Clinical Utility of a Digital Health Agent to Deliver Motivational Interviewing to Treat Alcohol

Abuse

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*Abstract.*

Web-based and online interventions that target preventable health behaviors and are based on evidence-based therapies such as Motivational Interviewing (MI) are more cost-effective, more accessible, and less stigmatizing than traditional therapy (Blandford et al., 2018). This study examined doctoral-level clinical psychology trainees' understanding and perception of the potential clinical utility of an online virtual health agent, called "eEVA" (empathic embodied virtual agent), that delivered a web-based MI intervention for alcohol abuse. MI-based interventions help individuals find intrinsic motivation to make healthy lifestyle changes (Miller & Rollnick, 2002). The current study qualitatively examined clinical psychology trainees' impressions and satisfaction of eEVA, and used quantitative data to test the perceived clinical utility of this technology for patients who may be at risk for alcohol problems, as literature indicates that user satisfaction is a strong predictor of patients meeting desired clinical goals and outcomes (Provoost et. al., 2017). This study showed that clinical psychology trainees found the technology to be significant in its clinical utility. Specifically, 59% of clinical psychology trainees who interacted with eEVA rated the overall clinical utility of the technology positively. As 60% of the study sample enjoyed interacting with the technology, this study shows that many new and early career psychologists will find significance and meaningful application in utilizing digital health interventions that are similar to eEVA.

**Key Personnel:**

**Maya Boustani, PhD** – *Principal Investigator.*

**Jaynish Hazari, MPH** – *Student Co-Investigator.* Responsible for recruitment of participants and data collection for doctoral project.

**Alcohol Use and its Burden in the US**

In the United States (U.S.), behaviors of alcohol misuse and abuse have become an epidemiological problem with health, safety, and financial consequences (Parsons, 2019; Rossow & Norström, 2013). According to the World Health Organization (WHO), alcohol use disorder (AUD) is estimated to affect 10-20% of US males and 5-10% of females over their lifetimes. In addition, excessive alcohol use is the third leading preventable cause of death in the US (79,000 deaths annually). Leggio and colleagues (2018) report that 86% of individuals aged 18 years and older have consumed alcohol at some point in their life (Leggio, De Witte, & Chick, 2018). Additionally, the prevalence of binge drinking and excessive alcohol use is 26% among those 18 years or older, and about 8% of those are considered heavy drinkers. Parsons (2019) notes that the consumption of alcoholic beverages has resulted in innate diseases and illnesses that increasingly worsen and lead to difficulty if individual control is lacking (Parsons, 2019). Additionally, individuals who consume excessive amounts of alcohol tend to also exhibit mental health problems such as depression and anxiety (Parsons, 2019). Indeed, some professionals conceptualize addiction to alcohol as a primary, progressive, physical, and chronic condition that results in fatalities if not treated (Scott, Grella, Dennis, & Nicholson, 2018).

**Effective Interventions for Alcohol Use**

Traditionally, evidence-based interventions for AUD involve psychotherapy that is delivered by a trained clinician (Cadigan, Martens, Dworkin, & Sher, 2019). However, there is a broad spectrum of traditional and effective services and strategies available to identify, manage, and treat AUDs (Min, Lee, & Shih, 2018). In a systematic review to measure the effect of interventions for alcohol misuse, Platt et. al. (2016) found that outcomes differed by setting, practitioner group and content of intervention. Interventions delivered by nurses compared to other

practitioners had the most effect in reducing quantity of alcohol consumption but not the amount of time points that alcohol was consumed; brief advice by any health professional in a medical setting was the most effective in the combination of reducing alcohol consumption with less time points of alcohol being consumed. Furthermore, since there is a lack of evidence indicated on the impact of content of intervention (i.e. brief vs non-brief), it is encouraged that individuals select the intervention that best suits their needs based on the severity of their alcohol consumption .

Screening and brief counseling for at-risk drinkers in ambulatory primary care has the most evidence for efficacy in lowering risk for excessive alcohol consumption, and some literature shows this method is cost-effective and decreases future morbidity and dysfunction (Willenbring, 2014). There has been a large implementation of screening and brief counseling in non-dependent heavy users outside of medical settings like colleges and universities (Kazemi, Borsari, Levine, Lamberson, & Dooley, 2018; Min et al., 2018; Prosser, Gee, & Jones, 2018), which has the potential to have a significant public health impact. Not many treatment and prevention strategies currently exist nor fit for people who have functional dependence, although such approaches might prevent or decrease the morbidity and other negative outcomes associated with the condition (Willenbring, 2014). For individuals living with AUDs, specifically severe and recurrent dependence, many analyses of treatments such as medical and community rehabilitation programs and administration of psychopharmacological medications have demonstrated improved outcomes in the short-term. However, there are no significant conclusions that the treatment of AUDs can lower long-term disease burden (Willenbring, 2014). Additional research is necessary in order to address functional, severe, and recurrent alcohol dependence (Willenbring, 2014).

Motivational Interviewing (MI) is a behavior change intervention that is used to help people find intrinsic motivation to make lifestyle changes (William R. Miller & Rollnick, 2002).

MI is among the most validated and widely disseminated of all psychosocial interventions for AUDs  (Miller & Rose, 2009) and has been effective at increasing health behavior change in other areas (e.g., diabetes management, Miller & Rose, 2009). MI is defined by Miller and Rollnick as a directive, person-centered counseling style for eliciting behavior change by helping clients to both address and clear ambivalence by increasing "change talk." One of the main goals of MI is to hone in on discrepancies that exist between someone's goals and current behavior. MI's basic principles are that a) if there is no discrepancy, there is no motivation; b) one way to develop discrepancy is to become ambivalent; c) as discrepancy increases, ambivalence first intensifies; if discrepancy continues to grow, ambivalence can be resolved toward change.

Brief Motivational Interviewing (BMI) procedures enhance the client's motivational changes through the use of four guiding principles that use the acronym RULE (Resist the righting reflex, Understand the patient's motivations, Listen to client problems, and Empower the patient accordingly, (Wells, Moonie, & Pharr, 2018), The efficacy of MI techniques lead to improved behavioral change outcomes such as increased change talk among individuals with AUD and are effective at reducing alcohol and other substance use in both adolescents and adults. For instance, Davis et. al. (2016) found that adolescents who received MI that included normative feedback had a high percentage of change talk in their communication, as well as significantly fewer days of alcohol and binge drinking at follow up compared to baseline data (J. P. Davis, Houck, Rowell, Benson, & Smith, 2016). In a study by Morenstern et. al. (2012), a sample of adult problem drinkers seeking treatment were randomly assigned to MI, relational MI without directive elements (Spirit-Only MI, SOMI), or a self-change (SC) control condition. The behavior of "change talk" significantly increased in MI relative to the SOMI and SC conditions, and drinking was significantly reduced. Evidence-based, patient-centered BMI interventions are particularly

effective in helping people find intrinsic motivation to change negative health behaviors (e.g., excessive drinking, overeating) after short counseling sessions, and to maintain healthy lifestyles over a long period of time once enough efficacy is reached (Dunn, Deroo, & Rivara, 2001; Emmons & Rollnick, 2001). A methodological review of 87 treatment methods for behavior-related issues showed that the top two ranked treatment styles were (1) brief interventions and (2) motivational enhancement therapies (William R. Miller & Rollnick, 2002). It is reported that about five minutes of advice and discussion about behavioral problems (e.g., alcohol or drug use) using techniques and components of MI after a screening can be as effective as a single session and that a single session can be as effective as multiple sessions (Babor & Grant, 1992; Hallgren et al., 2018). Literature has also suggested that, in regard to BMI interventions, "less is more" (Kulesza, Apperson, Larimer, & Copeland, 2010). Therefore, simpler and more straightforward single- or focused-component interventions of MI may be preferred, and there may be no advantage or even a disadvantage of covering additional components of MI. Treatments based on the MI model are utilized as both stand-alone interventions and in combination with other treatment strategies for substance use disorders (McHugh et. al., 2010).

Bien and colleagues (1993) conducted a meta-analysis of brief interventions for problem drinkers. When comparing pretreatment to posttreatment drinking, they found that brief interventions effectively reduced drinking consumption. In addition, when comparing brief-intervention patients with control group members, who were only surveyed about their alcohol use but did not participate in a formal intervention, the strength of the effect of the intervention was reduced. This outcome indicates that asking people about their drinking and related behaviors may prompt some of them to reduce their drinking through self-awareness (Bien, Miller, & Tonigan, 1993). Wilk et. al. (1997) also conducted a meta-analysis of brief interventions that were less than

60 minutes with heavy drinkers. The study found that heavy drinkers who received brief interventions were nearly twice as likely to successfully reduce their alcohol consumption within the following year compared with heavy drinkers who did not receive brief interventions (Wilk, Jensen, & Havighurst, 1997).

A meta-analytic review of interventions based on MI found effect sizes across studies in the small to moderate range for alcohol and the moderate range for drug use when compared to a placebo or no-treatment control group, and similar efficacy to active treatment comparisons (McHugh et. al., 2010). Most typically, MI is offered in an individual format (although group formats are also utilized) often consisting of a relatively brief treatment episode. Furthermore, greater efficacy may be achieved when a higher dose of treatment is used, as less use was associated with consistent follow up protocols (McHugh et. al., 2010). A study conducted by Gray et. al. (2005) examined the effects of single-session MI delivered by youth workers for alcohol use among young people. Upon 3-month follow-up, those who received MI reported significantly fewer days of alcohol use than those who did not receive MI. Brengpang et. al. (2014) found that MI interventions were effective at reducing alcohol consumption among a high-risk group of college students, when compared to alternative interventions or no intervention. Potential moderators of MI intervention effects were identified to include practitioner's adherence to MI techniques and individual's drinking motives.

The online Drinker's Checkup (DCU) is an evidence-based intervention that helps alcoholic clients take detailed information and assessment of individual drinking habits, and was developed based on the approaches and strategies of MI (Hester, Squires, & Delaney, 2005; William R Miller, Sovereign, & Krege, 1988). DCU is a computer-based program that allows alcoholic clients to acquire useful feedback about their drinking habits and including information

about risk factors and consequences (Wells et al., 2018). The final process of DCU involves a

section that helps clients to resolve their ambivalence about whether to change, to plan for a

change, to set goals for change, and offers other resources that help clients to meet their goals

sufficiently (Stringer & Baker, 2018). However, the DCU does not inform the clients of what to

do or not to do. Thus, what the client decides to do about their alcohol use is entirely up to them.

Arguably, DCU can help clients decide how to change because it offers recommendations and

resources that help clients to attain success in changing their drinking habits (Baucom, Epstein,

LaTaillade, & Kirby, 2008). Data from a sample of 42 problem drinkers receiving the DCU suggest

that this intervention may increase help-seeking and modestly suppress alcohol consumption

(William R Miller et al., 1988). A more recent study by Hester and colleagues measured outcomes

in problem drinkers who were randomly assigned to either immediate treatment (DCU) or a 4-

week wait-list control group (Hester et al., 2005). The study found long-term effectiveness in the

group who received the DCU as treatment. In this treatment group, participants reduced the

quantity and frequency of drinking by 50%, and had a similar rate sustained throughout a 12-month

follow-up period. Thus, the DCU appears to be effective in improving problem drinkers'

motivation to change. As mentioned later, the current study's brief intervention structure is based

on the DCU.

**Access to Healthcare and Treatment for Alcohol**

Despite the impact of alcohol abuse on population health, only about ten percent of

individuals with an AUD receive care, pointing to a substantial treatment gap in access to care and

perhaps to the healthcare systems in the US (Acevedo et al., 2018). The treatment gap varies

considerably across diverse populations based on gender, ethnicity, and race (Scott et al., 2018).

In a longitudinal study by Mulia et. al. (2014), racial and ethnic minorities had two-thirds the odds

of receiving an evidence-based alcohol intervention over a three-year period, compared to White individuals (Mulia, Tam, & Schmidt, 2014). Mellinger and colleagues (2019) found that women were less likely to utilize AUD treatment visits (Mellinger et al., 2019). The authors also mention that efforts to reduce gender-specific barriers to treatment are urgently needed to improve outcomes. Furthermore, Scott et. al. (2018) state that many individuals with AUD do not recognize the need for treatment, and thus do not seek it out (Scott et al., 2018).  However, recent healthcare developments, such as the implementation of Healthy People 2020 and Patient Protection and Affordable Care Act of 2010, are likely to improve the admission to substance abuse therapy (Shim et al., 2012). Additionally, available service delivery systems, new treatment approaches, and the advancement of innovative payments through the advancement of technology and public health insurance options may facilitate access to care for substance abuse (Scott et al., 2018). Due to the limited capacity and barriers to using specialized addiction programs, current efforts to extend evidence-based alcohol interventions into medical settings address an important need (Mulia et al., 2014). In doing so, however, various disparities in areas and populations of low access to high-quality treatment are likely to increase (Mulia et al., 2014).

Numerous factors can get in the way of individuals seeking treatment for alcohol misuse. Some of the significant barriers that exist include: lack of a trained workforce, inaccessibility in rural areas, transportation challenges, financial constraints, time management and stigmatization (Valdez, Garcia, Ruiz, Oren, & Carvajal, 2018; Wamsley, Satterfield, Curtis, Lundgren, & Satre, 2018; Williams, Housman, Evans, Bishop, & Ray, 2018). The lack of a sufficiently trained workforce in clinical settings to deal with alcohol and other substance misuse is a significant barrier (Wamsley et al., 2018). Scott et. al. (2018) note that the lack of qualified personnel, especially in rural areas, discourage the deployment of therapy programs among underserved and

vulnerable populations (Scott et al., 2018). Moreover, treatment-seeking in many rural areas makes anonymity difficult, because there are scarcer facilities and a higher incidence of recognition in group-based treatment meetings (Leggio et al., 2018). Wamsley et. al. (2018) add that given the ever-increasing alcohol abuse in rural areas, treatment has to focus on the challenges of delivering therapy in rural contexts (Wamsley et al., 2018). Indeed, rural areas continue to be disadvantaged, primarily due to a lack of services and an underutilization of available resources (Cucciare et al., 2018). Additionally, rural patients are more geographically dispersed and may have limited transportation options, further exacerbating the problem. Williams et al. (2018), indicate that shorter travel distances to healthcare facilities is linked to higher completion rates and longer stays in substance abuse management facilities (Williams et al., 2018). Mellinger et al. (2018) assert that the longer the travel distance to the substance abuse facilities, the lower the rate of recovery from substance abuse for clients with alcohol misuse problems (Mellinger et al., 2018). Additionally, Tarasoff et. al. (2018) argue that those who live in far-fetched areas find difficulty in travelling to facilities due to various problems associated with longer distances such as lack of efficient transport means and financial difficulties associated with poverty (Tarasoff, Milligan, Le, Usher, & Urbanoski, 2018). The authors also mention that there is a clear lack of diversity among service providers to meet the needs of individuals in rural treatment areas compared to urban facilities. Consequently, compared to individuals living in urban areas, those in rural areas carry the brunt of access to care in regards to access to a trained workforce and transportation barriers(Tarasoff et al., 2018).

Poverty and financial instability are multifaceted issues that exacerbate the impact of lack of access to appropriate health care in rural areas (Wamsley et al., 2018). Financial ability is an enabling factor for access to treatment, and without sufficient financial resources, most individuals

find it difficult to access proper healthcare or choose a preferred method of treatment (Tarasoff et al., 2018). Treatment of alcohol and other substances also requires a substantial time commitment. As such, individuals may find it difficult to commit to treatment. Exacerbating the issue, most service providers only operate during business hours, which is incompatible with most individuals' work schedules (Wamsley et al., 2018)

Stigma is another barrier of concern for individuals seeking out care to treat their AUD (Valdez et al., 2018). Stigma can cause many alcoholic clients to shy away from treatment because they are afraid of what family members, friends, colleagues, and others would think (Valdez et al., 2018). Individuals may also fear losing their jobs by entering treatment. In a comprehensive review, Livingston et. al. (2012) identified three substance use interventions that focused on people with substance use disorders (self-stigma), on the general public (social stigma) and on medical students and other professional groups (structural stigma). Their evidence indicates that self-stigma can be reduced through therapeutic interventions such as group-based acceptance and commitment therapy. Effective strategies for addressing social stigma include motivational interviewing and communicating positive stories of people with substance use disorders. For changing stigma at a structural level, contact-based training and education programs targeting medical students and professionals (e.g. police, counsellors) are effective since the overall cultural and institutional norms, values and beliefs can be changed in group processes (Livingston, Milne, Fang, & Amari, 2012).

Given these disparities in services utilization, an important question is whether evidence-based alcohol interventions can effectively be extended beyond community care or primary care to alternative modalities such as web-based technologies, and whether doing so might help to reduce these disparities (Mulia et al., 2014).

**Digital Health Interventions (DHIs)**

Digital health interventions have significant potential as a scalable strategy that can advance health care delivery. Dissemination and implementation of targeted interventions and services in health care requires a comprehensive and multi-modal approach, including digital platforms (Blandford et al., 2018). There are many advantages to using digital health interventions for the reduction of addiction to alcohol and other related illnesses. Some of the advantages of digital health interventions include its efficiency, safety, personalization, and cost-effectiveness (Blandford et al., 2018).

Many of the available digital health interventions have multiple components, which allow users to achieve their objectives, including providing them with access to more information about their health conditions, change their perceptions and cognitions about their wellbeing, and share their experiences with others on an online platform (Blandford et al., 2018). Digital health interventions can help individuals monitor their progress, assess their risk behaviors, clarify priorities, and reach treatment decisions. They are available at lower costs because they are not capital intensive in nature.

*Stigma.* One major benefit of internet-delivered, computer and mobile mental health interventions is the reduction of stigma (Lucas et al., 2017). In recent years, there has been an explosion of interest and development of online services to either supplement existing mental health treatments or expand limited access to quality mental health services (Fitzpatrick, Darcy, & Vierhile, 2017). Many studies have shown that patients are more honest with a computer than a human clinician when disclosing potentially stigmatizing behaviors such as alcohol consumption and HIV risk behavior (Ahmad et al., 2009; Card & Lucas, 1981; Ghanem, Hutton, Zenilman, Zimba, & Erbelding, 2005; Kissinger et al., 1999; Newman et al., 2002). The more a patient or

client discloses, the more opportunity for the problematic issue to be addressed. Internet-delivered interventions for alcohol reduction are particularly useful for people less likely to access traditional alcohol-related services, such as women and young people (White et al. 2011), and individuals living in remote areas with poor access to care (Mulia et. al., 2014). Thus, individuals with AUD or other problems related to alcohol use may find a relational agent more approachable than a clinician in many situations, making it more effective at screening and counseling for problems related to alcohol consumption.

*Access.* Digital health interventions (DHIs) address excessive alcohol use along with other preventable, unhealthy behaviors to promote responsible behavior and improve clinical outcomes (Blandford et al., 2018). Additionally, they can be used in remote areas where access to healthcare is limited by several factors such as transportation costs and financial constraints, among others (Zanaboni et al., 2018).  According to Prosser et. al. (2018), the self-management of alcohol misuse is achievable through the use of communication technologies. Online alcohol interventions are increasingly available for individuals with alcohol addiction. Over the past decade, several interactive computer-based online programs have been developed for screening to be delivered either through stand-alone computers or via the internet (Prosser et al., 2018). Today, internet programs range from web blogs/log and user-generated content applications, which deliver instant messaging discussions and messages to interactive computer and mobile phone applications (Garnett et al., 2018). Many multi-session modularized programs to normative feedback interventions, web-based messaging technologies, even within interactive applications, have minimized alcohol addiction and alcohol addiction relapse rates.

*Examples of digital health interventions for alcohol use.*  Rogers et. al. (2017) conducted a review of Internet-delivered health interventions, and identified eight currently available evidence-based

websites on alcohol use. All but three were tested using college or university students; some are specifically targeted to universities, offering a suite of programs regarding substance abuse, health, and wellness. The most common techniques utilized in these interventions were personalized and normative feedback, as well as goal setting, but did not quite address the innovations in their interventions that would allow users to maintain optimal engagement for the entire intervention period. Some sites included more tailored feedback and interactive journaling. The health benefit observed in the trials was generally a reduction in alcohol consumption, although some trials showed a reduction in the consequences of heavy drinking such as impairment in control and fewer embarrassing actions. The length of the programs varied—some being rather brief screening tools and others encompassing 6 months of structured activities.

A recent tool for self-management of alcohol misuse and addiction-relapse prevention that is currently being tested is the Alcohol Comprehensive Health Enhancement Support System (A-CHESS) program (Ramo et al., 2019). According to Garnett et al. (2018), the emergence of smartphones may come to play a significant role in the long-term management of alcohol and substance abuse because it offers advanced capabilities that have computer-like functionalities. The A-CHESS application is one example of the latest approach that can be utilized with smart phones for a variety of applications, such as relapse prevention in alcohol and other substance use (Garnett et al., 2018).

Mobile Applications, such as the "Drink Less" app, could deliver a model of evidence and theory-based interventions for health-related behavior. The Drink Less app has the potential to reduce extreme alcohol consumption significantly if used appropriately. This is an app that allows users to keep track of how much they drink, set goals to drink less, get feedback on whether what they're doing is working, and access ways to change their attitudes towards alcohol. Lisseti et. al.

(2013), assert that digital interventions to reduce alcohol consumption can reach significant

numbers of clients at a low incremental cost of provision, reduce stigmatization effects associated

with help-seeking in individuals, and offer convenience and privacy for clients (C. Lisetti, Amini,

Yasavur, & Rishe, 2013). The tendency for smartphones to be used repeatedly and to be carried

everywhere much of the time can improve the capacity to provide support promptly, particularly

in circumstances where people need immediate support.

BMI interventions are highly structured, as they assess target behavior patterns, offer

normative feedback, and provide a menu of change options depending on a client's readiness

level. Research on the specific attributes, content or components of implemented BMI

interventions is quite limited, and thus it is not clear what characteristics of MI content may be

responsible for changes in drinking outcomes. Some studies have attempted to identify specific

components related to BMI efficacy (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Carey,

Scott-Sheldon, Elliott, Garey, & Carey, 2012; Martens, Smith, & Murphy, 2013; M. B. Miller et

al., 2013), however, it is difficult to isolate the effect of one component (e.g., protective

behavioral strategies) when it is usually delivered in the context of several others (e.g., alcohol

use patterns, normative beliefs, consequences, expectancies, etc.) Therefore, the structure of BMI

interventions are a natural fit for delivery via computer as they provide multiple components of

MI and users can choose to select what they would like to attend to (Rizzo et. al., 2016). As

computer delivery of MI components in a brief platform have been viewed to be "personalized"

to users, it is likely that more components may be more helpful for participants when BMI

interventions are highly personalized although literature suggests that fewer components is better

than implementation of a more comprehensive BMI intervention (Ray et. al., 2014). That is, in a

personalized BMI such as a DHI delivered via computer, provision of a variety of content may

be more salient to participants, and thus more memorable, which may lead to changes in drinking behaviors over time.

**Engaging users in DHIs**

When evaluating Computer Delivered-Based Interventions (CDBI), or intervention platforms that are available through online websites or computer software, it is important to maintain user engagement, enjoyability, and acceptability so that users are motivated to use these systems and come back to use them over the long term when necessary (e.g. for booster sessions, follow-ups, maintenance sessions). Current BMI interventions delivered by computers are proven effective, but there are high attrition rates due to their users' low level of engagement during the interaction and lack of motivation to continue to use the system, which limits their long-term adoption and potential impact in society (Rizzo et. al., 2016). A significant factor affecting the outcomes of CDBIs involves the ability of the therapist to establish a relationship and to express empathy (Rizzo et. al., 2016). Current CBDIs can only express very little empathy due to their text-based only interfaces, whereas human empathy is communicated by both verbal messages and nonverbal messages (e.g. facial expressions, vocal intonation).

*Embodied Conversational Agents* (ECAs) are virtual characters who specifically focus on dialog-based interactions, and can be implemented in various DHIs and CDBIs to help form empathic conversation and education with users (C. Lisetti et al., 2013). Simulated human characters are becoming commonly utilized in different digital interfaces for a wide range of applications such as in interactive learning, video games, and various forms of entertainment. ECAs are different from the avatars used in typical video games as ECAs are virtual entities of their own whereas other avatars represent and are controlled by the user. ECAs are mostly developed by computer scientists and engineers to possess a physical anthropomorphic

representation and to be capable of having a conversation. Although its conversation may still be

quite limited with a human counterpart as this technology is quite novel, ECAs are digital

systems that use some artificial intelligence so they can broadly be referred to as "agents." With

their anthropomorphic features and capabilities, ECAs provide computer users a more natural

interface than other virtual avatars, in that they interact with humans using humans' natural and

innate communication modalities such as facial expressions, body language, speech, and natural

language understanding. Thus, ECAs are intended to provide users with an interface that does

not require much computer or technical literacy, but rather enables an approachable and

accessible computing system to both technologically-friendly and technophobic users. While

these systems have improved steadily in their degree of graphic realism and dialog abilities, their

social realism is still seriously lacking. Because virtual characters are recent interface agents,

designing and evaluating their social realism has not been well studied to date. One important

element of social and emotional competence is the ability of one agent to respond in ways that

are adaptive given the emotions, moods, personality, and preferences of another agent.

Provoost and colleagues reviewed over 50 ECAs that are currently used in clinical

psychology, and found that ECAs for mental health illnesses such as anxiety, depression and

substance use disorders are on the rise in terms of availability for health professionals to provide

additional support to their clients and patients; however ECAs are not well studied in regards to

their clinical application (Provoost et al., 2017). The authors mentioned that the abilities of ECAs

such as communicating through natural language and nonverbal behaviors, can be used toward

the delivery of psychotherapeutic interventions, and user satisfaction and engagement shows

hopeful results for their widespread uptake. However, evidence on the overall acceptance and

positive perspectives of ECA clinical application remains scarce. Thus, as mentioned later the

current study is choosing to investigate the clinical utility of an ECA among a sample of clinical psychologists in training.

Several character-animated, or "avatar-based" health interventions have been developed for a variety of contexts (T. Bickmore, Gruber, & Picard, 2005; T. W. Bickmore et al., 2010; Johnson, LaBore, & Chiu, 2004; Provoost et al., 2017; Silverman et al., 2001), and their evaluation indicates that users tend to accept them as interesting counterparts that improve their interaction with health interventions, with many users expressing the wish for characters to be less predictable and more expressive. Since MI-based interventions are especially useful for health dialog systems (C. L. Lisetti & Wagner, 2008), some researchers have continued to explore the use of 2D cartoon-like characters to provide MI-related material to patients or to train healthcare professionals in MI (Schulman, Bickmore, & Sidner, 2011). As mentioned later, the current study evaluated a 3D avatar-based ECA to be less predictable and more expressive for the purpose user acceptability, engagement, as well as further clinical utilization and application. With the combination of both traditional (i.e Brief Motivational Interviewing) and digital health intervention measures (i.e. online virtual health agent), screening for and treating alcohol misuse can be more easily disseminated so that emergent problems can be detected and treated.

**User Perspectives of CDBIs, ECAs, and other Virtual Health Agents**

The study of user engagement and satisfaction (e.g. acceptability, feasibility and utility) applied to the design of socially appropriate and responsive virtual characters can contribute to the enhancement and evaluation of CDBIs, ECAs and other virtual health agents. Without claiming that ECAs will fully empathize and have the ability to subjectively experience another's feelings, we posit that an empathic embodied virtual agent (eEVA) – a virtual health agent

designed by our research partners in the Department of Computer Science at Florida

International University (FIU) - will enable us to determine if it has enough personal

characteristics and social abilities to give the user the positive experience of interacting with an

empathic supportive character. Virtual health assistants such as eEVA may be an effective online

health intervention that sets the precedent for how BMI skills should be planned and delivered

for the well-being of individuals while de-stigmatizing the conversation of mental health in many

populations and cultures.

      Davis' technology acceptance model (TAM) (Davis, Bagozzi, & Warshaw, 1989) states

that user acceptance can be explained by two beliefs: perceived usefulness and perceived ease of

use. Perceived usefulness is defined as "the degree to which a person believes that using a

particular system would enhance his or her job performance" (Davis et al., 1989). Perceived ease

of use is defined as "the degree to which a person believes that using a particular system would

be free of effort" (Davis et al., 1989). A significant addition to the model is a third belief called

perceived enjoyment (Davis et al., 1989), which is "the extent to which the activity of using the

computer is perceived to be enjoyable in its own right, apart from any performance consequences

that may be anticipated" (Davis et al., 1989). Davis reported on the usage intentions for a

hedonic information system; analysis of this model showed that perceived enjoyment and

perceived ease of use are stronger determinants of intentions to accept and use a given form of

technology than perceived usefulness. Davis suggests that hedonic (self-fulfilling) value can play

a significant role to increase acceptance of digital system interfaces which are typically

utilitarian in nature. Hedonic systems aim to provide self-fulfilling (e.g. high engagement levels)

value to the user, unlike utilitarian systems, which only provide instrumental value to the user.

One can identify a system being utilitarian or hedonic by observing and identifying the tactics

that system developers build into the system in order to encourage usage or utility. The goal of a

utilitarian information system is to increase the user's task performance while encouraging

efficiency. Therefore, an important strategy that developers build into a system interface is to

match up system functionality with task requirements, and to provide minimal distraction so the

user can better perform his or her task.

An early contribution to the study of virtual characters or agents demonstrated that

human users react similarly in their social behavior to an agent as they would to a human, but

only if the agent's computer interface provides users with social cues (Reeves & Nass, 1996). As

the more novel ECAs have the ability to use sophisticated multimodal communication to build

rapport (Gratch et al., 2006; Gratch, Wang, Gerten, Fast, & Duffy, 2007; Gratch, Wang,

Okhmatovskaia, et al., 2007; Kang, Gratch, Wang, & Watt, 2008a, 2008b; McQuiggan & Lester,

2007), communicate empathically (Boukricha, Becker, & Wachsmuth, 2007; Boukricha &

Wachsmuth, 2011; Boukricha, Wachsmuth, Hofstätter, & Grammer, 2009; McQuiggan & Lester,

2007) and engage in social talk (T. Bickmore & Giorgino, 2006; T. Bickmore et al., 2005; T. W.

Bickmore & Picard, 2005; Cassell & Bickmore, 2003; Klüwer, 2011; Schulman et al., 2011),

they have the ability of being as engaging as humans, and have sometimes been identified to be

more engaging than humans (Gratch, Wang, Gerten, et al., 2007; Gratch, Wang, Okhmatovskaia,

et al., 2007).

Although 2D avatars employed in avatar-based technologies have indicated a basic level

of acceptance by users, they do not have the ability to show dynamic expressiveness, which is

key for demonstrating facial affect (Ehrlich, Schiano, & Sheridan, 2000). Thus, the ability for an

agent to possess dynamic expressiveness is highly necessary in establishing the MI component of

an empathic communication style (William R. Miller & Rollnick, 2002). eEVA is viewed as an

effort to address this issue as it uses 3D characters who are able to sense the user's facial expressions, display facial expressions dynamically in real time, and adapt to these in real time according to a model of nonverbal empathic communication designed for brief motivational interventions.

The outcome studied the most for ECAs is user satisfaction among patients (Provoost et al., 2017), but many methodological reviews of ECAs do not necessarily include the perspectives of the providers of services, such as clinical psychologists. Clinician perspectives can have important implications for future implementation and penetration of such technologies into usual care. Although there is not much literature available on the overall acceptance and clinical application of interventions that use ECAs in the field of health technology, there are studies that identify clinician perspectives of other mobile health (mHealth) and mobile rehabilitation (mRehab) interventions. In a national survey of over 500 rehabilitation clinicians in physical, occupational, speech, recreation and psychological therapy, 51% reported being comfortable integrating mHealth and mRehab technology into their practice; 23% felt knowledgeable about mHealth and mRehab interventions currently available (Morris, Jones, Thompson, Wallace, & DeRuyter, 2019). However, the study found that mHealth and mRehab are maturing rapidly and that the sample of clinicians recognize the need for such health technology interventions, but their knowledge and confidence in delivering mHealth and mRehab interventions for their patients represents a significant barrier to overall adoption and interest by their patients.

If clinicians' perspectives of health technologies such as BMI interventions that involve ECAs are positive, is likely that the current and future generation of healthcare providers have intent to utilize and suggest such interventions for clinical populations in relevant settings, as well as find meaning and significance in using such modalities of intervention. As such, it is important

that their voices be a part of the conversation. Therefore, the goal of this study is to better understand how clinicians in the field of mental health perceive and view the clinical utility of a virtual health agent called eEVA that uses BMI to address alcohol consumption.

**Current Study**

This study examined doctoral-level clinical psychology trainees' perception of the potential clinical utility, or usefulness, of an online virtual health agent, called "eEVA" (empathic embodied virtual agent), that aimed to deliver web-based Brief Motivational Interviewing (BMI) for alcohol abuse. We hypothesized that clinical psychology trainees will rate the clinical utility (usefulness) of the technology positively.

**Aim 1.** To describe clinical psychology trainees' perceptions of the clinical utility of using an online digital health agent to deliver MI for alcohol users.

*Hypothesis:* On average, more than half of the clinical psychology trainees ($n > 11$) will rate the technology positively ("agree" or "strongly agree") when considering its overall clinical utility. As such, more than half of the participants will find the technology useful, acceptable and feasible for a clinical population.

**Aim 2.** To determine the perceived clinical utility (recommendation of this technology to patients, usefulness, accessibility, stigma reduction, clinical relevance, ease of use, and structured format) of eEVA's application among clinical psychology trainees who found the technology enjoyable compared to trainees who did not find the technology enjoyable.

*Hypothesis:* Clinical psychology trainees who enjoyed interacting with eEVA will have a significantly higher score in their average overall perceived clinical utility compared to trainees who did not enjoy interacting with eEVA.

**Methods**

*Participants.* We recruited 22 doctoral-level clinical psychology trainees from Loma Linda University – a clinical psychology graduate training program situated in the only integrated medical center in the area outside of Los Angeles (known as the Inland Empire). To be eligible, trainees had to self-report a basic understanding of Motivational Interviewing (MI) by explaining what it is and must also have possessed some clinical experience (carry a caseload of clients for their clinical training). Any trainees who were being supervised or taking a class by the PI of the project, Dr. Maya Boustani, were not eligible to participate due to a risk of dual role / conflict of interest. Participants were asked to spend 30-45 minutes interacting with eEVA and to complete a post-intervention survey. Participants were recruited via a department-wide recruitment email and compensated with a $10 gift card.

*Procedures.* All procedures were approved by Loma Linda University's Institutional Review Board (IRB). Participants were asked for consent to participate in a research study in which data will be collected about their impressions of a virtual health assistant or agent (eEVA). No actual data of alcohol consumption was collected since they were asked to "role-play" their interactions with eEVA as either a low, moderate, or high-risk level alcohol user. Participants did not have any other visual or auditory distractions other than the research investigator guiding them if there was any difficulty in using the technology, as well as encouraging them to think aloud about their experience.

The protocol followed the format of the evidenced- and computer-based Drinker's Check-Up (DCU) intervention (Hester et. al., 2005) designed for adults experiencing issues with alcohol consumption, a brief MI (BMI) intervention mentioned earlier in the literature. Our participants were not the consumers of this intervention. Rather, they were the potential providers who may

recommend such an intervention to their clients. As such, the goal was not for them to participate

in the intervention but rather to provide feedback on their impressions about the intervention.

When participants first logged onto eEVA, they were provided with a diverse group of 30

different virtual health assistants to pick from. The eEVA program then took the user to their

chosen virtual health assistant's virtual office, where the virtual agent introduced themselves and

provided the menu of the intervention's five components (Screening, Get to Know Your Drinking,

Feedback, Action Plan, Resources). After participants met their preferred virtual health assistant

in the virtual office, participants were randomly assigned by the research investigators to provide

responses that qualified as low-risk, moderate-risk, or high-risk alcohol user when responding to

the eEVA screening component. This brief screening questionnaire that was administered by the

virtual health assistant adopted its questions from the Alcohol Use Disorders Identification Test

(AUDIT) developed by the World Health Organization (WHO) to identify individuals whose

alcohol consumption has become hazardous or harmful to their health (Babor et. al., 1992). The

AUDIT contains 10 questions with 3 questions on the amount and frequency of drinking, 3

questions on alcohol dependence, and 4 on problems caused by alcohol (Babor et. al., 1992).

Participants were then randomly assigned to one of six tasks from the second component of the

intervention ("Get to Know your Drinking"), in order for them to get an understanding of what the

intervention looks like – without having them go through the entire program (given that they are

not the consumers of the intervention). The six possible tasks in the "Get to Know your Drinking"

component involve answering questions that the virtual health assistant guides and verbalizes to

the user in his or her virtual office are as follows: (1) *What you like and don't like about drinking;*

*(2) How much and how often you drink; (3) Alcohol related problems; (4) A screening for*

*depressed mood; (5) Chances of success with moderate drinking; (6) How much you've come to*

*depend on your drinking.* If participants wanted to voluntarily view any other components of the intervention ("Feedback", "Action Plan", and "Resources"), they were welcomed to do so.

　　　　*Measures.* After interacting with the program, each participant completed a post-intervention questionnaire to understand their impressions of the program. Via Qualtrics, they answered questions based on a combination of the O'Brien's 6-attribute model to critically identify user engagement (O'Brien & Toms, 2008); Heerink's model to critically identify user acceptance of a virtual agent (Heerink, Kröse, Evers, & Wielinga, 2010); Bartneck's 'Godspeed questionnaire'; and Davis' technology acceptance model. Although all these measures that participants responded to also collected data on the acceptability and feasibility of the intervention, the current study is only analyzing specific items that measured clinical utility to help determine our participants' perceived clinical utility of eEVA (Bartneck, Kulić, Croft, & Zoghbi, 2009; Davis, 1989; Davis et al., 1989; Heerink et al., 2010); see Appendix.

　　　　Perceived clinical utility was conceptualized using the theoretical definition by Davis (1989), "the degree to which a person believes that using a particular method would enhance his or her job performance (*perceived usefulness*)" and "the degree to which a person believes that using a particular system would be free of effort (*perceived ease of use*)." Thus, using a composite score when analyzing the second aim of the study, the following seven post-intervention questions were drawn from Davis's technology acceptance model (1989) and asked on a five point "strongly disagree" to "strongly agree" Likert scale to each participant in order to determine the overall perceived clinical utility of eEVA (also in Appendix, Measure 2):

　　　　a.　*I would recommend this intervention to my patients.* (Recommending the health assistant to patients)

　　　　b. *I think the health assistant is useful to me.* (Usefulness)

*c. I would suggest seeking this intervention in an area with low-access to healthcare*

*(e.g. rural).* (Accessibility)

*d. This intervention is relevant for patients with alcohol abuse concerns.* (Clinical

relevance)

*e. I feel like patients may be more likely to be truthful about their alcohol use with a*

*virtual/live health assistant versus a live/virtual health assistant.* (Stigma reduction)

f. *This intervention would be easy to use with my patients.* (Ease of use)

g. *This intervention was well-structured to use.* (Structured format)

Each question included an optional blank write-in to elaborate on their responses. We explored

these qualitative responses to gain insight into the quantitative data collected.

*Intervention.* The content being delivered by the digital health agent was borrowed

directly from the DCU BMI intervention (Hester et al., 2005). The intervention consists of:

(1) using a collection of validated questionnaires to assess the individual's drinking patterns and

associated behaviors on a spectrum of alcohol consumption (low, medium, or high risk); (2)

calculating normative data based on this assessment and providing empathic feedback to raise

the individual's awareness about potential issues; (3) inferring the individual's readiness to

change from their responses (ready, unsure, not ready), it branches to menus of decision-making

strategies to help the individual make only the change that they are ready for at that time.

*Analysis.*

Aim 1: Descriptive understanding of clinical psychology trainees' perceptions of the clinical utility

of using an online digital health agent to deliver MI for alcohol users.

We generated frequency counts for each of the questions addressing the overall perceptions

and constructs of clinical utility (Table 2). Further, illustrative quotes from the post-intervention

questionnaire's optional write-in feedback were used to identify participants' reactions to their

experience regarding the clinical utility of eEVA.

Aim 2: Comparison of perceived clinical utility and its constructs among clinical psychology

trainees who enjoyed the technology compared to trainees who did not enjoy the technology.

Quantitative data was used from the post-intervention questionnaire to conduct a two-

sample t-test to highlight group differences in perceived clinical utility and its constructs

towards eEVA among those who enjoyed interacting with eEVA compared to those who did not

enjoy interacting with eEVA. The independent variable was the degree of agreeableness on the

item of *I enjoyed interacting with the health assistant* ("Strongly Agree" and "Agree" vs.

"Strongly Disagree" and "Disagree") and the primary dependent variable was the overall

composite score of the seven items, or constructs, regarding perceived clinical utility. Other

dependent variables included the scores on the seven individual items, or constructs, that make

up the overall perceived clinical utility score. Those who responded "Neither agree nor

disagree" were excluded from Aim 2's analyses.

**Results**

The demographic characteristics of the clinical psychology trainee participants in the

current study are shown in Table 1 ($n = 22$). Participants included 15 females (68%) and seven

males (32%). Ten participants (46%) were 23-25 years old, eight participants (36%) were 26-28

years old, and four participants (18%) were 29-30 years old. The average age of participants in

the study was 26 years old (M = 25.90, SD = 2.17). Ethnically, 12 participants (55%) identified

as Asian, eight participants (36%) identified as White or Caucasian, and two participants (9%)

identified as "Other". Racially, four participants (18%) were of Hispanic/Latino origin, and 18

participants (82%) were not of Hispanic/Latino origin.

<u>Aim 1: Descriptive understanding of clinical psychology trainees' perceptions of the clinical utility</u>

<u>of using an online digital health agent to deliver MI for alcohol users.</u>

The average number of participants who agreed or strongly agreed across all seven

Clinical Utility items (a.-g.), or constructs, was 13 participants ($\mu = 13.14$, $n = 22$). Specifically,

19 participants (86%) agreed or strongly agreed on the technology's ease of use, however, one of

the participants noted that it "*does have a small learning curve*" (Table 2). Also, 17 participants

(78%) agreed or strongly agreed on the intervention's clinical relevance, however, one of the

participants noted it's "*not useful without actual therapy*" (Table 2). There were 16 participants

(73%) who agreed or strongly agreed on the technology's accessibility, as one of the participants

said "*It's better to have something than nothing!*" (Table 2). Results also showed that 12

participants (55%) agreed or strongly agreed on the intervention's structured format, as one of

the participants noted it "*needs major improvements and refinements, but good foundation*"

(Table 2).  However, 10 participants (46%) agreed or strongly agreed on the intervention's

usefulness, as one of the participants claimed "*I think based on the questions asked the health

assistant would serve as a good screener, but I'm not sure if the MI [Motivational Interviewing]

would be able to be as personalized*" (Table 2). Only 10 participants (46%) agreed or strongly

agreed on the technology's stigma reduction, as one of the participants noted "*I never thought

about this but I think this could be a possibility*" (Table 2). Lastly, only eight participants (36%)

agreed or strongly agreed on recommending the health assistant to patients, as one of the

participants noted that "*it asks some questions that can help facilitate greater insight into one's

own alcohol use. I feel like it would be necessary for a clinician to follow up with the patient in-

person*" (Table 2).

Aim 2: Comparison of perceived clinical utility and its constructs among clinical psychology

trainees who enjoyed the technology compared to trainees who did not enjoy the technology.

Regarding the second aim's hypothesis of our study, 13 participants (59%) agreed or

strongly agreed that they found the health assistant enjoyable and 6 participants (27%) disagreed

or strongly disagreed that they found the health assistant enjoyable ($n = 22$) [Table 3]. When

comparing these two groups' differences in their averaged overall perceived clinical utility

scores ($\mu = 3.96$, $\mu = 2.67$) using each group's composite score from items a.-g. (constructs of

clinical utility) on a five point Likert scale, clinical psychology trainees who enjoyed the health

assistant rated the overall perceived clinical utility of eEVA significantly higher than trainees

who did not enjoy the health assistant [$a = .05$, $p < .0001$, 95% CI: (0.89, 1.68), $t(17) = 6.87$].

When analyzing the seven individual items, or constructs, of clinical utility, there were

also significant differences between participants who enjoyed the technology compared to those

who did not enjoy the technology (Table 4). In terms of recommending the health assistant to

patients on a five point Likert scale, clinical psychology trainees who enjoyed the health

assistant rated this item at an average of 3.77 out of 5 ($\sigma = 0.84$) and those who did not enjoy the

health assistant rated this item at an average of 1.85 out of 5 ($\sigma = 0.69$). Thus, clinical

psychology trainees who enjoyed the health assistant rated the recommendation of eEVA to

patients significantly higher than trainees who did not enjoy the health assistant [$a = .05$, $p <$

.0001, 95% CI: (1.11, 2.77), $t(17) = 4.93$]. With regards to the usefulness of eEVA on a five

point Likert scale, clinical psychology trainees who enjoyed the health assistant rated this item

at an average of 3.62 out of 5 ($\sigma = 0.74$) and those who did not enjoy the health assistant rated

this item at an average of 1.83 out of 5 ($\sigma = 0.37$). Thus, clinical psychology trainees who

enjoyed the health assistant rated the usefulness of eEVA significantly higher than trainees who

did not enjoy the health assistant [$a = .05$, $p < .0001$, 95% CI: (1.10, 2.46), $t(17) = 5.53$]. In terms of the accessibility of eEVA on a five point Likert scale, clinical psychology trainees who enjoyed the health assistant rated this item at an average of 4.08 out of 5 ($\sigma$: 0.47) and those who did not enjoy the health assistant rated this item at an average of 2.83 out of 5 ($\sigma$: 1.07). Thus, clinical psychology trainees who enjoyed the health assistant rated the accessibility of eEVA significantly higher than trainees who did not enjoy the health assistant [$a = .05$, $p < .01$, 95% CI: (0.51, 1.98), $t(17) = 3.59$,]. With regards to the clinical relevance of eEVA to patients with alcohol use issues on a five point Likert scale, trainees who enjoyed the health assistant rated this item at an average of 4.15 out of 5 ($\sigma = 0.74$) and those who did not enjoy the health assistant rated this item at an average of 3.00 out of 5 ($\sigma = 1.29$). Thus, trainees who enjoyed the health assistant rated the clinical relevance of eEVA for patients with alcohol use issues significantly higher than trainees who did not enjoy the health assistant [$a = .05$, $p < .01$, 95% CI: (0.36, 1.95), $t(17) = 3.06$]. In terms of patients feeling reduced stigma when using eEVA on a five point Likert scale, clinical psychology trainees who enjoyed the health assistant rated this item at an average of 3.77 out of 5 ($\sigma$: 0.84) and those who did not enjoy the health assistant rated this item at an average of 2.67 out of 5 ($\sigma$: 1.19). Thus, trainees who enjoyed the health assistant rated the stigma reduction in eEVA significantly better than with a live health assistant, compared trainees who did not enjoy the health assistant [$a = .05$, $p < .05$, 95% CI: (0.110, 2.09), $t(17) = 2.34$]. With regards to eEVA's ease of use with patients on a five point Likert scale, trainees who enjoyed the health assistant rated this item at an average of 4.31 out of 5 ($\sigma = 0.46$) and those who did not enjoy the health assistant rated this item at an average of 3.67 out of 5 ($\sigma = 0.47$). Thus, trainees who enjoyed the health assistant rated eEVA's ease of use with patients significantly higher than trainees who did not enjoy the health assistant [$a = .05$, $p <$

.05, 95% CI: (0.16, 1.13), *t(17)* = 2.80]. Lastly, in terms of eEVA's structured format on a five

point Likert scale, trainees who enjoyed the health assistant rated this item at an average of 4.00

out of 5 ($\sigma$ = 0.68) and those who did not enjoy the health assistant rated this item at an average

of 2.83 out of 5 ($\sigma$ = 0.69). Thus, trainees who enjoyed the health assistant rated eEVA's

structured format significantly higher than trainees who did not enjoy the health assistant [*a* =

.05, *p* < .01, 95% CI: (0.46, 1.88), *t(17)* = 3.47].

## Discussion

As predicted, more than half (*n* > 11), specifically 59%, of clinical psychology trainees

who interacted with eEVA rated the overall clinical utility of the technology positively ("agree"

or "strongly agree"). According to the Technology Acceptance Model, this indicates that some

early career psychologists may believe that supplementing their care with an online digital

health intervention that uses an ECA, or suggesting it as a standalone measure (depending on

severity) to clients, may enhance their clinical performance and would be free of effort (Davis,

1989). Specifically, more than half of the trainees rated the technology positively toward the

following constructs of clinical utility: accessibility, clinical relevance, ease of use for patients,

and structured format. As 73% of clinical psychology trainees gave a positive rating on eEVA's

accessibility, it is likely that many new and early career psychologists may suggest seeking this

intervention in an area with low-access to healthcare. The shortage of healthcare workers in

rural and other neglected areas may be a crisis that can be reduced through empowering

healthier behaviors in online digital health technologies such as eEVA. The norm of accessing

an online digital health intervention to help treat unhealthy alcohol consumption behaviors

would become stronger if new and early career psychologists endorse these technologies'

benefits, as the majority our study sample did. As 78% of clinical psychology trainees gave a

positive rating on eEVA's clinical relevance, it is likely that many new and early career

psychologists may claim that this intervention is relevant for patients with alcohol abuse

concerns. This means that the content being delivered by the digital was most likely accurate

information that increases its credibility as a reliable source of educating individuals on healthy

alcohol consumption behaviors. As 86% of clinical psychology trainees gave a positive rating

on eEVA's ease of use, it is likely that many new and early career psychologists may have no

difficulty navigating the technology. This makes sense, since our young study sample of

"Millennials" averaged at 26 years old is more comfortable with using technology in the era

they grew up in than all older age groups (PEW Research, 2019). It is worth noting that the only

individual item, or construct, of Clinical Utility that participants gave no negative ratings (did

not answer "strongly disagree" or "disagree") on was on ease of use, as all 22 participants

responded either neutral, agree, or strongly agree. This is a significant finding, as perceived ease

of use is a stronger determinant of intentions to accept and use a given form of technology than

perceived usefulness (Davis et al., 1989). Although this finding is not inclusive of modern and

current technological innovations such as ECAs, more current studies have found perceived

ease of use to have mediating effects on predicting behavioral intent to utilize various

technology (Henderson & Divett, 2003; McCloskey, 2006). As 55% of clinical psychology

trainees gave a positive rating on eEVA's structured format, it is likely that many new and early

career psychologists may claim this intervention is well-structured to use and is appropriately

following the format of a BMI intervention that provides a menu of components for individuals

to educate themselves on any risks of their alcohol consumption.

However, less than half of trainees rated the technology positively toward the following

constructs of clinical utility: recommending the health assistant to patients, its usefulness, and

stigma reduction. It is possible that trainees need more exposure to online digital health

interventions and need to see more research in support of its effectiveness before they can agree

to recommend such interventions to their clients. Although 78% of participants found the

intervention clinically relevant, they also were all aware that this technology was not yet an

actual product or application that is available for consumers or clients since it is still in

development. Thus, those who did not agree to recommend this intervention to patients may

have responded to this item in a literal context rather than a hypothetical context. It is also worth

noting that this study was conducted before the lockdowns resulting from COVID-19. Since

then, digital delivery of behavioral health has increased exponentially and has gained popularity

among both providers and consumers (Torous et. al., 2020). Only 46% of clinical psychology

trainees in our study felt like patients may be more likely to be truthful about their alcohol use

with a virtual health assistant versus a live health assistant. This is contradictory to the literature

on the significant relationship between stigma reduction and digital health technologies, as

many studies have shown that patients are more honest with a computer than a human clinician

when disclosing potentially stigmatizing behaviors such as alcohol consumption (Ahmad et al.,

2009; Card & Lucas, 1981; Ghanem, Hutton, Zenilman, Zimba, & Erbelding, 2005; Kissinger et

al., 1999; Newman et al., 2002). Also, literature indicates that younger health professionals are

more likely to "burnout" from their dedication to patient care and professional expectations

compared to older health professionals (Marchand et. al., 2018). Thus, our young study sample

of health professionals may feel like they have the capacity and expectation to reduce the stigma

of mental health through the evidence-based and traditional care they competently provide to

individuals. Furthermore, as there is another study in progress that focuses on the alcohol user

population, our work with consumers of eEVA (Boustani et al., in preparation) indicates that they feel more comfortable disclosing to a digital health agent than to their human providers.

As predicted, clinical psychology trainees who enjoyed interacting with the virtual health assistant were significantly more likely to rate the overall clinical utility of the technology higher than trainees who did not enjoy the virtual health assistant. We feel that these results – along with the recent movement towards digital interventions - make it more likely that the next generation of clinical psychologists will be more open to recommending the use of online digital health interventions that uses an ECA, such as eEVA – either as a supplemental or a standalone intervention. In primary care settings and mental health facilities, eEVA and other similar digital health interventions may serve as a helpful tool to support positive health behaviors. Individuals with abnormal alcohol consumption behaviors in the community who have low access to healthcare providers may have the most benefit from utilizing an online intervention such as eEVA. Indeed, about 20% of the U.S. population needed, but did not receive treatment for mental illness, substance use, and, or substance dependence due to the shortage of behavioral health providers (Coffman et. al., 2018). Online digital health interventions such as eEVA may be able to help reduce the burden of our shortage of behavioral health providers in the U.S.

This study's findings align with the technology acceptance model (Davis et al., 1989) that perceived enjoyment is a strong determinant of intentions to accept and utilize a given form of technology. User satisfaction is also an indicator of an intervention being effective in clinical outcomes (Provoost et al., 2017), so the potential for eEVA to create clinical benefits and changes is possible.

A major limitation to this study is the small sample size of our clinical psychology

trainee participants. Our small sample size may affect the reliability of our post-intervention

survey's results on eEVA's clinical utility because it leads to a higher variability, which may

lead to bias. Demographically, although this study had substantially more female participants

(68%) than male participants (32%), national data show that females make up 76% of new

psychology doctorates and 74% of early career psychologists (APA, 2020). Thus, this study's

proportion of female clinical psychology trainees to male clinical psychology trainees is

somewhat representative to the current generation of newly licensed clinical psychologists.

However, there is a major limitation in the lack of ethnic and racial diversity among the study

sample, as there were no participants (0%) who identified as American Indian or Alaska Native,

Black or African descent, and Native Hawaiian or Pacific Islander. Finally, our participants

represent one group of trainees from one institution in one geographical region and may not be

representative of other trainees.

Another limitation to this study is that after the first component of the intervention's

(health screening), participants were only required to view one of the six tasks (*What you like

and don't like about drinking, How much and how often you drink, Alcohol related problems, A

screening for depressed mood, Chances of success with moderate drinking,* and *How much

you've come to depend on your drinking)* in the second "Get To Know Your Drinking"

component. Also, participants were not required to, although some voluntarily did, view the

other three components of the intervention ("Feedback", "Action Plan", and "Resources") since

this study population was not an actual alcohol user/consumer population. As a result, they did

not see the entire intervention's structure, features, educational components, and behavioral

change techniques. This may have negatively impacted trainees' perceptions, given that they

only saw the screening features of eEVA. As there is another study in progress that focuses on

the alcohol user population, our alcohol consumer data indicates that they had much higher

satisfaction ratings compared to trainees (Boustani et. al., in preparation).

There are many future directions in furthering the development and evaluation of eEVA

to not only enhance its delivery, but also inform other computer-delivered health behavior

change interventions that use ECAs or other virtual agents. Currently, the developers of eEVA

are examining the role of artificial intelligence (AI) to build features such as facial and mood

recognition ability in eEVA's virtual health assistant, or agent. Future studies of eEVA involve

examining clinical outcomes in alcohol consumers and comparing the perceptions (i.e.

acceptance, feasibility) of eEVA among consumers with clinical providers/trainees. If clinical

outcomes in alcohol users can be enhanced through the utilization of eEVA in a prospective

study, there may be more positive perceptions in providers like psychologists when

recommending the technology to clients, its usefulness, and the reduced stigma that clients may

feel while aiming to create healthier alcohol consumption behaviors. Lastly, since the degree of

clinical utility of our technology was predicted using concepts and constructs from the

technology acceptance model (Davis, 1989), the model may not be inclusive of digital health

interventions and the innovation of ECAs. Thus, there should be future directions in creating a

specific mediation model in predicting the behavioral intent utilizing a digital health

intervention like eEVA (e.g. ease of use as a mediating effect toward clinical utility behavior).

Online interventions such as eEVA are not only cost effective, but also highly accessible

for people in need. These innovations may be relevant to a wide range of social and public health

issues and have the potential to enhance access to health education and brief treatments in a variety

of settings including home-based, school-based, elderly homes, and hospital-based settings. The

next generation of behavioral health providers will likely play an important role by supporting and

recommending the use of such interventions.

**APPENDIX**

*Measures*

**Measure 1**

Please rate your impressions interacting with the virtual counselor (O'Brien & Toms, 2008):

(1) Strongly Agree     (2) Agree     (3) Neither agree nor Disagree     (4) Disagree     (5) Strongly Disagree

| | |
|---|---|
| 1. I enjoyed participating in this session with the counselor. | **1   2   3   4   5** |
| 2. I found the counselor enjoyable. | **1   2   3   4   5** |
| 3. I found the counselor fascinating. | **1   2   3   4   5** |
| 4. I found the counselor boring. | **1   2   3   4   5** |
| 5. I think I learned quickly how to use the health counselor. | **1   2   3   4   5** |
| 6. I found the counselor easy to use. | **1   2   3   4   5** |
| 7. I think I can use the counselor without any help. | **1   2   3   4   5** |
| 8. I can use the counselor if there is someone around to help me. | **1   2   3   4   5** |
| 9. I think I can use the counselor if I have a good manual. | **1   2   3   4   5** |
| 10. I consider the counselor a pleasant conversational partner. | **1   2   3   4   5** |
| 11. I feel the counselor understands me. | **1   2   3   4   5** |
| 12. I think the counselor is nice. | **1   2   3   4   5** |
| 13. I think the counselor is empathizing with me. | **1   2   3   4   5** |
| 14. I think the counselor is useful to me. | **1   2   3   4   5** |
| 15. I felt like I'm talking to a real person. | **1   2   3   4   5** |
| 16. I sometimes felt as if the counselor was really looking at me. | **1   2   3   4   5** |
| 17. I can imagine the counselor to be a living creature. | **1   2   3   4   5** |
| 18. Sometimes the counselor seems to have real feelings. | **1   2   3   4   5** |
| 19. I would trust the counselor if it gave me advice. | **1   2   3   4   5** |

**Measure 2**

Please rate your thoughts on the clinical utility of the virtual counselor (Bartneck et al., 2009; Davis, 1989; Davis et al., 1989):

(1) Strongly Agree     (2) Agree     (3) Neither agree nor Disagree     (4) Disagree     (5) Strongly Disagree

20. I would recommend this intervention to my patients.

       **1    2    3    4    5**

21. I think the health assistant is useful to me.

       **1    2    3    4    5**

22. I would suggest seeking this intervention in an area with low-access to healthcare (e.g. rural).

       **1    2    3    4    5**

23. This intervention is relevant for patients with alcohol abuse concerns.

       **1    2    3    4    5**

24. I feel like patients may be more likely to be truthful about their alcohol use with a virtual health assistant versus a live health assistant.

       **1    2    3    4    5**

25. This intervention would be easy to use with my patients.

       **1    2    3    4    5**

26. This intervention was well-structured to use.

       **1    2    3    4    5**

**Measure 3**

Please pick one word to describe your impression of the counselor (Heerink et al., 2010):

My impression of the counselor is rated as

1. Fake / Natural

2. Machine-like / Human-like

3. Unconscious / Conscious

4. Artificial / Lifelike

5. Moving rigidly / Moving elegantly

6. Stagnant / Lively

7. Mechanical / Organic

8. Inert / Interactive

9. Apathetic/Responsive

10. Dislike / Like

11. Unfriendly / Friendly

12. Unkind / Kind

13. Unpleasant / Pleasant

14. Awful / Nice

15. Incompetent / Competent

16. Ignorant / Knowledgeable

17. Irresponsible / Responsible

18. Unintelligent / Intelligent

19. Foolish / Moving Sensible

20. Anxious / Relaxed

21. Agitated / Calm

22. Quiescent / Surprised

23. In your opinion, would patients prefer to talk to eEVA or a live counselor about their alcohol abuse issues? eEVA / live counselor

*Results*

**Table 1**

*Descriptive Statistics of Participants' Demographics*

| Characteristic | *n* | % |
|---|---|---|
| Gender | | |
|    Male | 7 | 32 |
|    Female | 15 | 68 |
| Age | | |
|    23-25 | 10 | 46 |
|    26-28 | 8 | 36 |
|    29-30 | 4 | 18 |
| Ethnicity | | |
|    American Indian or Alaska Native | 0 | 0 |
|    Asian | 12 | 55 |
|    Black or African Descent | 0 | 0 |
|    Native Hawaiian or Pacific Islander | 0 | 0 |
|    White or Caucasian | 8 | 36 |
|    Other | 2 | 9 |
| Race | | |
|    Of Hispanic/Latino | 4 | 18 |
|    Not of Hispanic/Latino | 18 | 82 |

*N* = 22

**Table 2**

*Descriptive Statistics of Perceived Clinical Utility Items*

| Item | Construct of Clinical Utility | Score | n | % | Notable Participant Quotes |
|---|---|---|---|---|---|
| a. I would recommend this intervention to my patients. | Recommend to patients | 1 | 3 | 14 | *"If they were to be laughing at and skeptical of the assistant, I wouldn't dare use it with patients because then they'd associate that with my competence."* |
| | | 2 | 5 | 23 | *"Further development of the technology needed."* |
| | | 3 | 6 | 27 | *"It depends on type of patient population."* |
| | | 4 | 6 | 27 | *"...perhaps only as a screening tool."* |
| | | 5 | 2 | 9 | *"...it asks some questions that can help facilitate greater insight into one's own alcohol use. I feel like it would be necessary for a clinician to follow up with the patient in-person."* |
| | | 1 | 1 | 5 | |
| b. I think the health assistant is useful to me. | Usefulness | 2 | 6 | 27 | *"I think it may help the respondent gain a bit of awareness of his/her alcohol use, but I am doubtful of its ability to encourage any kind of change in health behaviors."* |
| | | 3 | 5 | 23 | |
| | | 4 | 8 | 36 | *"I think based on the questions asked the health assistant would serve as a good screener, but I'm not sure if the MI would be able to be as personalized."* |
| | | 5 | 2 | 9 | |
| c. I would suggest seeking this intervention | Accessibility | 1 | 1 | 5 | |
| | | 2 | 1 | 5 | |

| Item | Category | Rating | n | % | Quote |
|---|---|---|---|---|---|
| in an area with low-access to healthcare (e.g. rural). | | 3 | 4 | 18 | *"I feel like online counseling with a real person would be a better option for individuals without access to in-person care."* |
| | | 4 | 14 | 64 | *"It's better to have something than nothing!"* |
| | | 5 | 2 | 9 | *"It is a great way for people to get help especially if they are not able to make it to ask a health professional in person…very accessible and innovative method."* |
| d. This intervention is relevant for patients with alcohol abuse concerns. | Clinical Relevance | 1 | 1 | 5 | |
| | | 2 | 1 | 5 | *"Not useful without actual therapy."* |
| | | 3 | 3 | 14 | |
| | | 4 | 12 | 55 | |
| | | 5 | 5 | 23 | |
| e. I feel like patients may be more likely to be truthful about their alcohol use with a virtual health assistant versus a live health assistant. | Stigma Reduction | 1 | 1 | 5 | |
| | | 2 | 5 | 23 | |
| | | 3 | 6 | 27 | *"I don't think there would be a difference if all information is stored confidentially."* |
| | | 4 | 5 | 23 | *"I never thought about this but I think this could be a possibility."* |
| | | 5 | 5 | 23 | |
| f. This intervention would be easy to use with my patients. | Ease of Use | 1 | 0 | 0 | |
| | | 2 | 0 | 0 | |
| | | 3 | 3 | 14 | *"Does have a small learning curve."* |
| | | 4 | 15 | 68 | |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
|   |   |   | 5 | 4 | 18 |   |
| g. | This intervention was well-structured to use. | Structured Format | 1 | 0 | 0 |   |
|   |   |   | 2 | 2 | 9 |   |
|   |   |   | 3 | 8 | 36 | *"Needs major improvements and refinements, but good foundation."* |
|   |   |   | 4 | 9 | 41 | *"Layout and format were fine."* |
|   |   |   | 5 | 3 | 14 |   |

*N = 22.*

*Score Key: 1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, 5 – strongly agree*

**Table 3**

*Descriptive Statistics of Enjoyability Item*

| Item | *Score* | *n* | % |
|------|---------|-----|---|
| I found the health assistant enjoyable. | 1 | 2 | 9 |
| | 2 | 4 | 18 |
| | 3 | 3 | 14 |
| | 4 | 10 | 46 |
| | 5 | 3 | 14 |

*N = 22.*

*Score Key: 1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, 5 – strongly agree*

**Table 4**

*Results of Overall Perceived Clinical Utility and its Constructs depending on Perceived*

*Enjoyability of eEVA*

| Clinical Utility Items | Enjoyable (n = 13) | | Not Enjoyable (n = 6) | | t(17) | p | Cohen's d |
|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | | | |
| Overall Perceived Clinical Utility | 3.956 | .229 | 2.667 | .604 | 6.875 | .0001 | 2.822 |
| Recommend to patients (item a.) | 3.769 | .836 | 1.833 | .687 | 4.934 | .0001 | 2.530 |
| Usefulness (item b.) | 3.615 | .738 | 1.833 | .373 | 5.538 | .0001 | 3.048 |
| Accessibility (item c.) | 4.077 | .474 | 2.833 | 1.067 | 3.588 | .002 | 1.507 |
| Clinical Relevance (item d.) | 4.154 | .361 | 3.00 | 1.291 | 3.064 | .007 | 1.217 |
| Stigma Reduction (item e.) | 3.769 | .836 | 2.667 | 1.187 | 2.343 | .032 | .661 |
| Ease of Use (item f.) | 4.310 | .462 | 3.667 | .471 | 2.803 | .012 | 1.378 |
| Structured Format (item g.) | 4.00 | .679 | 2.833 | .687 | 3.470 | .003 | 1.709 |

*Note.* Overall Perceived Clinical Utility is a composite score of its construct items a.-g.
*Note.* Items are in Measure 2 of Appendix.

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