

## Exploring User Acceptance of a Text-message Based Health Intervention

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### Abstract

*Information technology has been used in diverse ways. It has been utilized to reduce costs in the public sector and increase consumer satisfaction in the private sector. Technology may also be instrumental in improving individuals' healthy behaviors. For instance, statistics suggest that technology-based interventions may promote healthy sexual behaviors; however, few studies have explored willingness to participate in technology mediated interventions. This study uses Diffusion of Innovation Theory to identify factors that influence one's intention to use a text-message service to receive sexual health information. The results indicate that technology adoption factors rather than risk beliefs and privacy concerns impacted participant's intention to use a text-message intervention. The findings of this study have significant implications for innovative uses of technology to promote health.*

### 1. Introduction

According to Anderson et al. (2004) behavioral interventions are “interventions designed to affect the actions that individuals take with regard to their health.” At the individual level, “interventions encourage people who are at high risk for a particular disease to do something about it. Examples are programs that encourage smokers to quit...or diabetics to exercise.” Technology-based interventions have shown a lot of potential over the past decade by using computer technology as the primary or sole medium to deliver interventions to a variety of participants (Bull et al., 2012; Noar et al.,

2011). The promise shown by technology-based interventions is partially based on the large number of advantages it has over more traditionally delivered programs. Technology based interventions eliminate frequently cited barriers to prevention/care access such as transportation, child care, and insurance (Cole-Lewis & Kershaw, 2010; Ybarra & Bull, 2007). Similar to traditional programs, technology-based interventions allow for cultural tailoring of messages but surpasses traditional programs because recipients can easily share the content with their social networks (Noar et al., 2011). Technology-based interventions can play an important role in health-related prevention interventions by disseminating information to participants via avenues they are familiar with and regularly use (e.g., mobile technology, interactive webpages, and social networking sites).

In 2008, there were an estimated 4 billion mobile phone subscribers (Cole-Lewis & Kershaw, 2010). This is a four-fold increase from just six years previous. Further, the Kaiser Family Foundation (2007) reported that there are millions of text messages being sent between mobile telephones each month. Mobile technology, in particular, is a great avenue to deliver health information (Vogel et al. 2013) and is an emerging format among technology based interventions (Fjeldsoe, Marshall, & Miller, 2009; Leach-Lemens, 2009; Lim, Hocking, Hellard, 2008). Mobile technology used to deliver health – based prevention and interventions through voice calling, Internet, video messaging, and text messaging is referred to as mobile health (mHealth). mHealth is particularly valuable with younger populations given their rates of access and use of

mobile technology, especially text messaging (Lasica, 2007; Lenhart, 2009; Levine, McCright, Dobkin, Woodruff, & Klausner, 2008), which allows researchers to capitalize on their existing cultural behaviors. Technology based interventions have a number of advantages, but there are additional advantages to using text messaging, especially with younger populations. For example, text messaging does not require great technology expertise; it is readily available on most models of mobile telephones; it is asynchronous; participants can access the messages confidentially (Cornelius & St. Lawrence, 2009) and at their convenience (Fledjoe, Marshall & Miller, 2009); and it is the most frequently used mobile data service (Lasica, 2007). Despite these advantages, text messaging to provide sexual health messages presents some challenges relative to traditional face-to-face health interventions. For example, barriers to technology adoption such as concerns about privacy or risk associated with technology such as improper access, errors, and unauthorized secondary use may impact participants' willingness to use technology based interventions (Dinev & Hart, 2006; Van Slyke et al., 2006). Among African American populations who have experienced a long history of medical maltreatment (e.g. Tuskegee experiment) (Washington, 2007) issues of medical technology abuse may be particularly salient. Moreover, technology based prevention services provide fewer opportunities for participants to evaluate the sources of information and build relationships and trust.

Text messaging has been shown to be useful in delivering information, interventions, and maintenance for a number of other health-related behaviors, such as smoking cessation, asthma and diabetes management, and depression (Cornelius & St. Lawrence, 2009). An emerging body of literature has found preliminary support for the efficacy of text messaging services to increase access and use of sexual health services (Levine et al., 2008.), decrease time between diagnosis and treatment of an STI (Johansson, McNaught, Mandalia, & Sullivan, 2006), and increase sexual protective behaviors and knowledge (Gold et al., 2011). Gold and colleagues (2011) conducted a randomized controlled trial among Australian adolescents during which participants received text messages about safer sex and sun safety. After the intervention, participants in the "safer sex" messaging group reported fewer partners and greater knowledge about sexual health than participants in the sun safety groups.

Large scale efforts to use sexual health messaging include the San Francisco Department of Public Health efforts to develop 'SEXINFO' to

deliver an STI/HIV prevention program to local adolescents (Levine et al., 2008.). SEXINFO was modeled after a program in England, and the first of its kind in the US. This project received over 4,500 text messages during the first six months of implementation, and more than half of those led to access to more information and additional referrals. Since SEXINFO, there have been more interventions specifically focused on using text messaging to promote sexual health. More recently, the Centers for Disease Control (CDC) partnered with Verizon Wireless and the University of Georgia to launch a mobile telephone initiative aimed at increasing awareness and HIV testing among youth (Kaiser Daily HIV/AIDS, Report, 2008).

Given preliminary support for the efficacy of text messaging services as a means to promote sexual health, it is critical to determine barriers to the adoption of text messaging in interventions, particularly for groups experiencing the greatest burden of the STI/ HIV epidemic, such as African Americans youth and young adults.

The current study focuses on an African American college population because few HIV/STI prevention efforts are designed specifically for this population. This oversight has been attributed to the assumption that educational attainment is associated with greater avoidance of sexual risk behaviors (Hightow, MacDonald, Pilcher, Kaplan, Foust, Nguen, & Leone, 2005). Similar to other populations, college students are inconsistent condom users and engage in risky behaviors that facilitate HIV/STI infection such as engaging in unprotected sex and using drugs or alcohol during sexual encounters (Lewis, Miguez-Burbano, & Malow, 2009; Lewis, Malow, & Ireland, 1997). Because opportunities to engage in high-risk behaviors during college are high (Adefuye, Abiona, Balogun, & Lukobo-Durrell, 2009), increased attention to this population is critical.

African American young adults are disproportionately impacted by sexually transmitted infections such as HIV, chlamydia and herpes, despite engaging in greater condom use than their counterparts (CDC, 2009 Hallfors, 2007; Hou, 2009). The paradox of greater sexual health promotion behaviors and higher STIs has lead researchers to emphasize prevention measures that reach beyond individual risk behaviors (Hallfors et al., 2007) and include institutional and access related issues. For example, access to quality care, poverty, and disparities in resources are critical structural factors that may explain STI disparities affecting African American populations (Adimora & Schoenbach, 2002). Community and college health clinics that

have limited resources may have challenges providing regular testing, having staff provide timely notification of diagnosis, and providing STI/ HIV prevention services. If adopted, technology based interventions may serve as a means to combat challenges associated with limited resources.

To- date, few studies have explored the use of text-message based interventions (TMBI). Bull et al. (2012) call for more research on technology-driven health interventions. In this study, we utilize Rogers' (2003) diffusion of innovation theory (DOI) to present a model of TMBI adoption. Rogers' (2003) diffusion of innovation theory (DOI) is a generic explanation of adoption that can be applied to diverse fields. Scheirer (2013) posits that understanding technology alone is not sufficient for developing a sustainable health intervention. In light of the sensitive nature of sexual health information, we posit that perceived risk and privacy concerns will also be salient predictors of information technology adoption (Babel, 2012; Schaupp et al. 2010).

## 2. Background Literature

Technology adoption is a major facet within the field of information systems. Adoption research is concerned with identifying the factors that influence user acceptance of technological innovations. Davis' (1989) technology acceptance model and Rogers' (1983) diffusion of innovation theory (DOI) are two models commonly used to study user adoption of information systems. Unlike TAM (and its subsequent variations such as TAM2, UTAUT, UTAUT2, etc.), which refers specifically to technology adoption, Rogers (1983) conceptualizes a generic theory of adoption: the diffusion of innovation theory (DOI). In this study, we utilized the broader theoretical lense provided by the diffusion of innovation theory.

### 2.1 Diffusion of Innovation Theory

An innovation refers to a new idea, concept, object, or in this case, information system. Diffusion refers to the dissemination of an innovation into society. Rogers' theory identifies five constructs that influence a potential adopter's decision: relative advantage, complexity, compatibility, trialability and observability. Relative advantage refers to the belief that a new system has benefits above and beyond the current system. Someone who believes that a text-message based intervention is more useful than existing interventions will be more likely to adopt this innovation. Complexity refers to perceptions of difficulty associated with adopting a system. Someone who believes that a text-message based intervention will be easy to use will be more likely to

accept this technology. Compatibility posits that one will be more likely to adopt an innovation if it is consistent with his values, views, beliefs, and customs. Someone who uses her mobile phone to participate in other electronic services (view banking information, receive promotional notices) will be more likely to adopt a TMBI. The remaining constructs – trialability and observability – are not as salient in electronic environments (Van Slyke et al., 2004). Trialability posits that one will be more likely to adopt an innovation if he/she can try it out before actually committing to it. Observability suggests that one will be more likely to adopt an innovation if its benefits are visible and tangible (Rogers, 2003).

As aforementioned the Information Systems literature posits that three DOI constructs—relative advantage, compatibility, and complexity—are among the most relevant constructs to technology adoption research (Tornatzky & Klein, 1982; Van Slyke et al., 2004). Hence, we include these three constructs in our research model. Recent studies of electronic service adoption substantiate the importance of relative advantage and compatibility for electronic systems (Gefen & Straub, 2000; He et al., 2006; Schaupp & Carter 2005; Wu & Wang,2005). Regarding complexity, the literature suggests that it is task dependent for online systems (Fang et al., 2005; Gefen and Straub, 2000). Gefen and Straub (2000) posit that complexity (called ease of use in their study) is a dynamic construct with various effects depending on whether the task is intrinsic or extrinsic to information technology (IT). An intrinsic task refers to one in which the technology provides the primary end, while an extrinsic task refers to a task for which technology is merely the means to achieve the primary product or service (Gefen and Straub, 2005). Their results indicate complexity impacts intention to use when a website is used for intrinsic tasks, such as information gathering and inquiry; but it does not affect intended use when the site is used for purchasing (an extrinsic task). A text-message based intervention is intrinsic; its purpose is to provide information. A text-message based intervention does not represent a transaction (e.g. a purchase); it is simply a means for the recipient to obtain information.

### 2.2 Perceived Risk

In addition to technology related factors, other individual concerns may impact user adoption of text-message based interventions. In light of the threats to electronic information in this digital age, it is important to understand the impact that risk perceptions have on technology adoption. Perceived

risk is defined as *the citizen's subjective expectation of suffering a loss in pursuit of a desired outcome* (Warkentin et al., 2002). Perceived risk is composed of behavioral and environmental uncertainty. Behavioral uncertainty exists because online service providers may behave in an opportunistic manner by taking advantage of the impersonal nature of the electronic environment, while environmental uncertainty arises due to the unpredictable nature of Internet-based technology that is beyond the control of the consumer (Pavlou, 2003).

In e-commerce perceived risk reduces users' intentions to exchange information and complete transactions (Pavlou, 2003). According to Schaupp et al. (2010), perceived risk has a synonymous effect on citizen utilization of electronic services provided by the public sector. With regards to mobile technology, recent studies indicate that malicious attacks against smartphones increased 155% in 2011 (Savitz, 2012). Savitz (2012) also states that in a seven month period, the number of attacks against Android phones increased 3,325% in 2011. In light of the research findings and alarming statistics, we posit that perceived risk will reduce one's intention to use a text-message based intervention.

### 2.3 Privacy Concerns

Given the numerous threats to electronic transactions, many technology users are reluctant to disclose personal information electronically due to their concern for information privacy (Babel, 2012). These concerns are not without merit. In 2011, the Internet Crime Complaint Center (iC3) received over 300,000 complaints for a third year in a row. In 2011, the number of complaints rose by 3.4 percent when compared with 2010. The dollar loss associated with these complaints was \$485.3 million (iC3, 2011). A study conducted by PEW Internet and American Life Project revealed that 47 percent of internet users are aware of their digital footprint (Madden et al., 2007). Clarke (1999) posits that individuals are interested in having an appreciable influence on the handling of data about themselves. This desire highlights the importance of understanding the public's privacy concerns.

Information privacy refers to an individual's ability to control information about himself (Stone et al., 1983). The electronic environment introduces new challenges to maintaining information privacy. In light of the inherent risks of transmitting sensitive information electronically, many citizens want assurance that their personal information will not be made available to other individuals and organizations without their consent (Skinner et al., 2006). Laufer and Wolfe (1977) posit that the privacy calculus

refers to a decision-making process whereby citizens weigh the anticipated benefits and consequences before disclosing personal information. Culnan and Armstrong (1999) suggest that citizens are more likely to disclose personal information once they have been informed of the organization's privacy practices. Dinev and Hart (2006) extend the work of Culnan and Armstrong (1999) to account for internet transactions. Our proposed research model incorporates privacy concerns associated with using a text-message based intervention. In particular, we posit that an individual with a high concern for his information privacy will be less likely to adopt a text-message based intervention, than someone with minimal privacy concerns.

### 3. Research Model and Hypotheses

Based on the aforementioned literature, we propose the following research model (see figure 1). Intention to use a text-message based intervention is influenced by relative advantage, compatibility, complexity, privacy concerns and risk beliefs. Perceived complexity, perceived compatibility, and relative advantage are all predicted to increase intention to use a text-message intervention. Privacy concerns and risk beliefs are predicted to decrease use intentions. The proposed research model is presented in figure 1 and the research hypotheses are presented in table 1.

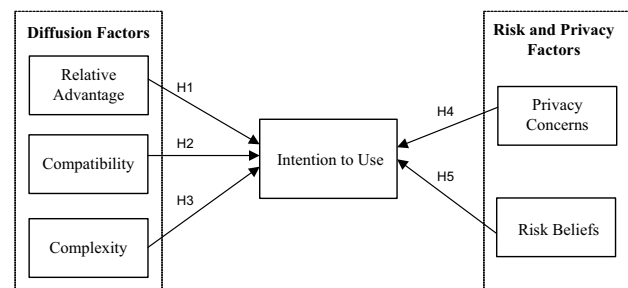


Figure 1. Proposed Research Model

Table 1. Research Hypotheses

H1.	Relative Advantage (RA) will have a positive effect on intention to use.
H2.	Compatibility (CT) will have a positive effect on intention to use.
H3.	A lack of Complexity (CX) will have a positive effect on intention to use.
H4.	Privacy concerns (PC) will have a negative effect on intention to use.
H5.	Risk Beliefs (RB) will have a negative effect on intention to use.

## 4. Methodology

To test our research model, a survey was administered to African American young adults attending a historically Black college/university (HBCU). Participants were given the option to complete the survey online or in-person. All participants elected to complete the survey online. The study was approved by the institution’s Internal Review Board. Multiple linear regression analysis was used to examine the impact of technology-related and psychosocial factors on the acceptability of a technology intervention to promote healthy sexual behaviors.

### 4.1 Sample

Participants were recruited from undergraduate psychology courses. Participants were given the opportunity to participate in any of five IRB approved research studies using the SONA website system. The SONA system is designed to anonymously manage research participation by allowing research participants to sign up for research studies and complete online or in person surveys anonymously. Approximately, 500 students were recruited to participate in the study making the response rate 24%.

The survey was completed by 120 participants. The majority of the participants (91%) were in the 18-24 age group. Most participants (96.7%) described themselves as African-American. Most participants (91%) use their phone to search the Internet for information and nearly all (99%) have used their cell phone to send a text-message.

### 4.2 Instrument Development

Questions were compiled from validated instruments (Carter and Belanger 2005, Dinev et al. 2006, Malhotra et al. 2004, Moore and Benbasat 1991). The items were adapted to assess user perceptions of a text-message based intervention. For instance, one

relative advantage reads “ Overall, I would find using a text-message service to be advantageous in my life.” A compatibility item reads “Using a text-message service for sexual health information would fit well with my current lifestyle.” A sample complexity item reads “I believe my interaction with a text-message service would be clear and understandable.” And one of the intention to use items reads “16. If presented with the opportunity, I would use a text-message service to receive sexual health information.”

Questions were measured using a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A copy of the survey is available upon request.

### 4.3 Data Analysis

Preliminary analyses included reliability analysis and confirmatory factor analysis. Items were tested for reliability using Chronbach’s alpha.

Table 2. Reliability Analysis

<b>Construct</b>	<b># items</b>	<b>Reliability</b>
Relative Advantage (RA)	5	.892
Compatibility (CT)	3	.903
Complexity (CX)	3	.844
Privacy concerns (PC)	4	.934
Risk Beliefs (RB)	4	.856
Intention to Use (USE)	3	.888

Factor analysis was conducted using principal component analysis with promax rotation. Most items loaded on the proper factor. Relative advantage (RA), compatibility (CT), and intention to use (USE) items loaded together. Similar occurrences have been noted in other studies. For instance, RA and CT loaded together in other DOI research (Moore & Benbasat, 1991; Carter & Bélanger, 2005). Moore and Benbasat (1991) conducted a thorough study using several judges and sorting rounds to develop reliable measures of diffusion of innovation constructs. Although the items for RA and CT were identified separately by the judges and sorters, they all loaded together. Moore and Benbasat concluded, ‘this may mean that, while conceptually different, they are being viewed identically by respondents, or that there is a causal relationship between the two (Moore & Benbasat, 1991)’. For example, ‘it is unlikely that respondents would perceive the various advantages of using [state e-government services], if its use were in fact not compatible with the respondents’ experience or [life] style (Moore & Benbasat, 1991)’. Finally, cross loading item RA6 was dropped from further analysis.

The research model was tested using multiple linear regression analysis. The goal of this study is to determine the relationship between use intentions (dependent variable) and participants' perceptions of information technology adoption (independent variables). The model includes five independent variables (relative advantage, compatibility, complexity, privacy concerns and risk beliefs) and one dependent variable (intention to use).

## 5. Results

The model explains a large percent of the variance in intention to use a text-message based intervention,  $adj R^2 = .731$ . Since the overall model was significant ( $F=55.865$   $p < .0001$ ), we tested the significance of each variable.

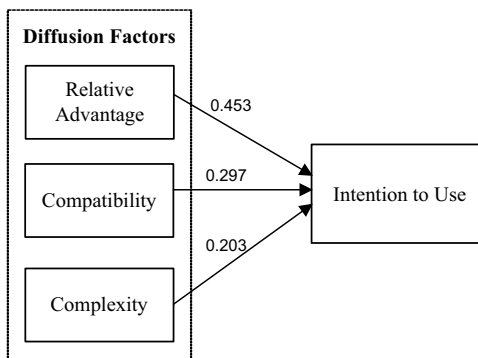


Figure 2. Significant Results with Path Coefficients

Three of the five hypotheses were supported. Relative advantage, compatibility, and complexity all have a significant impact on intention to use a text-message based service (see table 4).

Table 4. Results of Hypotheses Testing

Hypothesis	Coeff.	t-val.	Sig.	Supported
H1 (RA)	.453	4.981	.000	YES***
H2 (CT)	.297	3.024	.003	YES***
H3 (CX)	.203	3.001	.003	YES***
H4 (PC)	.023	.316	.753	NO
H5 (RB)	-.095	-1.324	.189	NO
* $p < 0.10$ , ** $p < 0.05$ , *** $p < .001$				

## 6. Discussion

In 2010, Healthy People 2020 was released and it includes a number of health care target areas (U.S. Department of Health & Human Services, 2012).

Four Healthy People 2020 objectives are to reduce the number of people who become infected with HIV, increase access to care and improve health outcomes for people living with HIV, reduce HIV related health disparities, and reduce the proportion of adolescents and young adults with STIs. Text messaging has been found to be a useful intervention tool for health promotion (Gold, et al; Levine et al., 2008) and is becoming an increasingly common intervention component. However, less is known about barriers to text messaging use for health promotion. The purpose of the current study was to examine variables that influence intention to use a text messaging service to receive sexual health information. Understanding barriers to text messaging may be useful in helping to reduce HIV and STDs and for understanding barriers to other CBTIs, such as social networking sites.

We found that technology factors, not privacy and risk concerns, have a salient impact on intention to use a text-message based intervention. These findings suggest that a mobile intervention would be more successful among people who perceive the benefits of a mobile intervention (relative advantage), who use mobile services to receive other types of information (perceived compatibility), and who feel confident in their ability to easily learn how to use this service (perceived complexity). Of these covariates (relative advantage, compatibility, and complexity), the most important factor was relative advantage followed by compatibility and complexity. Our findings are consistent with other studies (e.g., Ceccuci, Peslak, & Sendall, 2010; Llie et al., 2005).

Similar to the current study, Ke and Li (2009), Premkumar and Ramamurthy (1995), and Teo and Tan (2000) found that relative advantage is a significant predictor of intention to use a text-message based intervention. Further, Premkumar and Ramamurthy (1995) also found that the greater the complexity of a text messaging program, the slower the rate of adoption. Most recently, Ceccuci, Peslak, and Sendall (2010) used Rogers' Diffusion of Innovation Theory, End User Computer Satisfaction, Theory of Reasoned Action, Theory of Planned Behavior, and Technology Acceptance Model to examine text message intention. They examined psychosocial factors associated with intention to text message and found that compatibility and ease of use/complexity were significant predictors of text message intention. Hence, ease of use/complexity is an important factor as well as compatibility (e.g., text messaging fitting the respondents' communication style). Taken together, our findings, relative advantage, complexity, and compatibility suggest several elements need to be considered when

designing health interventions with a text messaging component.

The variance explained in our study (73.1%) is similar to other studies that have used Rogers' Diffusion of Innovation Theory to examine text message intention. For example, Ceccuci, Peslak, and Sendall (2010) explained 79.9% of the variance in a study that included additional covariates (e.g., attitude, satisfaction). Interestingly, we did not find support for our hypotheses that privacy concerns and risk beliefs would negatively affect intention to use text messages. Given African American young adults reported lack of barriers to technology adoption, high use of mobile technology, and disproportionate burden of the STI epidemic, mhealth interventions designed to promote sexual health may be an avenue that warrants increased emphasis for African American young adults. Future research should examine additional covariates (e.g. geographic locale, educational background) to determine if these variables impact risk perception and technology adoption.

Our study has several limitations. First, this study used a convenience sample, which suggests that its findings may not be generalized to the larger population. This study also used cross-sectional data, which limits our ability to establish causality. This study also used self-report data. As such, social desirability may be a potential threat to the validity of this study.

Despite these caveats, this study helps to fill a gap in the knowledge base. First, to our knowledge, this is one of the first studies (if any) to examine potential barriers to using text messages to receive sexual health information in a sample of African American young adults. Given that African Americans are more likely to be residentially mobile and use mobile cell phones (Lenhart, 2010) and are at a disproportionately higher risk of being diagnosed with HIV and STDs (CDC, 2009), this research is critical. In particular, we explore this population's perceptions of text-message based interventions (TMBI).

## 7. Conclusion

Mobile services, in general, and text messaging in particular, continue to be common methods of communication in the U.S. This form of communication is also becoming more prevalent in sexual health interventions. This study is one of the first to examine barriers to engaging in a text-message based intervention among African American young adults. In general, the findings (relative advantage, complexity, and compatibility) adhere to

the proposed conceptual model and should be useful to researchers and interventionists as they develop strategies to design future mhealth interventions. Program developers and interventions specialist should be aware that for African American young adults privacy and risk concerns may not deter use, but education regarding these issues may be necessary prior to implementation.

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