been outside the substance use disorder context and very few studies have been done on online forums for opioid use. It is unclear whether these findings hold for this context and further for the highly stigmatized population of patients struggling with opioid use disorder. Thus, in this study, we distinguish between content posted by moderators and content posted by peers. Our next research question is:

- RQ7: How does the type of content posted on online forums for opioid use disorder differ based on whether it is posted by a moderator or posted by a peer?

Further, it's likely that certain content by moderators (or peers) may yield greater engagement compared to other content. As participants on the online forum become accustomed to the forum space, they may respond differently to moderators versus their peers. Prior research indicates that moderator-led online support spaces obtain more engagement than peer-led support spaces (Klemm, 2012). Other work indicates that moderator-led spaces are more likely to insight emotional expression, expression of anxiety and other responses potentially more conducive to promoting positive mental well-being (Lieberman, 2008; Lieberman et al., 2005). Studies also examine whether forums need to be moderated by clinicians or whether technician-assisted forums also promote wellbeing, and they found both types of moderators to be effective (Titov et al., 2010); either one is better than unmoderated forums.

> Therefore, we hypothesized that the relationship between content type and different measures of engagement will be moderated by whether the message was initiated by a moderator or peer (i.e. author type).

Understanding which type of content facilitates engagement and *by whom* can help target strategies to increase engagement, promote well-being and prevent relapse. Thus, we sought to further assess how author type (peer vs. moderator) impacts engagement.

- RQ8: How does the relationship between content type and engagement change if the message is moderator-initiated or peer-initiated?

Though recommendations exist on how moderators are, and should be, utilized in online support systems for health, evidence on the impact of the moderator's role, content and style on engagement within the

forum is sparse and even less prevalent for online recovery spaces for opioid use disorder (Huh et al., 2016; O'Grady et al., 2010; Young, 2013). In fact, there are only a handful of studies to date that investigate the role of moderators in online health systems and they primarily focus on thematic analysis of moderator content and the association between author type and engagement, looking less at the features that drive engagement (Atanasova et al., 2018; Klemm, 2012; Lieberman et al., 2005; Male et al., 2017; Smedley & Coulson, 2017). Thus, our study attempts to fill these gaps among a critical population, opioid users in recovery. We aim to shed light on this question by comparing the types of content posted by moderators and the types of content posted by peers and quantitatively assess what types of content drive engagement. Our study adds to the evidence base regarding how moderators interact with forum users to increase engagement with the primary goal of improving relapse prevention.

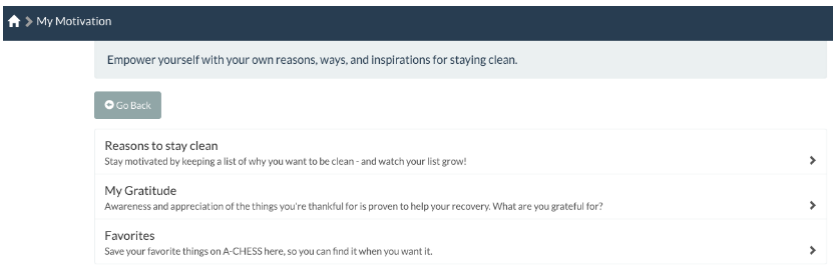
Method

Intervention

The intervention for this study is part of the Bundling program, developed by pairing medication-assisted treatment (MAT) for opioid use disorder with the A-CHESS mHealth intervention in order to improve recovery and maintain long-term abstinence (Gustafson et al., 2016). A-CHESS is a smartphone app that includes a space where patients can chat online as a support group. It is based on self-determination theory, targeting individuals' autonomy, competence and relatedness to improve adaptive functioning (R. M. Ryan & Deci, 2000). Users can obtain information or monitor their lifestyle via automated and tailored messages generated from personalized A-CHESS services. Users can also customize their A-CHESS options triggered in a moment of need. Figure 1 shows the A-CHESS user interface.

Figure 1. A-CHESS Main Panel

In the 'My Motivation' section, users can write down or take pictures of their reasons to stay in recovery. Notifications will prompt users to journal several times a week about the things for which they feel grateful. Users can come back to review these motivations when they are in a difficult situation in recovery. Figure 2 shows the My Motivation and 'Help with Cravings Window' which provides a list of quick links to sections that can relieve cravings. Users can easily contact their pre-approved supporters or perform positive and potentially distracting activities, such as playing games or watching TV. Figure 3 shows the Help with Cravings window.



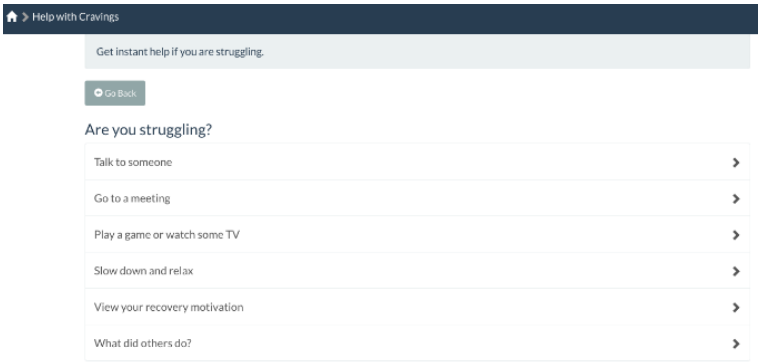


Figure 2. A-CHESS My Motivation and Help with Cravings Menu

A-CHESS also includes a location tracker function that uses GPS to monitor patient movement. Users can save their high risk locations in their personal settings. If a user approaches a location he or she previously defined as “high risk”, A-CHESS will initiate a customized recovery process. Figure 4 shows the ‘Information’ menu and the ‘Settings’ window, where users can manage their GPS records. In the ‘Information’ section, users can browse or search for *opioid-specific* information, i.e. content related to recovery, such as tips, information about relevant diseases and other people’s stories of recovery. Figure 5 shows the Information window.

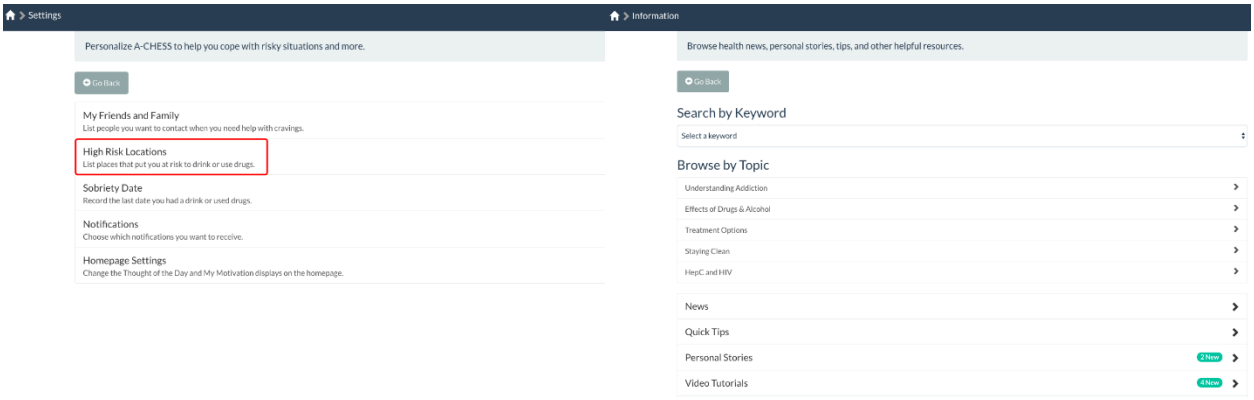


Figure 3. A-CHESS Settings menu (location tracker) and Information Menu

The ‘Discussion Groups’ section, shown in figure 6, hosts the online forum where users can post messages and comments to exchange information, advice and emotional support. This section is monitored by A-CHESS moderators or community managers. The moderators also review user data and encourage users to follow up with their health care providers. There are six groups in this section, each may be general or tailored to specific medication-assisted treatments. The groups are the Public Group, Vivitrol Group, Suboxone group, Methadone Group, Living Well with HIV and Staying Healthy group.

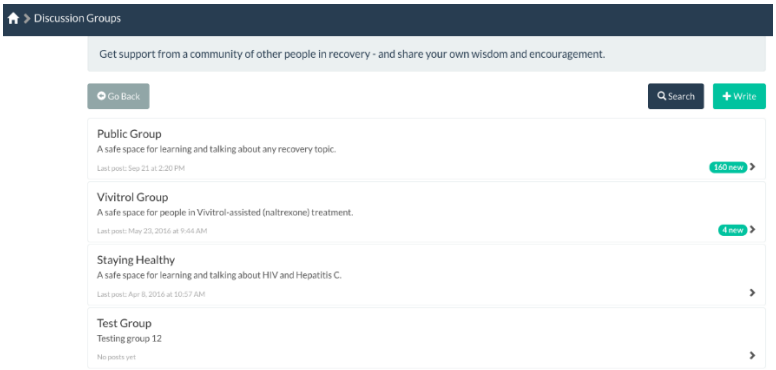


Figure 4. A-CHESS Discussion Groups menu

Bundling Sample

212 patients with opioids use disorder were recruited to receive both MAT (methadone, injectable naltrexone, or buprenorphine) and A-CHESS treatment (Gustafson et al., 2016) and 203 were assigned to the control group (without A-CHESS treatment). Participants filled out surveys at baseline, 6 months and 12 months on their emotional and physical health and drug use. The baseline survey was used to derive the following description of the sample: The average age of the participants was 37 years old (19 years old – 64 years old). The average level of education completed was high school graduate or GED, with 38% of participants not earning a high school diploma or GED. Roughly 30% of the users had some college level education. Nine percent of the participants were Hispanic/LatinX, 98% were White, 3% identified as Black/African American and 3% identified as American Indian or Alaskan Native. Nine percent of the participants did not have access to the internet; 36% accessed the internet at home and 64% accessed it on mobile phones. Forty-three percent of the participants, at baseline, held self-stigmatizing beliefs; they believed, at least sometimes, that 'they deserve bad things happening to them', 'they are inferior' or 'they screwed up their lives'. In addition, at the baseline survey, participants reported, on average, using

opioids for 3 days out of the last 30 days, 30% of the participants did not use opioids in the last 30 days and 63% of the participants used illegal/street drugs in the last 30 days.

Study Analytical Sample

8,970 messages were generated on the discussion board in A-CHESS during the study period. This study obtained a sample of 5,457 messages posted by participants and moderators between March 31, 2016 to April 24, 2018 (approximately the first two years of the study – the last message on the board was posted on March 30, 2021). Roughly 1,100 messages were used to establish reliability for 10 codes (see details below). Ten percent (435 messages) of the final sample of messages (4,353 messages) were used to assess the final round of reliability, with the analytical sample containing 3,918 messages. Among this sample, 227 messages (6%) were posted on the Living Well with HIV group, 807 messages (21%) on the Methadone Group, 2,695 messages (68%) on the Public Group, 56 messages (1%) on the Staying Healthy group, 112 messages (3%) on the Suboxone Group and 7 messages (0.2%) on the Vivitrol group.

Measures

IV: Message Content Type

We developed a codebook that included 10 coding categories related to social capital and social support on online forums as well as stigma associated with opioid use disorder: informational support, advice, emotional support, universality or relatedness, self-acceptance, negative perception of self/self-stigma, threat, anticipated stigma, societal stigma/enacted stigma and methadone negative perceptions/stigma

(see Table 1 for a brief definition and examples of each coding category). Each coding category was coded as 1 if the message included the content and as 0 if there was no such content in the message. Messages can be coded into multiple coding categories. Two coders were trained before coding. The reliability between two coders on each coding category is shown in Table 2. Almost all coding categories were 0.9 and greater. The reliability on Societal/Enacted Stigma was lower because there were too few messages containing this content with disparate agreement among the coders. The category Any Stigma was created by combining all stigma-related variables. A value of 1 means that the message mentioned any type of stigma including self-stigma, anticipated stigma, societal stigma/enacted stigma, and methadone negative perceptions.

Table 1 Showing Brief Definition and Example of Human-Coded Coding Categories

Coding category	Brief Definition	Example
Informational Support	Cognitive support refers to information, knowledge, and/or advice that helps the individual to understand his or her world. The commenter may convey how he/she thinks it would be useful or appropriate to think about or respond to a given situation or may suggest resources including websites, A-CHESS features, or other sources.	"Hello diva! Welcome to A-CHESS. This is Klaren, one of the A-CHESS staff. Pls. do not hesitate to ask if you have any questions at all using A-CHESS."

Advice	For messages categorized as including informational support, if the writer conveys his or her own opinion, or perspective relevant to another's situation, then it is advice.	"Sometime it hurt to say goodbye but it may be for the best hold your head up there's hope for you."
Emotional Support	Emotional support fosters feelings of comfort and leads the recipient to believe that he or she is understood, admired, respected and loved, and that others are available to provide caring and security. The commenter may convey that he/she feels for the recipient(s) and/or offers prayers and encouragement for his/her well-being.	"Welcome to our CHESS family." "I'm so sorry for you."
Universality	The commenter conveys that he/she has gone through a similar situation or understands the recipients' thoughts and feelings based on first-hand experiences.	"I missed it too yesterday.. Because idk they closed early."
Self-Acceptance	The participant expresses satisfaction with his or herself, or some positive quality of the self, or suggests that he/ she has grown to accept or value his/herself to a greater extent. This may or may not explicitly mention addiction.	"I've been really feeling good about myself lately"

Negative Perception of Self/Self-stigma	Message portrays any expression of negativity towards oneself. This should be a negative thought about oneself, not a feeling or an illness. (i.e. negative feelings will be captured as threat messages). Often, this is related to their identity as user of opioids	I amI so glad 4 you u don't want 2 be like me almost 60 on the clinic 4 20yrs and as soon as I get money I running. U can do it its not easy but u can do it gale
Threat	The writer describes a current or past threat to well-being and/or recovery efforts. The comment may either express feeling vulnerable or outline a specific problem.	"for me I had to call and say I'm having a hard day I need to talk and just say it becuse this is your life just give it a try one time"
Anticipated Stigma	Message portrays that the participant believes that others will look down upon, shun, discriminate or devalue them because of their identity as an addict. This is an expression of expectation or concern of stigmatization, not an experience of stigma as of yet.	"I always thought if people knew they would look down upon me and now I feel free!"
Societal Stigma/Enacted Stigma	Message portrays a perception that the general public stigmatizes or discriminates against those who use drug/alcohol.	"we are all fighting battles nobody understands"

Methadone Negative Perceptions	Message portrays indication of stigmatization perception of users that visit the methadone clinic or portrays negative perceptions of methadone as an addiction treatment option.	"Sad how they won't let anyone in late. There was atleast 6 I saw today....they don't care. I feel like crap if I don't get mine daily."

Any Stigma is not included in this table as it was calculated.

Table 2 Showing Reliability Between Two Coders

Coding category	Krippendorff's alpha
Informational Support	0.95
Advice	0.97
Emotional Support	0.99
Universality/Relatedness	0.92
Self-acceptance	0.95
Self-stigma	0.91
Threat	0.91
Anticipated Stigma	1.00 *(2)*
Societal Stigma/Enacted Stigma	0.67 *(2)*

Methadone Negative Perceptions	1.00 *(3)*
[a]Any Stigma	0.96

Italicized content type had less than 1% of the messages with that code. Values in brackets represent the number of instances of the code. In the case of societal/enacted stigma, there were only two instances and the two coders disagreed on those instances and thus reliability was 0.7. In each coders' coding document, 'Any stigma' was derived by indicating a 1 when either anticipated stigma, societal stigma, self-stigma or methadone stigma was coded as "yes=1". The reliability was then calculated between the coders any instances of stigma (Any Stigma).

DV: Views and Comments

The action log and user messaging log (including moderators and participants) on the A-CHESS app was used to derive a value for the number of views, view time, response time and number of comments corresponding to each message in our time period. Each message has a time stamp. However, the action log produces only a view time and number of views for the thread (i.e. the first message) and not for the comments. In addition, it cannot be ascertained whether a participant is responding to the first message in the thread or to subsequent comments, thus number of comments and response time were only derived for the first message in the thread (i.e. the original message). Here in this paper, we refer to "thread" as the first message in the thread and "message" refers to both threads and comments.

Views: Number of Views is the total number of views of the thread, derived from the action log. Since multiple users can view a thread multiple times, we also created a variable for *Number of Unique Viewers*, which is the number of unique usernames that viewed a thread from the action log. This accounts for

over-estimation in number of views from accidental opening of threads or other errors associated with the total number of views variable that do not reflect "actual" views. *View Time* is operationalized as the time (in days) it took the first user to view the thread (i.e. how quickly the thread was viewed). This was derived by subtracting the time stamp of when the first user viewed the thread from the time stamp of when the thread was written.

Comments: *Number of Comments* is a count of the total number of comments associated with a thread from the messaging log. Each thread has a unique thread ID. *Response Time* was operationalized as the time (in days) it took the first user to comment on the thread (i.e. how quickly someone responded to the thread). This was derived by subtracting the time stamp of the first comment in the thread from the time stamp of the thread. Note, messages that received no responses or comments were coded as missing for response time, as the time to receive the response never occurred since a response never occurred.

Moderators: We assessed whether the content was produced by moderators or whether it was produced by study participants (referred to here, as "peers"). A variable for *Author Type* was created (1=Moderator and 0= Peer). All moderators were indicated by not having a study ID in the dataset. Moderators included individuals that were clinicians, technicians and other research assistants who contributed content to the forum. There were 14 moderators on the forum over the time period of the study.

Control Variables: We controlled for *time* operationalized as the number of days from the first message on the system until the date of when the message was written and the *Author User ID*, i.e. who wrote the message. This is a unique ID associated with each username in the forum. We also controlled for where the message was written, i.e. different discussion groups (e.g. Vivitrol Group or Methadone Group). A variable called "*Topic*" was created to denote which of the seven groups each message was written (1-7).

Data Analysis

In order to assess the content of the message on the forum (RQ1-2), we used deductive content analysis. See the method explained above in the message content type measure section. In order to assess whether the different content types differ by author type (RQ7), we used Chi-square tests and t-tests. To assess the research questions (RQ3-6) related to engagement on the forum (i.e. views and comments), we ran analysis of covariance tests (ANCOVA models) for each content type on each dependent variable (# of views, view time, # of comments etc.). Separate models were ran for each content type predicting each dependent variable. Further, in order to assess whether the relationship between content type and engagement differs by author type (H1, RQ8), author type was included as a variable in the model in an interaction with content type. We ran a total of 45 ANCOVA models (5 engagement variables x 9 content types) for RQ-3-6 and 20 models for RQ-8 (5 engagement variables x 4 content type). All models controlled for time, author ID and topic. All analysis was done in SPSS v. 26.

Results

RQ1 and 2: What Types of Content are Posted on a Forum for Opioid Use Disorder?

RQ1 and RQ2 asked what types of content are posted on a forum for opioid use recovery and if users of the forum post about stigma. The results (Table 3) show that users posted messages including all 10 types of content. Emotional support was posted about most often (*n*=2526), followed by informational support (*n*=1312) and self-acceptance (*n*=507). Users of the forum indeed posted about stigma, such that 4.9% of the messages included at least one of the four types of stigma (*n*=195). Among the four types of stigma, self-stigma (*n*=88) and methadone negative perceptions (*n*=76) were posted most often.

Table 3. Number and Percentage of each type of messages, and Chi-squared test of association between number of messages and Author Type

	Overall		Moderator		Peer		Chi-squared (df=1)
	N	%	N	%[a]	N	%[a]	
Message Content							
Informational Support	1312	33.5	626	47.7	686	52.3	344.53***
Emotional Support	2526	64.5	879	34.8	1647	65.2	126.04***
Advice	405	10.3	162	40.0	243	60.0	27.69***
Universality	256	6.5	8	3.1	248	96.9	88.00***
Self-Acceptance	507	12.9	11	2.2	469	97.8	201.30***

Threat	326	8.3	2	0.6	324	99.4	137.70***
Self-stigma	88	2.2	1	1.1	87	98.9	33.58***
Anticipated Stigma	12	0.3	0	0.0	12	100.0	4.87*
Societal/Enacted Stigma	39	9.8	2	5.1	37	94.9	10.76**
Methadone Negative Perceptions	76	1.9	5	6.6	71	93.4	18.65***
Any stigma	195	4.9	8	4.1	187	95.9	61.01***
Total	3918	100					

*[a] Reflects row percentage, i.e. percent of the messages with that content type being written by a moderator versus peer. [+]p<0.1, *p<=0.05, **p<0.01, ***p<0.001.*

Below are examples of posts eliciting requests for support while talking about experiences of stigma and negative perceptions of self.

> "Thank u people but I have a lot of anxiety and depression and it sucks cause it really makes me mad so if anyone from a chess can help me out I appreciate"

> "It is hard to explain how difficult it is when things are going well and i should be happy proud and looking forward and I can't stop being hard on myself about all that I lost. Feeling like I have no energy and wanting to use has been a new normal for me recently"

> "Hay family it's a hurting feeling to be blamed for stealing something. Then to later they find it. That hurts. It makes mad. When they dont even apologized to to you. Thant is mess up."

The following quote is in response to the 'thought for the day' and illustrates another experience of stigma by users. The 'thought for the day' are motivational quotes aimed at aiding recovery and self-perception. Moderators began posting thoughts for the day on the forum. After noticing participant response, the team modified A-CHESS so that 'thoughts for the day' became embedded as a feature on the system. This particular thought was: "Never be bullied into silence. Never allow yourself to be made a victim. Accept no one's definition of your life; define yourself." The respondent posted in response:

> "To me this means don't let someone's thoughts or actions impact how you feel. You should be passionate about what you feel or believe. One should disregard those negative thoughts of others. When I made the decision to get back on the clinic, *many people told me that was just another excuse to get high*. I felt otherwise. I knew what worked for me and what didn't. I made the decision to get back on the clinic and have been clean since."

The following post, though lengthy, illustrates the many challenges a user undergoes with their treatment plan and interactions with clinicians. Notice that at the end of the message, the user essentially internalizes this challenge "as nobody's fault but his own", rather than a function of the systems and policies in place for recovery from opioid use disorder. He looks to the individuals on A-CHESS for advice

and support. Individuals responded with practical suggestions for what to do, what meds worked for them and how they experienced detox, while also providing emotional support and encouragement.

> “So here's my problem I just got 6 months clean after using for almost 7 years without any clean time during those seven years this is the first time I've ever gotten clean time and I've been doing really good but the clinic put in an administrative detox request because my benzo script is more than 2 milligrams which is against the policies and procedures of Lifeline Clinic so me it's supposed to be a 30 day detox but they're going to work with me a little bit and make it a 90 day detox which is a little bit better but I'm also really scared and nervous about getting sick and relapsing because everybody they're going to start detoxing who has had a habit before knows that feeling of being sick and how bad it is! And it's been so long since I've used and there's so much crap out there that I'm scared that if I used to try to just feel better not to get high just to help with not being sick because there is no way around it I'm going to be sick through this detox so if I was to use I'm scared I would overdose! Then on top of it I finally have clean time and I don't want to throw that away because it took a lot for me to get this clean time I never thought I would be able to get 6 months of clean time and if it wasn't for being on methadone and the support that I get through my clinician at the clinic and the IOP I don't know if I would have been able to put six months together and it pisses me off that when I'm finally doing good and finally getting my shit back together that now they want to kick me off the clinic I think it's a really shitty thing and I'm backed into a corner which ultimately is my fault it's nobody's fault but my own so I'll take responsibility for it but I'm just really scared and nervous so if anybody has any suggestions or advice for me open two any suggestions.”

RQ3-6: What Types of Content Drive Engagement?

Number of Views and View Time

RQ3 asked if certain types of content generate more views. Controlling for time, author ID, author type and topic, ANCOVA predicting the total number of views showed that threads with informational support (F=13.13, p=0.000) and emotional support (F=6.80, p=0.009) got less views than threads without these two types of support (Table 4). Threads with threat (F=44.06, p=0.000), self-stigma (F=15.55, p=0.000), methadone perceptions (F=26.73, p=0.000) and any stigma (F=39.31, p=0.000) got more views than threads without these types of content (Table 4). Controlling for time, author ID, author type and topic, ANCOVA predicting number of unique views found no statistically significant difference between threads with emotional and information support and threads without that content. However, threads with self-acceptance (F=11.96, p=0.001) had a lower number of unique viewers than threads without that content (Table 5). The results were the same for stigma and threat; threads with threat (F=36.79, p=0.000), self-stigma (F=14.31, p=0.000), methadone perceptions (F=47.92, p=0.000) and any stigma (F=52.16, p=0.000) got more unique views than threads without these types of content (Table 5).

Table 4. ANCOVA of total number of views between threads with certain content and threads without certain content

	M(SD) with the content	M(SD) without the content	*F*(1,677)	*p*
Informational support	25.04(27.47)	27.50(27.52)	13.13	0.000***
Emotional Support	22.07(23.82)	29.89(29.27)	6.80	0.009**
Advice	25.90(13.23)	26.84(27.67)	0.17	0.685
Self-Acceptance	22.73(24.79)	28.45(28.37)	1.16	0.281
Threat	39.22(32.15)	23.83(25.40)	44.06	0.000***
Self-stigma	40.56(26.00)	25.90(27.38)	15.55	0.000***
Anticipated Stigma	15.50(7.78)	26.86(27.54)	0.11	0.745
Societal/Enacted Stigma	31.17(20.30)	26.75(27.62)	0.87	0.352
Methadone Negative Perceptions	34.08(30.71)	25.83(26.89)	26.73	0.000***
Any stigma	43.03(28.01)	24.76(26.77)	39.31	0.000***

*ANCOVA was not conducted for universality because after pairwise deletion there was only 1 thread that include universality. Covariates include time, author ID, author type (i.e., moderator or peer), and topic panel. *p<=0.05, **p<0.01, ***p<0.001*

Table 5. ANCOVA of number of unique viewers between threads with certain content and threads without certain content

	M(SD) with the content	*M(SD)* without the content	*F*(1,729)	*p*
Informational support	9.64(8.13)	11.04(7.03)	3.03	0.082
Emotional Support	9.73(6.56)	11.16(7.83)	2.31	0.129
Advice	10.64(4.80)	10.61(7.44)	0.03	0.872
Self-Acceptance	9.37(6.25)	11.09(7.76)	11.96	0.001**
Threat	14.10(7.14)	9.84(7.25)	36.79	0.000***
Self-stigma	14.21(7.10)	10.39(7.37)	14.31	0.000***
Societal/Enacted Stigma	12.08(5.78)	10.59(7.43)	0.41	0.523
Methadone Negative Perceptions	19.83(9.32)	10.30(7.14)	47.92	0.000***
Any stigma	15.61(8.23)	10.02(7.08)	52.16	0.000***

*ANCOVA was not conducted for universality and anticipated stigma because after pairwise deletion there was only 1 thread that includes universality and 2 threads that include anticipated stigma. Covariates include days, author ID, author type (i.e., moderator or peer), and topic panel. *p<=0.05, **p<0.01, ***p<0.001*

RQ4 asked if certain types of content were viewed more quickly. Controlling for time, author ID, author type and topic, ANCOVA predicting view time showed differences for only two types of content (self-stigma and any stigma). Threads with self-stigma were viewed more slowly than threads without self-stigma (F=9.42, p=0.002) and threads with any stigma (F=4.77, p=0.03) were viewed more slowly than threads with any stigma (Table 6).

Table 6. ANCOVA of view time between threads with certain content and threads without certain content

	M(SD) with the content	*M(SD)* without the content	*F*(1,452)	*p*
Informational support	0.31(1.76)	0.25(1.80)	0.39	0.534
Emotional Support	0.36(2.45)	0.23(1.29)	0.49	0.487
Advice	0.02(0.02)	0.28(0.18)	0.14	0.712
Self-Acceptance	0.28(1.19)	0.27(1.95)	0.00	0.987
Threat	0.46(3.29)	0.23(1.28)	1.38	0.240
Self-stigma	1.36(6.05)	0.22(1.20)	9.42	0.002**
Societal/Enacted Stigma	0.17(0.19)	0.27(1.80)	0.00	0.951
Methadone Negative Perceptions	0.26(0.73)	0.27(1.81)	0.04	0.850

Any stigma	0.82(4.38)	0.21(1.22)	4.77	0.03*

*ANCOVA was not conducted for universality and anticipated stigma because after pairwise deletion there was only 1 thread that includes universality and 1 thread that includes anticipated stigma. Covariates include time, author ID, author type (i.e., moderator or peer), and topic panel. *p<=0.05, **p<0.01, ***p<0.001*

Number of Comments and Response Time

RQ5 asked if certain types of content generated more comments. Controlling for time, author ID, author type and topic, ANCOVA predicting the number of comments showed that threads with informational support (F=23.52, p=0.000) and emotional support (F=3.98, p=0.046) got less comments than threads without these two types of support (Table 7). Threads with threat (F=24.58, p=0.000), self-stigma (F=12.67, p=0.000) and any stigma (F=11.48, p=0.001) got more comments than threads without these types of content (Table 7).

Table 7. ANCOVA of number of responses between threads with certain content and threads without certain content

	M(SD) with the content	*M(SD)* without the content	*F*(1,729)	*p*
Informational support	2.34(3.58)	3.57(4.06)	23.52	0.000***
Emotional Support	2.81(3.44)	3.43(4.22)	3.98	0.046*
Advice	3.00(4.38)	3.19(3.95)	0.01	0.908
Self-Acceptance	3.33(3.61)	3.14(4.08)	0.66	0.416
Threat	4.66(4.04)	2.87(3.87)	24.58	0.000***
Self-stigma	5.21(4.46)	3.07(3.89)	12.67	0.000***
Societal/Enacted Stigma	3.33(2.93)	3.19(3.97)	0.04	0.836
Methadone Negative Perceptions	4.29(3.81)	3.15(3.96)	1.80	0.180
Any stigma	4.60(4.16)	3.03(3.90)	11.48	0.001**

*ANCOVA was not conducted for universality and anticipated because after pairwise deletion there was only 1 thread that includes universality and 2 threads that include anticipated stigma. Covariates include time, author ID, author type (i.e., moderator or peer), and topic panel. *p<=0.05, **p<0.01, ***p<0.001*

RQ5 asked if certain types of content generated more rapid responses. Controlling for time, author ID, author type and topic, ANCOVA predicting the response time showed that only threads with informational support had a statistically significant difference in response time (Table 8). Threads with informational support were responded to more slowly than other threads (F=5.99, p=0.015).

Table 8. ANCOVA of response time between threads with certain content and threads without certain content

	M(SD) with the content	*M(SD)* without the content	*F*(1,575)	*p*
Informational support	13.54(60.27)	2.48(17.34)	5.99	0.015*
Emotional Support	5.81(35.27)	4.90(33.12)	0.62	0.431
Advice	0.96(1.08)	5.29(34.12)	0.45	0.503
Self-Acceptance	1.39(4.54)	6.93(40.46)	1.18	0.278
Threat	1.77(6.50)	6.16(37.96)	0.65	0.422
Self-stigma	0.65(1.32)	5.57(35.09)	0.09	0.763
Societal/Enacted Stigma	1.25(1.52)	5.32(34.23)	0.22	0.642

Methadone Negative Perceptions	3.73(12.00)	5.30(34.47)	0.05	0.831
Any stigma	1.73(6.80)	5.71(35.99)	0.06	0.807

*ANCOVA was not conducted for universality and anticipated stigma because after pairwise deletion there was only 1 thread that includes universality and 1 thread that includes anticipated stigma. Covariates include time, author ID, author type (i.e., moderator or peer), and topic panel. *p<=0.05, **p<0.01, ***p<0.001*

H1, RQ7-8: Does Author Type (Moderators Vs. Peers) Matter?

Roughly thirty percent (28.8%) of the messages were posted by moderators while 71.2% were posted by peers.

Content Type:

RQ7 asked if the type of message content posted on the forum differed based on whether the message was posted by moderator or peer. Chi-squared test of independence (Table 3) shows that whether the message is posted by moderators or peers was significantly related to whether a message included informational support or not (X^2(1, N=3918)=344.53, p=0.000), whether it included emotional support or not (X^2(1, N=3918)=126.04, p=0.000), whether it included advice or not (X^2(1, N=3918)=27.69, p=0.000), whether it included universality or not (X^2(1, N=3918)=88.00, p=0.000), whether it included self-acceptance or not (X^2(1, N=3918)=201.30, p=0.000), whether it included threat or not (X^2(1, N=3918)=137.70, p=0.000), whether it included self-stigma or not (X^2(1, N=3918)=33.58, p=0.000), whether it included anticipated stigma or not (X^2(1, N=3918)=4.87, p=0.027), whether it included enacted

stigma or not (X^2(1, N=3918)=10.76, p=0.001), whether it included methadone negative perception or not (X^2(1, N=3918)=18.65, p=0.000), and whether it included any stigma or not (X^2(1, N=3918)=61.01, p=0.000).

Moderators posted more messages including informational support, emotional support and advice than what is expected if the null hypothesis is true (i.e., if content type is not associated with author type). Moderators posted fewer messages including universality, self-acceptance, threat, self-stigma, anticipated stigma, enacted stigma, methadone negative perceptions and any stigma than what is expected if the null hypothesis is true (i.e., if content type is not associated with author type). The opposite was found for peers. Peers posted fewer messages including informational support, emotional support and advice and more messages including universality, self-acceptance, threat, self-stigma, anticipated stigma, enacted stigma, methadone negative perceptions and any stigma than what is expected if the null hypothesis is true.

Engagement

We hypothesized that author type would moderate the relationship between content type and engagement and RQ8 asked how the relationship between content type and engagement changes if the thread is moderator-initiated or peer-initiated. Because there was none or only 1 moderator-initiated message containing threat, universality, self-stigma, anticipated stigma, enacted stigma, methadone negative perceptions and any stigma after pairwise deletion, ANCOVA was only conducted to examine the interaction between author type and one of the other four content types (i.e., informational support, emotional support, advice and self-acceptance).

Number of Views and View Time

Controlling for time, author ID and topic, ANCOVA predicting the number of total views and view time did not find any significant interactions between author type and any of the four content types (table not shown). Thus our hypothesis was not supported for view time and total number of views. Controlling for time, author ID and topic, ANCOVA predicting the number of unique views found that author type (F=4.74, p=0.030) moderated the relationship between emotional support and unique views (Table 9). Further, T-tests (see Table 14-15) showed that peer-initiated threads with emotional support (*M=9.65*, *SD*=5.87) had significantly fewer unique viewers than peer-initiated threads without emotional support (*M*=11.53, *SD*=7.80; *t*=7.84, *p*<0.001). Moderator-initiated threads with emotional support (*M*=8.01, *SD*=5.80) were also not significantly different from moderator-initiated threads without emotional support (*M*=9.10, *SD*=7.80) in number of unique viewers (*t*=1.38, *p=0.17*). Note that figure 5 shows a trend towards more unique viewers for moderator-initiated threads with (vs. without) emotional support.

Table 9 Two-way ANCOVA of Number of Unique Viewers by Author Type and Emotional Support

Source	*SS*	*df*	*MS*	*F*	*p*
Intercept	5952.14	1	5952.14	127.76	0.000
Topic	1135.48	1	1135.48	24.37	0.000
User ID	523.81	1	523.81	11.24	0.001
Time	1278.05	1	1278.05	27.43	0.000

Author type	1444.82	1	1444.82	31.01	0.000
Emotional support	3.28	1	3.28	0.07	0.791
Author type X Emotional support	220.83	1	220.83	4.74	0.030
Error	33868.81	727	46.59		

R^2=0.157, Adjusted R^2=0.150.

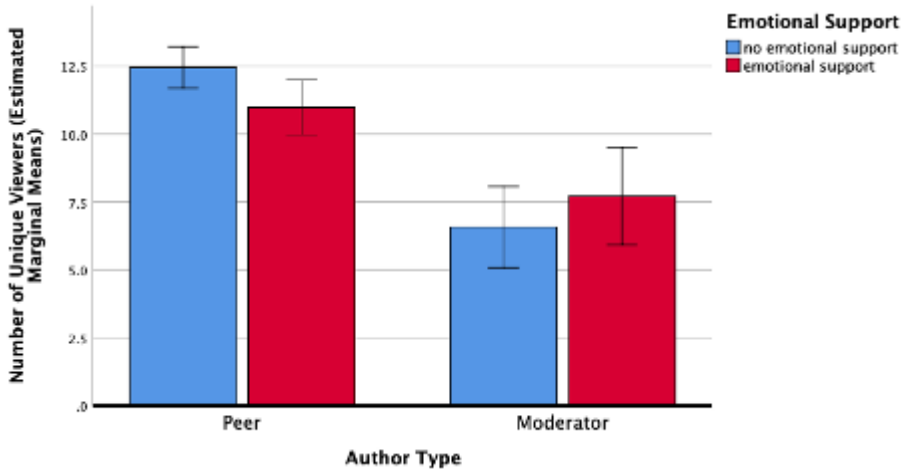


Figure 5. Interaction Between Author Type and Emotional Support in Number of Unique Viewers

Covariates were evaluated at the mean values. Error bars: 95% confidence interval.

Controlling for time, author ID and topic, ANCOVA predicting the number of unique views found that author type (F=4.62, p=0.032) also moderated the relationship between self-acceptance and unique

views (Table 10). T-tests (see Table 14-15) showed that peer-initiated threads with self-acceptance (*M=9.35*, *SD*=6.31) had significantly fewer unique viewers than peer-initiated threads without self-acceptance (*M*=11.64, *SD*=7.52; *t*=3.64, *p*<0.001). Moderator-initiated threads with self-acceptance (*M*=9.86, *SD*=3.80) were not significantly different from moderator-initiated threads without self-acceptance (*M*=8.43, *SD*=6.84) in number of unique viewers (*t*=-0.55, *p=0.58*), though figure 6 shows a trend towards more unique viewers in moderator-initiated threads with self-acceptance (vs. without), but the error bars are large. Thus, our hypothesis was supported for self-acceptance and emotional support and number of unique viewers.

Table 10. Two-way ANCOVA of Number of Unique Viewers by Author Type and Self-Acceptance

Source	*SS*	*df*	*MS*	*F*	*p*
Intercept	5103.67	1	5103.67	111.09	0.000
Topic	1173.47	1	1173.47	25.54	0.000
User ID	616.18	1	616.18	13.41	0.000
Time	1251.58	1	1251.58	27.24	0.000
Author type	187.44	1	187.44	4.08	0.044
Self-acceptance	15.17	1	15.17	0.33	0.566

Author type X Self-acceptance	212.31	1	212.31	4.62	0.032
Error	33445.07	728	45.94		

R^2=0.169, Adjusted R^2=0.163.

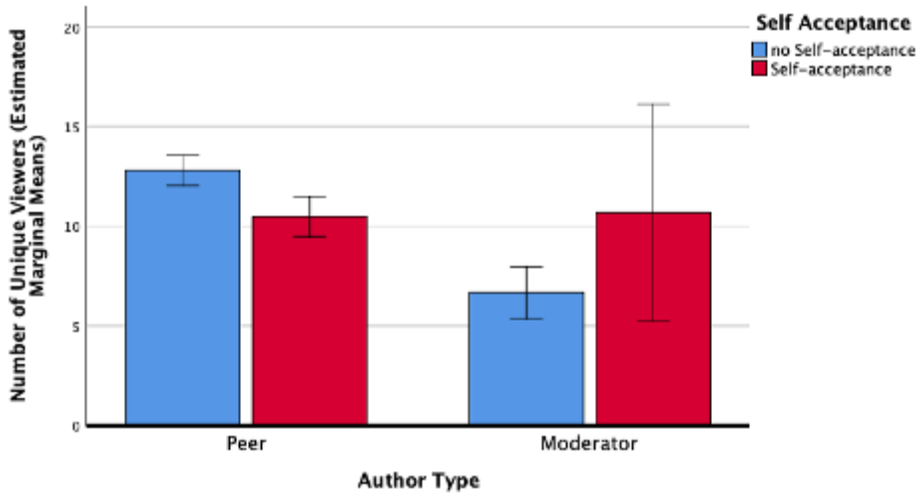


Figure 6. Interaction Between Author Type and Self-acceptance in Number of Unique Viewers

Covariates were evaluated at the mean values. Error bars: 95% confidence interval

Number of Comments and Response Time

Controlling for time, author ID and topic, ANCOVA of number of comments showed that author type marginally significantly interacted (F=3.37, p=0.067) with informational support such that the difference in number of comments between threads with informational support and threads without informational support was larger for moderator-initiated threads than for peer-initiated threads (see Table 11 and Figure 7). T-tests (see Table 14-15) showed that moderator-initiated threads with informational support (*M=1.92*, *SD*=3.44) had significantly fewer comments than moderator-initiated threads without

informational support (*M*=5.26, *SD*=3.74; *t*=7.84, *p*<0.001). Also, peer-initiated threads with informational support (*M*=3.21, *SD*=3.74) were not significantly different from peer-initiated threads without informational support (*M*=3.60, *SD*=4.07) in number of comments (*t*=0.77, *p*>0.05). Note figure 7 shows a trend towards peer-initiated threads with informational support (vs. without) obtaining fewer comments.

Table 11. Two-way ANCOVA of Number of Comments by Author Type and Informational Support

Source	*SS*	*df*	*MS*	*F*	*p*
Intercept	536.87	1	536.87	36.31	0.000
Topic	0.03	1	0.03	0.00	0.965
User ID	295.86	1	295.86	20.01	0.000
Time	18.57	1	18.57	1.26	0.263
Author type	280.45	1	280.45	18.97	0.000
Informational support	102.80	1	102.80	6.95	0.009
Author type X Informational support	49.86	1	49.86	3.37	0.067
Error	10764.92	728	14.79		

R^2=0.062, Adjusted R^2=0.055.

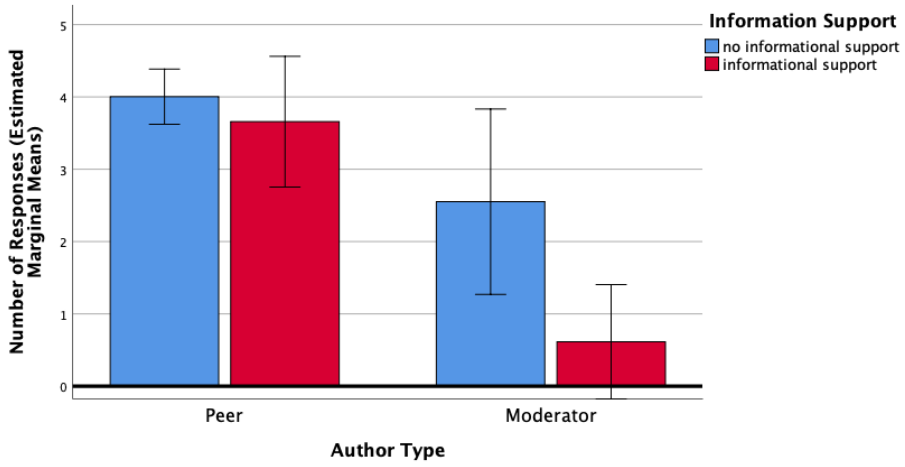


Figure 7. Interaction Between Author Type and Informational Support in Number of Comments

Notes. Covariates were evaluated at the mean values. Error bars: 95% confidence interval.

In addition, controlling for time, author ID and topic, ANCOVA of number of comments showed that author type significantly interacted (F=12.83, p=0.000) with emotional support such that difference between threads with emotional support and those without was larger for moderator-initiated threads vs. peer-initiated threads (see Table 12 and Figure 8). T-tests (see Table 14-15) showed that moderator-initiated threads with emotional support (*M=4.66 SD*=3.95) had significantly more comments than moderator-initiated threads without emotional support (*M*=1.98, *SD*=3.41; *t*=-6.16, *p*<0.001). Also, peer-initiated threads with emotional support (*M*=2.76, *SD*=3.11) had significantly fewer comments than peer-initiated threads without emotional support (*M*=4.03, *SD*=4.44; *t*=3.63, *p*<0.001), see figure 8. Thus, our hypothesis was supported for informational support and emotional support and number of comments.

Table 12. Two-way ANCOVA of Number of Comments by Author Type and Emotional Support

Source	*SS*	*df*	*MS*	*F*	*p*
Intercept	406.26	1	406.26	27.72	0.000
Topic	1.74	1	1.74	0.12	0.730
User ID	239.29	1	239.29	16.33	0.000
Time	19.35	1	19.35	1.32	0.251
Author type	409.11	1	409.11	27.91	0.000
Emotional support	2.91	1	2.91	0.20	0.656
Author type X Emotional support	188.11	1	188.11	12.83	0.000
Error	10655.98	727	14.66		

R^2=0.071, Adjusted R^2=0.063.

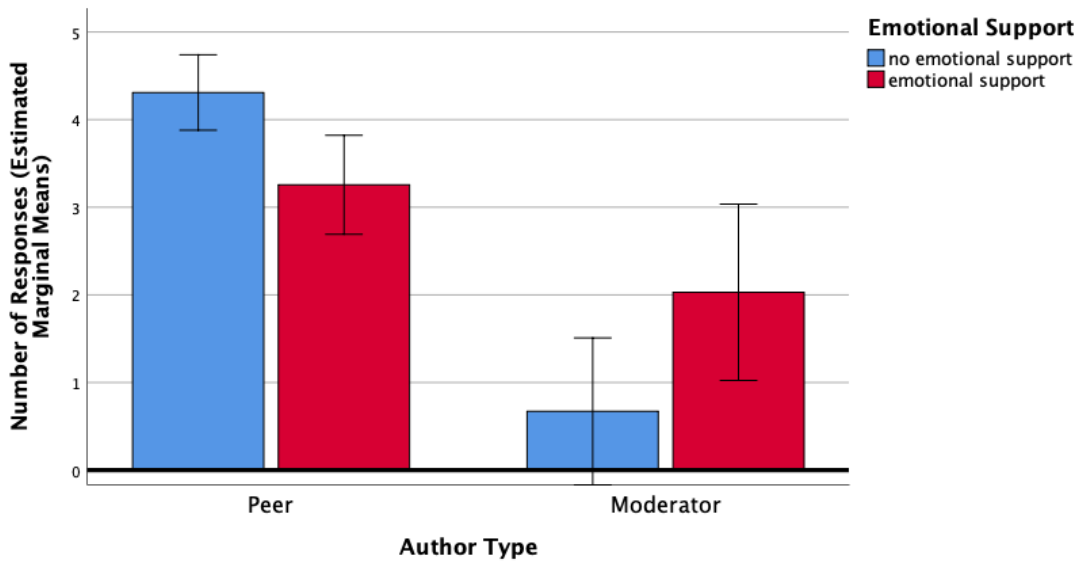


Figure 8. Interaction Between Author Type and Emotional Support in Number of Comments

Covariates were evaluated at the mean values. Error bars: 95% confidence interval.

Controlling for time, author ID and topic, ANCOVA of response time showed that author type significantly interacted with informational support (F=10.10, p=0.02), such that the difference between threads with informational support and those without was larger for moderator-initiated threads vs. peer initiated threads (see Table 13 and Figure 9).). Thus, our hypothesis was supported for informational support and response time. T-tests (see Table 14-15) showed that moderator-initiated threads with informational support (*M*=22.62, *SD*=77.61) were responded significantly slower than moderator-initiated threads without informational support (*M*=0.24, *SD*=0.99, *t*=-2.66, *p*<0.01). Peer-initiated threads with informational support (*M*=0.66, *SD*=1.63) were not significantly different from peer-initiated threads without informational support (*M*=02.59, *SD*=17.96) in response time (*t*=0.83, *p*=0.41). Note that figure 9 shows a trend towards peer-initiated threads with informational support (vs. without) obtaining quicker responses. However, the error bars are large.

Table 13. Two-way ANCOVA of Response Time by Author Type and Informational Support

Source	*SS*	*df*	*MS*	*F*	*p*
Intercept	2594.08	1	2594.08	2.47	0.116
Topic	12001.24	1	12001.24	11.44	0.001
User ID	2531.35	1	2531.35	2.41	0.121
Time	18955.98	1	18955.98	18.07	0.000
Author type	3983.86	1	3983.86	3.80	0.052
Informational support	6522.44	1	6522.44	6.22	0.013
Author type X Informational support	10597.41	1	10597.41	10.10	0.002
Error	601171.35	573	1049.17		

R^2=0.099, Adjusted R^2=0.089.

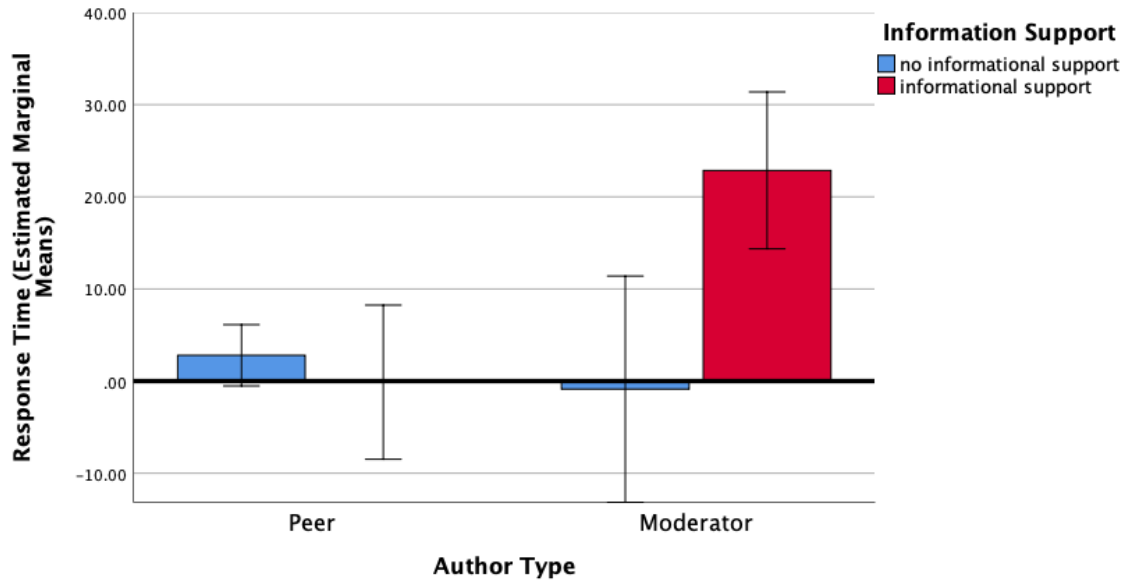


Figure 9. Interaction Between Author Type and Information Support in Response Time

Covariates were evaluated at the mean values. Error bars: 95% confidence interval. Response time was measured in units of days.

Table 14. T-Test Results for Difference in outcomes between Moderator threads and content type

	Number of Comments		Response time (in days)		Number of Views		Number of Unique Views		View time (in days)	
	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t
Content Type										

IS no IS	1.92(3.44) 5.26(3.74)	-7.84***	22.62(77.61) 0.24(0.99)	-2.66**	24.87(27.35) 17.82(14.52)	-2.51*	9.31 (8.64) 7.55 (3.76)	-2.30*	0.35(1.99) 0.13(0.54)	-0.82
ES no ES	4.66(3.95) 1.98(3.41)	-6.16***	6.24(41.69) 15.24(64.01)	1.23	18.57(20.23) 25.26(23.40)	2.41*	8.01 (5.80) 9.10 (7.84)	1.33	0.15(0.58) 0.38(2.15)	0.90
Ad no Ad	2.71(4.72)[b] 3.51(3.94)	0.52	0.98(1.68) 9.33(50.54)	0.29	24.50(9.67) 21.00(21.89)	-0.39	10.71 (5.62) 8.41 (6.81)	-0.89	0.01(0.02) 0.28(1.67)	0.36
Un no Un	na[a]	na	na	na	na	na	na	na	na	na
SA no SA	2.43(2.99)[b] 3.51(3.97)	0.72	1.99(3.48) 9.42(50.90)	0.36	20.71(10.29) 21.10(21.92)	0.05	9.86 (3.80) 8.43 (6.84)	-0.55	0.03(0.03) 0.28(1.65)	0.22
TH no TH	na[a]	na	na	na	na	na	na	na	na	na
SelfS no SelfS	na[a]	na	na	na	na	na	na	na	na	na
AS no AS	na[a]	na	na	na	na	na	na	na	na	na
SS/ES no SS/ES	na[a]	na	na	na	na	na	na	na	na	na

MNP no MNP	na[a]	na	na	na	na	na	na	na	na	na
AnyS no AnyS	1.00(1.16) [b] 3.52(3.96)	1.27	1.72(0.15) 9.28(50.43)	0.21	31.00(19.48) 20.93(21.71)	-0.92	16.25 (8.34) 8.36 (6.72)	-2.33*	0.07(0.08) 0.28(1.66)	0.22

IS=informational support, ES=emotional support, AD=advice, UN=universality, SA= self-acceptance, TH=threat, SelfS= self-stigma, AS= anticipated stigma, SS/ES= societal stigma/enacted stigma, MNP= methadone negative perceptions, AnyS=any stigma. [a]T-test was not conducted because the number of messages the content type was equal to or less than 2.

[b]Messages with this content were less than 10. For advice and self-acceptance, this was due to the nature of this type of content, being unlikely to be initiated by moderators, for any stigma, this was not due to the nature of the content. $^{+}p<0.1$, $*p<=0.05$, $**p<0.01$, $***p<0.001$.

Table 15. T-Test Results for Difference in outcomes between Peer threads containing and not containing certain content

	Number of Comments		Response time (in days)		Number of Views		Number of Unique Views		View time (in days)	
	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t
IS no IS	3.21(3.74) 3.60(4.07)	0.77	0.66(1.63) 2.59(17.96)	0.83	25.33(27.87) 27.68(27.79)	0.66	10.33 (6.92) 10.89 (7.23)	0.62	0.23(1.02) 0.27(1.86)	0.14

ES no ES	2.76(3.11) 4.03(4.44)	3.63 ***	2.21(12.09) 2.42(18.97)	0.13	21.40(21.51) 31.20(30.58)	4.32 ***	9.65 (5.87) 11.53(7.80)	3.22 **	0.44(2.82) 0.16(0.58)	-1.08
Ad no Ad	3.50(4.36) [b] 3.54(4.03)	0.02	0.95(0.68) 2.36(16.85)	0.17	28.00(18.96) 27.36(27.85)	-0.05	10.50 (3.70) 10.82 (7.21)	0.89	na[a]	na
Un no Un	na[a]	na	na	na	na	na	na	na	na	na
SA no SA	3.39(3.64) 3.63(4.23)	0.66	1.38(4.57) 2.91(20.79)	0.95	22.85(25.12) 29.86(28.89)	2.91 **	9.35(6.31) 11.64(7.52)	3.82 ***	0.28(1.20) 0.25(2.01)	-0.15
TH no TH	4.66(4.04) 3.18(3.96)	-3.69 ***	1.77(6.50) 2.55(19.15)	0.44	39.22(32.15) 23.38(24.97)	-5.18 ***	14.10 (7.14) 9.78 (6.89)	-6.25 ***	0.46(3.29) 0.20(0.86)	-0.71
SelfS no SelfS	5.33(4.44) 3.39(3.96)	-3.02 **	0.65(1.32) 2.50(17.52)	0.66	41.10(26.08) 26.18(27.64)	-3.37 **	14.33 (7.14) 10.53 (7.12)	-3.33 **	1.42(6.18) 0.18(0.78)	-0.95
AS	na[a]	na	na	na	na	na	na	na	na	na

no AS										
SS/ES	3.45(3.05)	0.07	1.19(1.59)	0.22	31.91(21.12)	-0.55	12.09 (6.06)	-0.59	0.17(0.20)	0.13
no SS/ES	3.54(4.05)		2.37(16.96)		27.27(27.91)		10.79 (7.21)		0.26(1.78)	
MNP	4.59(3.83)	-1.25	3.84(12.31)	0-0.41	55.23(31.37)	-4.91***	19.64 (9.56)	-6.06***	0.28(0.76)	-0.04
no MNP	3.50(4.03)		2.28(16.96)		26.16(27.01)		10.45 (6.84)		0.26(1.79)	
AnyS	4.79(4.18)	-2.87**	1.73(6.90)	0.32	43.68(28.35)	-5.34***	15.58 (8.28)	-6.28***	0.88(4.54)	-0.99
no AnyS	3.35(3.97)		2.45(17.90)		24.75(26.82)		10.09 (6.72)		0.17(0.79)	

IS=informational support, ES=emotional support, AD=advice, UN=universality, SA= self-acceptance, TH=threat, SelfS= self-stigma, AS= anticipated stigma, SS/ES= societal stigma/enacted stigma, MNP= methadone negative perceptions, AnyS=any stigma.

[a]T-test was not conducted because the number of messages that include the content type was equal to or less than 2.

[b]Because of the nature of this type of content, messages initiated with this content by this source was less than 10.

$^{+}p<0.1$, $*p<=0.05$, $**p<0.01$, $***p<0.001$.

Discussion

Information-communication technologies and mobile health interventions are being investigated as potential solutions to help support those in recovery from substance use disorders (D'Agostino et al., 2017; Hochstatter et al., 2021; Nesvåg & McKay, 2018). This is an area of great need as most treatment and recovery programs only last six months, despite substance use disorders being a chronic condition with reoccurring potential for relapse over the course of a lifetime (Nesvåg & McKay, 2018). Alternative continuing care programs, such as Alcoholics Anonymous and recovery group meetings, can sometimes have low participation rates, with rates even lower for those using heavily stigmatized substances, such as opioids (McCradden et al., 2019; Olsen & Sharfstein, 2014). Scholars have indicated that individuals with stigmatized identities prefer online support groups compared to in-person groups and some studies show that online support groups can reduce stigma and increase support and empowerment among these marginalized individuals (Barak et al., 2008; Lawlor & Kirakowski, 2014). However, opioid use disorder carries an even larger stigma barrier compared to other substance-use disorders and few studies investigate whether and how individuals with opioid use disorder would benefit from online support groups (Gunn & Guarino, 2016; B. L. Perry et al., 2020).

Content of Conversations on Online Forums for Opioid Use

Similar to prior studies (D'Agostino et al., 2017) on substance use disorders and online support groups, we find that users exchange informational and emotional support, advice, personal experiences and circumstances (universality), messages promoting self-acceptance and self-esteem and messages relating to different types of stigma, perceived or anticipated, societal, internalized or self-stigma and stigma

related to methadone and medication-assisted treatment. Unsurprisingly, a large majority of the messages were related to processes that support recovery – informational support, emotional support and self-acceptance. This is a positive indication of the function of this forum in supporting recovery for those with opioid use disorder.

In addition, stigma is an important factor that drives treatment and recovery decisions among patients with this disorder (Olsen & Sharfstein, 2014). Thus, consistent with prior studies (D'Agostino et al., 2017), a portion of the messages in our sample also contained messages relating to stigma, with the most common being conversations around self-stigma and medication-assisted treatment. However only 5% of all messages contained stigma as a theme. Prior studies are finding that self-stigma mediates impact on well-being and that it can be reduced in online support groups (Birtel et al., 2017b; Lawlor & Kirakowski, 2014). However, in these studies, only certain groups experienced reduced stigma; for some, increased online support group use had the opposite effect (Lawlor & Kirakowski, 2014). This could be attributed to differences in the type of use or the type of messages individuals are exposed to, among other factors. It is unclear what factors within online support groups help to reduce self-stigma. If stigma conversations help to facilitate the reduction of self-stigma and improve self-esteem, then this indicates a need to include moderators to help facilitate conversations around stigma and target efforts to reduce self-stigma and promote mental healing and health among this group. Future research should seek to tease out this relationship between conversations of stigma in online groups and reduction in self-stigma among users.

Relationship Between Content and Engagement

The utility of online support groups for their users occurs only if users utilize the beneficial features of the system, meaning posting, reading and engaging with content. Thus, understanding how to drive engagement among system users is critical in helping to facilitate benefits received. Here we assess the type of content as a factor that drives engagement in the online discussion forum. Engagement is investigated as a function of reception (i.e. viewing) and expression (i.e. commenting). We find here that different types of content impact engagement in different ways.

Viewing

In general, messages with support tend to get a lower number of views compared to messages without support and messages with stigma tend to get more views than messages without stigma. We found the impact of support messages on views did not hold when investigating the number of unique viewers. This finding provides insight into what the community may value most, as it relates to obtaining different types of capital from online spaces. There may be a greater interest in stigma conversations more so than general information messages. Our study did not empirically test this question. However, this is not unlikely to be the case as these individuals may have other channels for receiving informational support but fewer channels for finding others who also struggle with opioid use disorder to engage in stigma conversations. Individuals with concealable stigmatized identities, such as those with opioid use disorder, find it difficult to find others offline who share similar experiences and often face barriers to offline self-disclosure, such as increased cues and reduced anonymity (Choudhury & De, 2014; Desjarlais et al., 2015; Yeshua-Katz et al., 2019). Thus, the A-CHESS forum may be one of few spaces these participants feel comfortable to connect with others who can relate to their experiences with stigma, fueling greater engagement and eagerness to have these conversations. A meta-analysis of the association between different types of stigma and different types of support in online health systems did also find that the

prevalence of informational support messages among individuals with concealable stigma was lower than other types of support (Yeshua-Katz et al., 2019).

Encouragingly, threads with threat messages got more views than threads without threat messages, which potentially indicates that users are detecting threatening messages and responding by engaging with messages of threat more than other messages on the system through views (both unique and total views). Response to threatening messages could help to alleviate that threat by providing support and help to the user. This is a positive indication of utility of this system in relapse prevention. However, unfortunately, there was no difference in the speed to which threat messages were viewed compared to non-threat messages. In fact, only self-stigma and any stigma messages impacted view time and both of these types of content were viewed slower than messages without this content, with the longest message taking 29 days to be viewed. The implication of this is that individuals who need support or are requesting support because of a stigmatizing experience (such as in the example above) may not receive the support needed in a timely manner. Similarly, individuals on the forum do not view messages of threat any quicker than other messages with other content. This is a concerning finding as rapid detection of threatening messages is critical for preventing relapse.

It is important to assess the view time of messages as this is the first step of engagement with content on a forum space. After viewing the message, a user may then decide to comment based on the content of the message. How quickly a message is viewed will impact how quickly an individual can respond to the message. Thus, strategies to reduce view lag time could help those in recovery receive needed support

more quickly. Further, prior studies indicate that views may provide beneficial effects on well-being and empowerment measures (Han et al., 2014). Individuals often view posts first to assess whether they feel comfortable enough in the online space to start posting (Han et al., 2014; Nonnecke & Preece, 2000). Decreasing the time to view may also decrease the time needed to feel more comfortable and increase comments on the forum, which may then lead to further increased engagement among other users.

Uden Kran found that lurkers (individuals who primarily view rather than post on forums) were more likely to be dissatisfied with the forum compared to posters (van Uden-Kraan, Drossaert, Taal, Seydel, et al., 2008). Thus, it may suit interventionists and moderators to decrease view time and increase the likelihood that individuals will move from viewing to commenting as this may negatively impact satisfaction and engagement with the system. This same study also found that though viewers experienced empowering outcomes too, such as improved self-confidence, optimism, self-esteem and information exchange, they did report lower social well-being compared to those who posted to the forums (van Uden-Kraan, Drossaert, Taal, Seydel, et al., 2008). The importance and impact of commenting should also be assessed.

Commenting

Similar to views, supportive threads received fewer comments than threads without emotional and informational support and threads with threat, self-stigma and any stigma received more comments compared to threads without this content. This finding is indicative of the effectiveness of the online space in facilitating active conversations around the difficult experiences relevant to opioid users, i.e. conversations around stigma and potential threats of relapse. We demonstrate here that engagement translates beyond views to responses and comments. Specifically, the increase in commenting to stigmatizing and threatening messages point to the community's responsiveness towards individuals who

may be expressing warning signs and calls for help. It also indicates that individuals are eager to engage, beyond views, in conversations around stigma and that this may be a potential avenue by which online support groups can reduce internalizing stigma and improve self-esteem.

Lastly, our study found that differences in response time occurred only for informational support. Content with informational support received slower responses with the longest response time being over 1 year (463 days). This finding may indicate that opioid users have less of a need or want to engage in discussions around content that is focused mostly on providing information and resources. Informational support may appeal more to individuals with specific needs and orientation. For example, those with need for cognition may be more interested in informational resources and want to engage in dialogue, but this audience, with lower reported educational attainment, may be less interested in discussing information and resource-driven content and more interested in personal experiences (often found in stigma threads). It should be noted, we did not find differences in self-acceptance and advice, which could indicate that individuals are not any more or less eager to engage with messages of this type. We also found no differences with societal stigma, possibly because there were very few occurrences of this type of message and reliability was low for this construct.

Moderating Online Forums for Opioid Use

The last set of analysis was aimed at assessing whether our results differed based on whether the message was written by a moderator or peer. We find here that almost one third of the messages were written by moderators. We found that moderators posted more of the messages associated with lower engagement (i.e. informational and emotional support) than the ones associated with increased

engagement (i.e. stigma messages and threat messages). Moderators also posted more advice and as expected less universality and less self-acceptance, as moderators are typically not opioid users. As supportive messages have been a hallmark of online support groups, it is not surprising that moderators posted more of these messages and more advice. Consistent with prior studies and recommendations regarding the role of moderators in online support systems for health, this finding adds to the evidence distilling the role of moderators in online support groups for opioid users (Coulson & Shaw, 2013; Huh et al., 2016; O'Grady et al., 2010). In contrast to our moderator finding, we found that peers posted less supportive messages and more stigma, universality and self-acceptance messages. This finding illustrates the distinct roles moderators vs. peers play on online support systems for opioid use disorders. Consistent with prior findings of forums with both clinician moderators and peers simultaneously, peers serve more to provide experience-based support and moderators provide expert-based informational support (Vennik et al., 2014). Since posting emotional supportive messages has been associated with improved well-being in other illness populations (Namkoong et al., n.d.), future studies, should assess the impact of posting about informational and emotional support on well-being among opioid users.

We also sought to assess whether author type moderated the impact of content type on engagement. Our hypothesis was not supported for the relationships between view time, total number of views and any of the content types. Supportive messages led to less views and stigma messages led to more views, regardless of whether the person who wrote the thread was a moderator or peer. We did find that our hypothesis was supported for the relationship between number of unique viewers and self-acceptance and number of unique viewers and emotional support messages. We also found support for author type

moderating the effect of emotional and informational support content on the number of responses and informational support content on the response time.

Messages of emotional support and self-acceptance received different amounts of unique viewers depending on the author. For moderator-initiated threads, there were no differences in unique views between self-acceptance and emotional support threads and those without these content types. However, if the message came from a peer, these types of messages received fewer unique views, indicating that individuals may respond differently to these messages when posted by a peer versus a moderator. A similar result was found for number of comments. Prior studies indicate that users prefer experience-based information to come from peers (Vennik et al., 2014). Thus, one would expect that messages providing emotional support would be more valued coming from a peer with a similar experience rather than from a moderator. However, our finding indicates that fewer individuals viewed and commented on these messages. It is unclear why peer sources may be leading to lower engagement of messages encouraging or providing emotional support. Future studies should investigate this phenomena as viewing and posting messages of emotional support has been shown to provide beneficial impacts on well-being for participants of online support groups for breast cancer (Namkoong et al., n.d.), though it is unclear whether this holds in the opioid use context.

It also possible that, at least for commenting, users may see less of a need to comment on messages displaying emotional support from other peers if they believe the message is sufficiently supportive and needs no additional feedback. We do find that moderator messages displaying emotional support

received more comments, possibly indicating that these messages do require additional feedback. It's also more likely that in the moderator role, emotional support messages may prompt feedback from users to share their own personal experiences and encourage social sharing. Threads with emotional support may be more likely to contain such content compared to other threads, like a thread solely providing information on HIV or clinic information. Threads from peers may be less likely to prompt feedback, as facilitating discussion is not a function of the "participant" role and thus, they may merely serve as encouraging comments or provisions of support to the entire group (see Table 1).

We also found that author type significantly interacted with informational support for number of responses and response time with the difference being attributed to moderators as the source. We saw no difference in responses for informational support messages by peers. Given that users regard messages by experts differently than messages by peers, with users looking to expert moderators for more informational support, it is not surprising that moderator messages of this type received a different level of engagement compared to messages of other types (Atanasova et al., 2018; Vennik et al., 2014). However, instead of higher engagement, we saw lower engagement, potentially indicating the level of interest among this population of users for this type of content or a difference in the style of messages written by moderators with this content. Moderators may be less likely to solicit feedback with informational support messages or are less likely to encourage social sharing in the context of informational support messages. This may have led to lower engagement by participants with this content. Lastly, no interactions were found for advice and self-acceptance (for responses). Whether a message of this type originated from moderator or peer did not have an impact on engagement. For moderators, the n for these types of content was less than 10 and could have impacted these findings.

Limitations and Future Directions

This study is not without limitations. The main limitation of this study is that we did not assess how the type of content on the forum space changes over time. It is possible that, overall, while moderators may post more informational support, their posting behavior may change as they respond to the needs of the system. Similarly, as peers become more accustomed and comfortable with the forum space, their content may change over time as well. Examining temporal differences may yield additional insights into how individuals with opioid use utilize online support systems. Additionally, the impact of certain content and author types may also change over time. Prior research indicates that individuals may be more motivated by experts in the beginning stages of behavior change but are motivated by peers in the latter stages (de Vries et al., 2017). Thus, the type of content that drives comments and views may change as individuals' progress in their recovery and as the intervention progresses. Assessing change over time was outside the scope of this study but an important area for future research.

A strength of this paper is that it is one of few studies that assesses stigma as a main source of discussion content that takes place in online support systems for health. Though this is a factor unique to stigmatized identities, such as opioid use disorders, only 5% of the messages in our sample were related to stigma. We attempted here to assess different types of stigma, but occurrences were too low to establish strong reliability and it was sometimes difficult to distinguish between different types of stigma as there was overlap. Unfortunately, low incidence was a limitation of our study and reduced the potential to do more in-depth analysis on stigma. However, we do see here that content surrounding stigma was related to engagement and that different types of stigma were associated with different engagement outcomes. Additionally, the low incidence of moderator messages on stigma made it difficult

to assess the impact of the moderator content on stigma and any potential interactions with author type. Future studies should investigate this relationship.

Furthermore, the action log produced from the A-CHESS system does not account for views on comments; an assessment of whether a comment was directed at another comment or to a thread was not possible. Thus, we had to reduce our analysis to only threads and not engagement with all messages (comments and threads). Future research can assess whether the results hold when views are included for all messages on the system.

Lastly, our current study begins the work of understanding the role of moderators and peers in an online forum for addiction treatment. It demonstrates what types of content moderators choose to post in these forum spaces and whether this content aids engagement. We assess moderators and peers as the source of the messages and assume the source of the engagement is the general forum community. However, another level of analysis would distinguish between moderators or peers as the source of the responses. This will allow greater understanding of motivators for peer engagement, i.e. which type of content they are more likely to engage with to determine whether moderator efforts are targeted towards the messages that need their engagement the most (i.e. assessing the commenting behaviors of moderators). These are important next steps for future study.

Despite these limitations, strengths of this study include the use of quantitative analysis, rather than a purely descriptive approach, the assessment of differences in the content relevant to the opioid use context, such as self-stigma and medication-assisted treatment stigma, the large number of messages analyzed (3951 messages), the subgroup analysis distinguishing between moderator threads and peer threads and the inclusion of five different measures to assess engagement, both viewing behavior and posting behavior.

Practical Implications

Advocates for the use of online support systems to aid recovery of substance use disorders may make assumptions regarding the engagement of users on these platforms. However, prior deployments of these interventions find varying levels of engagement and high drop-out rates in the first few weeks (Nesvåg & McKay, 2018). One study recommends instituting plans to re-engage participants after drop-out (Ford et al., 2015). Keeping participants engaged on the platform can be challenging. Thus, understanding the motivators and drivers of engagement can help the creation of platforms that yield sustainable engagement. Three findings here have practical significance. First, at least among opioid users, informational support had lower engagement compared to content without informational support, while emotional support had higher engagement but only when posted by moderators. Thus, moderators ensure forum content does not over-emphasize informational support but rather helps to facilitate more balanced engagement and support. Overall, support messages had lower engagement and participants were less likely to post these messages. Given that supportive messages are associated with increasing social capital and studies show that expression (comments) and reception (views) of these messages increase well-being, moderators should include additional strategies to help increase engagement with these types of messages (Choi & Toma, 2014; Han et al., 2011; Namkoong et al., n.d.; Smyth & Helm, 2003; Tanis, 2009). Future research should assess whether expressions and reception of support in this opioid use context is associated with well-being.

Second, opioid users respond to posts about stigma and threat. Though only 5% of the messages contained stigma content, the affordances of this online interface helped users feel comfortable sharing their experiences, despite their conspicuous stigmatized identity. With the exception of response time, engagement increased for all measures of engagement with content related to any stigma. This may be

indicative of a need for a safe space to share experiences of stigma and the online space could potentially provide an empowering avenue for this marginalized group to experience increases in self-esteem and reductions in stigma. Practitioners should incorporate additional strategies to promote engagement around this topic on these spaces. This was under-utilized in this study as very few moderator messages included stigma. Further, prior studies indicate that sometimes spaces specifically designed for certain marginalized groups can still contain content that stigmatizes and re-traumatizes that group (Basterfield et al., 2018; Steinke et al., 2017). Spaces should serve to promote healing and empowerment, rather than further re-traumatize or stigmatize these populations. Additional research is needed as to how moderators can foster these safe spaces online.

Lastly, there were no differences in response or view time to threat messages, along with slower view time for stigma messages. One role of the moderator would be to help alleviate negative perceptions on the forum and combat the public stigma and negative internalizing stigma among opioid users (Olsen & Sharfstein, 2014). These as well as other debilitating cognitive thought processes often promote relapse (McCradden et al., 2019). Thus, moderators of a forum for opioid users would need to respond quickly to these types of messages. Further, a rapid response to a threat message is instrumental in relapse prevention. Thus, differences should emerge for these types of messages. An absence of differences potentially points to the need for improvements in the efficacy of the moderator role. Further, it was more than a month (55 days) before the threat message with the longest response time received a comment and threat messages had the fourth longest mean response time out of the 10 content categories, taking almost two days on average (Table 8). Prior studies of moderators on online health systems indicate the challenges and limits of the moderator to be able to respond to the many needs of different users on the forum (Atanasova et al., 2018). Automated machine learning strategies and text-

classification strategies have been investigated to aid moderators in detecting threat messages just in time, with the ultimate goal of improving the response time to the most urgent messages (Huh et al., 2013; Kornfield et al., 2018). This is an emerging area of research and our study adds to the evidence demonstrating a need for more effective strategies to detect messages requiring additional attention by forum moderators, especially among communities where poor timing can create detrimental setbacks.

Conclusion

This study fills the gap in research regarding how opioid users engage with online support systems and what content helps to drive engagement. Here we investigate the types of content shared on a mobile app intervention for opioid use disorder, assess the type of content that drives engagement and whether moderator or peer authors impact these relationships. We find that author type impacts the level of engagement with certain types of messages, and that supportive messages are associated with lower engagement while threat and stigma messages are associated with higher engagement. Moderators can play critical roles in facilitating engagement in online forums for substance use disorders. We discuss important implications for the role of moderators in facilitating engagement that promotes healing and reduces stigmatization on these forums among this highly stigmatized groups.

Chapter 4

Reaching Populations with Trauma History:

Designing Healing-Centered Messages for Online Engagement

Abstract – The impact of trauma on mental and physical well-being over a lifetime has been well-documented. Scholars have called for trauma-informed care practices when serving populations with a higher trauma and mental health burden, such as individuals with substance use disorders, those with mental illnesses and racial, ethnic and sexual minorities. Trauma-informed care has largely been applied in social work, nursing and mental health disciplines. Too few studies apply this approach when implementing public health interventions among the populations with high risk of trauma history. Furthermore, despite increased use of online communities by these populations and the emergence of multiple digital interventions targeting these groups, few models exist on how to apply a trauma-informed or healing-centered approach to online interventions. There has also been little attention given to the impact of trauma or healing in intervention design and implementation. To address this, this paper reviews the role of trauma in marginalized populations and the research on technology-based trauma-informed care. It also proposes five principles (Be Political, Build Strengths, Be Cultural/Spiritual, Promote Whole-Being and Be Responsive/Rebuild Control) for applying trauma-informed care and healing-centered engagement in online messages. We demonstrate the use of this framework among moderator messages in the A-CHESS app for opioid use disorder and test whether healing-centered messaging is associated with online engagement. We find that promoting whole-being was related to increased online engagement while building strengths was associated with decreased engagement. 'Rebuilding control' among participants was associated with increased engagement in some cases and decreased engagement

in others. There is an urgent need for more healing-centered and trauma-informed approaches online to engage with marginalized populations. Implications for these relationships and healing-centeredness is discussed.

Background

In 2017, 45% of children in the United States had experienced at least one adverse childhood experience before the age of 17 (Sacks & Murphey, 2018). Adverse childhood experiences (ACE) refer to distressing life events, trauma and stressors that occur in childhood, such as emotional, physical or sexual abuse, emotional or physical neglect, divorce, separation, living with violence or living with an adult with a mental illness. A large body of research indicates that adverse childhood experiences have deleterious effects on both physical and mental health over one's lifespan, including increased risk of depression, anxiety, cancer, substance use and self-injury (LaBrenz et al., 2020; Shonkoff et al., 2012). Vulnerable and often marginalized populations, such as racial, ethnic and sexual minorities, those with substance use disorders, such as opioid use disorder, adults over 65 and those with mental health illness are likely to have a history of adverse childhood experiences and studies show that these populations often have higher mental health morbidity (Y. Kim et al., 2021; Larkin et al., 2017; Rhee et al., 2019a; Sacks & Murphey, 2018). Many of these groups also experience other traumatic stressors in their lifetime, like financial strain, racism, extreme poverty and social stigma.

However, population health interventions targeting these groups don't often account for the impact this trauma has on one's ability to change health behavior or ability to interact with an intervention. Further the theoretical models that guide communication interventions largely ignore trauma as a factor and if included, it is viewed as an individual-level factor rather than also as a community-level factor. In the

previous chapters, I presented two digital interventions for populations likely to have a history of adverse childhood experiences and trauma, older adults (with a specific focus on those with depression and isolation) and individuals with opioid use disorder. Despite the likelihood of trauma history, neither of these interventions specifically cite a trauma-informed component and in both studies, results indicated system use could lead to potential harm or reduction in benefits received. In chapter 2, depressed and socially isolated elders who used the Elder Tree system and reported prior comfort with social network systems had lower mental well-being compared to control and in Chapter 3, we found slow response to messages addressing stressors like stigma and no difference in response time to messages threatening the opioid use recovery process (averaging 2 days to receive a response). Evidence-based models are needed for moderating forums designed for participants who are vulnerable or carry a stigmatized identity, like an opioid user, sexual abuse survivor, or someone with severe mental health illness.

Just as in the offline space, I propose that moderators or community managers and mHealth intervention designers should utilize a more healing-centered or trauma-informed approach when designing and implementing interventions for populations with higher mental health burden, such as those with opioid use disorder or elders with a mental health illness. The goal of this chapter is to propose a framework for utilizing trauma-informed and healing-centered engagement in online communication interventions and to test whether the use of more healing-centered messages by moderators impacts online engagement. This study will begin the work of establishing a framework that public health practitioners and prevention scientists can incorporate into the design of online health interventions for populations with trauma history and build the evidence base for the effectiveness of this model.

Trauma Prevalence in Marginalized Groups

Studies report that marginalized groups, such as elders, those with substance use disorders, (e.g. opioid use disorder) and individuals with major depressive disorders have a significant prevalence of adverse childhood experiences (Quinn et al., 2019; Rhee et al., 2019a). Among a sample of 457 patients with opioid use disorder, Stein and colleagues found that the mean number of adverse childhood experiences was 3.64 (±2.75) and ACEs were associated with recent injection drug use, risk of overdose and lower age of initiating opioid use (Stein et al., 2017). Other studies of over 5,000 elders in the 2012-13 National Epidemiological Survey found that 34.7% of adults over 65 have experienced some form of adverse childhood experience with the most common being parental psychopathology, neglect and physical/emotional abuse (Rhee et al., 2019a). ACEs were also associated with greater likelihood of having a substance use disorder, a major depressive disorder and a lifetime suicide attempt (4X) (Larkin et al., 2017; Rhee et al., 2019b, 2019a). Other studies on this same elderly group found that major depression mediated the relationship between some ACEs and substance use disorders (Y. Kim et al., 2021).

Further, studies examining these relationships among racial and ethnic minority groups are finding similar results with one study of 233 American Indian older adults finding that childhood neglect and household dysfunction were positively associated with depressive symptoms (Roh et al., 2015). Other studies report prevalence rates of over 78% for Native Americans, 61% for Black, non-Hispanic children and 51% for Hispanic children having survived at least one adverse childhood experience (Brockie et al., 2015; Koss et al., n.d.; Sacks & Murphey, 2018). In a study of 26,020 individuals, 63.02% of them experienced at least one adverse childhood experience and a higher proportion of Blacks, Hispanics, Native Americans and multi-racial individuals experienced five or more adverse childhood experiences, compared to non-Hispanic Whites (LaBrenz et al., 2020).

Childhood Trauma and Health

Heightened stressors in childhood and over a lifespan (e.g. abuse, job loss and divorce) can create significant burden on one's mental health. Adverse childhood experiences increases the risk of attempted suicide (Dube et al., 2001), frequent depressive symptoms, frequent tobacco use and frequent marijuana use (Mersky et al., 2013). Studies show that individuals with four or more adverse childhood experiences are nearly twice as likely to die prematurely than individuals with no adverse childhood experience (LaBrenz et al., 2020). Additionally, those who report two or more ACEs reported low life satisfaction and poor overall health (Mersky et al., 2013). Similar associations are also found when examining adult physical health (Monnat & Chandler, 2015).

Monnat & Chandler's study of 52,250 U.S. adults aged 18 to 64, revealed that adverse childhood experiences were associated with poor self-rated health, functional limitations, diabetes and heart attacks in adulthood. This points to the long-term impacts of adverse childhood experiences on health outcomes (Monnat & Chandler, 2015). Their study also revealed that multiple, but not all, of these associations were mediated by other factors, such as socio-economic status and mental health. Given that studies report particular groups being especially vulnerable to adverse childhood experiences, such as racial and ethnic minorities, and these groups, compared to Whites, are also more likely to report low income and poor mental health in adulthood, it's no surprise that LaBrenz et al found that race moderates the effect of ACEs on mental and physical health (LaBrenz et al., 2020). The effect of ACE on mental and physical health was worse for those individuals who were non-Hispanic White (LaBrenz et al., 2020).

Additional traumatic events over the life course can also negatively impact health, namely the societal stigma that occurs for multiple marginalized groups, such as those with substance use disorders, elders, the homeless, or those with mental health illness, the historical and intergenerational trauma for Native Americans and the systematic oppression and racism impacting Black and Hispanic Americans (Bombay et al., 2011; J. J. Bulanda et al., 2014; Olsen & Sharfstein, 2014; Paradies, 2006; Radmanović & Burgić, 2017; Singh et al., 2018). Multiple studies indicate that these socio-ecological factors unique to these populations have significant impacts on mental and physical health (Bombay et al., 2011; J. J. Bulanda et al., 2014; Paradies, 2006; Radmanović & Burgić, 2017). In some cases, they work to build resilience and in others create significant comorbidities with other health conditions.

Furthermore, the impact of trauma on mental and physical health has gained increased visibility during the COVID-19 pandemic (Ho et al., 2020; Zhou et al., 2020). The effects of the pandemic have been worse for the already vulnerable populations indicated above. For example Liu and colleagues found that COVID-19 disease progression and mortality is three times higher among the elderly population and rates of mortality among Blacks and Hispanics have been reported as twice as high or more than in Whites (Liu & Epidemiology Working Group for NCIP Epidemic Response, Chinese Center for Disease Control and Prevention, 2020; S. S. Patel & Clark-Ginsberg, 2020; Tai et al., 2021). COVID-19 is associated with traumatic stressors, such as the death of loved ones, financial strain, job loss, recession, extreme fear and increases in physical, sexual and emotional abuse among families (Bavel et al., 2020; Ho et al., 2020, p. 19; Zhong et al., 2021).

Furthermore, social distancing, a method recommended to reduce viral spread, has only added further complexity as it has dramatically increased the number of individuals experiencing isolation, having little

to no contact with family and friends. As explained in Chapter 2, social isolation is associated with increased depression, functional decline and mental and physical morbidity and mortality (Cacioppo & Cacioppo, 2014; Loboprabhu & Molinari, 2012; National Institute on Aging, 2019; Steptoe et al., 2013; von Känel et al., 2021). Multiple scholars have pointed to the damaging short and long terms effects of social distancing. (Banerjee, 2020; Berg-Weger & Morley, 2020). The trauma and mental health burden associated with COVID-19 alone present a significant psychological burden and concerns regarding mental illness and PTSD due to the pandemic have increased (Ho et al., 2020; Stefana et al., 2020; Zhai & Du, 2020). Thus, we urgently need additional interventions developed that support mental health and well-being while including a trauma-informed approach.

Trauma-Informed Approach

Scholars have been investigating how traumatic experiences can shape our decisions, our lives and our health care decision making (A. M. Ryan et al., n.d.). Increasingly, practitioners are adopting trauma-informed practices and trauma-informed care in their work (Bruce et al., 2018; Reeves, 2015). Trauma-informed care is a strength-based approach that focuses on a heightened awareness of prior trauma and potential effects, provides opportunities to re-build control and has an emphasis on safety (Bath, n.d.; J. Bulanda & Byro Johnson, 2016; Reeves, 2015). The elements of a trauma-informed approach have been identified by the Substance Abuse and Mental Health Administration as: a) realization of the widespread impact of being exposed to trauma, b) recognition of how trauma can impact individuals and families, in terms of the specific signs and symptoms c) responses that apply this knowledge into practice and policy, i.e. individuals, programs and systems respond in a comprehensive and integrated manner and d) an

attempt to prevent re-traumatization (Bruce et al., 2018; Substance Abuse and Mental Health Services Administration, 2014; Tebes et al., 2019).

Multiple studies indicate that incorporating trauma-informed care into interventions targeting marginalized groups yields positive outcomes (Kahan et al., 2020; King, 2017; Morrissey et al., 2005; D. L. Perry & Daniels, 2016; Reeves, 2015). One study of a trauma-informed health intervention targeting homeless female survivors of gender-based violence found that facilitating an inviting and safe space, facilitating empowerment and facilitating group cohesion through shared experiences were key ingredients of the trauma-informed intervention. The intervention was also reported to successfully engage participants (Kahan et al., 2020). In addition, a review of trauma-informed interventions for incarcerated women revealed that trauma-informed interventions for these groups had a positive impact on PTSD symptoms. However, only 9 studies were reviewed (King, 2017).

There are multiple critiques on the limitations of the SAMHSA guidelines and the lack of clarity regarding the implantation of trauma-informed care in practice (Berliner & Kolko, 2016; Ginwright, 2021). Some studies have begun to address these, including deriving a scale to measure trauma-informed practice but there is still work to be done to determine how to implement this in other contexts, (i.e. outside of clinical care, like in community-based participatory research or in health communication interventions) (V. B. Brown et al., 2013; Goodman & Sullivan, 2016; D. L. Perry & Daniels, 2016; Tebes et al., 2019). Some scholars have also begun to propose models for the use of trauma-informed practices in youth engagement and youth participatory research, but it has not yet been universally applied (J. Bulanda & Byro Johnson, 2016; Falkenburger et al., n.d.; Stephens et al., 2018). Few studies have systematically applied trauma-informed practice to public health interventions for adult populations with higher risk for

trauma, such as African Americans, Native Americans, those with COVID-19 or those with mental health illnesses and therefore, the evidence-base for its effectiveness is limited.

The vast majority of trauma-informed studies are focused on marginalized populations, who would traditionally interact with the mental health or social service sectors, such as those with sexual abuse history, incarcerated individuals and individuals with substance use disorders, etc. (Kahan et al., 2020; Morrissey et al., 2005). However, as Tebes et al explains in their call for more trauma-informed population health interventions, addressing acute trauma in the clinical setting, though important, has led to only limited improvements in health among populations with higher trauma burden (Tebes et al., 2019). An approach addressing social and ecological determinants of health that addresses systems and policies while including individual-level factors, among a larger population at higher risk for trauma, will lead to greater improvements in population health (Tebes et al., 2019). They argue that a shift in perspective is needed within the trauma-informed space from targeting clinical symptoms (i.e. "ill health") in small, sub-sections of the population towards more population health interventions targeting marco-level determinants of health for a larger majority of the population with lifetime exposure of trauma, such as racial, ethnic minorities or sexual minorities (Tebes et al., 2019).

Similarly, I argue that as we serve these marginalized groups at higher risk for trauma and mental health burden, in order to design equitable interventions to improve health and health behaviors, scholars should include some form of trauma-informed practice in the design and implementation of these interventions. Trauma-informed practice should not only occur in the nursing, clinical and social work space, but should translate into the public health, population health and community health spaces

targeting underserved and marginalized populations. Emerging interventions have begun to take this approach in order to improve health and health behaviors (Amaro et al., 2005; Goldstein et al., 2020; Tebes et al., 2019). One study of a systems-wide trauma-informed intervention for drug and alcohol use disorder highlighted that both providers and patients called for an integration of mental health, trauma and drug and alcohol use disorder services, as these are often co-occurring (Amaro et al., 2005). They created The Boston Consortium of Services for Families in Recovery Model and demonstrated an integration of services across systems under a trauma-informed lens with the goal of trauma-informed practice being instituted to improve recovery and likely to improve population health (Amaro et al., 2005). They targeted primarily poor urban LatinX and African-American women (Amaro et al., 2005).

Another study seeking to change health risk behaviors among low-income, Black primary care patients demonstrates this principle well; the scholars emphasized the need for clinicians to reframe adverse health behaviors as coping strategies resulting from trauma and to engage with Black participants by emphasizing strengths and resilience in an effort to motivate change (Goldstein et al., 2020). Their study demonstrates how a trauma-informed lens can be utilized within current public health frameworks for health behavior change and the need for clinicians to utilize this practice to motivate behavior change among underserved patients, such as those from racial and ethnic minorities with higher trauma risk (Goldstein et al., 2020). The motivation-based intervention led to decreases in stress, alcohol use and risky sex behaviors. Participants also reported high satisfaction with the intervention (Goldstein et al., 2019). These are only a few examples that demonstrate the need and utility of utilizing a trauma-informed or healing-centered approach when seeking to improve public health among populations with higher lifetime trauma risk.

Applying Trauma-Informed Care Online

As explained in Chapter 1, marginalized individuals, such as those with opioid use disorder are often stigmatized in the offline space. In order to seek support and help for physical and mental health services, many of these individuals turn to the internet and online health communities. However, it is unlikely that these spaces have been modified to reduce re-traumatization or re-stigmatization. In fact, multiple studies report both occurring on these spaces and studies investigating the potential for creating a trauma-informed space online show that participants are ambivalent about the safety and privacy of such spaces (Basterfield et al., 2018; Saraiya et al., 2020; Steinke et al., 2017). However, online communities have been demonstrated to promote empowerment for many groups including individuals with stigmatized identities and they have been effective in improving health outcomes for various groups, such as those with opioid use disorders and those struggling with mental illness (Barak et al., 2008; Hochstatter et al., 2021; Lawlor & Kirakowski, 2014; van Uden-Kraan, Drossaert, Taal, Shaw, et al., 2008). However, these studies do not specifically mention any modifications or adaptations to make their online spaces more trauma-informed.

Increasingly scholars are investigating the use of digital interventions for mental health improvement and trauma-recovery (Z. Wang et al., 2016; Yeager et al., 2018; Yeager & Benight, 2018). Technology-based trauma-informed interventions have begun to be investigated for feasibility, utility and efficacy among multiple populations with acute trauma, such as those facing intimate partner violence, sexual assault and women with substance use disorders (Emezue, 2020; Emezue & Bloom, 2021; Gilmore et al., 2019; Orengo-Aguayo et al., 2018; Sugarman et al., 2019). Reviews of these interventions have shown some efficacy on PTSD symptoms, self-efficacy, feelings of support and parenting skills, and some studies report

feasibility and satisfaction with the interventions among patients and providers (Gilmore et al., 2017, 2019; Sugarman et al., 2019; Sullivan et al., 2019; Z. Wang et al., 2016). Other studies of women with opioid use disorder report an ambivalence among the participants regarding the use of technology as a replacement for in-person treatment and concerns about whether the space would be useful or safe (Saraiya et al., 2020).

In many cases, these interventions are trauma-informed, evidence-based treatment and interventions that have been adapted to be "web-based" versions (Sugarman et al., 2019; Z. Wang et al., 2016; Yeager et al., 2018). But in other cases, they have been co-designed with participants based on the affordances of digital technology or utilized a hybrid approach of both strategies (Raynor et al., 2021; Stockman et al., 2021). In either scenario, it is not often explained what critical features deem the intervention "trauma-informed" and a clear framework to guide new intervention components and design is not always available (Gilmore et al., 2019; Stockman et al., 2021; Sugarman et al., 2019; Yeager et al., 2018). In fact, in one study of the feasibility of a female-specific intervention for substance use disorder, it seems a trauma-informed lens was not applied, yet in the first iteration, the need for more modules on trauma was still suggested by participants in the pre-pilot phase (Sugarman et al., 2019). In many cases, these interventions have been designed for the unique and specific populations in the study, for e.g. Black women facing intimate partner violence, those who have experiences sexual assault, gender-based violence or individuals with co-occurring substance use and mental health disorders (Gilmore et al., 2019; Stockman et al., 2021). Though tailored to the target user, this makes it difficult to apply a "best practice" for interventions in other contexts, especially with the goal of application to a larger population at trauma risk.

Further, in other studies, scholars argue that trauma history and triggers can affect engagement with digital interventions and that more theoretically-grounded research is needed to demonstrate how the intervention impacts engagement (Yeager & Benight, 2018). They propose a model (HAPA) for engagement that accounts for trauma history. Based on prior work, the authors proposed that PTSD symptoms may affect perceived need for an intervention or reduce participation in the digital intervention (Yeager et al., 2018). In an application of the model, the authors did find that baseline trauma symptoms affected intention to engage in the intervention (Yeager et al., 2018). However, the focus of this model is on determinants of increased engagement with digital interventions rather than on the critical components needed or best-practices for the intervention to be "trauma-informed" in the digital space. That is, the scholars utilized a prior web-based intervention, deemed as "trauma-informed" and tested engagement with this intervention. The underlying assumption in many technology-based trauma-informed interventions seems to be that similar rules and practices for trauma-informed engagement offline apply in similar ways online. However, if scholars find it difficult to apply the trauma-informed framework offline, then it may be even more difficult to translate these principles to the online space. Given that research is still emerging regarding negative effects of online spaces, there is still much work to be done in fostering safe, "trauma-informed" online spaces. There is a great need for research to formulate key foundations for its application online.

In an attempt to produce a trauma-informed framework that can be utilized as best-practice for intervention design targeting populations likely to have a trauma history, I propose five principles built on a framework proposed by Ginwright, called Healing-centered Engagement. His framework is an extension of the trauma-informed model that attempts to fill some of the gaps and limitations of trauma-informed care (Ginwright, 2021; Watts, n.d.; Wilson & Richardson, 2020). Given the critiques that exist regarding

the practical application of the trauma-informed model, the evidence-base for the application and the need to shift perspectives from an acute-treatment level lens to a prevention and promotion population-health lens, Ginwright's healing-centered framework provides a good a starting point for the development of principles to guide trauma-informed interventions online. The elements and principles proposed in this framework align well with the Population Health perspective proposed by Tebes et al and with qualitative assessments from patients and providers of trauma-informed interventions and digital interventions for health (Ginwright, 2021; Tebes et al., 2019).

Healing-Centered Engagement

Ginwright argues that trauma-informed care focuses on the problem of "trauma" and the pathology, rather than the solution of fostering well-being. It assumes trauma is only an individual, clinical experience rather than a collective and sometimes political experience, as is the case for many racial and ethnically-diverse groups (Wilson & Richardson, 2020). In the qualitative arm of the Boston Consortium trauma-informed intervention study, the providers emphasized the need for the intervention be more family-based rather than individual-centered (Amaro et al., 2005). In Wang et al's study deploying My Trauma Recovery in China, they argue that social factors, such as social functioning, in additional to individual factors, such as psychological trauma should be considered in the delivery of technology-based trauma-informed interventions, especially in collectivist cultures (Z. Wang et al., 2016).

From the perspective of population health and the evidence regarding wider-range impact, Tebes et al, also emphasized the limitations of focusing on the problem of acute, trauma with treatment-based solutions rather than on solutions focused on fostering well-being, health promotion and prevention

(Tebes et al., 2019). Further, in studies examining trauma-informed interventions for substance use disorders, multiple studies emphasize the need for the intervention to include mental health and well-being focused aspects in addition to elements targeting substance use (Amaro et al., 2005; Gilmore et al., 2017; Sugarman et al., 2019). In other studies targeting marginalized high trauma groups, they utilize frameworks including social and structural factors, with the individual-level factors (Stockman et al., 2021).

Further, because the focus is on trauma, trauma-informed care should expand awareness of the impact of trauma on health and improve response to trauma with efforts to reduce re-traumatization. However, preventing re-traumatization can be difficult with current practices in mental health and nursing, according to some studies; others argue that a "trauma-informed" approach requires no-screening for trauma (i.e. trauma history assumed) if an appropriate response is not in place (Agar-Jacomb & Read, 2002; Ashmore, 2014; Wilson et al., n.d.). In fact, in a study aiming to develop a trauma-informed psychosocial group intervention for female youth who experienced homelessness and gender-based violence, the scholars reported unanticipated trauma disclosures that were both empowering to some but re-traumatizing for others. Despite having supports and a response in place, this led to drop-outs. They urged scholars to prepare systems to reduce re-victimization prior to intervention implementation. When designing interventions to improve health for the larger majority at higher risk for trauma, it's not unlikely that if the emphasis of an intervention is on trauma factors, it will be more difficult to reduce re-traumatization. Rather, if focus is shifted towards a solutions based model that focuses on fostering well-being, under the assumption that trauma-history has occurred, the likelihood of re-traumatization may be less diminished. This remains to be empirically tested.

Additionally, research on the effectiveness of the principles of trauma-informed care is still needed. It is unclear whether trauma-informed care or healing-centered care reduces re-traumatization. This is an important area for additional research. However, multiple scholars agree that additional guidance is needed regarding the application of a meaningful trauma-informed approach to drive both well-being and engagement (Yeager et al., 2018). Ginwright argues that trauma-informed care "provides little insight into *how* we might address root causes of trauma", whereas healing-centered engagement is an assets-based framework that focuses on potential solutions for healing, affirms cultural diversity as a tool for healing and includes addressing root causes as a guiding principle (Ginwright, 2021; Watts, n.d.). The four elements of healing-centered engagement (Ginwright, 2021)are:

Healing is political rather than clinical – In the healing-centered model, trauma and healing is seen from a political lens. The factors that contribute to trauma and healing and the factors that should and do impact engagement are a function of the social, economic and environmental factors in which individuals work, live and play. Thus, there is critical reflection on issues, such as lack of access to mental health, issues of power, justice and oppression. Trauma is viewed from a collectivist perspective and action is taken collectively as well. This is consistent with the Population Health approach proposed by Tebes and other scholars that emphasize a life-course perspective for health and the evidence demonstrating macrosocial determinants of health that exacerbate trauma risk, such as food insecurity, housing, racism and neighborhood deprivation, in additional to individual and family factors (Erving & Hills, 2019; Falkenburger et al., n.d.; Larkin et al., 2012, 2014; Radcliff et al., 2019; Strompolis et al., 2019; Tebes et al., 2019). They also argue that we should shift the focus away from a clinical perspective alone towards a multi-modal strategy that includes risk prevention and policy development (Tebes et al., 2019).

Healing is cultural – Ginwright proposes a promotion of the connection between healing and identity. He proposes that culture should be a way to group and support healing (i.e. incorporate culturally-grounded rituals and activities to promote well-being). Various studies also emphasize the importance of culturally-tailoring trauma-informed interventions, in some cases as a necessary tool to ensure the intervention is accessible to the population, such as language changes, and in other cases, to better support well-being. For example, in the Boston Consortium of Services for Families in Recovery targeting LatinX and African-American families, they recommend individuals plan for the inclusion of cultural adaptation of intervention content as this can deem the intervention inaccessible to the target population. In other studies, on usability of a mobile app for sexual assault survivors, participants requested that identity, including, race/ethnicity, gender and sexual orientation, be included as part of the content (Gilmore et al., 2019). In other studies of the LinkPositively app, a technology-based trauma-informed intervention targeting Black women, there were multiple strategies to infuse culture into the app content and approach, including images of Black women, themes of empowerment, customization of backgrounds and content around the issues of medical mistrust and HIV stigma, common among communities of Black women living with HIV/AIDS. Participants in each focus group also expressed the need to include culturally-tailored content into the application and were enthusiastic about the already included pieces.

It is an asset-based framework – healing-centered engagement "focuses on well-being we want, rather than the symptoms we want to suppress: build healing spaces rooted in people's experiences, knowledge and skills" (Ginwright, 2021). It requires utilization and acknowledgment of existing strengths in a person and community (i.e. assets-driven strategies). Multiple studies demonstrate the utility of asset-based approaches in improving well-being (R. J. Pan et al., 2005; Torres & Sacoto, 2020; Whiting et al., n.d.). In the LinkPositively app, strategies to build upon knowledge and skills were utilized, such as self-care tips,

virtual peer navigation and the social networking features that promoted the sharing of experiences and informational resources (Stockman et al., 2021). The app was also developed and modified through active engagement of individuals in that community, which is also an empowering process. Other studies demonstrate and utilize similar participatory approaches as this principle is grounded in the guiding principles of the trauma-informed care framework (J. Bulanda & Byro Johnson, 2016; Falkenburger et al., n.d.; Gilmore et al., 2019; Kahan et al., 2020; Raynor et al., 2021).

Consistent with Ginwright and Tebes' argument for more multi-level interventions to support trauma and promote health, Falkenburger, Arena and Wolin argued that a model for "trauma-informed" community building must go hand-in-hand with promoting the strengths of the community and healing for the community. Thus, in collaboration with residents in public housing and other marginalized communities in San Francisco, they created a new version of the trauma-informed community building model (Falkenburger et al., n.d.). Similar to Ginwright's argument, this new version places greater emphasis on structural harms as determinants of community trauma and emphasizes that the community lead the design and implementation of interventions for change using equitable participation and accountability (Falkenburger et al., n.d.).

It supports adult providers with their own healing – A distinguishing factor of Ginwright's healing-centered framework is the addition of this principle requiring consideration be given on how to support the individuals administering care to the communities. Multiple studies call for more attention towards the stress and trauma on providers serving populations with a high mental health burden (Christodoulou-Fella et al., 2017; Devilly et al., 2009; Strauss Swanson & Schroepfer, 2018; Wilson & Richardson, 2020). Studies of secondary stress or trauma emphasize the need for systems and policies to promote mental

health and well-being of caregivers and service providers (Agar-Jacomb & Read, 2002; Wilson et al., n.d.; Wilson & Richardson, 2020). In two case studies, Wilson and Richardson demonstrated the importance and utility of applying the healing-centered framework to reduce burnout and stress among caregivers of survivors of trauma (Wilson & Richardson, 2020). Additional studies are needed to apply this model to intervention design for those serving individuals with higher trauma risk and potential to disclose trauma histories.

Building on these principles above, the principles of trauma-informed care and prior applications of healing-centered engagement (J. Bulanda & Byro Johnson, 2016; Chavez-Diaz & Lee, 2015; Ginwright, 2021; Wilson & Richardson, 2020), the following five principles (Be Political, Build Strengths, Be Cultural/Spiritual, Promote Healing and Be Responsive) can help to guide the design and implementation of messaging in online health interventions targeting groups with a higher mental health burden and trauma history.

Applying Healing-Centered Engagement Online

Be Political because Healing is Political

Healing-centered engagement proposes that trauma and healing should be viewed from a political lens, rather than from a clinical lens. Engagement with participants online should include strategies to promote a critical reflection and/or collective action towards the greater social, economic and environmental factors that facilitate trauma and inhibit the promotion of well-being. The online conversation should include messaging focused on collective determinants in addition to individual determinants of trauma and well-being. Online posts may include news regarding social inequality or motivational messaging

recognizing the impact of social factors, such as income or transportation, and their impacts on well-being. Posts can address racism, historical trauma, stigma and other systemic issues. Strategies for health improvement should also focus on collective impact, like utilizing approaches that improve beliefs of the entire community and a greater preference towards more community-level interventions, such as social media interventions on spaces like Facebook and Twitter, or other interventions that promote community-level engagement.

Be Strengths-Based/Focus on Building Capacity

Online engagement strategies that are healing-centered should build on the assets of the online community and aim to increase capital. Strategies should also build on the strengths of the community manager or moderator as well. Strengths-based online messaging includes content that helps to build capacity. This may include providing additional skills, resources or tools the target user can utilize to promote well-being for the whole-person. Whole-person refers to resources that impact the social determinants and psychological determinants in addition to the biological determinants of health. In ICTs and online health interventions, this principle is most intuitive as these interventions are designed to promote empowerment and social capital. Thus, they often already include features providing informational resources and emotional support.

Be Cultural/Spiritual because Healing is Cultural and Spiritual

Healing-centered online engagement and health promotion should include strategies rooted in culture and spirituality. Online messaging and posts should be culturally tailored beyond language. Language-based tailoring is primarily a feature of accessibility. However, cultural and spiritual tailoring makes the post more relevant to the shared lived experiences of specific races, ethnicities and intersections

between those where culture and spirituality is critical and interconnected with identity and well-being. There are multiple ways in which messages and digital intervention strategies can be culturally and spiritually tailored. However, this often requires intentional work towards learning shared values and culture within a community, working with existing community structures, collaborating with local advocates and leaders and exercising cultural humility. Directing attention towards this aim will yield an intervention that is more responsive to community needs and increase sense of belonging among the online community.

Promote "Whole"- Being and Mitigate Harm

Healing-centered engagement strategies should include an element to promote healing from trauma and reduce harm. Strategies can promote hope, empathy and well-being in the online community as well as for the practitioner. Posts should promote mental health, hope, empathy and provide validation. Often this can be in the form of emotional support, messages that promote self-confidence and self-efficacy. In online support groups, this may also be messages that share lived experiences and personal stories that can often foster hope and empowerment. Given that these groups are particularly vulnerable to the harmful effects of online engagement (see Chapter 1), messages and strategies that serve to reduce re-traumatization and reduce stigma among these populations should also be implemented.

Be Responsive and Rebuild Control

Healing-centered online engagement should provide target users with opportunities to give input on community needs and practitioners should be responsive to those needs (i.e. their individual and collective voices are being heard and strategies are empowering). This is often in the form of requesting community feedback. Thus, beyond requesting feedback in the design and implementation phase of the

intervention, frequent messaging on the platform, should also solicit feedback from the participants. Inquiring on community needs and encouraging individuals to share their own experiences. This can be in the form of short online surveys, using the feedback mechanism from the platform (e.g. likes, emoticons etc.). Instagram stories with embedded polls can also be used or simply posting a question on the discussion board can be a great way to obtain input from the community.

Research Question and Hypothesis

The proposed framework can serve as a model of best-practices for trauma-informed and healing-centered messaging online. However, research is needed to assess the effectiveness of this framework and whether it is applicable for multiple stigmatized populations. Further, studies should assess whether the framework leads to greater or less engagement of intervention participants as the design of ICTs and digital health interventions need to facilitate engagement of their target audience. For populations with high stigma, it is recommended that community managers and moderators help to facilitate engagement and provide informational and emotional support to the online community. Therefore, we will assess whether messages utilizing the above healing-centered principles, by moderators, impacts the engagement of an online community population with trauma history. This will start to build the evidence for the utility of a healing-centered and trauma-informed framework for online engagement with marginalized populations. We sought to answer the following research question:

> *RQ: To what extent do moderators use a healing-centered approach for messages they initiate on an on an online forum for opioid use disorder?*

H1: We also *hypothesized that messages that are more healing-centered will produce higher engagement (more views, more responses and quicker view and response time) among the online community of individuals with opioid use disorder.*

Methods

Sample

This study utilizes messaging from the A-CHESS BUNDLING app (Gustafson et al., 2016) adapted for opioid use disorder. The study sample and characteristics were described in Chapter 3's methods section. The analytical sample consists of all moderator-initiated messages from March 31, 2016 to March 26, 2020, excluding the samples used to obtain inter-coder reliability and blank messages found in the action log by moderators. The final analytical sample consisted of 186 moderator-initiated messages posted by 15 moderators.

Measures

The dependent variables are *Number of Views, Number of Unique Viewers, View Time, Number of Responses and Response Time*. The control variables are *Topic, Author User ID and Time*. The same operationalization and method used to construct these variables in Chapter 3 was used. Please see Chapter 3 methods for full details.

Independent Variables

We developed a codebook that included the five coding categories each related to the principles of healing-centered engagement: Be *Political, Build Strengths, Be Culturally Tailored, Promoting Whole-*

Being, Be Responsive/Rebuild Control (see Table 1 for a brief definition and examples of each coding category). We did not include spirituality in the coding for "Cultural." Each coding category was coded as 1 if the message include the content and as 0 if there was no such content in the message. Messages could be coded into multiple coding categories. Two coders were trained before coding. The reliability between two coders on each coding category is shown in Table 2. Almost all coding categories had a reliability of 0.7 and greater. 10% (113) of the moderator messages were randomly selected from 1,129 moderator messages (both threads and comments) generated between March 31, 2016 to April 24, 2018 to establish reliability. Two additional rounds of reliability were done (each with an additional 60-100) messages). In the last round of reliability (100 messages), there were very few instances of the code for culture and political.

Table 1. Showing Brief Definition and Example of Healing-centered Hand-Coded Coding Categories

Coding category	Brief Definition (excerpts from codebook)	Example Moderator Messages
Be Political	Post addresses social and or/economic causes (incl. stigma issues) or impacts of the behavior. Posts incites critical reflection in the reader and talks about taking action against these issues.	"Eric Haram is the former director of a substance abuse treatment facility in Maine. In this clip he talks about the pressures those in recovery face from stigma. "

Build Strengths	Posts that have any element intended to build on the strengths of the audience and/or strengthen the audience (i.e. empowerment). This will mostly materialize in the form of providing resources, skills or tools to the audience on the topic of the post.	“Welcome to A-CHESS J1988! I'm one of the A-CHESS staff, do let us know if you have any questions.” “This [link https://www.thefix.com/content/video-what-suboxone]short video[/link] from The Fix talks about how Suboxone works. “
Be Culturally Tailored	Post has a clear element of cultural tailoring, i.e the post includes cultural features or cultural history. The resources or tips have been culturally tailored. Culture here refers to race and ethnicity.	“Join Black Treatment Advocates Network (BTAN) as they screen and discuss the powerful, award-winning documentary "13th" about the criminal justice system and mass incarceration post-slavery.”
Be Responsive	Any requests for input from the audience either on the current topic or a future topic	“I'm so sorry you're still having so much pain. I can only imagine how frustrated you are with the various doctors and never getting any answers. I'm glad you reached out

/Rebuild Control	or the post asks the audience what they would like to talk about	here on A-CHESS, and I don't think you're alone. Are there others out there who struggle with chronic pain and the depression that often comes with it?" "Welcome to ACHESS. Let me know if you have any questions."
Promote Whole Being	Includes content intended to help the participants heal from stress or trauma, promote hope or empathy and promote wellness and well-being. Includes posts providing emotional support, encouragement and validation for the different aspects of the "Whole Person" (mental, physical, social, economic well-being).	"5 months sober is huge - keep it up! You're so right about drugs and alcohol being everywhere, but for you it sounds like Vivitrol is a big part of your success." "Everyone's recovery is unique, and what works for you may not work for someone else. Yet mindfulness has been shown to be a valuable tool. This [link http://www.breakingthecycles.com/blog/2016/05/03/mindfully-recover/]blog post[/link] from [link http://www.breakingthecycles.com/blog/]breakthecycles.com[/link] talks about how incorporating meditation in recovery can be a wonderful tool for some people as a means of controlling the crazy "thinking" that can be part of one's addiction. Because addiction is seeded in the mind, meditation and mindfulness practices help to slow down the racing

		thoughts and to allow urges to come and go without negative action. By becoming aware of your feelings and becoming present in the moment, mindfulness can help you to pause before acting. Like any "skill," mindfulness takes practice, yet another tool in your recovery took kit is always a good thing. Have you tried mindfulness to help your recovery?"

Table 2 Showing Reliability Between Two Coders

Coding Category	Krippendorff's alpha
Be Political	*1 (1)*
Build Strengths	0.86
Be Culturally Tailored	*NA (0)*
Be Responsive	0.95
Promote Healing	0.71

Italicized content type had less than 1% of the messages with that code. Values in brackets represent the number of instances of the code.

Data Analysis

Frequency of healing-centeredness and the five different categories were derived in order to answer the research question. In addition, a variable for Total Healing-centeredness was calculated by summing the individual categories to assess the amount of messages that included the five different categories. Given this is the first study to test this new construct and apply it in the online context, evidence is limited regarding the best method of constructing the "healing-centered" variable. Thus, we ran a factor analysis with Varimax rotation and correlation analysis to assess whether we should add the different categories as separate independent variables in the models predicting engagement or whether categories should be grouped together. The factor analysis produced two components, one with Promoting Whole Being and the other with the other variables (see Table 3). Culturally Tailored was excluded because none of the messages were culturally tailored. The factor loading for Be Responsive was negative and correlational analysis revealed that it is negatively correlated with the other two variables, Building Strengths and Be Political (see Table 4). Thus, given that this is a new construct, we decided to also include this variable as a separate construct in the model. Among this sample, only five messages were identified as Political; therefore, based on the factor analysis, we created a summative variable we call here "Strengths-Based" (since Political n is limited) from the addition of the Political variable and Building Strengths variable. We decided to run all the models with two sets of Independent variables. One set with all the independent categories added separately and the other set with the "Strengths-Based" variable, Be Responsive and Promoting Healing as the predictors.

To test our hypothesis, separate general linear models were used to assess whether the healing-centered categories were significantly associated with any of the five different engagement variables. All analysis was done using SPSS Statistics v. 27.

Table 3. Factor Loadings Healing-centered Categories within the A-CHESS Moderator Threads

	Component	
	1	2
Build Strengths	**0.558**	0.247
Promote Whole Being	0.032	**0.962**
Be Responsive	-0.793	0.184
Be Political	**0.569**	0.051

Varimax Rotation used for analysis above. Factor loadings greater than 0.4 are in bold.

Table 4. Pearson Correlations for the Healing-centered Categories

	Healing-centered Categories				
Categories	Promote Whole Being	Be Responsive	Be Political	Build Strengths	Strengths-Based
Promote Whole Being	1	0.017	0.059	0.069	0.085
Be Responsive	0.017	1	-.174*	-.182*	-.229**
Be Political	0.059	-.174*	1	0.024	.364**
Build Strengths	0.069	-.182*	0.024	1	.940**
Strengths-Based	0.085	-.229**	.364**	.940**	1

**. Pearson Correlation is significant at the 0.05 level (2-tailed).*

***. Pearson Correlation is significant at the 0.01 level (2-tailed).*

Results

A small portion of the moderator threads were written on the Methadone, Suboxone and Vivitrol groups. Most of the threads were written on the Public Group; about 60% of the moderator messages were initiated on that space (Table 5).

RQ: *To what extent do moderators use a healing-centered approach for messages they initiate on an online forum for opioid use disorder?*

None of the moderator messages, posted by the 15 moderators, contained all five categories for healing-centered engagement online (Table 5). Three categories was the highest in any messages, with 18.8% of the messages containing three categories. Below is an example of a moderator thread containing three categories (Building Strengths, Be Responsive/Rebuild Control and Promoting Whole Being).

Example 1:

> *"Everyone's recovery is unique, and what works for you may not work for someone else. Yet mindfulness has been shown to be a valuable tool. This link* ***(Resource – Intended to Build Strengths****) talks about how incorporating meditation in recovery can be a wonderful tool for some people as a means of controlling the crazy "thinking" that can be part of one's addiction.*
>
> *Because addiction is seeded in the mind, meditation and mindfulness practices help to slow down the racing thoughts and to allow urges to come and go without negative action. By becoming aware of your feelings and becoming present in the moment, mindfulness can help you to pause before acting. Like any "skill," mindfulness takes practice, yet another tool in your recovery took kit is always a good thing.* ***(Mindfulness is intended to Promote Whole Being)***

Have you tried mindfulness to help your recovery? Have you heard about it and think you may give it a try? Share your thoughts with the group - we'd love to hear what you think. ***(This Section Rebuilds Control/Be Responsive)***

Example 2:

"Join Black Treatment Advocates Network (BTAN) ***(Culturally-Tailored)*** *as they screen and discuss the powerful, award-winning documentary* ***(Provide Resource – Build Strengths)*** *"13th" about the criminal justice system and mass incarceration post-slavery* ***(Political)****.*

It will be at 801 West Baltimore St. from 5:30 pm - 8 pm ***(Provide Resource – Build Strengths)***

RSVP at BTANMaryland@gmail.com

Roughly 4% of the messages contained no healing-centered engagement. Thus, 96% contained at least one coding category. The most frequently occurring category was Building Strengths, followed by Being Responsive/Rebuilding Control. Forty-two percent of the messages were intended to promote whole being, hope and empathy (Table 5). Thus, 58% were not intended to promote whole being. None of the coded messages contained culturally-tailored elements and only five messages (2.7%) were categorized as political. Thirty seven percent of the messages contained two healing-centered categories. Two percent of the messages were both political and built strengths. Twenty five percent were not strengths-based. See Table 5 for additional details

.Table 5. Descriptive Statistics of the Discussion Board Messages

Discussion Group	N	%

Living Well	19	10.2
Living Well with HIV	41	22.0
Methadone Group	2	1.1
Public Group	109	58.6
Staying Healthy	12	6.5
Suboxone Group	1	0.5
Vivitrol Group	2	1.1
Healing-centered Engagement		
Be Political	5	2.7
Build Strengths	137	73.7
Be Culturally Tailored	0	0.0
Promote Whole Being	79	42.5
Be Responsive	97	52.2
Total Healing-centeredness		
No Healing-centeredness	7	3.8
Healing-centered Category = 1	75	40.3
Healing-centered Category = 2	69	37.1
Healing-centered Category = 3	35	18.8
Healing-centered Category = 4	0	0.0
Healing-centered Category = 5	0	0.0
Strengths-Based		
Not Strengths-Based	48	25.8

Strengths-Based = 1	134	72.0
Strengths-Based = 2	4	2.2

Hypothesis: The more healing-centered the message, the higher number of views, the more comments and quicker to view and more rapid response time.

Views

Out of all the messages with the five coding categories, messages that promote whole being had the highest mean total number of views (M=26.03, SD=31.78) and mean number of unique viewers (M=10.72, SD=9.37), while messages that built strengths had the lowest mean total number of views (M=22.50, SD=22.54). Messages that were political had the lowest mean number of unique viewers (M=7.92, SD=11.55) (see Table 6).

Table 6. Showing the Means and SD of Healing-centered Categories and the 5 Online Engagement Variables

	Number of Views Mean (SD)	Number of Unique Viewers Mean (SD)	View time (days) Mean (SD)	Number of Comments Mean (SD)	Response time (days) Mean (SD)
Be Political= 1	24.33 (30.99)	7.92 (11.55)	0.02 (002)	0.20 (0.45)	0.08 (.)
Be Political = 0	24.28 (27.58)	8.79 (7.92)	0.40 (2.10)	2.29 (3.78)	24.58 (81.54)
Build Strengths = 1	22.50 (22.54)	8.33 (8.05)	0.44 (2.36)	1.68 (2.80)	26.85 (82.32)

Build Strengths = 0	28.25 (36.28)	10.00 (7.80)	0.21 (0.56)	3.78 (5.34)	19.52 (79.88)
Promote Whole Being = 1	26.03 (31.78)	10.72 (9.37)	0.60 (2.76)	2.32 (4.06)	32.35 (96.98)
Promote Whole Being = 0	22.54 (22.60)	7.33 (6.49)	0.14 (0.48)	2.17 (3.51)	17.92 (66.11)
Be Responsive = 1	22.84 (26.09)	9.40 (7.59)	0.188 (0.55)	1.99 (3.23)	32.21 (97.46)
Be Responsive = 0	26.25 (29.50)	8.08 (8.41)	0.71 (3.25)	2.49 (4.24)	15.96 (59.09)
Strengths Based = 2	24.33 (30.99)	9.75 (12.55)	0.20(0.023)	0.25 (0.50)	0.082 (.)
Strengths Based = 1	22.44 (22.44)	8.23 (7.94)	0.46(2.41)	1.71 (2.82)	27.27(82.91)
Strengths Based = 0	28.25 (36.28)	10.19(7.78)	0.22 (0.57)	3.85(5.37	19.5(79.88)

Controlling for time, author ID, and topic, ANCOVA predicting the total number of views, showed that none of the healing-centered categories were significantly associated with total number of views (Table 7 and 8). Controlling for time, author ID, and topic, ANCOVA predicting the number of unique viewers showed that messages promoting whole-being had more unique viewers (β=-2.346, 95%CI (-4.550 - -0.190), p=0.03) than those without that content (Table 9). None of the other healing-centered categories were significantly associated with the number of unique viewers at the 5% significance level (Table 9 and 10).

Table 7. ANCOVA of Healing-centered Categories Predicting Total Number of Views

Parameter	β	t	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Topic	1.633	0.822	0.412	-2.296	5.562

Author User ID	-0.018	-0.614	0.540	-0.076	0.040
Time	-0.017	-1.715	0.089	-0.037	0.003
Be Political	5.416	0.329	0.742	-27.098	37.930
Build Strengths	8.131	1.564	0.120	-2.149	18.410
Be Responsive	8.210	1.629	0.106	-1.756	18.176
Promote Whole Being	-2.346	-0.503	0.616	-11.574	6.883

**p<=0.05, **p<0.01, ***p<0.001*

Table 8. Model 2: ANCOVA of Healing-centered Categories Predicting Total Number of Views

				95% Confidence Interval	
Parameter	β	t	Sig.	Lower Bound	Upper Bound
Topic	1.633	0.822	0.412	-2.296	5.562
Author User ID	-0.018	-0.614	0.540	-0.076	0.040
Time	-0.017	-1.715	0.089	-0.037	0.003
Strengths-Based = 0	13.547	0.800	0.425	-19.937	47.031
Strengths-Based = 1	5.416	0.329	0.742	-27.098	37.930
Be Responsive	8.210	1.629	0.106	-1.756	18.176
Promote Whole Being	-2.346	-0.503	0.616	-11.574	6.883

**p<=0.05, **p<0.01, ***p<0.001*

Table 9. ANCOVA of Healing-centered Categories Predicting Number of Unique Viewers

Parameter	β	t	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Topic	0.809	2.450	0.015*	0.157	1.460
Author User ID	-0.001	-0.077	0.939	-0.014	0.013
Time	-0.010	-4.214	0.000***	-0.015	-0.005
Be Political	2.123	0.622	0.534	-4.608	8.854
Build Strengths	2.193	1.750	0.082	-0.280	4.666
Be Responsive	1.027	0.871	0.385	-1.300	3.354
Promote Whole Being	-2.370	-2.145	0.033*	-4.550	-0.190

**p<=0.05, **p<0.01, ***p<0.001*

Table 10 Model 2: ANCOVA of Healing-centered Categories Predicting Number of Unique Viewers

Parameter	β	t	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Topic	0.824	2.504	0.013*	0.174	1.473
Author User ID	0.000	-0.069	0.945	-0.014	0.013
Time	-0.010	-4.206	0.000***	-0.015	-0.005
Strengths-Based = 0	2.861	0.728	0.468	-4.895	10.617
Strengths-Based = 1	0.457	0.121	0.904	-7.019	7.933
Be Responsive	0.977	0.831	0.407	-1.342	3.295

Promote Whole Being	-2.337	-2.113	0.036*	-4.520	-0.155

*p<=0.05, **p<0.01, ***p<0.001*

As it relates to view time, out of all messages with the five coding categories, messages that were political had the quickest mean view time (M=0.02, SD= 0.02) while promoting whole-being had the slowest view time (M=0.60, SD=2.76). Controlling for time, author ID, and topic, ANCOVA predicting the view time, showed that messages that were responsive/rebuild control had a quicker view time (β=0.888, 95%CI (-0.019 - 1.186), p=0.055) than those without that content (Table 11). None of the other healing-centered categories were significantly associated with view time at the 5% significance level (Table 11 and 12).

Table 11 ANCOVA of Healing-centered Categories Predicting View Time

				95% Confidence Interval	
Parameter	β	t	Sig.	Lower Bound	Upper Bound
Topic	0.134	0.708	0.481	-0.241	0.509
Author User ID	0.002	0.273	0.785	-0.010	0.014
Time	-0.002	-1.783	0.078	-0.005	0.000
Be Political	0.702	0.704	0.483	-1.278	2.682
Build Strengths	0.018	0.037	0.970	-0.912	0.947
Be Responsive	0.898	1.943	0.055*	-0.019	1.816
Promote Whole Being	-0.313	-0.763	0.447	-1.127	0.501

*p<=0.05, **p<0.01, ***p<0.001

Table 12 Model 2: ANCOVA of Healing-centered Categories Predicting View Time

Parameter	β	t	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Topic	0.138	0.738	0.462	-0.234	0.511
Author User ID	0.002	0.265	0.791	-0.010	0.014
Time	-0.002	-1.781	0.078	-0.005	0.000
Strengths-Based = 0	0.804	0.690	0.492	-1.508	3.115
Strengths-Based = 1	0.806	0.736	0.464	-1.368	2.979
Be Responsive	0.888	1.937	0.056*	-0.022	1.799
Promote Whole Being	-0.329	-0.800	0.425	-1.143	0.486

*p<=0.05, **p<0.01, ***p<0.001

Comments

Out of all the messages with the five coding categories, messages that promote whole being had the highest mean number of responses (M=2.32, SD=4.06) but the slowest mean response time (M=32.35, SD=96.98). Messages that were political had the lowest mean number of responses (M=0.20, SD=0.45 but had the quickest mean response time (M=0.08) (Table 6). Controlling for time, author ID, and topic, ANCOVA predicting the number of responses, showed that messages that were responsive/rebuild control (β=1.304, 95%CI (0.152 – 2.456), p=0.027) and that built strengths (β=2.264, 95%CI (1.040 – 3.488), p=0.000) had a smaller number of responses compared to those without that content. None of

the other healing-centered categories were significantly associated with number of responses at the 5% significance level (Table 13 and 14).

Controlling for time, author ID, and topic, ANCOVA predicting the response time showed that none of the healing-centered categories were significantly associated with response time at the 5% significance level (Table 15 and 16).

Table 13. ANCOVA of Healing-centered Categories Predicting Number of Responses

				95% Confidence Interval	
Parameter	β	t	Sig.	Lower Bound	Upper Bound
Topic	-0.008	-0.049	0.961	-0.330	0.314
Author User ID	-0.003	-0.746	0.457	-0.009	0.004
Time	-0.001	-0.773	0.440	-0.003	0.001
Be Political	2.992	1.772	0.078	-0.340	6.324
Build Strengths	2.264	3.651	0.000***	1.040	3.488
Be Responsive	1.304	2.234	0.027*	0.152	2.456
Promote Whole Being	-0.201	-0.368	0.713	-1.281	0.878

**p<=0.05, **p<0.01, ***p<0.001*

Table 14. Model 2: ANCOVA of Healing-centered Categories Predicting Number of Responses

Parameter	β	t	Sig.	95% Confidence Interval

				Lower Bound	Upper Bound
Topic	-0.001	-0.005	0.996	-0.323	0.321
Author User ID	-0.003	-0.743	0.458	-0.009	0.004
Time	-0.001	-0.761	0.447	-0.003	0.001
Strengths-Based = 0	4.813	2.471	0.014*	0.969	8.656
Strengths-Based = 1	2.480	1.321	0.188	-1.225	6.185
Be Responsive	1.279	2.197	0.029*	0.130	2.428
Promote Whole Being	-0.199	-0.363	0.717	-1.281	0.883

**p<=0.05, **p<0.01, ***p<0.001*

Table 15. ANCOVA of Healing-centered Categories Predicting Response Time

				95% Confidence Interval	
Parameter	β	t	Sig.	Lower Bound	Upper Bound
Topic	11.750	1.953	0.054*	-0.201	23.701
Author User ID	0.142	1.262	0.210	-0.081	0.364
Time	-0.084	-2.256	0.026*	-0.158	-0.010
Be Political	5.023	0.062	0.951	-157.021	167.066
Build Strengths	0.752	0.043	0.966	-34.073	35.577
Be Responsive	-10.838	-0.645	0.520	-44.206	22.530
Promote Whole Being	-9.361	-0.562	0.575	-42.442	23.720

*p<=0.05, **p<0.01, ***p<0.001

Table 16. Model 2: ANCOVA of Healing-centered Categories Predicting Number of Responses

				95% Confidence Interval	
Parameter	β	t	Sig.	Lower Bound	Upper Bound
Topic	11.750	1.953	0.054*	-0.201	23.701
Author User ID	0.142	1.262	0.210	-0.081	0.364
Time	-0.084	-2.256	0.026*	-0.158	-0.010
Strengths-Based = 0	5.775	0.070	0.944	-157.831	169.380
Strengths-Based = 1	5.023	0.062	0.951	-157.021	167.066
Be Responsive	-10.838	-0.645	0.520	-44.206	22.530
Promote Whole Being	-9.361	-0.562	0.575	-42.442	23.720

*p<=0.05, **p<0.01, ***p<0.001

Discussion

Multiple quantitative and qualitative studies show that individuals with substance use disorder also have a higher burden of mental illness and have a history of adverse childhood experiences and trauma (Larkin et al., 2017; SAMHSA, 2017; Stein et al., 2017). Patients with substance use disorders in multiples studies report wanting supportive interventions for recovery that include trauma-informed elements in addition to mental health promotion and substance use disorder assistance (Amaro et al., 2005; Saraiya et al., 2020; Sugarman et al., 2019). In our study of an opioid app for addiction treatment, we found that the most posted content by participants included concerns of stigma, self-stigma or negative perceptions of

self. Moderators were the least likely to post about this sort of content in which participants were actively engaged (see Chapter 3). Further threat messages and self-stigma threads had slow response time (Chapter 3). We propose here a need for messages and interventions that are more trauma-informed and healing-centered to guide interactions and aid response to patients with a higher mental health burden and trauma history. In response to these needs and the gap in public health interventions and population-level interventions serving individuals with higher trauma, we recommend five principles to guide healing-centeredness. We also utilize the moderator messages on the A-CHESS app to assess whether more healing-centered messages, posted by moderators would, in fact, increase online community engagement.

We found that though 96% of the messages contained at least one healing-centered category, only a small percentage (18%) of the messages were mostly healing-centered (i.e. three categories at most), none were culturally-tailored and only five were political. This finding indicates that additional measures and strategies are needed if moderators are to adopt a more healing-centered framework among this population as this is not currently being employed on this space. In terms of engagement, our hypothesis was only supported for view time and number of unique viewers. Total number of views and response time was not related to any of the healing-centered categories and number of responses was negatively associated with the healing-centered categories, contrary to our hypothesis.

Messages with content that rebuilt control among the community and built strengths and capacity among the community were more likely to receive fewer responses. It is possible that instead of promoting response from community members, healing-centered messages promote critical reflection (i.e. what Ginwright proposed it should do in order to facilitate healing), internal assessment and a further need to engage cognitively by viewing and reading more messages. We do see some support for this as healing-

centered messages were not related to response time, but were related to view time and number of unique viewers.

Messages that promoted whole being, hope and empathy had a higher number of unique viewers than messages without that content. This type of message also generated the largest numbers of unique viewers. This indicates a greater motivation by forum participants to engage with messages that are empowering and promote hope and healing by moderators. The Unique viewers variables is less subject to over-estimation, compared to total views. This provides an indication of the number of individuals who opened these messages, the mean being 11 participants. Further, messages that rebuilt control among the community had a quicker view time compared to those without that content. This demonstrates that individuals respond quickly to messages posted by moderators asking for their input and providing ways to share and be a part of the community. Response here being, they are likely to open the message more quickly. However, this does not always translate into a comment on the message as this category (response time) was not related to Rebuilding control.

In addition, though political messages were not significantly associated with view time in the ANCOVA, we suspect that this was because of under-power because n=5. In Chapter 5, we found more active engagement with stigma messages posted by peers. In addition, the few messages here with this type of content had the shortest mean view time of all five categories. With a larger n, we are likely to also find that individuals on this forum space are quicker to view messages with content related to the social and economic issues surrounding opioid use disorder.

Only a few studies found examine characteristics associated with reading vs. commenting on online health forums and these studies are not in the context of opioid use disorders. However, those with

opioid use disorder experience a higher level of stigma that could impact their engagement in healing interventions, support spaces and online support spaces (Lawlor & Kirakowski, 2014; Olsen & Sharfstein, 2014; B. L. Perry et al., 2020). In addition, other studies investigating a model (Health Action Process Approach) of online engagement indicate that trauma level is a predictor of intention to engage with a digital intervention (Yeager et al., 2018; Yeager & Benight, 2018). Thus, the higher level of trauma experienced by those with opioid use disorder may also impact viewing and commenting. Also, multiple other studies indicate that substance use disorders are associated with problematic internet use and that includes addiction to social networks, among other behaviors. This indicates that these populations may use online spaces in non-traditional and sometimes harmful ways (Akanni & Adayonfo, 2020; Baroni et al., 2019; Faghani et al., 2020b). However, in one study examining multiple substance use disorders, they did find that problematic internet use was less severe among those with opioid use disorder (Baroni et al., 2019). Further research is needed to understand what drives motivation to engage in specific ways, namely reading versus commenting among populations with opioid use disorder.

It is also possible that commenting is more driven by excitation from an affective reaction to a message, such as anger. Thus, messages that incite anger or other stimulating emotions may lead more to commenting versus messages that incite reflection. Healing-centered messages are not particularly intended to incite an emotive response and therefore may not be related to increasing the number of comments. In this study, the action log for the A-CHESS app only provides the number of views and comments, while other reactions to messages on the discussion board were not included as features, such as likes. It is possible that individuals may have read these messages and would be more likely to "like" them, but it was not possible to assess this. Future interventions should include other reactions in these online spaces as these can help to provide additional insight as to whether forum users are

engaging with the message beyond views, or whether they find the message more stimulating than others as a reflection of additional reaction or engagement.

Our findings here may also point to the mechanism by which healing-centered messages promote well-being and healing. We found that healing-centered messages primarily impact views and in a lesser way, total engagement measures. It is possible that healing-centered messages target the quality of online engagement with forum participants rather than the quantity. That is, individuals may not post more comments or view a message multiple times but they may be more likely to view the message and experience increased empowerment from that message through critical reflection and psycho-social processes. They may also be more likely to have a deeper connection with the message because of the content of these messages. This is not unlikely as multiple studies indicate that viewing messages is also related to improved well-being (Han et al., 2014; van Uden-Kraan, Drossaert, Taal, Shaw, et al., 2008). However, this is an important area for future research to assess the mechanism of action for the principles of healing-centeredness impacting healing and well-being.

The construct of healing-centered engagement based on these five principles may be operating as five separate constructs (at least the four we were able to assess here loaded somewhat separately during the factor analysis). Political and Building Strengths loaded together, however, there were only five instances of political messages, so it is unclear whether this is a reliable finding. One of the other constructs, Be responsive, was negatively correlated with the other variables and had a negative loading. Much more research is needed to assess exactly how healing-centeredness should be analyzed and whether these variables should be separately included in models or combined for one construct. In order to do this work, a larger sample size is needed where individuals are applying all five principles of healing-

centered engagement. Unfortunately, in this sample, we were limited by the number of messages, as very few messages were Political and there were no instances of culturally-tailored messages.

Additionally, our findings have limited generalizability as this was only conducted in one trauma context on one media platform. Future research should assess these principles in multiple populations that have trauma history and suffer from a higher mental health burden to assess whether the principles and findings here still hold. Despite these limitations, this is the first study to demonstrate how one could apply a trauma-informed and healing-centered approach online, how one could assess healing-centered engagement as a construct online and quantitatively investigate its impact on online engagement. Much more work is needed to improve the validity and reliability of the construct and modify and expand it to various settings.

Conclusion

There is great need for public health research and population health work to move towards constructing more healing-centered and trauma-informed interventions for populations with higher trauma risk, such as those with substance use disorders, elders and racial and ethnic minorities (Ginwright, 2021; Tebes et al., 2019). Further, conducting this online is even more pertinent as many individuals with these stigmatized identities and others seek online spaces for engagement (Lawlor & Kirakowski, 2014; Tanis, 2009). However, it is unclear how one would conduct trauma-informed engagement online and only a few studies have attempted to conduct and investigate web-based interventions that are trauma-informed (Saraiya et al., 2020; Sugarman et al., 2019; Z. Wang et al., 2016). A guiding framework or principle for these interventions to facilitate best practice and replication has not yet been proposed.

Here, I propose such a set of principles to help guide engagements online with populations with trauma history. Public health practitioners can begin to utilize healing-centered engagement online and expand their reach beyond unique population sets. We see here that at least in this sample of opioid users, messages with some of the healing-centered categories, produced increased engagement (view time and number of unique views). Given that views are the first interaction before participants become actively engaged in a system and it has been connected to well-being, constructing healing-centered messages online can potentially be the first step to higher engagement, especially among highly stigmatized communities whose barriers to engagement are high.

Chapter 5

Discussion

Building a Case for Trauma-Informed and Healing-Centered Online Engagement

This first goal of this dissertation was to build a case for trauma-informed and healing-centered practices in ICT interventions targeting populations with high trauma and mental health burden. Chapters 2 and 3 accomplish this goal. Chapter 2 (study 1) investigated the impact of an online health intervention (Elder Tree) for elders, with specific attention to those who were depressed and socially isolated. We found a trend in those who were depressed, using Elder Tree, reporting slower change in mental well-being compared to control. We also found that among these elders with the highest mental health burden and with the highest likelihood of trauma, those most comfortable with social networking systems reported the lowest mental well-being after Elder Tree use compared to the control group. These results indicated a potential need for moderators and intervention designers to include specific strategies, such as healing-centeredness, to promote well-being among this population and mitigate harms.

Chapter 3 (study 2) investigated the use of a second ICT or digital intervention in a second population with high likelihood of trauma history, those with opioid use disorder. We investigated the types of content posted on the ICT and whether the different content posted is related to online engagement. We also sought to find out whether the source of the message, moderator or peer, affected the relationships. This is key as moderators can be trained to adapt to the needs of the community and can align with evidence-based strategies to promote mental health. Again, we found potential concerns regarding moderator messaging and online engagement. Author type moderated the effect of certain types of messages on certain types of engagement. In general, moderators posted supportive messages and peers

posted messages about stigma, threat and less supportive messages. Stigma and threat messages are those requiring more rapid attention. Unfortunately, those messages were found to be responded to most slowly, indicating a need for moderators to respond more effectively to certain messages more than others. Further, few conversations from moderators addressed stigma, despite our study results revealing that stigma threads obtain higher engagement. This finding indicates participants' need to be more engaged in these conversations and others focused on reducing stigma and promoting healing. Both of these studies were conducted in two different populations with a higher mental health burden, higher likelihood of a history of trauma and both conspicuous and concealable stigma (see chapter 4).

Both of these together help to build the case for using more trauma-informed and healing-centered engagement when designing and implementing mHealth interventions for these two populations to promote well-being and reduce harm.

Proposing a Model for Healing-Centered Online Engagement

The second goal was to present a model for utilizing healing-centered engagement in online communication interventions aimed at populations with a higher mental health burden and provide prevention scientists and public health practitioners with practical examples on ways to design these interventions with a healing-centered approach. In Chapter 4 (study 3), I present a model or framework for healing-centered engagement online that builds on the trauma-informed practice literature and limitations. The framework draws from the Healing Centered Engagement model proposed by Ginwright and proposes five principles to guide the practice of healing-centered engagement online: 1. Healing practices should be Political, 2. Build Strengths, 3. Be Cultural/Spiritual, 4. Promote Whole Being and 5. Be Responsive/Rebuild Control. Putting these principles to practice, and to provide some concrete examples

of this framework in action, we coded 186 moderator-initiated threads on the mobile app for substance use disorder, A-CHESS adapted for opioid use disorder, for these healing-centered principles. We also assessed whether healing-centeredness was associated with engagement. We found that only 20% of the moderator threads on the ACHESS app had three or more healing-centered principles. However, over 90% had at least one healing-centered principle. Not all healing-centered categories were related to engagement. We found that none of the categories were related to total message views and response time. Promoting whole-being yielded more unique viewers and re-building control was positively associated with quicker view time while it was negatively associated with number of comments. Building strengths was also associated with fewer comments. We propose here that healing-centered engagement impacts certain types of engagement, with effects seeming to be more related to thoughtful engagement that incites critical reflection and viewing rather than commenting.

We also suggest that healing-centered engagement may be more related to the quality of the engagement rather than the quantity of engagement. Future research needs to investigate this construct in more depth in the online space and seek to assess whether healing-centered engagement is related to greater well-being received among participants. A possible likely pathway is through improving engagement via views. In this chapter, we provided a framework for practitioners and designers of online interventions to utilize in their designs for the improvement of the health of populations with higher trauma burden. We provide an example of this framework applied to moderator messaging on a discussion board for opioid use disorder, fulfilling the second goals of this dissertation.

Only a fifth of the moderator threads on the A-CHESS app were primarily healing-centered (more than three principles) and moderators did not specifically set out to write healing-centered messages as this was not a proposed part of their role. Thus, below are examples of healing-centered messages in another

context, social media, under each of the five principles. These messages are from a project, funded by the University of Wisconsin-Madison School of Medicine and Public Health Wisconsin Partnership Project, to promote accurate COVID-19 information among Black, LatinX and Native American communities in Wisconsin. The project aimed to maximize a collaborative partnership between the university, local community organizations and local community influencers with online social media presence to decipher the areas of need and deploy strategies to combat misinformation. Influencers (now called community advocates) co-designed messaging with media and communication specialists. Over the course of the project, the advocates called for more messaging and posts geared towards mental health and healing due to the trauma of COVID-19 and later, due to the widely covered systematic incidences of injustice locally and nationally. The team started to adopt a healing-centered approach to weekly social media messages posted to their online community pages. Below are examples of these messages within the recommended five healing-centered principles. All three communities post on Facebook but the LatinX community also posts on Instagram and Twitter.

Healing Centered Social Media Messaging for COVID-19

Be Political because Healing is Political

Healing-centered engagement proposes that trauma and healing should be viewed from a political lens, rather than from a clinical lens. The top right post refers to the connection between COVID-19 and racism. The top left post is intended to promote the use of the COVID-19 Facebook page for collective action towards supporting Black business that still wear masks. Many individuals in the Black community are ambivalent about the reduced restrictions and the impact this may have on their community, so this post is focused on helping to economically support Black businesses while attending to community

concerns. The bottom left post is a video with content regarding the issue with requiring an ID to get the COVID-19 vaccine as a barrier for undocumented immigrants. The bottom right is touches on the mass shooting that occurred at the Oneida Casino in the Oneida Nation. The community advocate responded to the issue of gun violence and acute community trauma with multiple posts, including the one in bottom right. Though the event was seemingly unrelated to COVID-19, social distancing provided fewer ways for the community to heal together and restricted some traditional practices.

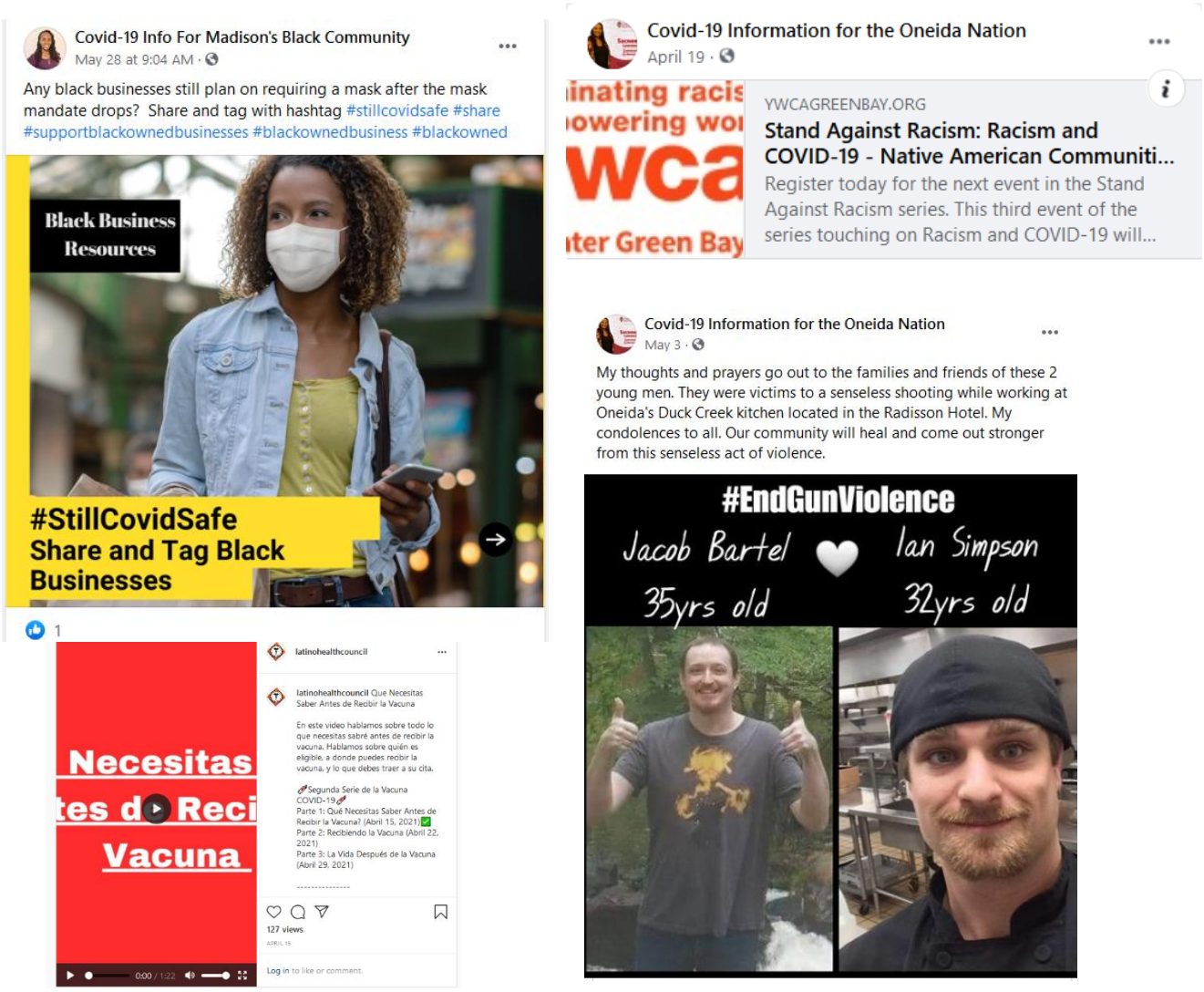


Figure 1 showing political messages posted on the LatinX's Instagram, Black and Oneida's Facebook pages

Be Strengths-Based/Focus on Building Capacity

Healing-centered online engagement strategies should build on the assets of the online community and aim to increase capital.

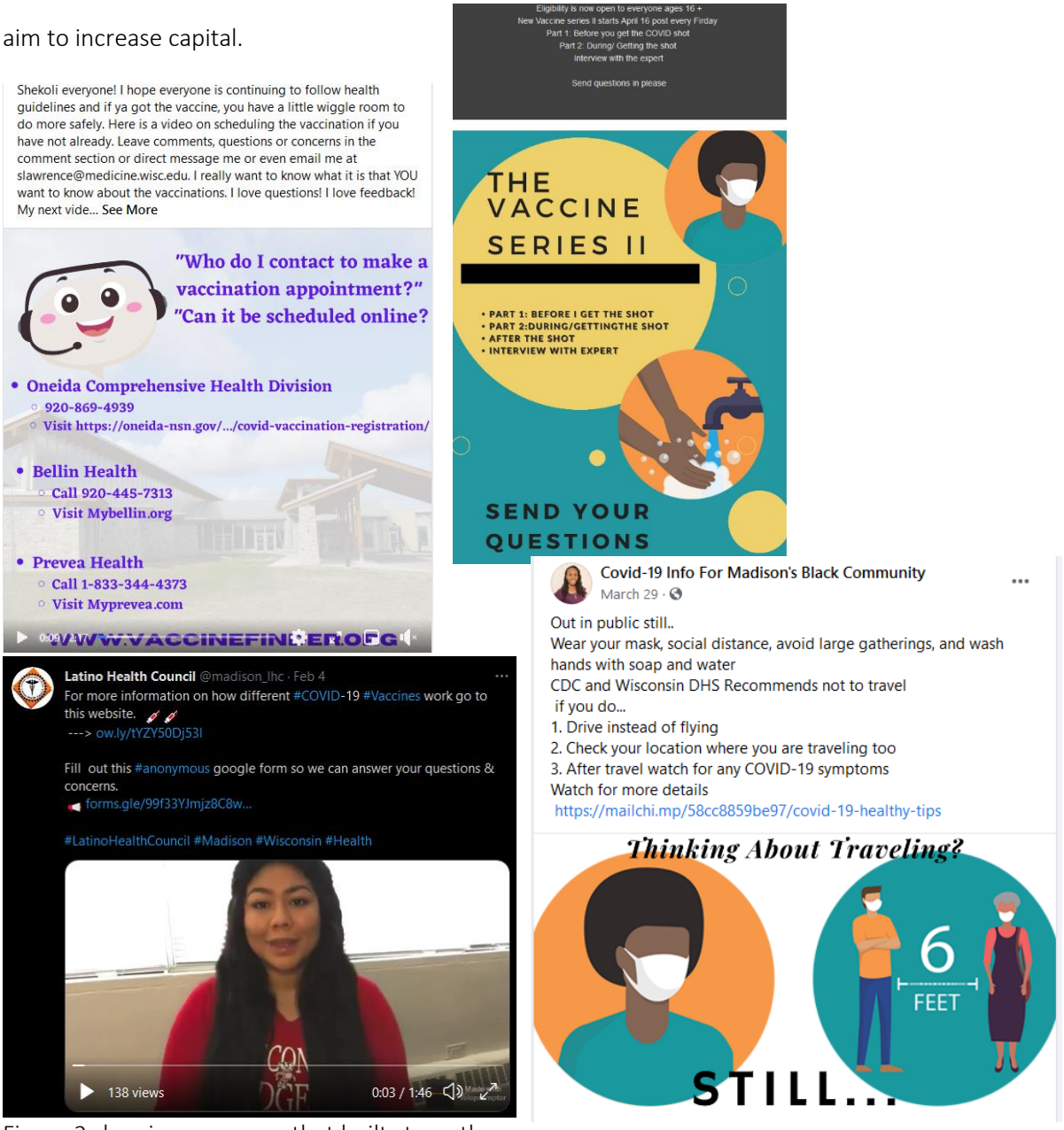
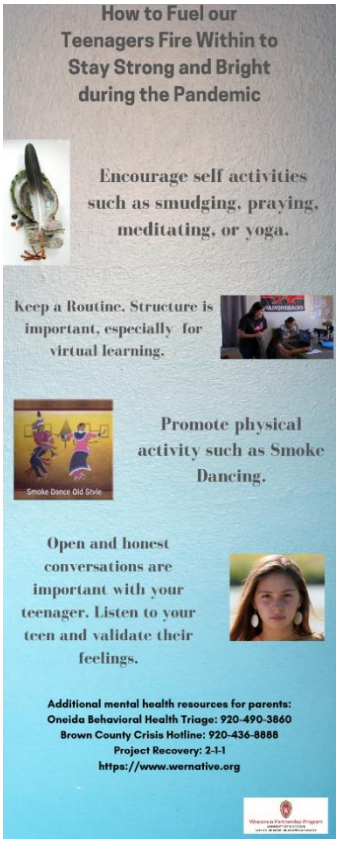


Figure 2 showing messages that built strengths posted on the Oneida nation's Facebook page (top left), LatinX's Twitter page (bottom left) and the Black community's Facebook page (top and bottom right)

Be Cultural/Spiritual because Healing is Cultural and Spiritual

Healing-centered online engagement should include strategies rooted in culture and spirituality.



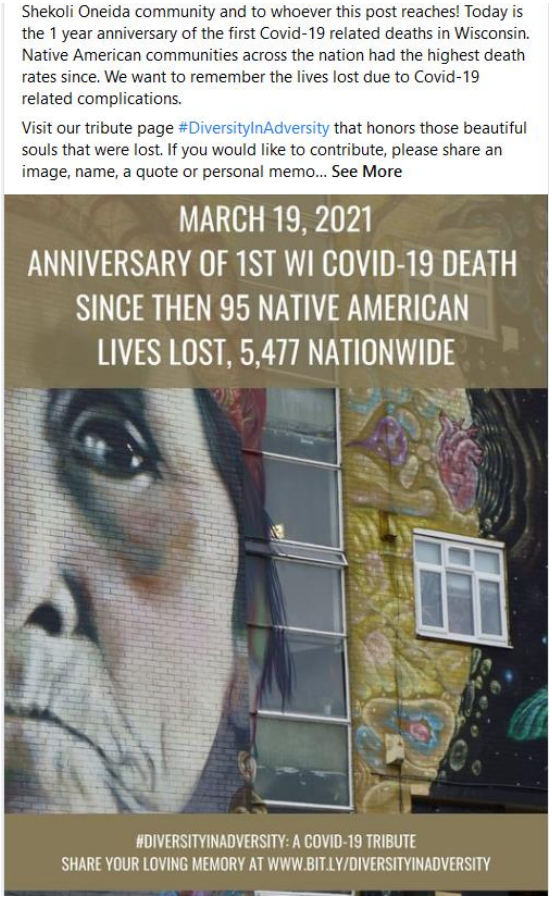
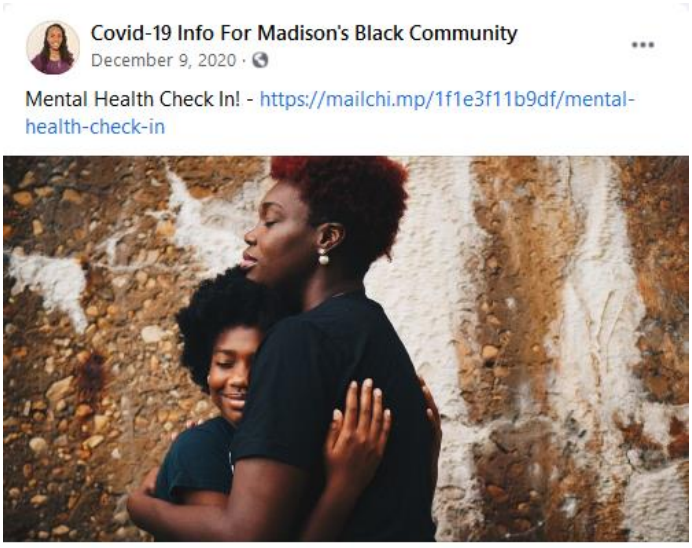
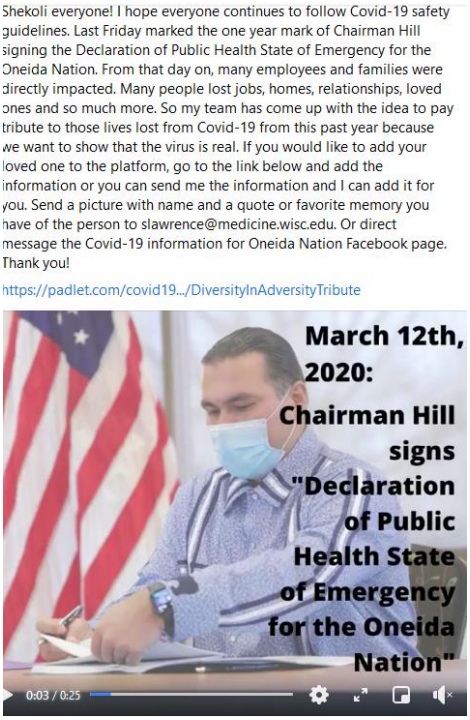


Figure 3 showing culturally tailored posts on the LatinX's Twitter (top left), Black community's Facebook page (top right) and the Oneida's Facebook pages (bottom posts).

Promote "Whole"- Being and Mitigate Harm

Healing-centered engagement strategies should include an element to promote healing from trauma and reduce harm. Strategies can promote hope, empathy and well-being of the online community as well as the practitioner. Top left post was intended to help reduce the stigma around mask wearing.





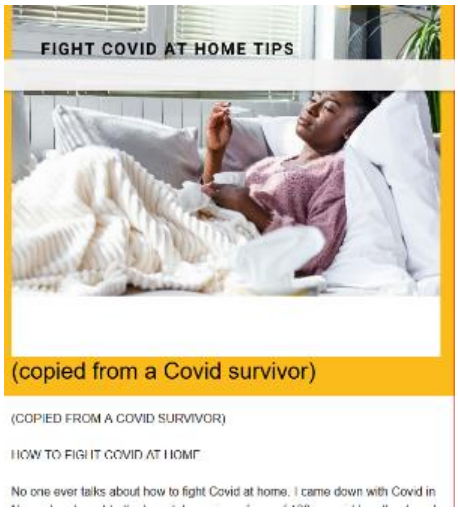
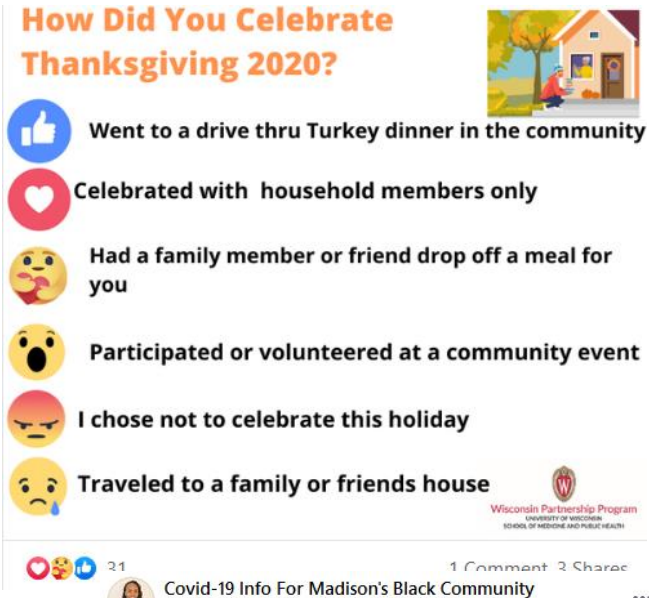


Figure 4 of different posts promoting whole-being posted on LatinX's Twitter (top left), Oneida's Facebook (bottom left) and Black community's Facebook COVID-19 pages (right)

Be Responsive and Rebuild Control

Healing-centered online engagement should provide target users with opportunities to give input on community needs and practitioners should be responsive to those needs (i.e. their individual and collective voices are being heard and strategies are empowering). Both polls use emoticons to facilitate feedback in the poll.



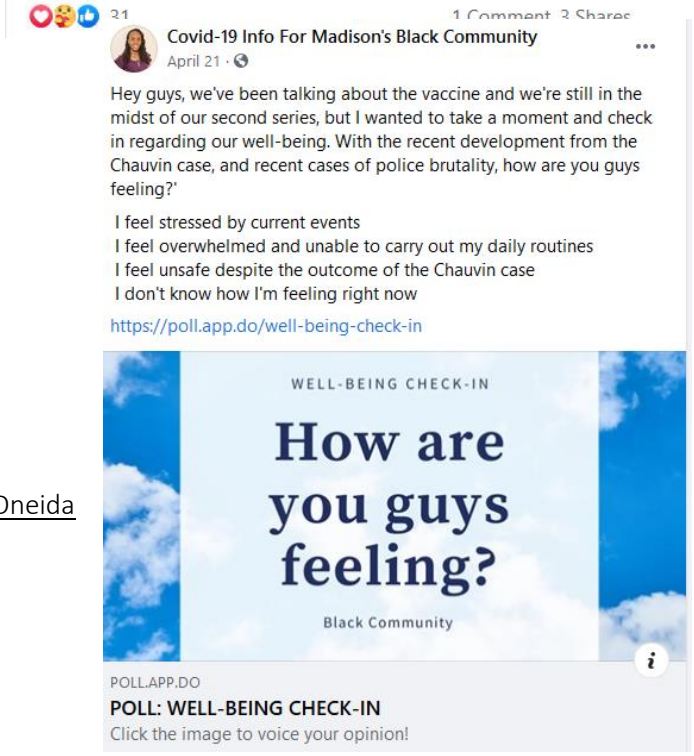


Figure 5 of Polls used in Black community on Facebook (left and bottom right) and in the Oneida Nation (top right) for the COVID-19 project

Posts that incorporate All Five Principles

The below posts on the Oneida Nation's Facebook page include elements of political content (e.g. mass shooting and conversations around job loss, income and COVID-19), mental health resources for building strengths and promoting whole being (in the video), culturally tailored elements (hashtag, #OnediaStrong, as well as the resources proposed and the language used) and includes a check-in with the audience to facilitate rebuilding control and being responsive to needs.

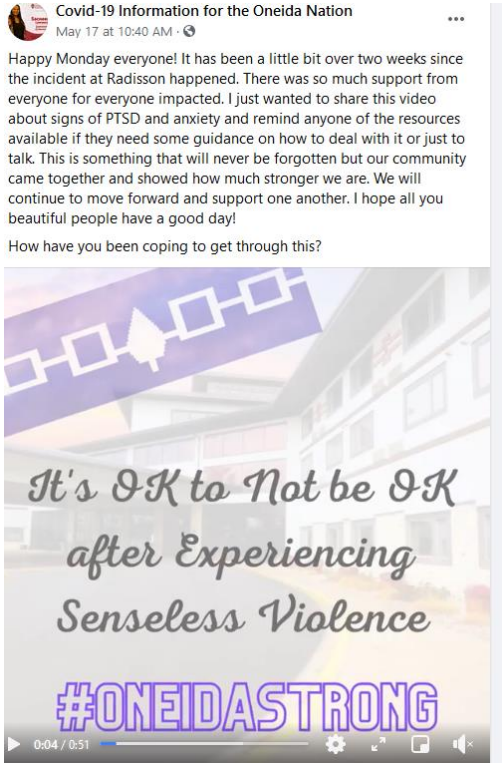


Figure 6 of COVID-19 Oneida Facebook Posts including all five elements of Healing-Centered Engagement Online

Healing-Centered Digital Intervention Design

Above, I provide examples of posts that apply healing-centered principles to the design of online messaging. However, healing-centeredness can also be applied to the design and implementation of public health interventions, not just messaging. The explanation and examples of the principles applied are guides that can help designers understand the concept and plan strategies to fulfill each principle. The design of trauma-informed and healing-centered ICTs and digital interventions should incorporate strategies to attend to the five principles:

Be Political - Intervention strategies should give attention to political influencers. Given that trauma can occur on a community level, community-level strategies should be utilized to impact community-level factors, such as income, education or racism. Social marketing and social media interventions on spaces with a wider reach, like Facebook and Twitter, can provide avenues for facilitating collective impact. As in the example above, utilizing and working with local community organizations' social media pages can provide a means to reach a marginalized audience (see Chapter 1 on community-level trauma and examples of studies with geographically bound and non-geographically bound online communities (M. E. Brown et al., 2021; Francis, 2021; Harden et al., 2015)). Health interventions could utilize similar approaches to address community-level factors, such as racism and highlight social movements that promote healing from historical trauma.

Build Strengths – Strategies should build on the user strengths and help build their capacity. This is set in asset-based development and can have many forms. It could be in the form of providing resources but it could also involve taking stock of what the actual community assets are through online polls and then finding ways to build their capacity towards the health behavior being targeted. A great approach would also include maximizing the strengths of the community managers and moderators. Rather than providing

general informational resources to the entire online community, predictive tools allow you to tailor the users resources based on their assets and areas desiring improvement and then make suggestions based on changes over time. The digital space allows for more creative ways of building capacity among users of an online community. Personalization and customization can improve online engagement and well-being received (Hawkins et al., 2008; Kreuter et al., 2013; Moreau et al., 2015; Ruffin et al., 2011).

Be Cultural/Spiritually-Tailored – Elements of the intervention should be culturally and spiritually grounded. It's likely that individuals in an intervention aiming to be trauma-informed belong to underserved racial and ethnic groups, so tailoring the intervention to utilize examples of healing practices and beliefs grounded in shared culture will potentially help to increase belonging and engagement among the community. It's also important, especially when targeting marginalized groups, to include diversity in representations online. There is diversity within Black, LatinX, Native American, LGBTQ and disabled communities and though sometimes difficult, interventions should strive to include attention to multiple representations. As described in Chapter 1, this is important to prevent repeating stigmatization of groups with conspicuous identities in the online space (J.-E. R. Lee, 2014; Steinke et al., 2017). Cultural tailoring goes beyond including representative imagery and language. In the above examples, for the Oneida Nation, the community advocate encouraged evidence-based healthy behaviors but tailored to the cultural context; for example, she proposed increasing physical activity, listing running and biking, but also smoke dancing. She also encouraged activities such as smudging and praying. Note that digital affordances now allow for very advanced cultural tailoring. Virtual Reality can now be utilized to actively engage and submerse individuals in other cultures and places. Videos can be used to add cultural elements, in addition to images. The richness of media allows multiple ways in which this can be executed. Lastly, a culturally tailored digital intervention would ensure the platform being used is tailored,

like using WhatsApp over Facebook Messenger and Skype or other video platforms over FaceTime. Knowing the media preferences of your target user and modifying the intervention to fit their usage patterns is also tailoring the intervention, especially if the platform is strongly connected with specific groups.

Promote Whole Being - Healing-centered engagement strategies should include an element to promote mental well-being and reduce harm. Strategies may foster hope, empathy and provide emotional support. In addition to diversity in resources, diversity in content that promotes well-being and attends to the varied experiences within marginalized groups is important and was highlighted as a weakness of multiple interventions targeting sexual and gender minority youth (Steinke et al., 2017). With digital interventions providing multiple ways to generate content, text, image and video, there are a variety of means to deliver e-mental health interventions or facilitate social support among ICT group participants. Designers should think carefully about the allowable features and affordances included in the intervention. Affordances like anonymity can facilitate social sharing for stigmatized groups and those struggling with avoidance, but it can also facilitate flaming and disinhibition among other individuals (Andalibi et al., 2016; Cho & Kwon, 2015). Including enhanced editability and customization features can allow individuals to feel empowered but it can also foster harmful self-presentations in some cases (Jang et al., 2018; Walther, 2007; Yee & Bailenson, 2007). One study of sexual abuse, internet victimization and digital avatars found that choosing provocative self-presentations was associated with sexual abuse history and with online sexual advances (Noll et al., 2009).

Further including different feedback types also has implications on self-awareness, self-acceptance and social comparison (Forchuk et al., 2020). More research is needed regarding the implications of likes, thumbs down and different emoticons in marginalized groups to understand their effects on psychosocial

processes and well-being. Designers and content creators should think carefully about the content used in these interventions as multiple studies report triggering, traumatizing or stigmatizing content in online health interventions targeting their community (Basterfield et al., 2018; Steinke et al., 2017). To avoid these potential mishaps, co-designing content and the intervention with the target community is recommended whenever possible. This also would align well with the healing-centered approach and the next principle. A good illustration of this is the LinkPositively App, where the scholars included Black women living with HIV/AIDs in a participatory approach to design the interventions (Stockman et al., 2021). Creating a safe space for participants was a concern for the group and they also highlighted the need to avoid re-traumatizing participants (Stockman et al., 2021). The app included a trigger warning feature for content that could be potentially traumatizing to others. The groups also highlighted the importance of culturally tailoring the content to fit their population (Stockman et al., 2021). Taking care to ensure a safe space is facilitated with additional features is critical to promoting whole-being and generating engagement among the community.

Lastly, a key part of the healing-centered approach is the promotion of whole-being for the individuals designing and implementing the intervention, meaning the moderators or clinicians responding to participants' posts or private messaging. Including strategies to prevent burn-out and strategies to respond to participant self-disclosures and reduce secondary stress is important. This could take place online, including in their own forum space to share experiences and provide emotional support or provide digital mental health resources targeting providers (Carolan et al., 2017; Goldberg et al., 2020). Using healing-centered engagement, Wilson et al provides two offline case study examples of healing-centered collective care for the intervention staff serving those with trauma that could provide insights for future

strategies to incorporate in intervention implementation, specifically attending to staff care (Wilson & Richardson, 2020).

Rebuild Control/Be Responsive - Provide opportunities to rebuild control, obtain feedback and respond to the online community needs. While the mechanism of asking for feedback may make the community feel heard and help rebuild control, the response to that feedback may have different implications depending on the tool utilized online. Sometimes inactivity may also unintentionally signal a disempowering message to the user. Thus, designers should build in a response strategy for feedback and should find ways for the target user to use choice and wield control in the intervention. A popular way of implementing choice into an intervention is through affordances, such as custom virtual avatars. Individuals can build their own avatar to fit whichever persona they want to adopt.

Multiple studies have also looked at the use of avatars to facilitate self-presentation and identification among those with concealable stigmatized identities. Identification is defined as "a mechanism through which audience members experience reception and interpretation of the text from the inside, as if the events were happening to them (Cohen, 2001)." Identification with a character can be central to media effects and requires that we "assume ourselves the identity of the target of the identification" (Cohen, 2001). It can occur via empathic pathways, meaning shared feelings with the character, cognitive pathways, meaning shared perspectives with the character, motivational pathways, meaning internalizing the character's goals and/or absorption, meaning a loss of self-awareness when exposed to the media (Moyer-Gus, 2008).

Because of the multiple ways individuals can interact with characters and stories digitally, there are multiple types of identification. Wishful identification, for example, occurs when the viewer experiences a desire to emulate the character. Studies have shown that individuals identify more wishfully with same-

gender characters and characters that emulate positive characteristics (Hoffner & Buchanan, 2005). In one study, researchers found women identified more with attractive and intelligent characters while men identified with successful and intelligent characters (Hoffner & Buchanan, 2005). Similarity identification is the degree to which an individual perceives the character as similar to themselves (homophily), maybe in terms of appearance, beliefs, personality or values. Lastly, embodied identification is identification with a character based on the degree to which one feels they control the character or are inside the character, or how much one feels that their actions directly influence the character (M. Birk et al., 2016; Moyer-Gus, 2008). The latter can prove very beneficial in healing-centered interventions for populations with higher trauma burden. In fact, in the design of the LinkPositively app, a trauma-informed web app based on feedback from Black women living with HIV/AIDS, the scholars included many customizable features including a virtual avatar for use in the system (Stockman et al., 2021).

The avatar identification theory is based in the idea that the more a player identifies with a character, the greater the likelihood the character's actions may influence attitudes and behaviors (Birk et al., 2016; Moyer-Gus, 2008). In addition, identification increases the motivation to engage with the game and find enjoyment (M. Birk et al., 2016). One study of avatars and self-disclosure online found that appearance similarity was associated with homophily and increased self-awareness, which also increased self-disclosure (Hooi & Cho, 2014). Another study examining all three types of identification on enjoyment motivation to play the game found that all three types were associated with increases in autonomy, immersion, effort in the game, enjoyment and positive affect. In turn, this was associated with motivation (M. Birk et al., 2016).

Studies show that customization can be harnessed to change behavior; they demonstrate that individuals conform to the behaviors of their online representation (often their avatar), regardless of outside

perceptions (Yee & Bailenson, 2007). Yee & Bailenson, in their study, found that controlling an avatar (embodied identification) that was taller or more attractive led to participants behaving more confidently and assuming behaviors consistent with those avatars (Yee & Bailenson, 2007). Birk and colleagues have also investigated the use of customization for a mental health intervention and found that customizing the avatar not only improved identification but also improved anxiety after participants were exposed to an image with strong negative valence, like it had a protective effect (M. V. Birk & Mandryk, 2019). The focus of their study was on improving engagement with mental health training in the moment. Avatar customization was so effective at improving task engagement that the effect of engagement in the control condition (no mental health intervention) led to worsened anxiety after viewing the negative mood (M. V. Birk & Mandryk, 2019). This is important because it reinforces that the customization tool itself is linked to engagement and not to improved well-being, and thus, if the user is engaged with a damaging stimulus, customization will produce greater deleterious effects as compared to conditions without customization. This demonstrates the importance of understanding the mechanisms through which the digital features act so as to reduce harmful effects.

Lastly, modifying the intervention based on feedback is one of the best ways to be responsive to community needs. One way to do that, as mentioned above is co-designing the intervention with the target group. This could facilitate empowerment and improve ownership of the intervention while preventing mishaps that normally lead to decreased activity. Online media provides multiple ways one could obtain feedback from the community, through online forums, private messaging, commenting or polls. For those with stigmatized identities, they may be less likely to use comments or private messaging and may be more inclined to use anonymous polls. Various platforms have different affordances for polls. Polls with emoticons, as shown in the above examples, can be very appealing to target users and may

work well for individuals with literacy challenges. Other platforms allow polls embedded in an Instagram story; see an example of an Instagram poll below from the COVID 19 grant and the follow up.

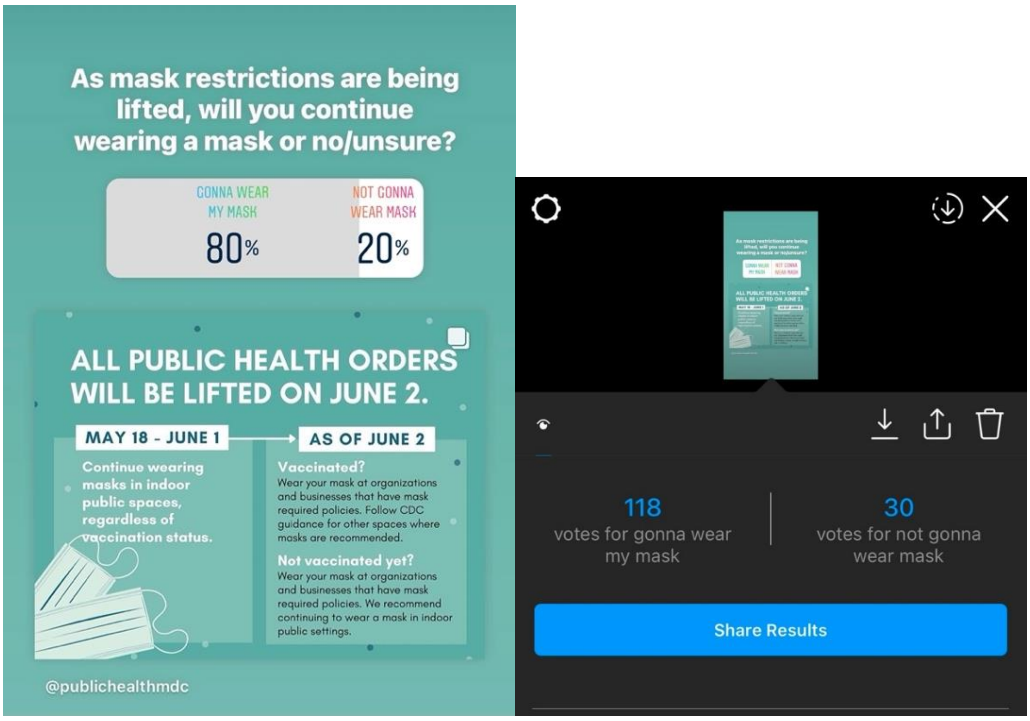


Figure 7 of LHC Instagram Poll and Results on Mask Restrictions

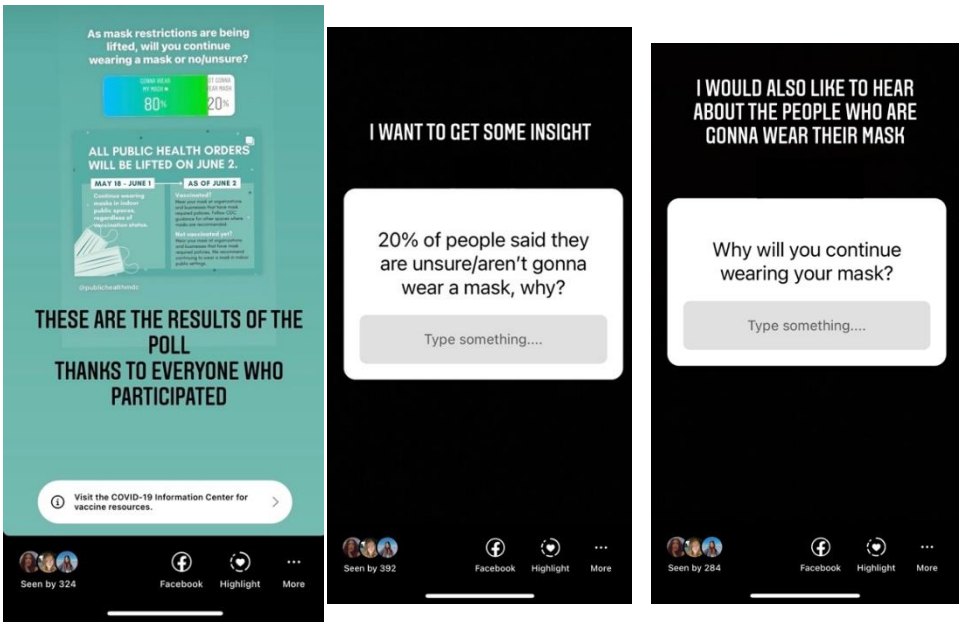


Figure 8 of Follow-up Instagram Poll

Limitations and Future Directions

One of the main limitations of this dissertation is the generalizability of the findings made in the three studies. The healing-centered framework was only applied to messages in the opioid use disorder context, as were the findings in study 2 and the findings of study 1 were focused on elderly populations. The findings in this dissertation may not translate to other age groups or other substance use disorders. Additional research should examine these research questions in other contexts and multiple other stigmatized identities, such as sexual minority youth, men who have sex with men, those with eating disorders, those with clinical depression, racial and ethnic minorities, and other identities. These all require a trauma-informed framework when aiming to change behavior. Further, replicating these findings among larger populations at risk for trauma, like racial and ethnic minorities, Native Americans or individuals with other co-morbid conditions. Also, given these findings examine digital interventions for

these marginalized groups, they cannot be generalized among individuals without access to these technologies or individuals who have very limited e-literacy and usage patterns. Another limitation relates to the measures used to define engagement being limited by the action log provided by the A-CHESS intervention. We were unable to assess engagement measures for comments, only for threads.

For all three studies, we were also unable to assess which comment was associated with which comment/thread. This is important network data that can help to elucidate the specific connections between participants in the online support system that may be driving engagement (i.e. additional social network analysis). For example, here we were only able to assess speed and quantity of engagement with threads. However, with a more granular level of data, we may be able to ask additional questions regarding how variables are related to the size of the network or the centrality of specific members in the online network. For example, are moderators central to the network (i.e. tests of between-ness and centrality)? These could help us assess whether moderators are truly critical actors in this network of opioid users and whether removal of moderators would isolate participants. We could also assess whether certain moderators are more likely to post healing-centered messages and if this is connected to well-being outcomes by forum users, based on their connection with moderators in the forum.

A strength of this dissertation is the inclusion of multiple different types of health interventions as well as the use of two different populations with higher mental health burden. This will help practitioners see the potential range of need for trauma-informed engagement and its use across contexts. Further, this dissertation is the first to propose a framework for applying trauma-informed practices online for population-level change. Thus, much additional research is needed to further understand this framework and its operationalization. The findings in this work on the construct of healing-centeredness should be replicated across other contexts. Additional studies should also examine other ways of operationalizing

and testing the principles proposed in this framework. The next immediate step for research would be to refine the five principles of healing-centeredness to further understand the direction of the relationships between the principles. Are they separate constructs or should they be combined, and how? Additional qualitative and experimental studies on these five principles and how they impact online engagement for those with stigmatized identities would need to be conducted to establish validity and reliability.

We suggest here that healing-centered engagement may be affecting the quality of the engagement rather than the quantity. Future research into this hypothesis is needed. What are the potential mediators and moderators of the relationship between healing-centeredness, well-being and engagement? For example, sense of belonging could mediate the relationship between healing-centeredness and engagement. Cultural and spiritual tailoring could increase sense of belonging and this could then increase engagement. Further, other confounding factors may be facilitating or promoting engagement in this space that were not assessed here, such as level of perceived anonymity. This is another potential limitation of this study. Future study should investigate what social and psychological processes are impacted by healing-centered messages that then would moderate and/or mediate the impact on engagement and well-being improvements.

Another strength of this dissertation is the use of multiple different measures of online engagement, as we used both viewing and commenting within online forums and two dimensions within those (speed and quantity). We found different types of content and healing-centered principles have different impacts on varying measures of engagement. One key finding is that moderators posted more informational and emotional support, which had less engagement, and peers posted more about stigma, which had higher engagement. However, posting more supportive messages was related to well-being effects in other studies (Namkoong et al., n.d.; Yoo et al., n.d.). Thus, forum moderators may want to find ways to

improve emotional support posts by participants. Some studies indicate that the frame of certain content can motivate posting more supportive messages (W. Wang, 2014). Wang found that participants used advice/supportive messages more frequently when responding on a health forum to narratively-framed messages rather than information-framed messages (W. Wang, 2014). This may be a way for moderators to encourage supportive messages by peers in online health systems. Thus, moderators on the A-CHESS app may need to modify their strategies to post more narrative threads in order to encourage peer support. It should be empirically tested whether this finding would hold among populations with opioid use disorder.

More research is needed in the area of viewing and commenting for online engagement among different online communities, including communities for substance use disorders. Research is sparse on what motivates individuals with opioid use disorder to comment rather than primarily view messages on these spaces. It is possible that emotionally stimulating or triggering messages might drive more commenting. The HAPA model has been proposed as a model that may explain engagement as measure, but further testing is needed as the model focuses on engagement as an outcome rather than proposing variables that may affect different types of engagement (Yeager et al., 2018). Additionally, prior research indicates that anonymity can reduce disinhibition, which leads to increased commenting in online forums (Fredheim et al., 2015). Future research could investigate how different levels of anonymity among individuals with opioid use disorders impact viewing vs. commenting. Other studies indicate that the norms of the community, like the quality of responses, can impact thoughtful participation and willingness to respond (Stroud et al., 2014; Sukumaran et al., 2011). Interactivity and forum moderation are other factors that have been shown to affect intent to comment (Wise et al., 2006). However, most of

these studies are not in the context of substance use disorder and, given this context is highly stigmatized, results may be very different for this population of internet users.

The ways in which these users engage may be different than other users and there may be existing preferences based on social norms established in other digital spaces that may impact engagement in an online intervention designed for health improvement. For example, frequent users of social network spaces may be accustomed to emoticons, likes, thumbs up and other ways of reacting to messages that may not be available in a mHealth app. This may make it appear as though users are not engaged, but it may be that the preferred avenue for engagement is not present on the intervention space. On the A-CHESS app, few other ways of expressing engagement and reactions were included and it is therefore unclear whether individuals may have responded to message content in other meaningful ways. Future study is needed to understand how other reactions and ways of expressing feedback may be used by individuals with stigmatized identities, such as elders and individuals with opioid use disorder, and how this may be related to engagement in the community and improved well-being. As we found in Chapter 2, level of comfort with Facebook (potential indicator of frequent use of Facebook) moderated the impact of Elder Tree and depression and social isolation on mental well-being.

Lastly, we look to next steps. An overarching goal of my career is to understand how we can increase the effectiveness of the design and implementation of digital interventions to improve health for marginalized groups. Thus, I expect two strands of research to evolve from this dissertation. First, my next set of studies will further investigate how we can optimize the role of the moderators on the A-CHESS bundling forum and further understand the potential impact on well-being. The next set of studies would investigate the patterns of moderator responses to specific content types. We found here that stigma messages are getting slower response times than others and no difference is observed for threat

messages. We did not assess whether this result is different if the person responding is a moderator or peer. Are moderators responding more or less to different threads and does this change over time? Are moderators getting more efficient? Are they responding to threat messages more often over time? Are they responding more to threat messages than other messages? These questions will help assess whether additional strategies need to be in place to improve the moderator role and better direct efforts. Additionally, though a bit limited, conducting a social network analysis on the role of moderators is also an immediate next step for my work in this area. In this analysis, linking to the well-being and stigma outcomes collected in the Bundling surveys would be critical to assess whether network position in relation to moderators, or specific moderators, is related to increased well-being or reduction in stigma.

The second set of studies would be related to investigating the healing-centered construct, further refining the construct and establishing reliability and validity. We will code all the moderator messages for healing-centered engagement to assess whether moderators are responding with healing-centered messaging to certain types of messages, such as those with threat, stigma or emotional support. It is possible that certain principles may be associated with certain types of messages. Another goal is to be able to investigate whether engaging with healing-centered messaging is associated with well-being or reduced stigma. Here, I present examples of healing-centered messages for the COVID-19 grant to improve accurate information. Assessing whether these messages are related to engagement in the online communities compared to messages without healing-centered principles is another step for this work. Additional qualitative studies that seek to understand more about how moderators working with stigmatized communities may already be applying some of the principles proposed; or how they view the strengths and limitations of the construct in their work, thus yielding important findings to validate and

refine the construct. Lastly, proposing and demonstrating other ways in which healing-centered engagement can be utilized in digital interventions would also be another priority for my career's work.

Implications

This healing-centered framework for online engagement is not intended to replace current theoretical frameworks that guide health behavior change and public health communication interventions. Instead, the intent is to provide a guiding implementation framework for communication and public health interventionists who seek to design and implement interventions for marginalized populations. The five principles proposed (and accompanying examples) can help researchers think thoughtfully about the impact of messaging and feature design on intervention development. Staff and program managers can also use these principles to guide the delivery of the intervention, ensuring that the intervention delivery methods promote whole-being, are strengths-based, account for socio-ecological determinants, and reduce harm. As discussed above, more research is needed to understand the short and long-term outcomes associated with utilizing this approach.

Given that this approach is intended to be more implementation focus, short-term outcomes of this approach may be more related to participant/user engagement, attrition, and satisfaction. These outcomes are critical because of historically difficult engagement with marginalized populations and populations with high trauma, such as racial and ethnic minorities and those with substance use disorders and mental health disorders. With the additional focus on healing and mental health promotion, long-term mental health improvement is also expected. However, other research is needed to understand the short and long-term outcomes of such an approach. Further mapping of a logic model to guide this approach can also provide additional benefits.

Conclusion

This dissertation set out to build a case for trauma-informed and healing-centered practices among populations with a higher mental health burden and potential trauma history, such as those who are depressed, racial and ethnic minorities and those with substance use disorders. I also aimed to provide a framework for the use of healing-centered practices, translated to the digital space to guide mHealth and information-communication technologies designed for marginalized populations and those with conspicuous and concealed stigmatized identities. I propose five principles to guide the design and implementation of healing-centered digital interventions: intervention strategies should give attention to political influencers, they should build on the user strengths and help build capacity, they should be culturally and spiritually grounded, they should promote the well-being of the whole person and they should provide opportunities to rebuild control and respond to the online community needs. I show multiple examples of these principles applied to the design of online health messages on an app for those with opioid use disorder and other examples in the design of social media messages for those in the Black and LatinX communities. Study 1 and study 2 investigated ICTs among elders (conspicuous stigma) and those with opioid use disorder (concealable stigma), demonstrating potentially harmful effects of these ICTs on these vulnerable groups and the need for strategies to reduce harm or relapse. Study 3 showed that moderators on the A-CHESS app for opioid use disorder are only somewhat healing-centered and that healing-centered principles are associated with some types of engagement more than others. Examples of healing-centered messages are provided and potential future directions are discussed.

Digital technology presents many affordances that distinguishes it from traditional communication mechanisms (e.g. in-person or telephone), like the ability to edit text prior to posting, anonymity, video audio and emoticons. As discussed in Chapter 1, the different affordances can have negative or positive

impacts on engagement, the type of engagement (positive, like social sharing, or negative, like flaming) and on mental and physical health. Scholars are still investigating how individuals in marginalized groups use and are affected by online communities and digital affordances. As designers and practitioners, it is important to understand the role these affordances play and how they can impact mental health but also be used to reduce harm. As internet access and use grows among marginalized and stigmatized groups, the practices we use in the offline space to mitigate harm and reduce stigmatization to these groups need to be translated into the online space. Too often, digital interventions are designed and implemented without careful attention to those strategies. Individuals in these communities are then negatively impacted or re-stigmatized by the very spaces designed to help (see chapter 1 for additional details) and are often ambivalent about these spaces. Thus, engagement of a new intervention may be limited, which further limits well-being and wastes valuable resources.

Trauma-informed care is a recommended practice in the offline space to help promote well-being and reduce harm to populations with a high trauma burden, yet it has not yet become standard practice online. Here we propose a framework for applying trauma-informed care and healing-centered care online for populations with a trauma history. The proposed framework pays particular attention to mitigating re-traumatization of stigmatized groups. Encouraging diversity in representations and resources and strategies to reduce the harmful impact of self-presentation and stigmatizing content is discussed. Scholars should also be mindful of the ways they may be excluding populations with the greatest need for interventions, those without access to technologies and digital interventions. These are often low-income individuals or those in rural areas who also suffer a high mental health burden. Instituting strategies to provide a low-tech version of the intervention is recommended. It is important to understand the critical components and ensure they work well in low-technology settings.

Over 50 million individuals in the U.S. struggle with mental illness (Substance Abuse and Mental Health Services Administration, 2019). Multiple scholars are investigating the ways in which we can facilitate mental health treatment and promotion online for marginalized groups (Amstadter et al., 2009; Anderson-Lewis et al., 2018b; M. V. Birk & Mandryk, 2019; Y.-R. R. Chen & Schulz, 2016; Luppino et al., 2010; Nesvåg & McKay, 2018). It is pertinent that before we implement interventions for marginalized groups, groups that often carry a high trauma burden and concealable and conspicuous stigma, that we utilize specific strategies to ensure our intervention design will be trauma-informed and healing-centered in the online space, so as to promote well-being while reducing harm. Application of this approach online is sparse, but we provide a model to help guide the research and design of healing-centered interventions online.

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Appendices

Appendix A. The Items from the Elder Tree Survey used to assess Socio-emotional Support

13. These items are about support you receive from another person.

How often is there someone…	Never	Seldom	Sometimes	Often	Most of the time
a. you can count on to listen to you whenyou need to talk?	☐	☐	☐	☐	☐
b. who gives you information to help youunderstand a situation?	☐	☐	☐	☐	☐
c. with whom to share your most privateworries and fears?	☐	☐	☐	☐	☐
d. to turn to for suggestions about how todeal with a personal problem?	☐	☐	☐	☐	☐
e. to help you if you were confined to bed?	☐	☐	☐	☐	☐
f. to take you to the doctor if you needed it?	☐	☐	☐	☐	☐
g. to prepare your meals if you were unableto do it yourself?	☐	☐	☐	☐	☐
h. to help with daily chores if you were sick?	☐	☐	☐	☐	☐
i. to love and make you feel wanted?	☐	☐	☐	☐	☐
j. with whom you can have a good time?	☐	☐	☐	☐	☐
k. to confide in or talk to about yourself oryour problems	☐	☐	☐	☐	☐
l. who understands your problems	☐	☐	☐	☐	☐
m. to give you good advice about a crisis	☐	☐	☐	☐	☐
n. whose advice you really want	☐	☐	☐	☐	☐

Above is a snapshot of the survey questions given at baseline, 6 months and 12 months to all participants regarding the support they receive. The highlighted items were used to assess socioemotional support. These highlighted items (Items a-d, I and k-n) were averaged to create the socioemotional support

variable. All other items were excluded as they are focused on assessing other types of support, such as support for physical health issues, daily living and care and are not related to social and emotional support.

Appendix B. Showing the Interaction of Social Network Comfort, Socioemotional Support and Clinical Trial Condition on Change in Mental Well-Being

						95% CI	
	β	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	-26.357	57.519	373.949	-0.458	0.647	-139.459	86.744
Time	-5.336	54.493	327.748	-0.098	0.922	-112.536	101.864
Trial Condition	1.114	4.013	373.075	0.278	0.781	-6.776	9.004
Gender	-1.406	0.937	373.937	-1.501	0.134	-3.248	0.436
Age**	0.140	0.057	375.547	2.433	0.015	0.027	0.252
Education	0.497	0.402	374.656	1.238	0.217	-0.293	1.287
Race/Ethnicity	1.596	1.253	371.965	1.273	0.204	-0.868	4.061
Social Network Comfort Level	1.456	1.268	373.834	1.147	0.252	-1.039	3.950
Zip Code	0.001	0.001	374.021	0.911	0.363	-0.001	0.003
[a] Socio-emotional Support ***	2.465	0.703	371.454	3.508	0.001	1.083	3.846
Social Network Comfort x Socio-emotional Support	-0.195	0.333	372.533	-0.586	0.558	-0.850	0.460
Trial Condition x Social Network Comfort*	-3.279	1.766	373.382	-1.857	0.064	-6.752	0.194
Trial Condition x Socio-emotional Support	-0.127	1.054	373.127	-0.120	0.904	-2.200	1.946
Trial Condition x Social Network Comfort x Socio-emotional Support *	0.804	0.463	372.753	1.736	0.083	-0.106	1.714
Time x Gender	0.387	0.895	333.136	0.433	0.665	-1.373	2.148
Time x Age	-0.036	0.057	353.385	-0.626	0.531	-0.149	0.077
Time x Education	0.039	0.390	337.413	0.099	0.921	-0.728	0.805
Time x Race/Ethnicity	-1.894	1.168	325.982	-1.621	0.106	-4.191	0.404
Time x Zip Code	0.000	0.001	328.110	0.220	0.826	-0.002	0.002
Time x Trial Condition	-1.976	3.748	325.030	-0.527	0.598	-9.350	5.398
Time x Social Network Comfort	0.348	1.183	325.770	0.294	0.769	-1.980	2.676
Time x Socio-emotional Support	-0.669	0.653	326.124	-1.024	0.307	-1.955	0.616
Time x Social Network Comfort x Socio-emotional Support	-0.092	0.308	324.313	-0.297	0.767	-0.698	0.515
Time x Trial Condition x Social Network Comfort	1.683	1.653	328.099	1.019	0.309	-1.567	4.934

Time x Trial Condition x Socio-emotional Support	0.452	0.987	325.034	0.458	0.647	-1.490	2.393
Time x Trial Condition x Social Network Comfort x Socio-emotional Support	-0.380	0.430	325.368	-0.884	0.377	-1.225	0.465

a. Continuous version of social group activity used in this model. *p<0.1, **p<0.05, ***p<0.01

Appendix C. Showing the Interaction of Social Network Comfort, Health Group Activity and Clinical Trial Condition on Change in Mental Well-Being

						95% CI	
	β	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	-51.956	60.759	376.793	-0.855	0.393	-171.426	67.514
Time	2.621	54.914	332.514	0.048	0.962	-105.402	110.644
Trial Condition	0.714	1.186	376.158	0.602	0.547	-1.618	3.046
Gender	-1.170	0.989	376.187	-1.183	0.237	-3.115	0.774
Age**	0.141	0.060	378.063	2.337	0.020	0.022	0.259
Education	0.709	0.428	377.131	1.656	0.099	-0.133	1.551
Race/Ethnicity	1.325	1.338	374.821	0.990	0.323	-1.307	3.957
Social Network Comfort Level**	0.839	0.347	375.492	2.419	0.016	0.157	1.522
Zip Code	0.002	0.001	376.879	1.429	0.154	-0.001	0.004
[a]Health Group Activity	-3.345	2.124	375.064	-1.575	0.116	-7.522	0.831
Social Network Comfort x Health Group Activity	0.007	0.874	376.522	0.008	0.994	-1.711	1.725
Trial Condition x Social Network Comfort	-0.489	0.476	375.836	-1.029	0.304	-1.425	0.446
Trial Condition x Health Group Activity	2.773	2.788	375.538	0.995	0.321	-2.709	8.255
Trial Condition x Social Network Comfort x Health Group Activity	0.292	1.181	375.235	0.248	0.805	-2.029	2.614
Time x Gender	0.310	0.899	338.555	0.344	0.731	-1.459	2.078
Time x Age	-0.036	0.057	359.719	-0.623	0.534	-0.148	0.077
Time x Education	-0.026	0.395	341.769	-0.065	0.948	-0.803	0.752
Time x Race/Ethnicity*	-2.022	1.187	330.412	-1.703	0.090	-4.358	0.314
Time x Zip Code	0.000	0.001	333.070	0.033	0.973	-0.002	0.002
Time x Trial Condition	-0.241	1.074	336.944	-0.225	0.822	-2.353	1.871
Time x Social Network Comfort	-0.011	0.313	335.257	-0.035	0.972	-0.627	0.605

Time x Health Group Activity	1.293	1.975	360.890	0.655	0.513	-2.591	5.177
Time x Social Network Comfort x Health Group Activity	-0.120	0.772	337.606	-0.155	0.877	-1.638	1.399
Time x Trial Condition x Social Network Comfort	0.338	0.429	337.876	0.789	0.431	-0.505	1.182
Time x Trial Condition x Health Group Activity	-1.851	2.553	347.535	-0.725	0.469	-6.872	3.170
Time x Trial Condition x Social Network Comfort x Health Group Activity	-0.054	1.039	332.827	-0.052	0.959	-2.097	1.990

a. Binomial version of social group activity used in this model, where 1=participation in at least 1 social group and 0 is no participation in any groups. *p<0.1, **p<0.05, ***p<0.01