Alternative Sexuality, Sexual Orientation, and Mobile Technology: Findings from the National Coalition for Sexual Freedom Technology and Health Enhancement Feasibility Study

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Abstract

The alternative sexuality and sexual orientation minority (SM) communities are at risk for numerous health disparities. However, there is a dearth of research exploring the potential receptivity of these communities to the use of mobile technology to promote health. The present study reports findings from a feasibility study comprising two aims: (1) describe health enhancement app usage among alternative sexuality community members, as well as variation by sexual orientation status; and (2) assess the Technology Acceptance Model (TAM) in understanding factors influencing health enhancement app usage. An online cross-sectional survey of National Coalition for Sexual Freedom (NCSF) members (N=332) was conducted. Key findings include: (1) almost half of participants reported current mobile technology usage for health enhancement; (2) participants held positive beliefs concerning intention to use, perceived usefulness (PU) and ease of use (PEU) of mobile technology; (3) the TAM was appropriate to explain health enhancement app usage; and (4) significant TAM-supported direct and indirect pathways predicting behavioral usage of mobile technology. Moderation results indicate TAM application may be more appropriate for SM participants. Findings suggest that there are perceived health benefits in use of mobile technology by NCSF members. Recommendations for mobile technology development for NCSF and similar communities are provided.

Key words: Sexual orientation; Technology Acceptance Model; Alterative Sexuality; Mobile Technology; Health

Introduction

Persons with alternative sexual practice interests consist of the Bondage, Dominance/submission & Sadomasochism (BDSM), kink and polyamory communities. They represent a vulnerable population with regard to heightened experiences of discrimination and myriad challenges related to their well-being. The alternative sexual interest community has a long history of enduring stigmatization of BDSM and related practices (Hughes & Hammack, 2019; Richters et al., 2008; Wright, 2006, 2018). For instance, in a 2008 study of over 3,000 BDSM practitioners, 37.5% had been discriminated against, had experienced some form of harassment or violence, or had some form of harassment or discrimination related to BDSM engagement (Wright, 2008). Rates of discrimination experienced from mental health providers ranged from 4.5% to 15% among BDSM practitioners (Sprott & Randall, 2017; Wright, 2008).

Due in part to discrimination experiences, suicide is one mental health concern receiving recent attention in the alternative sexuality community health literature. Cramer and colleagues (2017) reported findings that members of the National Coalition for Sexual Freedom (NCSF), a non-profit education and advocacy organization of BDSM and non-monogamy-identifying practitioners, were between two and three times more likely to be at elevated suicide risk compared to college student and community-dwelling adult comparisons. Moreover, internalized stigma, shame and guilt were significant risk factors for elevated rates of suicidality in one sample of BDSM practitioners (Roush et al., 2017), with notions of shame and limits in disclosing BDSM identity also being common among members of this community (Damm et al., 2018). Speaking to potential resilience of these communities, engaging in BDSM behaviors can have a protective effect, with some reporting BDSM practices as part of their healing or countering negative messages (Sprott & Hadcock, 2018) and themes of empowerment and resilience being common among narratives of BDSM practitioners (Damm et al., 2018).

The alternative sexuality community is not monolithic, necessitating consideration of intersectional identities (Damm et al., 2018). In fact, reflecting this diversity, NCSF and the broader alternative sexuality community comprise a range of sexual orientation identities. Sexual orientation minority (SM) adults (i.e., gay, lesbian, bisexual, queer, and other non-heterosexual self-identified

persons) represent a double minority within the alternative sexuality community. While very little research exists on health disparities associated with this double minority subgroup, general SM literature may lend insight into elevated risk for mental and physical health concerns as compared to their heterosexual counterparts. SM persons experience a high degree of minority stress (i.e., chronic exposure to rejection, discrimination, harassment related to SM identity) (Frost et al., 2015; Hatzenbuehler, 2009; Institute of Medicine [IOM], 2011; Meyer, 2013). Such stress has been hypothesized and empirically shown to predispose SM persons to a variety of poor health outcomes (IOM, 2011; Meyer, 2013). Mental health difficulties commonly experienced by SM adults include heavy drinking, past-year illicit drug use, and reduced function in activities of daily living (Medley et al., 2016). Moreover, SM persons report higher rates of past-year and lifetime anxiety and depression, as well as more frequent lifetime suicidal ideation and past-year and lifetime suicide attempt (King et al., 2008). Regarding physical health disparities, SM individuals are more likely to report chronic health conditions, such as asthma, heart attack, stroke, and cancer, as well as poorer overall health, higher prevalence of disability, and greater functional impairment due to physical health or presence of a disability (Fredriksen-Goldsen et al., 2012, 2017; IOM, 2011; Sandfort et al., 2006). Literature shows that both alterative sexuality and SM communities experience mental health difficulties. However, little research has evaluated potential solutions for health-related challenges among SM members within the alternative sexuality community. This study sought to understand interest in and potential use of mobile technology usage as a medium for health enhancement for double minority group SM members of the alternative sexuality community.

Prior to describing relevant background and study aims, it is necessary to establish key definitions for the present study. We employed the following health enhancement definition: any health promotion or healthcare activity aimed at improving physical, mental, or social well-being (Nordenfelt, 1998). Following from this definition, we considered health enhancement applications (apps) as those specifically designed to boost an individual's subjective sense or objectively measured physical (e.g., hypertension), mental (e.g., anxiety level), or social (e.g., social activity) health indicators. Further, we adopted a public health definition of mobile health ("mHealth"): "Medical and public health practice

supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital

assistants (PDAs), and other wireless devices" (World Health Organization, 2011, p. 5). As such, health

enhancement apps represent a subcategory of mHealth.

Mobile Technology Usage for Health Enhancement Purposes

Given the disproportionate rates of negative mental and physical health outcomes among SM

individuals, and burgeoning evidence suggesting similar disparities among the BDSM community,

investigation of potential avenues for prevention and intervention are warranted. Thus, a next step is to

investigate feasibility of use of mobile technology for physical and mental health enhancement. The use

of technology has been instrumental in sharing information and increasing the number of individuals

involved in BDSM (Weiss, 2011). Also, SM individuals are more likely to engage with mobile

technology, including increased use of social media (Pew Research Center, 2013).

Advances in the accessibility and affordability of mobile technologies have led to an increase in

the use of mobile devices in physical and mental health and behavior interventions (Borrelli & Ritterband,

2015; Heron & Smyth, 2010). However, to date there are very few studies that utilize mobile technology

in health behavior assessment and intervention for SM individuals and none that could be located among

members of the alternative sexuality community. As an exception, several mobile technology-based

studies address health behaviors for men who have sex with men (MSM) (Hirshfield et al., 2016;

Holloway et al., 2014; Yang et al., 2015). For instance, Holloway and colleagues (2014) reported findings

showing that more than two-thirds of MSM using dating apps would be willing to engage mobile

technology for HIV prevention. Likewise, Yang and colleagues (2015) demonstrated high acceptability of

an ecological momentary assessment program aimed at assessing and managing HIV prevention and

alcohol use among Black MSM.

The lack of research using mobile technology-based interventions for SM individuals has led to

recent calls to use mobile health (mHealth) approaches to promote health among sexual and gender

minorities (Bowen et al., 2016). mHealth approaches might be particularly beneficial for SM individuals

and alternative sexuality community members because they can reduce stigma and general burden (e.g.,

travel, time, cost) associated with existing interventions. The anonymity and privacy afforded by many mHealth mediums (e.g., stress coping or mindfulness apps) may aid in reducing exposure to healthcare-related discrimination experiences. Also, communication with providers could occur in a safe technology-mediated environment (Bowen et al., 2016). Furthermore, mHealth approaches might help extend the "reach" of interventions to SM individuals who may otherwise not have access to, or chose not to access, mental and physical healthcare options. For instance, rural dwelling SM or alternative sexuality community members may be able to access needed specialized services via telehealth or address health concerns via well-designed, evidence-based app interventions. In order to develop feasible, acceptable, and ultimately effective mobile interventions for SM and alternative sexuality community members, it is necessary to first understand the ways in which these communities currently use, and would be willing to use, mobile devices for healthcare. The present study describes frequency and potential variation of interest in, perceived usefulness of, intention to, and actual use of health enhancement applications (app) by NCSF members by sexual orientation group.

Technology Acceptance Model (TAM): Definition and Application to Healthcare

Use of an applicable theoretical framework is crucial to advance understanding of SM and alternative sexuality community members' health enhancement app usage. The Technology Acceptance Model (TAM) was developed as one method to better evaluate the observable and latent factors that predict actual technological behaviors (Davis, 1989; Davis et al., 1989), as access to information and available communication technologies are not an absolute indicator of technology use. The traditional TAM comprises four core concepts (definitions contextualized with health app usage): (1) Perceived Usefulness (PU): extent to which a person believes that using a particular technological innovation would enhance personal health; (2) Perceived Ease of Use (PEU): extent to which a person believes that using a particular technological innovation would be free from effort; (3) Intention: extent of a person's motivation or willingness to engage with the technological innovation; and (4) behavioral use: objective use of the technological innovation. Figure 1 depicts the original TAM and its theorized pathways.

Since TAM's introduction, the model has become a staple in research examining technology use across disciplines (Ali et al., 2016). TAM is rooted in the theory of reasoned action as evidenced by the central placement of individual PEU and PU as predictors of attitudes and intention toward usage. Users' attitudes, whether positive or negative, are then conceptualized in the model to predict the intent and incremental behaviors that lead to actual observed usage. The original TAM (Davis, 1989; Davis et al., 1989), therefore, provides testable links and pathways to technology use in the forms of: (1) PEU to PU; (2) PEU to intention; (3) PU to intention; and (4) intention to behavioral usage (see Figure 1). Despite widespread application, previous research is mixed as to the ability of the original TAM model to predict use in every setting (Turner, 2010). Thus, with any new TAM application, a logical first step is to determine the overall fit of the model's tenets and prediction.

In recent years, several systematic reviews of TAM have shed light on user behavior in healthcare settings (Ali, 2016; Rahimi et al., 2018). Scholars found that the model is most often used in health settings to predict telemedicine, electronic health records, and mHealth usage (Rahimi et al., 2018). An illustrative example of the TAM's application to healthcare can be seen in a study of medical adherence; Kurth et al. (2016) concluded that a TAM-developed computer-based treatment program was a cost-effective approach to deliver counseling to Spanish speaking patients. While TAM has been validated in studies of health promotion, the application with SM populations has been severely restricted to persons facing physical health challenges or risks. For instance, Zhang et al. (2019) recommend further application of TAM as a way to assess the usefulness of an mHealth tool for HIV prevention among MSM in China.

TAM is also an effective feasibility tool for healthcare researchers. The model has been used to gain a deeper understanding of the concepts that contribute to technology use among stigmatized populations. In a study of women seeking care for pregnancy termination services, roughly four out of five patients used a smartphone to support their healthcare (Eysenbach et al., 2019). Many of these patients reported valuing access to a wide-ranging website with resources for mental health, follow-up care, and ongoing sexual health. Findings from another study showed that TAM concepts aided in

uncovering likely barriers to use of HIV prevention treatments among MSM (Chakrapani et al., 2017).

Lastly, researchers leveraged TAM to explore the post-hospitalization needs for suicidal youth and their

caregivers (O'Brien et al., 2019). They found commonalities not only in the types of mHealth content

desired by the respective groups, but also in their prior use of technology to seek out health support before

the hospitalization. In all, the literature reveals that TAM is a useful model to describe and predict the use

of technology for health purposes among varied populations.

The Present Study

NCSF and academically-based researchers located within the mid-Atlantic region of the United

States formed a community-academic partnership toward the goal of developing solutions to previously

observed problems in suicide risk and stigma-related experiences among NCSF community members.

Consistent with principles of community-engaged partnership (Michener et al., 2012), NCSF served as an

equal study partner with relevant expertise on the alternative sexuality community, having joint input on

all research-related steps and materials, supporting participant recruitment and incentivizing, and co-

developing a dissemination plan. Through a community-engaged partnership, the present investigation

sought to: (1) describe health enhancement app usage among the overall NCSF sample, as well as by

sexual orientation status; and (2) assess the potential for the TAM (Davis, 1989; Davis et al., 1989) to

provide theory-based guidance in understanding factors influencing health enhancement app usage. The

TAM was selected as a conceptual frame of reference due to its ubiquitous and practical application to

technology-related healthcare questions (Holden & Karsh, 2010). Moreover, conducting a theory-

informed technology feasibility study may inform future health application and other program

development tailored to the partnering group. Finally, we examined sexual orientation as a moderator of

the TAM model given (a) the well-documented health disparities endured by SM persons (IOM, 2011;

Meyer, 2013), as well as (b) the unexplored question of whether technology feasibility and usage for

health enhancement purposes may follow the same disparate trend.

The following hypotheses and research question were examined:

H1: SM individuals, compared to heterosexual counterparts, would display greater interest in, perceived usefulness of, intention to, and actual use of health enhancement apps.

H2: The TAM would explain health enhancement app usage among NCSF members.

H3: The following significant positive TAM-informed links concerning usage of mobile technology for health enhancement purposes would be observed: (a) PEU to PU; (b) PU to intention; (c) PEU to intention; and (d) intention to behavioral use.

H4: Significant indirect pathways would emerge as follows: (a) PEU to intent through PU; (b) PEU to behavioral use through intent; and (c) PU to behavioral use through intention.

RQ1: Do TAM-related findings vary by participant sexual orientation?

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Methods

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Procedure. The survey was advertised via email by the National Coalition for Sexual Freedom (NCSF) and its coalition partners (n=6,678 listserv members[1]). Inclusion criteria included being a member of NCSF and its listserv, over 18 years of age, and possessing computer access and the ability to read English. Listserv members were asked to consider participating in an online survey about sexual orientation, health, and technology use in order to help build new community programming and enhance services for community members. Data were collected over a five-month period using a cross-sectional, anonymous Qualtrics-administered survey lasting approximately 20 minutes per participant. Study details and consent information were provided at the outset of the survey, with electronic consent indicated by the participant clicking through to participate in the study after reading the informed consent page. Participants were debriefed at the end of the survey completion. Participation in the survey was incentivized by offering participants the chance to enter into a raffle for e-gift cards.

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[1] The overall pool of listserv members does not count invalid email addresses. Further, the survey was advertised via additional steams such as NCSF's social media accounts. However, it is likely that listserv members may also be social media followers. As such, it is impossible to tabulate an accurate response rate.

Participants. Eligible persons for this study were NCSF members, and therefore adults 18 years of age or older. Participants were 332 adults residing in the United States (U.S.) who were identified members of NCSF. NCSF is a non-profit sexuality public education and advocacy group drawing its membership from across the U.S; membership criteria include adults who aim to advance the rights of, and advocate for, consenting adults in the BDSM and alternative sexuality communities (NCSF, n.d.). Table 1 summarizes primary demographic information. Sample demography was primarily White and non-Hispanic, with a spread of representation in terms of gender, sexual orientation and relationship status.

Measures

Demographics. Participants completed a demographics questionnaire requesting information such as gender, sexual orientation, ethnicity, race, and partner status.

TAM questions. Members of the research team developed an 8-item questionnaire to assess mobile technology acceptance for health enhancement (see Appendix A). Each item was scored on a Likert scale that ranges from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). Items were developed specifically to address each of the three TAM constructs applied to use of mobile technology for health enhancement purposes: PEU, PU, and behavioral intent to use technology. Two items for PU addressed both physical and mental health due to documented disparities experienced by sexual minority persons in both categories (e.g., Cramer et al., 2017; IOM, 2011); likewise, the community partnering agency was interested in understanding both aspects of health. Four PEU items covered conceptually relevant aspects of ease of use such as likelihood of success, enjoyment, affordability, and perceived ease. Behavioral intent to use technology was assessed with two items assessing willingness to employ such technologies. Finally, actual usage of technology was assessed via a binary (i.e., no/yes) question (see Appendix A for all TAM questions).

The TAM measurement tool of PU, PEU, and behavioral intent to use technology was exposed to psychometric testing to ensure its appropriate usage for hypothesis testing. Confirmatory factor analysis (CFA) for the TAM measurement tool included three inter-correlated latent variables: PU (two items),

PEU (four items), and behavioral intent to use technology (two items). After initial model analysis, two error terms were permitted to correlate due to theoretical support with TAM (i.e., error terms for perceived ease and affordability items). Final CFA results for the TAM measure supported good fit to the data (see Table 3 for fit indices). Further, subscale characteristics indicated acceptable internal consistency and expected significant positive factor loadings: PU (λ range = .85 to .92, ps < .001; α = .88), PEU (λ range = .30 to .90, ps < .001; α = .78), and intention (λ range = .96 to .95, ps < .001; α = .97). As such, we proceeded with using the TAM subscales for primary hypothesis testing.

Data analysis. Missing data (range 0 to 0.9% on items of interest) was addressed via multiple imputation recommendations in the literature (e.g., Enders, 2017). TAM construct internal consistency was tabulated via internal consistency in SPSS v. 26, with a TAM measurement model conducted via confirmatory factor analysis in AMOS v. 26 (see measures section). H1 was examined via independent sample t-test and Pearson Chi-square analyses. H2 through H4 were examined via path analysis in AMOS v. 26. Model fit for the TAM measurement model and TAM path analysis was determined via inspection of fit indices (CFA, TLI, RMSEA, and RMR) in line with recommended cut-scores in the literature (e.g., Kline, 2011; Schmitt, 2011). Indirect pathways were examined via AMOS v. 26 bootstrapping with 200 samples and calculation of 95% bias corrected and accelerated confidence intervals (BCa CIs). Significant indirect pathways are observed where the 95% BCa CI does not include zero (Preacher, Rucker, & Hayes, 2007). The role of sexual orientation for RQ1 was examined via two techniques. First, overall TAM model fit variation was inspected via a Chi Square difference test (i.e., heterosexual versus sexual minority subsamples). Where model fit variation was observed, subsequent inspection of indirect pathway 95% BCa CIs were also checked for variation. Second, multi-groups analysis (Vandenberg & Lance, 2000) via AMOS v. 26 was used to assess whether the TAM links varied by subsample (i.e., heterosexual versus sexual minority).

Results

Sexual Orientation Reclassification & Assessment. Sexual orientation was recoded due to small cell counts across the majority of sexual minority categories (see Table 1). Reclassification

occurred along a binary sexual orientation grouping of heterosexual versus SM. That is, everyone indicating a non-heterosexual orientation was reclassified into the SM subgroup. This approach was necessary due to low sample size counts in many SM categories that would be under powered for sample size requirements in path analysis (Kline, 2011). While not ideal in terms of capturing the full spectrum of SM identity, this practice is common in SM health research (e.g., Cramer et al., 2012; Oliver et al., 2019). This dichotomous variable was utilized for RQ1 below. We examined sexual orientation group differences by other demographics. The only significant difference observed was for a collapsed and reclassified relationship status variable, $X^2(2) = 7.05$, $p = .03$, Cramer's V = .14. SM persons were approximately 1.25 times more likely than heterosexual counterparts to report being in a polyamorous or open relationship.

H1: Health Enhancement App Perceptions and Usage by Sexual Orientation. Just under half of participants reported using mobile technology for health enhancement purposes (see Table 1). Table 2 summarizes sample statistics for perceptions of health enhancement app usage. Item means on TAM-derived subscales indicated average perceptions between neutral and strong agreement in intention, PU and PEU concerning mobile technology for health enhancement. Sexual orientation was unassociated with: (1) PU (T[330] = -0.32, $p = .75$); (2) PEU (T[330] = -0.13, $p = .90$); and (3) intention to use health enhancement apps (T[330] = -0.77, $p = .44$). Further, actual health enhancement app usage did not vary by sexual orientation, $X^2(1) = 0.12$, $p = .72$. H1 was unsupported.

H2 to H4: **TAM Application to NCSF Community, Links, and Indirect Pathways**. TAM constructs (i.e., PEU, PU, and intention) were examined via observed scales in hypothesis testing in order to represent the key constructs in their wholly quantified format, and to be consistent with how actual usage was measured. Figure 2 contains a visual depiction of the TAM path analysis with standardized pathways. Supporting H2, the TAM path model displayed good fit to the data (see Table 3 for fit indices), indicating appropriate TAM applicability to explain health enhancement app usage among NCSF members. Confirming H3a to H3c, all TAM direct pathways were significant and positive (see Figure 2 for standardized estimates, all ps < .001). In support of H4a to H4c, all TAM-supported indirect pathways

were significant (see Table 4 for indirect pathway statistics), indicating mediation is present for hypothesized pathways.

RQ1: Sexual Orientation as a Moderator of TAM. The Chi-square difference test was significant, $X^2/df = 88.86$, $p < .001$, suggesting TAM model fit for the SM subsample was stronger than for the heterosexual subsample. Multi-groups analysis examining specific TAM link differences by sexual orientation were non-significant (Z range -1.13 to 0.86, all ps > .05). Therefore, TAM links did not vary by sexual orientation. Indeed, all direct TAM links remained significant (all ps ≤ .001) across subgroups. Table 4 contains a summary of indirect pathway statistics by subsample. All indirect pathways remained significant in the SM subsample, whereas only the PEU-Intent-Use indirect pathway remained significant for the heterosexual subsample.

Discussion

The overall picture of health enhancement app usage among NCSF members is promising. A large proportion of community members report use of health and lifestyle apps already; moreover, perceived ease of use and intention to use mobile technology for health enhancement was relatively strong among the whole sample, with no variation based on bivariate analyses. The specific context of health enhancement and/or unique nature of the alternative sexuality community may explain why all members of the sample reported relatively equal perceptions and use of mobile technology in this study. For instance, NCSF is comprised of a relatively high proportions of college or post-graduate educated persons and individuals with high income (Gemberling et al., 2015). This may contribute to increased access to technology because of affordability and regular usage through education, respectively. The generally high PEU and intent to use technology is consistent with literature showing strong willingness and acceptability of technology-based health assessment among MSM (e.g., Holloway et al., 2014; Yang et al., 2015). Finally, the collective picture of positive receptivity to app use and TAM-related constructs may be due to the alternative sexuality community's comfort with use of technology as a mode of communication. Indeed, empirical literature suggests that for members of the alternative sexuality community, technology use may promote disinhibition, yielding use of technology for a variety of

reasons such as relationship communication, exchange of sexual fantasy, and lessening chance of threat (Rubinsky, 2018). Similar logic may apply for health enhancement such that technology use is seen as useful, less threatening, and easy due to enhancing well-being and reducing barriers to healthcare access and communication. Taken as a whole, descriptive patterns show promise for the use of health enhancement mobile technology with members of the alternative sexuality community. However, our explanations are tentative and in need of further empirical inquiry.

We also evaluated the applicability of the TAM in explaining health enhancement app usage. Doing so holds promise to identify factors to address in future design and implementation of health enhancement app programming. Employing the original TAM (Davis, 1989; Davis et al., 1989), model fit findings support high applicability of the model to comprehend contributing factors to intention and actual health enhancement mobile technology. Specific supported pathways showed that PU (e.g., to improve mental and physical health) and PEU (e.g., over ease, enjoyment) explain intent and actual use of apps for health enhancement. This set of findings adds to the range of healthcare-related TAM applications in the literature (Holden & Karash, 2010; Rahimi et al., 2018). It also adds to literature (e.g., Chakrapani et al., 2017) showing the TAM may be useful in understanding mobile technology and related intervention feasibility.

Given the general receptivity to mobile technology usage for physical and mental health, a next step concerns subject matter which to address with members of the alternative sexuality community. Members of NCSF and this broader sexual subculture have endured a history of stigma and discrimination (Wright, 2008, 2018). Likewise, emerging evidence (Cramer et al., 2017; Roush et al. 2017) highlights suicide as a potential high risk issue for the community. Initial efforts in app testing with members of the alternative sexuality community may, therefore, seek to redress discrimination, suicide, and related stressors. For instance, there is growing evidence to support stress reduction and improved well-being through mindfulness skill-enhancing apps in non-clinical samples (e.g., Bostock et al., 2019; Champion et al., 2018). Investigation of the use of these types of apps in conjunction with seeing a mental health or other healthcare provider may also be valuable in light of evidence that apps targeting suicide

risk factors may assist in reducing ideation (Kreuze et al., 2017). Apps may also be developed and piloted for alternative sexuality-specific needs. For example, apps may be developed to catalogue and identify BDSM/kink culturally competent providers or life coaching apps facilitating self-assessment of social, sexual, and mental health. Consistent with recent theory-based app research (e.g., Motulsky et al., 2019; Turk et al., 2019), design of new and implementation of existing topic-specific apps (e.g., mindfulness, stress coping) with NCSF members should first feature qualitative or mixed-methods development research to account for tenets of the TAM tested in the present study. For instance, issues such as user enjoyment, affordability, ease of use, and perceived usefulness in addressing physical or mental health needs is a critical first step to ensure impactful health enhancement app implementation.

Building on the limited SM TAM literature (e.g., Zhang et al., 2019), another pattern observed in the present study is that TAM fit and indirect pathways may be more appropriate for SM members of the alternative sexuality community compared to heterosexual counterparts. A number of explanations exist for this double minority trend. Higher SM interest and intent to use apps for health enhancement may be due to an increased need to redress mental health and physical health disparities by NCSF status (Cramer et al., 2017; Wright, 2008) and sexual minority status (e.g., Frost et al., 2015; IOM, 2011). In other words, double minority status may yield increased need and desire for practical, convenient health enhancement resources. Alternatively, the observed diversity in relationship status or number of sexual partners by sexual orientation may drive an overall elevated interest in and familiarity with app use for a variety of reasons. Although SM by relationship/partner cell sizes were too small for moderation analysis, the potential moderating role of relationships and sexual partners is worthy of further study. Finally, the modest sample size of heterosexual-identifying persons may have yielded low statistical power. As such, sexual orientation-related findings are tempered by this potential limitation.

SM findings in combination with the private and oft stigmatized nature of BDSM/polyamory collectively point to another potential domain of app development: virtual peer support. Social and community support are documented buffers against the negative health effects of stigma and discrimination (Meyer, 2013). Although no SM/BDSM peer support app-based study could be located in

the literature, Flickinger and colleagues (2016) conducted a descriptive assessment of a mobile phone-based support program for persons living with HIV. Of note is that much of the content focused on psychosocial support and communication among members of the mobile technology-based community. A similar app-based forum could be developed as a peer support model for coping with discrimination and building a sense of a safe community. Initial steps should involve members of the NCSF and broader community in order to address user needs and perceptions of ease, safety, and usefulness.

A number of limitations beyond those noted warrant mention. The sample demography was limited with respect to country (U.S. only), race and ethnicity; moreover, sexual orientation was collapsed into a restrictive binary variable for analyses. Future alterative sexuality community health research should seek to over sample by other countries and intersectional categories through community-engaged partnership, social media advertising, or comparison to other adult samples. A procedural limitation may be seen in the use of an incentive and use of both email listserv and social media recruitment streams. Although use of modest incentives can generally enhance likelihood of completing an online survey, members of an already private community may perceive financial inducement negatively because of the need to provide a separate email address. It is noteworthy that prior NCSF surveys without incentives (e.g., Wright, 2008) have yielded larger sample sizes. Measurement limitations include assessment of app usage using "health and lifestyle" phrasing and intention with "willingness" wording. Health enhancement app studies would benefit from more precise measurement of app subtypes and intention to use apps in the future. Finally, our TAM definition was limited to the original model. TAM healthcare literature often adapts the model (Holden & Karsh, 2010). Example TAM adaptations include, but are not limited to, inclusion of perceived social norms and expected effort as factors in the model, as well as accounting for population- or topic-specific variation (e.g., including prior experience with a particular type of technology). Future SM and alternative sexuality TAM research may benefit from expanding to other technologies (e.g., those in sexual practice) and account for population-specific factors (e.g., perceived need based on experiences of discrimination). For instance, the TAM could be employed to assess factors influencing use of telehealth for sexual healthcare needs and relationship/dating apps.

Likewise, the TAM can be adapted to incorporate expectations and experience of healthcare-related discrimination, as well as perceived or actual support and connectedness to the alternative sexuality community.

   Conclusions. PEU, intention to use, and actual use of mobile technology for health enhancement purposes were relatively strong among NCSF members and did not vary by sexual orientation. The TAM (Davis, 1989; Davis et al., 1989) was useful in understanding factors influencing intent and actual usage of mobile technology for health enhancement purposes. Findings point to a high potential for health app development and implementation with members of the alternative sexuality community. The TAM may be more suitable for application among SM compared to heterosexual members of the alternative sexuality community. This finding is tempered by demographic confound and low sample size limitations. Next steps in this line of research should focus on wider engagement with the alternative sexuality community, as well as testing health enhancement app adoption and impacts in partnership with NCSF.

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Table 1. Sample Demographic Information.

Variable	N (%)
Gender	
Male	116 (34.9)
Female	172 (51.8)
Male-to-Female	7 (2.1)
Female-to-Male	3 (0.9)
Transitioning	1 (0.3)
Gender Queer	20 (6.0)
Other (e.g., Fluid)	13 (3.9)
Sexual Orientation	
Gay	15 (4.5)
Lesbian	4 (1.2)
Queer	18 (5.4)
Straight	73 (22.0)
Questioning	1 (0.3)
Experimenting	8 (2.4)
Pansexual	46 (13.9)
Demisexual	2 (0.6)
Heteroflexible	27 (8.1)
Bisexual	63 (19.0)
Other	2 (0.6)
Multiple Identities	73 (22.0)
Sexual Orientation (Collapsed Subgroups)	
Sexual Minority	259 (78.0)
Heterosexual	73 (22.0)
Ethnicity	
Hispanic/Latino(a)	14 (4.2)
White/Non-Hispanic or Latino(a)	318 (95.8)
Race	
White	308 (92.8)
Black	9 (2.7)
Chinese American	2 (0.6)
Indian	2 (0.6)
American Indian/Alaskan Native	15 (4.5)
Vietnamese American	1 (0.3)
Guamanian	1 (0.3)
Filipino	5 (1.5)
Other Pacific Islander	1 (0.3)
Other Race (e.g., Biracial)	18 (5.4)
Partner status	
Single (not dating)	35 (10.5)
Dating one partner	24 (7.2)
Polyamorous	113 (34.0)
Dating several partners	17 (5.1)
In a monogamous relationship	46 (13.9)
In an open relationship	55 (16.6)
Engaged to be married, married, or civil union	42 (12.7)
Use mobile technology for health enhancement?	
No	176 (53.0)
Yes	156 (47.0)

Table 2. Sample Technology Acceptance Model Descriptive Statistics.

Technology Acceptance Model* Variable	M (SD)	Qualifier
Perceived Usefulness[a]	4.73 (1.71)	Neutral
Perceived Ease of Use[a]	5.14 (1.34)	Neutral-to-Strongly Agree
Intention to Use[a]	5.08 (1.88)	Neutral-to-Strongly Agree

Notes: M = mean; SD = standard deviation; Qualifier = approximate qualitative label associated with item mean for Technology Acceptance Model (TAM) construct; *Item mean for TAM construct applied to use of mobile technology for health enhancement purposes; a = seven-point scale where 1 = *strongly disagree*, 4 = *neutral*, and 7 = *strongly agree*.

Table 3. Fit Statistics for Technology Acceptance Model Analyses.

Model	X^2 (df), p	CFI	TLI	RMSEA (90% CI)	RMR
TAM measurement model	37.57 (16), p = .02	.99	.98	.06 (.04, .09)	.06
TAM path analysis (full sample)	7.96 (2), p = .02	.99	.97	.09 (.03, .17)	.02

Notes: CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; RMR = Root Mean Square Residual; TAM = Technology Acceptance Model.

Table 4. TAM Indirect Pathway Test Statistics.

Indirect Pathway	β	95% BCa CI	p	Significant Pathway?
PEU-PU-Intent (Full sample)	.44	.32, .62	.01	Yes
PEU-Intent-Use (Full sample)	.13	.11, .15	.01	Yes
PU-Intent-Use (Full sample)	.06	.04, .08	.01	Yes
PEU-PU-Intent (Heterosexual subsample)	.39	-.05, .74	.10	No
PEU-Intent-Use (Heterosexual subsample)	.13	.07, .20	.01	Yes
PU-Intent-Use (Heterosexual subsample)	.04	-.004, .10	.07	No
PEU-PU-Intent (Sexual minority subsample)	.45	.31, .64	< .01	Yes
PEU-Intent-Use (Sexual minority subsample)	.13	.11, .14	.01	Yes
PU-Intent-Use (Sexual minority subsample)	.06	.04, .08	.01	Yes

Notes: β = Mediation estimate; BCa CI = Bias corrected and accelerated confidence interval; Significant pathway? = indirect pathway suggests mediation (yes/no); PEU = Perceived Ease of Use; PU = Perceived Usefulness; Intent = Intention to use mobile technology for health enhancement; Use = Behavioral use of mobile technology for health enhancement.

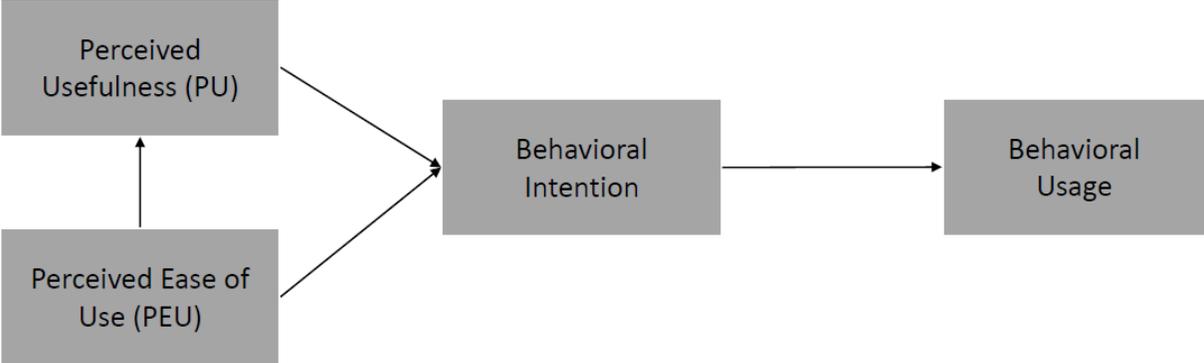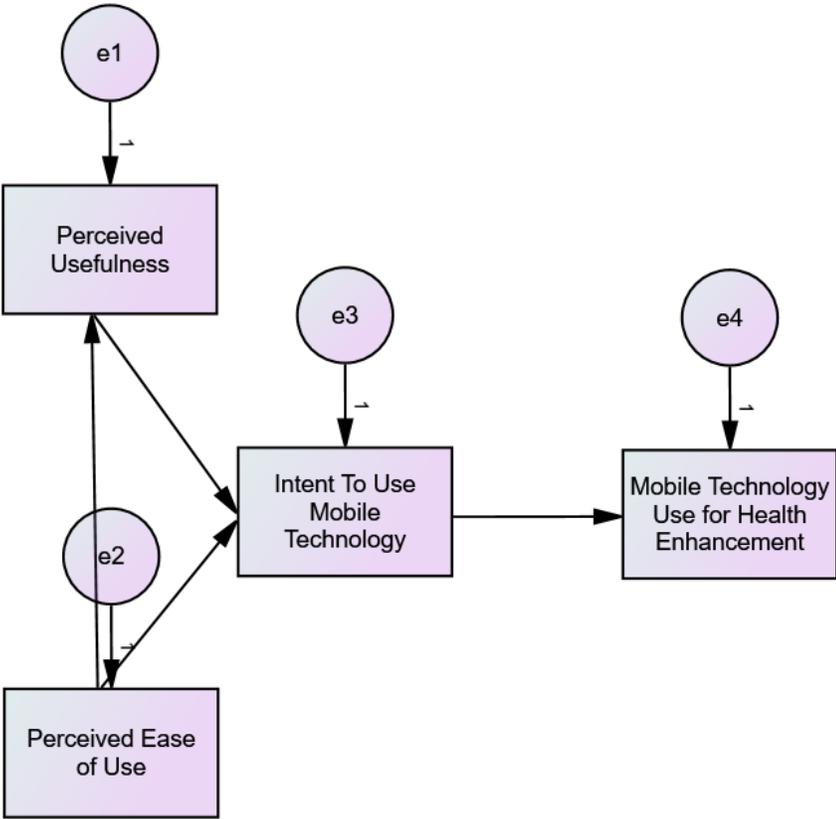Figure 1. Technology Acceptance Model (TAM)

Figure 2. Technology Acceptance Model Path Analysis.

Notes: Perceived Ease of Use, Perceived Usefulness, and Intention = subscale item means; Behavioral Use = no/yes.

Appendix. Technology Acceptance Questions

Instructions: The following questions ask about are about your willingness to use a mobile phone or similar device – for example, a tablet or iPad – to track or change aspects of your physical and mental health.

	Strongly Disagree			Neutral			Strongly Agree
1. I am willing to use mobile technology for tracking my health.[a]	1	2	3	4	5	6	7
2. I am willing to use mobile technology to help me try to improve my health.[a]	1	2	3	4	5	6	7
3. I think using mobile technology for healthier <u>physical health behaviors</u> (e.g., apps for eating habits, physical activity, drinking, etc.) can improve my physical well-being.[b]	1	2	3	4	5	6	7
4. I think using mobile technology for <u>mental health</u> improvement (e.g., apps for tracking mood, relaxation, etc.) can improve my emotional well-being.[b]	1	2	3	4	5	6	7
5. I think I would be successful in using mobile technology to improve my health.[c]	1	2	3	4	5	6	7
6. I think I would enjoy using mobile technology to improve my health.[c]	1	2	3	4	5	6	7
7. Mobile technology is easy to use for me.[c]	1	2	3	4	5	6	7
8. Mobile technology is affordable for me.[c]	1	2	3	4	5	6	7

Note: [a] = intent to use; [b] = perceived usefulness; [c] = perceived ease of use

Health app usage:
Which type or types of apps do you use? (select all the apply)
- Productivity apps, for example calendar, alarms, or list-making apps
- Social media apps, for example Facebook, Instagram, or Twitter
- Health and lifestyle apps, for example apps to track diet or weight, physical activity, or sleep*
- Entertainment apps, for example apps to play games, listen to music, or watch sports
- Travel or Weather apps, for example apps to access maps, check traffic, plan trips, or check the weather

Note: * = behavioral use of health app outcome used in the present study.