EFFECTS OF INTERACTIVITY, CONTINGENCY AND CONVERSATIONAL TONE ON USER RESPONSES TO A WEB-BASED HEALTH APPLICATION.

A Dissertation in
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by
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ABSTRACT

Does the power of interactive media rest in their ability to afford natural and human-like conversations? Do we believe that human-machine interactions are capable of successfully engaging us, if they can mimic the back-and-forth dialogue found in human-human interactions? The current study (N = 172), employing a between-subjects experiment, examines the effects of two dialogue-based variables—(i) message-interactivity, operationalized via contingency in message exchanges, and (ii) conversational tone, operationalized in terms of informal turn-taking cues—in how they influence participants’ responses to an online health information tool. Findings suggest that the effect of message-interactivity was positively mediated via perceived contingency and negatively mediated via perceived interactivity in influencing health-related attitudes and behavioral intentions. By enhancing perceptions of contingency in the system’s interaction with the user, message interactivity serves to increase user engagement with the health content supplied by the system. However, users’ perception of interactivity (or the degree of feedback and two-way communication) was at odds with message interactivity, with study participants perceiving greater interactivity when there was lesser contingency in the system’s responses to user input. This, in turn, led to greater perceptions of message relevance, resulting in greater cognitive elaboration of health information. An informal conversational tone, in the form of verbal turn-taking cues, lowered perceptions of relative susceptibility to health risks. Implications for designing future interactive health technologies and theoretical considerations surrounding the concepts of interactivity, contingency and turn-taking cues are discussed.
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INTRODUCTION

A recent poll by the National Public Radio, the Robert Wood Johnson Foundation and the Harvard School of Public Health (2012) revealed that a majority of individuals (61%) are dissatisfied with the amount of time that doctors spend talking with their patients. Data like this demonstrate that many individuals come away from doctor’s office visits feeling that their information and psychosocial needs are not met as effectively as they had hoped. Given the resource constraints of the health care system, this kind of problem is understandable, but it is important to address it. How do individuals try to cope with this need for more face-time and need for more information from their physicians? Surveys and reports have shown that they are increasingly turning to health information online (Ferguson, 1998; Fox & Jones, 2009; Spielberg, 1998), which is easily accessible, thanks to the growth of the Internet and the ubiquitous access to health information via smart phones and tablet PCs.

Sensing the public’s demand for more health information, several websites have cropped up that try to present health information to users in highly interactive formats. For instance, WebMD’s Better Health Evaluator™ invites individuals to a friendly conversation that can help them think about and rehearse the type of questions they could ask their doctors in their next visit. The conversation in the WebMD tool takes on the form of a casual chitchat with a friend, with the online tool asking users “What can you tell us about your cholesterol?” or “Compared to your friends, how often would you say..."
you exercise” and so on. Other examples of such interactive quizzes, calculators and assessment tools on the Internet cover a wide array of health topics (e.g., diet, exercise, anxiety, depression, cancer, heart disease, diabetes, etc.). How do such interactive health tools draw and sustain users’ attention and involvement? A common characteristic is their interactive nature. By trying to mimic everyday forms of human-human dialogue these tools strive to interactively provide information based on each user’s unique input into the system. Furthermore, they do so with remarkable socialness, by increasingly imitating the conversational tone of informal human-human communication.

Indeed, a hallmark of face-to-face communications is their capacity to engage individuals in an active, back and forth conversation. Extending this to our interactions with media technologies, many studies have relied on a ‘conversation metaphor’ (Cassell et al., 1999). The metaphor is used to point out how human-computer interaction is very similar to talking with another human being, in our everyday lives. This ability of machines to engage in back and forth conversation has been defined as the principle of contingency. Regardless of whether it is human-human or human-machine interaction, contingency has been thought of as the capacity of a system (or an interaction partner) to invoke and maintain highly interdependent message exchanges (Burgoon et al., 2000a; Rafaeli, 1988; Rafaeli & Sudweeks, 1997; Sundar, Kalyanaraman & Brown, 2003; Sundar, 2007). It could be argued that, psychologically, contingency rests on an inherent human tendency to mentally ‘connect the dots’. In our everyday interactions, we try to piece together various fragments of thoughts, facts and information into a threaded, coherent pattern. One of the defining features of contingency is this ability to see how messages are interrelated to one another. But how does such increased perceptions of
contingency affect the quality of interaction or its outcomes? Some have argued that it can promote a sense of mutuality and involvement among communication partners (Burgoon et al., 2000a; Walther, Pingree, Hawkins & Buller, 2005c). Others claim that these interdependent message exchanges lay the groundwork for shared understanding, also known as building ‘common ground’ (Brennan, 1998; Clark & Brennan, 1991). Therefore, a practical challenge for those who design interactive health tools is how they can incorporate the logic of contingency and also showcase interconnected conversational threads, as an integral part of the technological features of an interactive tool.

Although there has been a proliferation of interactive health tools, very little is known about how these tools affect users’ understanding of health risk information, and how they impact users’ attitudes and behavioral intentions. Does the promise of interactive health tools rest on their ability to engage individuals in a contingent dialogue? Do assurances of an active and empathetic listener on the other end enhance perceptions of interactivity? With its potential to offer more feedback and two-way communication, does interactivity affect individuals’ evaluation of a medium and the content it carries? This study seeks to explore answers to some of these questions by posing contingency-driven message interactivity as one of the independent variables. To this end, message interactivity was studied in the form of a health and wellness Question and Answer (Q&A) tool that lends itself well to a natural back and forth interaction between the user and the system.

However, contingent back and forth of information may not always constitute communication. We know from every day conversations that individuals are preoccupied not only with what they tell each other, but also how they say it (Brennan, 1998). This
preoccupation could pose challenges in online settings that are supposedly not as rich in social cues (e.g., facial expressions), when compared with face-to-face communication (Sproull & Kiesler, 1986). However, studies based on Social Information Processing theory (Walther, 1992) have shown that, given enough time, individuals adapt and compensate by using one set of cues (e.g., text and language) to make up for the absence of others (e.g., non-verbal behaviors). Further, studies based on the logic of Media Equation have demonstrated that individuals are highly skilled at applying “social scripts” from human-human interaction, even when they are dealing with computer systems for interaction partners (Reeves & Nass, 1996). This is because, our interactions with media systems are said to be “fundamentally social and natural” and whenever media systems are designed with any hints or cues to human-like behaviors, such as speech or facial expressions, we treat them as social actors (Reeves & Nass, 1996, p.5). Hence, our reactions to interactive media are driven by an affiliation motive (Argyle & Dean, 1965, as cited in Walther, 1992), which also governs how we cooperate, converse and socialize in everyday life situations. If a communication scenario were to involve strictly task-oriented dialogues, like an ATM machine dispensing cash, display of affiliation behaviors, such as a friendly conversational tone, may not be important. But, as studies in patient-physician communication have shown, healthcare interactions in particular, not only possess task-oriented dialogue but a good deal of psychosocial discourse as well (Roter & Hall, 2004). Such psychosocial dialogue, characterized by empathy, active listening, humor, etc. with one’s doctor will not only leave patients feeling more satisfied but also affect how closely they follow and stick to treatment recommendations and regimes. Hence, looking at the role of conversational tone in online
interactive tools is critical to understanding how effective offline patient-physician communication scenarios can be translated into a congenial dialogue with an online system. Therefore, the second independent variable examined in the study is the conversational tone of the interactive health tool, employed during the Q&A interaction.

In sum, the goals of this study are to understand how (a) the variable of message interactivity, manipulated as a structural affordance of an interactive health tool and (b) the conversational tone, manipulated as part of the content emerging from the tool, can influence how users’ think, feel and behave toward online health information. By situating these variables across interdisciplinary theoretical frameworks, three key explanatory mechanisms are tested. Some of the early theorizing on interactivity has promulgated the (i) role of contingency, which is examined at the structural, content and perceptual levels in this study. Theories based in computer-mediated communication (e.g., SIP) and human-computer interaction (e.g., CASA) literature have emphasized the psychological perceptions of mutuality, sociability and rapport as potential underlying mechanisms. This study explores whether interactive media are capable of generating such (ii) “interactive warmth” and if this variable is likely to affect other outcomes of interest. Further, studies coming from computer-delivered health interventions and patient-physician communication literature have pointed us toward elements of message design (e.g., tailored and adaptive feedback) and interpersonal interaction strategies (e.g., active listening) that have resulted in positive health outcomes. This study tests whether an interactive health tool that combines both elements—adaptive feedback and an informal conversational tone—is likely to make health messages seem (iii) more relevant and thus, enhance overall user engagement and satisfaction.
There is growing recognition that the present day healthcare system is no longer “reactive” and “disease-oriented”. Patients today are not merely passive recipients of health information coming from their physicians or other sources. Instead, medical care is becoming more and more proactive, preventive and “patient-centered” (Mynatt, 2011, n.p.; Roter & Hall, 2004). Therefore, looking at how modern day health information consumers respond to interactive technologies offers valuable and exciting opportunities for research.
Chapter 1

LITERATURE REVIEW

This chapter is organized into three sections. The first section will briefly review definitions and explications pertaining to the concept of interactivity. Subsequent to this, the key framework adopted in the study--the model of interactivity effects (Sundar, 2007)--and the role of contingency will be explored in detail. The second section will discuss the relevance of the Computers as Social Actors (CASA) paradigm and the computer-mediated communication literature, as they serve to inform the second independent variable manipulated in the study, namely, the role of conversational tone. Finally, the third section will review studies from computer-delivered health interventions and studies on interactive health technologies, which highlight the role of perceived relevance and how it can be leveraged to influence other theoretical implications and practical outcomes.

Interactivity Definitions

Since the turn of the 20th century, the concept of interactivity has grabbed the scholarly attention and imagination of several researchers (Ha & James, 1998; Heeter, 1989; Jensen, 1998; Newhagen, Cordes & Levy, 1995; Rafaeli, 1988; Steuer, 1992) because of its potential to bridge the domains of the mass and interpersonal communication (Bucy, 2004; Rafaeli & Ariel, 2007).
One of the approaches to defining interactivity is the technological or the Human-Computer Interaction (HCI) approach also called the functional view (Sundar et al., 2003). This involves looking at the features present in the medium or the technology that allow for interactivity to occur. Several such functionalities have been identified in prior literature, for e.g., presence of email links, hyperlinks, multimedia (audio, video, images), feedback form, chat rooms and so on. Stromer-Galley (2000) describes these as media interaction marked by the "ease with which people can control the medium to make it provide the information they want" (p.118). This is akin to Steuer’s (1992) definition of the concept in terms of active user control. The underlying premise with this functional approach to defining interactivity is that the sheer presence and increase in the number of such features constitutes higher levels of interactivity.

A different class of definitions adopt a more computer-mediated communication (CMC) approach to interactivity that point toward an interpersonal and social component. In contrast to media interaction, Stromer-Galley (2000) proposes human interaction as transaction between people via technology, which is marked by a greater degree of responsiveness and reflexivity (p.117). In her later work, the scholar further distinguishes between, interactivity-as-product, where a “set of technological features allow users to interact with the interface or system itself” (Stromer-Galley, 2004, p. 391) versus interactivity-as-process, which looks at interactivity as it unfolds between people. Similarly, McMillan (2002) proposes a typology of cyber-interactivity with two dimensions comprising “level of receiver control” (high or low) and “direction of communication” (one-way or two-way). This leads to four different categories—monologue, feedback, responsive dialogue and mutual discourse—with mutual discourse
being the most interactive category as it involves both two-way communication and greater symmetry in the level of control, with an individual switching between the roles of a sender and receiver (p. 276).

A third way of looking at interactivity is via the process view. One of the proponents of this approach, Rafaeli (1988), considers interactivity not as a characteristic of the medium but as a dynamic process that occurs as an interchange between communication partners. One of the advantages of the Rafaeli conceptualization, as Walther, Gay and Hancock (2005a) observe is that this definition is “medium independent” (p. 641) and hence, can be extended to the study of other communication contexts, beyond the group CMC processes that initially fostered it. But, as Bucy (2004) remarks, this message-exchange definition approach tends to “rarify the concept” (p. 376) and place it exclusively in the CMC realm, at the cost of overlooking how this process view might work in other mass media contexts. Does this mean that Rafaeli’s (1988) conceptualization breaks down when there are three or more people interacting? Not quite. As Sohn (2011) observes, there are ample studies (Thorson & Rodgers, 2006; Wise, Hamman & Thorson, 2006) that have been done about bulletin boards, blogs and other virtual communities where, even though, back and forth message exchanges may not be happening in real time (i.e., synchronously) with several interaction partners, individuals still consider such forums to be highly interactive, due to perceived interactivity and potential for interactivity that could occur. This aspect of perceived interactivity will be considered more fully in the sections to come.

In sum, even though there seem to be many differences in how scholars define and explicate the concept of interactivity, there is a convergence of ideas with several
models and frameworks trying to situate interactivity among three main elements of communication phenomena. For instance, Kiousis (2002) recognizes technological structure of the media, defining features of the communication setting and individuals’ perceptions as factors. McMillan (2002) consolidates them into user-to-user, user-to-document and human-to-computer domains of study (p. 286). Sundar (2007) locates them in modality-based, source-based and message-based realms. The next section will examine a model that combines all three elements into one testable framework.

**A Model of Interactivity Effects**

Sundar (2004; 2007; 2008b) considers interactivity to be one among four types of media affordances that suggest action possibilities to users. Developing this idea from Gibson’s (1977, 1979) ecological psychology realm, the concept of affordances has been widely studied in the design of digital interfaces where scholars (Norman, 1999) have argued that these action possibilities can be either perceived (i.e., imagined by the user) or real (i.e., built into a medium). Recently, the same idea has been extended to the study of *actual interactivity* and *perceived interactivity* (Tao & Bucy, 2007), where the effects of interactivity could vary, depending upon not only whether it is a real or perceived affordance, but also on whether it is a “mere presence” or if it is actually used (Sundar & Bellur, 2010, p. 489).

This dissertation uses the Interactivity Effects model (Sundar, 2007) as its primary framework since it examines, very closely, the role of the concept in the design of new media interfaces (Sundar, Xu & Bellur, 2010). The model distinguishes between three species of interactivity: modality, source and message (Figure 1). Source interactivity refers to the extent to which users act as active sources and recipients of information,
which they choose to gather, format, gatekeep and process in a manner that suits their unique needs and preferences. This phenomenon is also known as customization.

Modality interactivity pertains to the various interaction tools on the interface that offer different ways of exploring the underlying content. These are not limited to different forms of modality outputs alone, such as text, video, image, audio, and so on. They also include unique affordances present in new media that allows users to perform various actions, as part of their interaction (e.g., clicks, zoom, mouse-over, scroll, drag, etc). This study explores the role of message-based interactivity, which can be explained with the theoretical concept of contingency (Sundar, 2007; Sundar et al., 2003) described in detail below.

The rationale for adopting the interactivity effects model include: (a) The model situates interactivity in three key elements—medium, user and message—that form the fundamental variables examined across most communication processes. (b) The model propagates an affordance-view of interactivity (Sundar, 2008b) such that it discourages experimenters from treating interactivity as a monolithic construct, and instead encourages the identification of key action possibilities that different types of interactivity afford to users. (c) Further, the model recognizes potential mediating mechanisms for each of the three types of interactivity; thereby enabling tests of theory; and (d) the model’s pertinence to this study comes from the fact that it provides one of the most explicit linkages between message-interactivity (that is situated in the medium) and the notion of perceived contingency (as its perceptual counterpart in users’ minds) that aids one of the main theoretical mechanisms being tested: How does message
interactivity operate at the level of structural affordances? And how does perceived contingency promote this influence?

![Interactivity Effects Model (Sundar, 2007)](image)

**Figure 1: Interactivity Effects Model (Sundar, 2007)**

**Message Interactivity and the Contingency View**

The concept of interactivity in general, and message interactivity in particular, signals a major shift in the modeling of communication phenomena. Moving away from one-way, linear models such as Shannon and Weaver’s (1949) mathematical processes to a more bidirectional configuration proposed by Schramm (1949), the core principle of message interactivity rests more in a model such as Dance’s (1967) helical-spiral. The shape of the helical model signifies one of the core ideas that even as communication exchanges move forward, they form an interconnected loop with prior messages that were initially exchanged. Hence, Rafaeli (1988) used this as a basis to conceptualize interactivity as this model emphasizes the iterative, “circular and progressive” nature of communication processes (p. 113). More importantly, the helical-spiral model contains one of the key defining features of contingency in Rafaeli’s (1988) view, that is the
dependency, or the “contingency” on past actions. Thus, formally, he defines it as “an expression of the extent that in a given series of communication exchanges, any third (or later) transmission (or message) is related to the degree to which previous exchanges referred to even earlier transmissions” (Rafaeli, 1988, p. 111, see Figure 2).

Figure 2: A graphical illustration of Rafaeli’s (1988) model of interactivity

Elaborating on this view, Rafaeli and Sudweeks (1997), conceptualize message-based interactivity by considering the chief unit of interest to take on the form of “thread of messages”. In a content analysis of user-discussion groups these authors defined a message thread as a “chain of interrelated messages” and interactivity emerging from them as the extent of “dependency among messages in threads.” (Abstract, para 2). For full interactivity to occur, communication roles between the senders and receivers of messages need to be interchangeable, and further, as Rafaeli (1988) notes, these defining
characteristics of role assignment and turn-taking become almost automatic. Hence, Rafaeli proposes a continuum of interactivity with the low end marked by simple action-reaction responses, what he terms two-way responses, followed by the reactive stage. The higher end of the continuum is marked by full interactivity. To illustrate this continuum, Rafaeli uses the example of a press conference held by a politician. If the politician allows press reporters to ask questions, it is at best, only a two-way communication. If, however, the politician decides to reply to a question asked by a reporter, it becomes reactive. The exchange, however, is not really interactive, unless there are more follow-up questions from the reporter, and the politician takes into account the relationship (or the contingencies) among other previous questions and responses that were discussed as part of this press conference (Rafaeli, 1988, p. 119).

Although, in early work, Rafaeli’s conceptualizations were explored in a collaborative, group CMC settings (i.e., interactions between two or more humans, mediated by a computer) such as bulletin boards and chat rooms, this message exchange definition can also be extended to the user-system dialogue as it occurs in the human-computer interaction (HCI) context (i.e., interactions between a user and the system). As Sohn (2011) notes, even though Rafaeli’s attempt in defining interactivity was to make a theoretical distinction between a simple “action-reaction” response (or a “quasi” response) with more, fully considered responses that take previous exchanges into account, this conceptualization need not be restricted to situations where there are only two interactants (e.g., Person A and Person B) in a narrowly defined one-to-one communication setting (p. 1323). In order to show that this is not an insurmountable limitation, we need more operationalizations and empirical tests of Rafaeli’s (1988)
conceptualization that can translate well into user-to-system or the human-computer interaction realm. Some of the empirical studies discussed below demonstrate how this can be achieved via interesting operationalizations of the contingency principle.

Newhagen and Rafaeli (1996) situate the concept of interactivity among the five defining qualities of communication phenomena on the Internet, the other four concepts being multimedia, hypertextuality, packet-switching and synchronicity. Thus, along with the concept of interactivity, the notion of hypertext is key to our understanding of how interactive processes behave, since communication phenomena on the Internet are no longer considered linear. Rather, the World Wide Web is a “special structure of threads” (Newhagen & Rafaeli, 1996, p. 5) operated by networks of hyperlinks. A study by Sundar et al. (2003) explored the effect of such a definition of hypertext when they operationalized message interactivity in the form of structural hyperlinks that allowed users to access information via an idiosyncratic path while browsing a website. In this approach, the path of user actions exemplify the contingent back and forth (active user input and exclusive system output) that takes place, as the responses given by the website are contingent upon specific user inputs (in this case, clicking on hyperlinks). Thus, contingency here is not operating at the level of content in messages, but the way in which these messages are organized for information retrieval. Hence, Sundar et al. (2003) propose a “contingency view” of interactivity that rests upon the degree to which users get an exclusive response to their active input, as evidenced by “a looping mechanism for the transmission and reception of messages” (p. 34). In their study, Sundar et al. (2003) developed three different versions of a political candidate's website that were identical in content, but differed in the degree of contingency shown by the system. The low-
interactivity version showed all the content on a single web page that users could scroll. In the medium-interactive and high-interactive versions, either one (medium) or two (high) additional layers of hyperlinks had to be traversed by users before accessing the information. Findings from the study on impression-formation measures showed a curvilinear pattern such that participants liked the political candidate more and indicated greater agreement with his policy positions when the site had medium interactivity rather than low or high levels of interactivity. Sundar and Kim (2005) extended this ‘contingency view’ operationalization from websites to web-based advertisements. Specifically, the study looked at Interactive Marketing Units (IMUs) since these ads also contain animation that further enhance the interactivity potential. Using a transaction-based approach, the study designed contingencies in these IMUs by altering the number of layers that users had to traverse (in the form of contingent back and forth) to access product information in these ads. Data demonstrated the ability of interactivity to significantly influence attitudes toward the ad and users’ extent of product involvement.

Apart from attitudes, interactivity has also been known to influence conation. Along the lines of Sundar et al.’s (2003) work, Thorson and Rodgers (2006) investigated the affordance of being able to offer feedback to a political candidate’s blog with a structural feature, in the form of a hyperlink. This hyperlink would allow users to post their feedback on the politician’s blog in such a way that their feedback would also be visible to the public. The findings from this study showed that the sheer presence of this interactive feature created a favorable impression in the minds of the blog readers where, perceived interactivity (in the form of the potential to carry out contingent message exchanges) not only made blog readers develop favorable attitudes toward the candidate,
but also enhanced their voting intentions. Wise, Hamman and Thorson (2006) examined a similar phenomenon where interactivity provoked participants to exhibit higher intentions of participating in an online community. Wise et al. (2006) operationalized message interactivity at two levels—non-interactive and interactive. In the interactive condition, messages that came later in a thread were related to previous messages, which in turn, referred to those preceding them. Further, messages in the interactive condition were marked by first-person pronouns and use of direct address of message-posters by their name. For example, most users in virtual communities use forms of address such as “@Name/Username” to directly refer to one of the messages posted in the thread. Messages in the non-interactive condition had the same content, but these messages did not reflect back on previous messages and nor did they include elements such as first-person pronouns or addressing users directly, via their usernames. The findings showed that higher levels of interactivity, backed by slower response rate, did enhance individuals’ intention to participate in the online community. In the context of this study, the focus is on participants’ intentions to perform preventive health behaviors and also their intentions to engage with the site. Based on the outcomes discussed in the studies above the following hypotheses are proposed:

H1: Greater levels of message-interactivity, will lead to better attitudes toward the website (H1a) and toward the content (H1b).

H2: Greater levels of message-interactivity, will lead to better behavioral intentions toward preventive health behaviors (H2a) and (H2b) toward the website.

Apart from documented effects of interactivity on attitudes and behaviors, there have been other attempts to test how the underlying psychological principle of
contingency falls into this picture. Burgoon et al. (2000b) tested the contingency principle in a proposed theory of interpersonal interactivity, which examined the role of three factors: mediation (face-to-face or mediated via computer agents), contingency and modality richness. Contingency manipulation in the study involved asking confederates during the Desert Survival Problem task to either (a) ignore remarks that were not associated with the task (minimally contingent) or, (b) to take into account even the task-irrelevant comments made by the study participants. The findings showed that sense of mutuality was greater when there was contingent face-to-face interaction or when there was an animated anthropomorphic computer agent. Lack of contingency or the use of static, anthropomorphic agent was not as effective. Additionally, the data also showed that contingency promoted a sense of being understood and a sense of connectedness with the communication partner, but only in the face-to-face, contingent condition.

A recent study (Sundar, Bellur, Oh, Jia & Kim, 2012a) adopted a visual approach of graphically displaying the interaction between the user and the system, in the form of an interaction history to operationalize contingency. In the human computer interaction literature, scholars have relied on a similar “history of use” metaphor (Pelaprat & Shapiro, 2002; Terveen, McMackin, Amento & Hill, 2002; Wexelblat & Maes, 1999; Will & Hollan, 1993) to design media interfaces that show users what actions they performed on the site and how that affected the responses they received from the system. For instance, the “History” tab is a mandatory feature in nearly all the popular Web browsers (e.g., Mozilla Firefox, Internet Explorer, Safari, Chrome, etc). These browser history tabs not only provide a shortcut to all the websites that a user has visited, but the way in which it is ordered (most recently visited site, shown first) also tells users how
they navigated from one site to another, thus fulfilling a breadcrumb function (Lida, Hull, & Pilcher, 2003; Nielsen, 2007). The use of “undo” and “redo” buttons provide another example of user-system interaction history that can encourage users to review their past actions and learn from them (Pelaprat & Shapiro, 2002).

Therefore, contingent interactivity when operationalized via user-system interaction history can boost perceptions of interactivity. This is possible mainly because of its ability to document unique actions of each user and also showcase these actions as users’ idiosyncratic path (Sundar, 2007) to a task goal. Empirical data from the Sundar et al. (2012a) study supports this claim. This study, situated in the context of an online movie website showed the participants a record of their actions, i.e., a list of movies that they browsed during their interaction. For the first manipulation (Recently Browsed feature), in the Low interactivity condition, there was no user-system interaction history revealed. In the Medium and High conditions, the number of user actions displayed differed such that in the Medium condition, the two most recently browsed movies were shown, whereas in the High condition, all the movies that users browsed were displayed. Graphically, these appeared as a list of hyperlinks on the left navigation bar on the webpage. The second feature manipulated was the Most Recent Searches feature located under a search box as a drop-down list. Similar to the first manipulation, there was no display of recent searches in the Low condition. There were either two (in Medium) or five (in High) most recently searched items shown. The data showed that the level of message interactivity, operationalized as the amount of interaction history displayed by the site, significantly affected participants’ evaluations and further still, perceived
contingency significantly mediated the effects of message interactivity on outcome measures related to attitudes, behavioral intentions and user engagement.

In an attempt to replicate these findings, this dissertation study also adopts the visual display of interaction history as a way of operationalizing contingent interactivity. Additionally, the mediation hypothesis via perceived contingency is also tested in the form of:

H3: *Perceived contingency* will mediate the effect of message interactivity on participants’ *attitudes* (H3a) and *behavioral intentions* toward the site (H3b) and the content conveyed by the site (H3c).

Apart from broad persuasive outcomes (i.e., attitudes and behavioral intentions) toward the website and the content, the literature reviewed above also needs to be examined in the specific context under study, that is, how can message interactivity promote preventive health behaviors? How does such contingency driven interactivity affect individuals’ processing of health messages? Does greater message interactivity directly influence participants’ perceptions of susceptibility and severity to health risks? These are tested via the following hypothesis:

H4: Greater levels of *message-interactivity*, will lead to increased *risk perceptions* as reflected in the extent of perceived susceptibility (H4a) and perceived severity (H4b).

Extending the mediation hypothesis via perceived contingency in H3, it will also be examined whether:

H3: *Perceived contingency* will mediate the effect of message interactivity on *risk perceptions* as reflected in levels of perceived susceptibility (H3d) and perceived severity (H3e).
Role of Perceived Interactivity

A consistent line of empirical findings have prompted researchers to look closely into the role of perceived interactivity, that is, interactivity situated purely in the subjective and perceptual realms of the users’ minds. As Bucy (2004) notes, looking at interactivity from this “bottom-up perspective” has opened up new avenues for research and has aided this body of work in “routinizing the concept” (p. 377), thereby making it a part of everyday media experiences. While reviewing the work on perceived interactivity, Wu (2005) remarks that there are several distinctions: “actual versus perceived interactivity” (Williams, Rice & Rogers, 1988); feature-based versus perception-based interactivity (McMillan, 2000, 2002; Wu, 1999) or structural versus experiential elements (Liu & Shrum, 2002), to name a few. A commonality among these distinctions can be summarized with two competing definitions that Tao and Bucy (2007, p. 399) propose: (1) “effect-labeled media attribute definitions” that refer to “intrinsic message or medium properties, including both message content and structural features” and (2) “effect-based psychological states” that tap into the impact caused by the above mentioned media attributes on the perceptions of the user, hence, perceived interactivity. As Wu (2005) notes, the debate of actual versus perceived interactivity is not just a philosophical one where the researcher is trying to decide where interactivity belongs, but the question is also one of empirical urgency, posing its own set of measurement challenges and advantages. In sum, both Wu (2005) and Tao and Bucy (2007) urge scholars to consider the effects of both manipulated interactivity (as a media attribute), and measured perceived interactivity (as a psychological state) in the same study model. Doing so will help researchers understand whether manipulated and perceived interactivity work in
consonance, or if they differ in how they influence outcomes. Hence, testing both concepts in the same study design provides an opportunity to methodologically probe how the two concepts behave in the empirical realm.

There is sufficient empirical evidence to show that perceived interactivity often has a more significant influence on final outcomes, when compared to the effect of manipulated interactivity. For instance, Kalyanaraman and Sundar (2006) showed that perceived interactivity affected attitudes toward website more directly than experimentally manipulated levels of customization. McMillan, Hwang and Lee (2003) found that both individuals’ level of involvement and perceived interactivity were better predictors of user attitudes. Jee and Lee (2002) also found perceived interactivity to be highly correlated with other outcome measures. Thorson and Rodgers (2006) show that mere presence of an interactive feature (feedback hyperlink) was powerful enough in creating a “bonus effect” of invoking possibilities of a “one-to-one” relationship (p.42) with the communication partner, the system, or both.

In sum, these findings show that just because we design sophisticated interactivity media attributes (or affordances) and manipulate them in tightly controlled experimental settings, it does not mean that users will always notice them, psychologically. Hence, we need to measure and account for perceived interactivity and statistically assess its impact. This brings us to the next set of hypotheses:

H5: Perceived interactivity is likely to mediate the effect of manipulated, message interactivity on attitudes toward the website (H5a) and toward the content (H5b).
H5: *Perceived interactivity* is likely to mediate the effect of manipulated, message interactivity on *behavioral intentions* toward preventive health behaviors (H5c) and toward the website (H5d).

H5: *Perceived interactivity* is likely to mediate the effect of manipulated, message interactivity on *risk perceptions* as reflected in levels of perceived susceptibility (H5e) and perceived severity (H5f).

Additionally, several tests of Sundar’s (2007) interactivity effects model, have shown that the effects of modality-based (Sundar, Xu, Bellur, Oh & Jia, 2011), source-based (Sundar, Oh, Bellur, Jia & Kim, 2012b) and message-based (Sundar et al., 2012a) interactivity, are mediated via user engagement. The concept of user engagement has become a buzzword across different media platforms. Industry experts and academics in the gaming realm have often equated user engagement with psychological states such as absorption, immersion, transportation, flow and presence (e.g. Agarwal & Karahanna, 2000; Jennet et al., 2008; Slater, Usoh & Steed, 1994). Film and entertainment studies consider user engagement to be the degree of narrative and perceptions of richness (e.g. Green, Brock & Kauffman, 2004) that emerges as a result of media experiences. Web advertisers and marketing professionals consider user engagement as the level of ‘stickiness’ and the extent to which media forms go ‘viral’ (Dobele, Toleman & Beverland, 2005). What is common across all these different conceptualizations is that user engagement is marked by psychological states that involve some degree of attention, control, involvement, interest, fun and enjoyment. In this study, user engagement is measured as the extent of self-reported absorption and immersion with the user-system interaction (Agarwal & Karhanna, 2000). Specially, message interactivity provides many
invitations for the user to act (Sundar, 2007) because of the ways in which information is organized (for e.g., hierarchically hyperlinked and layered content as discussed in Sundar et al., 2003) to encourage active back and forth. Further, it can be argued that the outcomes related to attitudes and behavioral intentions tend be short-lived. But in order to explore the possibilities of interactivity leaving a more lasting impression, considering the role of user engagement in potentially sustaining the effects of interactivity becomes important. In a test of this mechanism, Sundar et al. (2012b) found that the presence of two forms of source-based interactivity (customization and active blogging) in a web portal sustained user engagement over a period of two-weeks. In a test of message interactivity, Sundar et al. (2012a) found a significant indirect of interactivity on attitudes and behavioral intention, when user engagement was modeled as a mediator. Thus, based on such studies that have tested the relationship of manipulated interactivity on final outcomes, via the path of user engagement, the current study proposes the following hypotheses:

H6: Level of perceived contingency and the degree of user engagement will mediate the effect of message interactivity, on attitudes toward the website (H6a) and toward the content (H6b).

H7: Level of perceived contingency and the degree of user engagement and will mediate the effect of message interactivity, on behavioral intentions toward the website (H7a) and toward the content (H7b).

Role of Power Usage

While interactivity affordances can lead to various outcomes on their own, there is growing recognition that user-characteristics can also moderate when and under what
conditions, interactivity can result in various outcomes. One such variable is the extent of power usage (Marathe, Sundar, Bijvank, van Vugt & Veldhuis, 2007; Marathe & Sundar, 2011; Sundar & Marathe, 2010) that is said to qualify how users interact with technology and what they take away from their mediated interactions. In creating a psychological profile of power users, Sundar and Marathe (2010) describe them as self-motivated learners who are willing to invest time and effort in figuring out newer technologies on their own. These users tend to express greater confidence in exploring a new gadget by themselves, instead of relying on help desks or technical support from others. As a contrast, non-power users tend to show less enthusiasm and are more averse to deciphering intricacies in technological artifacts.

The psychological effect of self-efficacy, in general, has been well researched and documented (Bandura, 1997). More recent scholarship is extending the same idea to examine how competent and skillful users feel during their interactions with media technologies and what implications this carries for various cognitive, attitudinal and behavioral outcomes. For instance, Sundar and Marathe (2010) examined how power usage can alter the effects of customization—a form of source-based interactivity (Sundar, 2007)—among power and non-power users. The study found that power users were motivated by their ability to take on the role of an active source, also termed sense of agency (Sundar, 2008a), which subsequently affected power users’ positive attitudes towards a news aggregator website. Non-power users’ attitudes on the other hand, was found to be positively influenced by the degree of content tailoring that a system automatically performed on their behalf. Similarly, Sundar et al. (2011) reported how participants scoring high on power usage displayed more positive attitudes toward
content, when they were interacting with different types of functional features on web-based stimuli (e.g., mouse-over actions, 3D carousel, zoom-in/out functions, etc). Other studies that surround the use of the World Wide Web have started to urge researchers to account for Internet Self-Efficacy (Bucy & Tao, 2007) as a moderator that can qualify our media experiences and how they differ from one group of individuals to another. Studies in the realm of electronic health are also recognizing the need to measure individuals’ self-reported competence with technology, as part of eHealth literacy scales (Norman & Skinner, 2006).

Given the emphasis on such dispositional factors, this study will examine the role of power usage as a moderating variable with the following research question:

RQ1a: Will the degree of power usage moderate the effects of message interactivity on participants’ attitudes, behavioral intentions and risk perceptions?

RQ1b: Will the degree of power usage moderate the effects of conversational tone on participants’ attitudes, behavioral intentions and risk perceptions?

Computers as Social Actors (CASA) Paradigm

Another source of theoretical arguments and empirical evidence, which support the notion that greater interactivity leads to greater sociability, comes from the Computers as Social Actors (CASA) paradigm. Proponents of this theory (Reeves & Nass, 1996) argue that one can directly apply theories from psychology and social psychology to human-computer interaction. Studies from the CASA paradigm argue that user-interface design ought to be guided by psychological principles that capture the essence of human-human interaction. In their book titled the Media Equation, Reeves and Nass (1996) give examples of several everyday instances where we mindlessly treat
mediated life as if were “real” life. For instance, they note that if an animated dog on a computer says “Hello” and smiles at us, we are very likely to smile and greet in response. Several individuals name their computers, like they name their cars. Thus, we apply “social scripts” from human-human interaction to human-computer interaction, whenever there are cues to humanness. Reeves and Nass argue this media equation phenomenon is not “rare” or “unreasonable” but rather it is fairly common. The core thesis of their research is that our interactions with computers, television and various other forms of new media are “fundamentally social and natural” (p. 5). Although the rules for “socialness” emerge from interpersonal communication in the “real world” domain, they apply very well and hold true in our basic interactions with machines as well.

Extending this notion to the design of interactive media, these authors remark that the cues to socialness coming from the system are “pivotal for the design of interactive media” (pp. 28-29). Nass and Moon (2000) identify three features in machine interactions that allow us to draw parallels to human-human communication, or what they call the “human prototype” (p. 84). One of the factors is the use of verbal output. So if a machine is capable of generating textual or verbal output, we see cues to humanness and their reliance on advanced language capabilities. The second factor is interactivity defined in the Rafaeli (1988) sense of “responses based on multiple prior inputs” and thirdly, the extent to which computers can take on roles that were typically held by humans (virtual travel agent, automated navigation guides on GPS, ATM machines instead of bank tellers, etc). Since this study’s objective is to explore how the concept of message-based interactivity works, it emphasizes the role of text-based and verbal language output, at the level of content conveyed by the system. Such text-based interactivity can provide
another key theoretical mechanism that could moderate the effects of interactivity occurring at the technological level, and could also have direct effects of its own, as discussed later in this chapter.

There have been several empirical demonstrations of the media equation principle with studies examining personality and similarity-attraction between computer-users and their systems (Isbister & Nass, 2000), computer elicited self-disclosure (Moon, 2000), application of voice, speech and gender rules to media (Nass & Lee, 2001), source orientation (Sundar & Nass, 2000) and many more, where scholars have looked at how we evaluate both the computers (media) systems and the messages they convey based on social cues they possess or project. One of the studies (Fogg & Nass, 1997) on rules of politeness (flattery vs. criticism) is particularly pertinent to this dissertation since the key manipulation took place in the form of textual dialogues between the study participants and the system. Surrounding the context of a popular game of 20 Questions, participants were randomly assigned to one of the three conditions—positive, negative or no feedback—from the computer to their responses. Example of a positive response from the system was in the form of “Your question makes an interesting and useful distinction. Great job!” whereas a negative feedback was in the form of “The addition you made complicated the game unnecessarily. That was a bad decision.” The key findings from the study showed that participants liked to be flattered even when they knew that the flattery was coming from a communication system (computers). Flattered participants also thought they performed better on their task. Therefore, data from this study show that verbal feedback by machines can have a significant impact on how we evaluate the quality of the task and the outcomes of the interaction. Other examples of verbal
behaviors that Reeves and Nass (1996) discuss are a spell-checker that praises users every time they spell a complex word correctly, by saying “Your spelling was significantly above average. You should be commended for your work”, or “You spelled this difficult word correctly. Congratulations.” If a user finds a site that is rare and not visited often, they could be congratulated for finding interesting content. Similarly, movie recommendation sites could commend users for their aesthetic taste or make an appropriate comment regarding the movie genre they pick (p. 61).

The underlying principle in these instances is one of — the system taking on the role of an encouraging coach or a collaborator (Hawkins et al., 1997; Walther et al., 2005c) — persuading users to continue their mediated interaction and also adopt behaviors that could potentially help them meet their goals. What if the same rules could be extended to online health tools? What if such a tool commended users’ efforts every time they entered information about a healthy diet or exercise regimen that they followed? There are already attempts in the industry in this direction (e.g., WedMD’s Better Health Evaluator assessment). Sohn (2011) classifies such features under the label of “semantic interactivity”, defined as the capacity of the system to provide "personally relevant messages" (p. 1327). Harkening back to Rafaeli’s (1988) conceptualization of interactivity as a sequential exchange of messages, Sohn remarks the reason why semantic interactivity becomes important is because: "a reciprocal interaction should entail a higher level of informational processing (i.e., cumulative exchange of semantic information with mutual interest and involvement) rather than mere sensory or physical action-reaction" (p. 1323). Therefore, apart from interactivity at the physical and sensory levels, language and speech at the symbolic level, also act as ways in which interactivity
can engage users by virtually roping them into a conversation with the system. Warnick, Xenos, Endres and Gastil (2005) refer to this as ‘text-based interactivity (TBI),’ differentiating it from the typical ways in which interactivity is usually examined, i.e., as a structural feature of the medium. In the Warnick et al. study that examined the website of a political candidate, text-based interactivity was manipulated by either including or excluding certain stylistic features such as the use of first person address, active voice, candidate’s statements and third party endorsement messages (mostly all textual, except for presence of an additional modality in the form of pictures). The study found that users paid attention to these text-based “rhetorical features” on the website, and further, the TBI variable had a more powerful effect (when compared to structural features) on outcomes such as cognitive engagement.

This brings us to the next central question in this study, what is it about verbal messages that makes them appealing and powerful? And further, how do we create “social meaning” in mediated communication environments that lack in nonverbal cues? Some potential answers emerge from studies on verbal turn-taking cues and behaviors discussed below.

**Conversational Tone and Turn-taking Behaviors**

Social Information Processing theory (Walther, 1992) maintains that we adapt our communication strategies when there is an absence of physical and nonverbal cues. Specifically, the theory posits that we infuse textual or verbal messages with a variety of contextual and stylistic cues (for e.g., use of emoticons) to convey socio-emotional information. We are said to perform this “filling in” process in order to assess the qualities of our communication partners, and to grasp their cognitive and affective mental
states (Walther, Loh & Granka, 2005b). One of the main insights to emerge from this literature is the notion that when nonverbal immediacy cues are either reduced or blocked, then linguistic cues compensate for them in order to convey a range of relational messages (Walther, 1992). Thus, when head-nods to show approval (a form of nonverbal back-channeling) is absent, people make it up with a short utterance such as “I quite agree” (Short, Williams & Christie, 1976, as cited in Walther et al., 2005b, p. 42),

An experiment was conducted by Walther et al. (2005b) to test whether individuals do indeed employ verbal communication behaviors in order to match the type of relational communication goals (in this case, affinity) that are similar to face-to-face (non-mediated) interactions. In the study, confederates were randomly assigned to either CMC synchronous chat or face-to-face (FtF) condition and were asked to express either affinity or disaffinity toward their communication partner in their first minute of interaction. The data showed four specific verbal cues, which explained about 73% of the variance on CMC immediacy, one of which was the use of “explicit positive statements of affection” (pp. 54-55). Other empirical findings (Utz, 2000; Tidwell & Walther, 2002) also reiterate one of the core propositions emerging from studies of SIP that verbal and text-based CMC is not impersonal and can affect how we communicate with and evaluate our communication partners. While SIP studies have been situated mostly in the CMC domain (mediated interactions that involves at least two human beings as message senders and receivers), this dissertation examines how the use of an informal conversational tone, in the form of textual turn-taking messages, can impact users’ attitudes and evaluations of an interactive health website, from a HCI (human to machine interaction) point of view.
The term “back-channel” was coined by Yngve (1970) in the context of studies that explored the dynamics of turn-taking in interpersonal speech processes. Duncan (1972) uses the analogy of how we have social rules for not colliding with people when walking on a path. He proposes that we have similar, universal norms to avoid “verbal collisions”. And thus, linguistic turn-taking cues are one form of communication signals that govern verbal accommodation behaviors. Verbal turn-taking cues have been studied in the form of short utterances (also called back channel responses) such as “yeah”, “huh” and “mm-hmm” and often accompanied by nonverbal head-nods to indicate active listening. Heinz (2003) has documented following functions of both verbal and nonverbal interaction cues as signals to indicate there is active listening going on, to acknowledge that the other person (i.e., the speaker) currently has the floor and both listener and the speaker want the interaction to continue (p. 1114). Heinz also notes that the idea of back-channeling is based on Grice’s Cooperative Principle (1989) that most human-human dialogues or conversational exchanges tend to be cooperative efforts, akin to the affiliation motive discussed above. Similarly, in theories such as the Common Ground (Clark & Brennan, 1991), language is viewed as a collaborative activity that allows users and systems to achieve grounding, when they share their “knowledge states” by deliberately looking for and also consciously providing evidence about what was said and also how much of it they were able to comprehend. Interactants in a conversation are said to build common ground by signaling each other. As Brennan (1998) observes, the “currency” of these signals could include a varied mix of text, icons or speech (p. 201).

While studying the role of Embodied Conversational Agents (ECA), Cassell et al. (1999, p.520) observe that one of the main metaphors surrounding human-computer
interaction is one of “conversation”. Cassell and colleagues argue that those who design
conversational interfaces have not taken the metaphor seriously and are yet to realize the
potential of such interfaces in enhancing user-system dialogue. One of the reasons for an
increase in the development of conversational interfaces has been attributed to
technological developments (e.g., speech recognition and speech synthesis), which are
able to support a larger vocabulary, along with more spontaneous and interactive
exchanges made possible between users and systems. These interfaces have found many
applications in everyday life that support communication-intensive tasks, for example,
science education in classroom settings, stock market trades and transactions (Meng,
Ching, Chan, Wong & Chan, 2004), entertainment, navigating unmanned aerial vehicles
scholars note, conversational interfaces are highly intuitive, feel natural, are flexible and
thus encourage learning outcomes (Cassell et al., 1999; Zue & Glass, 2000).

Bickmore and Cassell (2005) distinguish between two types of information in the
content that is conveyed by the ECAs. One is “propositional information” (p. 27) that
refers to the actual content of the conversation. The second type, called “interactional
information”, consists of turn-taking cues that can help monitor the conversation.
Interactional information comprise both non-verbal cues such as head nods as well as
verbal cues in the from of regulatory speech patterns, for e.g., “huh?”, “do go on” and
other similar paraverbal features (Cassell et al., 1999, p.522). These verbal and non-
verbal turn-taking cues serve an important function, apart from developing continuity and
rapport in a conversation. As Brennan & Hulteen (1995) note, interactional information
serve to provide “positive evidence” (p.144) of what has been understood by the
communication interactants engaged in a dialogue. It has been observed that user interfaces in new communication technologies, mostly tend to provide “negative evidence” of what has not been understood or processed, for example, error messages when a computer is unable to fulfill a user’s command. But it is very rare that systems are designed to provide positive evidence, thus offering scope for future research and design in this area. While discussing one of the unique properties of the embodied conversational agent, Rea, Bickmore and Cassell (1999) argue that Rea’s ability to conduct “small talk” and engage the user in a social dialogue serves to meet both task and social-oriented goals of the interaction; a dimension that has also been widely studied in patient-physician interactions (Roter & Larson, 2002; Roter & Hall, 2004). Studies of psychotherapy (Fitzgerald & Leudar, 2010) also adopt these verbal turn-taking cues in the form of acknowledgement tokens or “continuers” that a skilled therapist is said to use. These seemingly “empty vocalizations” (p. 3188) are said to demonstrate to a client that the psychotherapist is actively listening and encouraging the latter to continue the interaction. Hence, apart from the main function of building rapport and trust, interactional conversation strategies, when operationalized in the form of verbal turn-taking behaviors (paraverbals, continuers, short utterances) not only reduce face threats (Goffman, 1981) by maintaining a casual interactional style but also encourage an overall sense of friendliness and camaraderie (Bickmore & Cassell, 1999). Based on the literature reviewed above that have examined affect-based outcomes with the use of verbal dialogue with humans, computers and conversational agents, the following hypotheses are proposed:
H8: Presence of an informal conversational tone, will lead to a perception of increased *warmth* toward the user-system interaction.

H9: Presence of an informal conversational tone, will lead to a perception of increased *satisfaction* toward the user-system interaction.

Scholars have argued that we do not respond to conversational systems at the linguistic level alone; but as studies in the CASA paradigm discussed above have shown, even *behaviorally*, we respond to conversational computers by treating them as our social partners. In a study of 24 young children, Oviatt, Darves and Coulston (2004) found that children spontaneously adapted some of their acoustic-prosodic features to match those of the text-to-speech patterns found in their animated communication partners (embodied marine animals). Bickmore, Caruso and Clough-Gorr (2005) conducted a study with an animated conversational agent Laura, who acts as an exercise advisor to older adults. Laura interacted with participants for everyday over a period of two-months, via a preprogrammed conversational script. The interaction involved simple touch-screen computer that initiated a dialogue about their physical activity for the day. Results showed that users expressed overall satisfaction, liking and trust for the agent. Apart from these attitudinal outcomes, participants also actively looked up more health information, thus lending support to the use of a relational, conversational agent for promoting long-term behavior change. With such findings as basis, this study proposes that:

H10: Presence of an informal *conversational tone*, will lead to more positive *attitudes* toward the website (H10a) and its content (H10b).

H11: Presence of an informal *conversational tone*, will lead to greater *behavioral intentions* toward the website (H11a) and its content (H11b).
H12: Presence of an informal *conversational tone*, will lead to greater risk *perceptions* as seen in the level of perceived susceptibility (H12a) and perceived severity (H12b).

It could very well be argued that much of the positive feelings (rapport, liking, trust, etc) that have been reported in the studies done with ECAs, is primarily based on having an anthropomorphic agent or avatar. Other studies on interactive, animated avatars and agents (Kim & Sundar, 2012; Lee, Peng, Jin & Yan, 2006; Skalski & Tamborini, 2007) have shown that some of the reasons why avatars and agents evoke positive outcomes is because they create a sense of social presence, and suggest ways in which a participant is likely to think that they are interacting with an intelligent being. Therefore it is but natural that human-like interaction partners evoke social responses. But as Reeves and Nass (1996) note, it is not necessary to build highly anthropomorphic, modality-infused, or sophisticated artificial intelligent systems to evoke social responses. Based on their studies’ findings, Reeves and Nass remark that even plain text, shown on plain black and white screens, are sufficient to “trigger rich social scripts for social interactions” (p. 28). Even though conversational interfaces may be devoid of avatars or anthropomorphic agents, assumptions from SIP and the Media Equation literature give sufficient warrant to expect that text-based, verbal interactional behaviors (e.g., turn-taking cues), by themselves, can enhance the presence of another social actor, leading to the following hypothesis.

H13: Presence of an informal *conversational tone*, will lead to perception of increased *social presence*. 
Hypotheses H8, H9 and H13 pertain to the effects of the conversational tone variable (content-based, semantic interactivity) on outcomes such as perceived warmth, satisfaction and social presence, respectively. Theoretically, it is also interesting to see whether structural interactivity (i.e., the manipulated interactivity variable) will also affect these outcomes, leading to the following research questions:

RQ2: Will higher levels of message interactivity significantly influence perceptions of warmth (RQ2a) and user satisfaction with the interaction (RQ2b)?

RQ3: Will higher levels of message interactivity significantly influence perceptions of social presence?

While most studies have looked at self-reported evaluations of greater mutuality, rapport, congeniality and so on, as final outcomes, it is not clear whether these perceived warmth variables are likely to mediate the effects of the conversational tone manipulation on the outcomes examined in the study. This is examined in the form of a research question below:

RQ4: Does perceived warmth mediate the effect of conversational tone on the outcomes hypothesized in H10 to H12?

**Interactive Health and Computer-Delivered Interventions**

Interactive Health Communication (IHC) as defined by the Science Panel on Interactive Communication and Health (SciPICH) constitutes “the interaction of an individual – consumer, patient, caregiver, or professional – with or through an electronic device or communication technology to access or transmit health information or to receive guidance and support on a health-related issue” (Robinson, Patrick, Eng & Gustafson, 1998, p. 1264). Some of the earliest studies in the realm of interactive health
technologies came under the gambit of the Comprehensive Health Enhancement Support System (CHESS) as reviewed by Hawkins et al. (1997). One of the main research questions addressed by these CHESS studies was, if we develop interactive health education materials—mostly on acute health topics, for instance, breast cancer, HIV risk behaviors that target a minority, but nevertheless, a high risk population—how likely are they to use and benefit from such interactive material? These interventions had a clear, information, decision support and social support components that included interactivity features ranging from modality-based information module, along with scope for conducting CMC-based message interactivity exchanges in the form of discussion groups and avenues for sharing personal stories and testimonials (source-based interactivity). In a study of high-risk HIV population, data revealed that the social support services, comprising the discussion groups and personal stories, were the most widely used features, which also resulted in greater quality of life outcomes in long-term follow-up.

Based on similar logic that drove the CHESS projects, there have been an innumerable number of computer-delivered interventions and randomized control trials that have tried to systematically explore what aspects of interactive, computer-assisted technologies can be harnessed to meet health promotion goals in the community (Kroeze, Werkman & Brug, 2006). For instance, in a computer-delivered intervention (CDI), Di Noia, Schinke, Pena and Schwinn (2004) examined whether tailored content and the ability to segment audiences would result in reduced HIV risk behaviors among adolescent women. When compared to a no-intervention control group, their study showed that the CDI group did show significant differences in the pretest to posttest change scores on measures such as HIV/AIDS related knowledge and risk reduction
efficacy. In a similar CDI intervention aimed at college students, Kiene and Barta (2006) administered two short, HIV/AIDS sessions, compared to a control group that was exposed to a tutorial on nutrition education. This study used a “dialog-based tailoring” (p. 407) approach where the system asked users what their personal goals were and then recommended messages that were relevant to those goals. Data showed that those in the computer delivered intervention group showed significant changes from their baseline scores (compared to the control group), especially on outcomes such as increased condom use knowledge and greater frequency of performing safer sex behaviors.

In a meta-analysis of randomized trials that have examined the effectiveness of computer-tailored interventions on preventive health behaviors, Kroeze et al. (2006) found that only three out of eleven studies on physical activity, and 20 out of 26 on diet behaviors, found significant effects that supported the use of a computer-tailored interventions. In their review, Kroeze et al. (2006) summarize some of the advantages of CDI interventions as follows: Computer-delivered interventions can “mimic” aspects of interpersonal counseling scenarios without requiring face-to-face contact (p. 205). They allow individuals to easily monitor (via self-assessments) and compare their health behavior performance metrics with either their own prior scores or with other peer norms and standards. Even though many studies in the realm of health communication have noted the benefits of using such computer-delivered interventions, very few tell us why they are effective and what specific feature of the interactive health technology resulted in a particular effect. The term computer-tailored intervention is a very broad description that can fit many studies. And hence, as Kroeze et al. (2006) argue, at most we know that compared to a non-computer based intervention (that is, a standard control group) there
was a significant effect in the computer-delivered intervention group. But what was it, *within* the computer-delivered intervention that led to significant findings? Furthermore, apart from looking at direct effects, we also need studies that look at the underlying psychological and social processes that may mediate the effect of these interventions on outcomes of interest. One such theory-based explanation comes from the role of perceived relevance discussed below.

**Role of perceived relevance**

Studies in the realm of tailored health communication have recognized that individuals consider tailored material as being more relevant than “generic” or non-tailored material (Kreuter, Stretcher & Glassman, 1999; Kreuter & Wray, 2003). Brinol and Petty (2006) also note that a chief mechanism driving the effects of tailoring is one of perceived relevance. Their argument is that as long as some part of the message is matched with some aspect of the individuals’ self (such as their values, outcome goals, information-processing styles, etc.) then it is likely to evoke greater perceptions of relevance. Using the Elaboration Likelihood Model (Petty & Cacioppo, 1986) as their basis, they argue that tailoring makes the message more personally salient for the individual and hence enhances the extent of elaboration on the topic. Additional findings have also shown that tailored messages that are perceived as being irrelevant or inconsistent, can lead to avoidance of the information and also, to less careful processing of such messages (Radcliffe & Klein, 2002). As Noar, Benac & Harris (2007) remark, while the evidence for the effectiveness of print-based tailoring is well documented; we do not yet have a systematic understanding of how this phenomenon will translate into web-based interventions. It could be argued that tailoring systems also function on the
principle of contingency where the system continuously takes into account users’ unique input and provides adaptive feedback that keeps changing dynamically, based on the information entered by the user. Hence, tailoring systems need not be simply reactive, but they can be designed better to make them fully interactive (Rafaeli, 1988). But, what remains an open question is whether such tailored, plus fully interactive messages will be perceived as being more relevant. This is tested via the next hypothesis:

H14a: Greater levels of message-interactivity, is likely to result in higher perceived relevance.

The domain of human-computer interaction is conducting research in the realm of such interactive, self-monitoring tools (for e.g., heart-rate monitors) and context-sensitive tools that recognize user activity and send context-sensitive feedback. Examples include messages that remind individuals to wear seat belts, take medication, attend to doctor’s appointments and so on. Point-of-decision tools (Intille, Kukla, Farzanfar & Bakr, 2003) provide another case in point, which can provide highly tailored messages at the point of decision making. For instance, Intille et al. (2003) have developed a mobile, PDA prototype that can scan information from barcodes on food products and provide highly tailored messages to individuals at the point of making purchases in grocery stores. Tsai et al. (2007) tested the effectiveness of a mobile phone application called Patient-Centered Assessment and Counseling Mobile Energy Balance (PmEB). The tool allows individuals to self-monitor their caloric intake on a real-time basis, and thus encourages them to take charge of their weight management goals. Oliveira, Cherubini, and Oliver (2010) created a similar interactive social-support mechanism called MoviPill. This cell-phone application allows users to monitor not only their own but also their friends’ and
families’ daily medication intake. In sum, these tools not only provide ample scope for interactive feedback, but also open up opportunities for providing highly relevant messages to individuals. But, is this likely to affect how users think and process health information? The study formally tests this via the following hypothesis:

H14b: *Perceived relevance* is likely to mediate the relationship between different levels of message-interactivity and *cognitive outcomes*.

In sum, the study proposes to test the effects of levels of message interactivity and the type of conversational tone on a set of cognitive, attitudinal, behavioral intention and risk perception outcomes. Figure 3 below summarizes the proposed hypotheses in the study.

*Figure 3:* Summary of hypotheses in the study
Chapter 2

METHOD

Study design

In order to explore the research questions and hypotheses stated above, this dissertation study proposes to conduct a 3\(^{\text{rd}}\) (Level of Interactivity: Low, Medium, High) by 2 (Conversational Tone: presence or absence of verbal turn-taking cues) between subjects factorial experiment. Six versions of the stimulus website were designed that varied in the level of message-based interactivity and the presence (or absence) of verbal turn-taking cues. Since the purpose of the study was to adopt a ‘Question and Answer’ (Q&A) dialogue format that is found in several existing interactive health assessment tools on the Internet, the website was created to look like an Instant Messaging (IM) or texting-like interface where the questions, participants’ response input and messages from the system were all presented in chat-like dialogue boxes. To distinguish user versus system interactions, the questions and messages from the system were presented in blue colored dialogue boxes. The response options, with which participants had to interact by selecting an answer choice, were presented in green colored dialog boxes (Figure 4). Participants’ interactions with the system were restricted to mouse-based input for selecting answers from a set of multiple choice options provided by the system. Participants were not able to type in any open-ended messages, unlike regular IM-ing, texting or chat applications available online or on mobile media.
Pretesting health topic

One of the key issues facing researchers before designing an interactive health education tool is the choice of health topic. As Hawkins et al. (1997) note, there are some inherent trade-offs. If a very specific health crisis or topic is chosen (e.g., breast cancer), it will be relevant to a very narrow (albeit significant) section of the population. When a specific and acute health topic is chosen, it is possible to go in-depth and offer very precise recommendations and suggestions. But the tool does run the risk of being used by very few people, intermittently. If a broader, more general health topic is chosen, then researchers could run the risk of making the information too shallow, so as to keep it broad enough to be useful for large sections of the populations. However, a major consideration is the extent to which the topic is relevant to the sample under study. Further, the extent to which the design of the system is flexible will also determine how easily it can be modified and adapted to a different health topic, as and when need arises (Hawkins et al., 1997). With these criteria in mind, a pretest was conducted among college-aged adults, who were representative of the larger population of college students that were recruited in the main study.

A survey was conducted (N=54, with 32 females and 22 males, mean age 21.7 years, SD=5.5) that asked participants to indicate how worried they were as college students, about a list of ten health topics (e.g., unhealthy diet, sexually transmitted infections, alcoholism, etc). Participants could rate their response on a 10-point scale of 0=Not at all worried to 9=Very worried. Another question in the survey asked participants to indicate to what they extent they felt prone (0=Not at all prone to 9=Highly prone) toward a list of eleven health risks that they were more likely to face as college
students. (Please see Appendix B for complete wording and lists of health topics surveyed in the pretest). The findings from the pretest showed that unhealthy diet ($M=6.37, SD=2.54$) and sexually transmitted infections ($M=5.33, SD=3.11$) were among the top two health risks about which participants reported being most worried. On the question of what health risks they felt more prone to as college students, the top two responses were sleep disorder ($M=5.44, SD=2.91$) and anxiety disorder ($M=5.04, SD=2.67$), followed closely by alcoholism ($M=4.48, SD=2.8$) and poor nutrition ($M=4.11, SD=2.7$). Since the goal of this study is to focus on preventive health behaviors, the final set of health topics chosen for the study included a combination of diet, exercise, drug, alcohol, HIV and AIDS related risk factors.

**Health message Q&A**

The following resources were used as references while compiling the information content for the Q&A information conveyed by the website. The Dietary Guidelines for Americans 2010 report by the U.S. Department of Agriculture <http://tinyurl.com/7scj9wr>, WalgreensTM Diet and Nutrition Assessment <http://tinyurl.com/7yjkex9>, HIV risk assessment questionnaires developed by the Minnesota AIDS Project <http://tinyurl.com/7c7lrry> and The Body.com <http://www.thebody.com/>. Information from these sources were modified and adapted to suit the needs and design requirements of the main study. There were a total 25 questions in the Q&A. The first set of questions (Q1 to Q11) consisted of items dealing with diet, nutrition and exercise routines. The second set of questions (Q12 to Q25) related to risk factors associated with alcohol, drug use and HIV and AIDS risk factors. For each question, participants were given a range of three to five response options. The
website gave a tailored response that was contingent upon a specific response option chosen by the participant. Participants were able to choose only one response option for each question (except for Q21). The complete list of questions, response options and message recommendations made by the system are included in Appendix A. The Q&A information used in the study was checked for accuracy and validity by the staff at the Pennsylvania State University Student Health Services. The Institutional Review Board approved the study design and procedure.

Participants

The study sample consisted of 172 undergraduate students (142 females and 30 males) recruited from several communications classes at a large public university. The average age of the sample was 20.5 years ($SD = 1.19$, $N = 149$, 23 missing data). Majority of the participants reported being Caucasian or White (70.93%). The sample consisted of 6.4% African Americans, 4.65% Hispanic and 16.3% Asians. About 1.7% reported belonging to other ethnic categories. On the question of self-reported sexual orientation, about 91.3% reported being heterosexual, with 1.74% identifying as bisexual. One participant identified being lesbian, 4.07% chose the “other” option and 2.3% preferred not to answer this question. Forty percent of the students identified themselves as sophomores, followed by 31.18% juniors, 27.65% seniors and 1.18% freshman. Upon successful completion of the study, all the students received extra credit (a percentage of their grade), as determined by the course Instructor.
Independent variables

Message Interactivity. The first independent variable examined in the study is the level of message interactivity, operationalized on the basis of three levels of contingency—two-way, reactive and interactive (Rafaeli, 1988)—situated in the participant-website interaction that took the form of health Q&A interaction. In the Low interactivity (two-way) condition (Figure 4), participants were engaged in a simple back and forth exchange that involved: the system asking questions, participants picking an answer option, and then the system providing a tailored response based on the answer option selected by the participant.

*Figure 4: Q&A interaction in the Low Interactivity condition*
These tailored responses from the system took the form of brief recommendations messages that gave basic information and guidelines on safety and preventive health behaviors, related to the question being asked. The website in the Low interactivity condition did not display any signs or traces of the ongoing interaction that occurred between the system and the user. Hence, the Low interactivity condition did not contain any signs or visual cues of the degree of threadedness or back and forth in the Q&A task. It was thus devoid of any displays of interaction history.

In the Medium interactivity (reactive) condition, participants took part in the same Q&A task but after each question, whenever participants chose a response option (for e.g., if they chose “Sometimes” for the question on how often they eat out in restaurants), the site would not only take this response option into account but it would also display this information visually in the form of a box that said “Your response: Sometimes” (Figure 5). Therefore this simple textual cue serves two functions: (i) it is conveying to users that the site is carefully registering their response, and hence the system’s health messages and recommendations are contingent upon the particular answer choice that they made. Additionally, (ii) this visual cue also acts as an evidence (or instance) of the interaction history, a way to display the back and forth dialogue happening between the user and the system (Figure 5). In the High interactivity condition (Figure 6), the system-user interaction was designed such that the same set of questions, responses and recommendations (as employed in the Low and Medium conditions) were used but, there were two additional features that were designed to boost the visual and semantic cues to convey higher degree of back and forth (or contingency) by the system. First, the system displayed the entire Q&A interaction history that occurred during the process. In addition
to conveying the “Your response: _____” message that was shown in the Medium interactivity condition, participants in the High condition could scroll up to see the entire history of Q&A that transpired between the user and the system.

Figure 5: Q&A interaction in the Medium Interactivity condition

Thus, a continuous stream of interactions in the form of cumulative dialogues between the user and the system was made apparent to the user. Secondly, the site factored in responses that was based not just on the most immediate (or preceding
question) but also took into account participants’ responses given to a question that was answered one step earlier in the process.

For example, when Q8 asked participants if they would like to lose weight, the system would first give message recommendation to the most current question in hand (i.e., Q8), but in the next immediate step, the system would also take into account what

Figure 6: Q&A interaction in the High Interactivity condition
the users’ response was to Q7 that asked about how often they ate out at restaurants. Thus, in the High interactivity condition, apart from giving a tailored response to Q8, the system would also give message recommendations to Q7, so as to make the looping mechanism (contingency between Q7 & Q8) more obvious. Semantically, this was done by including sentences in the form of “Previously, you mentioned that sometimes you tend to eat out in the restaurants” or “Earlier, you reported saying you would like to lose weight” and so on.

Thus, in the High interactivity condition, the system would employ a looping mechanism to combine responses from previous inputs. This operationalization is therefore, close to Rafaeli’s (1988) definition of interactivity as “an expression of the extent that in a given series of communication exchanges, any third (or later) transmission (or message) is related to the degree to which previous exchanges referred to even earlier transmissions” (p. 111).

**Conversational tone.** The second independent variable being examined in the study, is the conversational tone operationalized as the presence or absence of verbal turn-taking cues. The presence of verbal turn-taking cues condition involved several short sentences conveyed by the system, such as, “Let’s move on to the next question”, “OK, let’s talk about exercise”, “All right, let’s look at the next question now” and so on. These sentences were inserted between questions; only in the turn-taking cues present (versus absent) condition. The sentences were brief and they did not add any extra information about the health content contained in the Q&A. Instead, these turn-taking utterances served as transitional statements that regulated the flow of the interaction (from one question to another), to convey a sense of casual and informal dialogue occurring
between the system and the participant. The list of verbal turn-taking cues used in the study is presented in the Appendix A.

**Power usage.** The study design examined the role of power usage as a moderator. The scale for measuring power usage contained twelve items adapted from (Marathe et al., 2007; Sundar & Marathe, 2010; Sundar et al., 2011) pertaining to the degree to which participants’ express their liking toward technology, their dependence on information technologies, their extent of use and so on. It involved items such as “I make good use of most of the features available in any technological device” and “I love exploring all the features that any technological gadget has to offer”. These twelve items were combined together to form a scale of Power Usage (Cronbach α = 0.79).

**Mediating Variables**

Four variables comprising perceived contingency, perceived interactivity, perceived warmth and perceived relevance were hypothesized as the mediating variables in this study.

(a) *Perceived contingency* was measured with the help of four items that looked at the extent to which the system took into consideration participants’ prior inputs and response choices. The scale consisted of the following four items: “The website took into account my previous interactions with it”, “The website’s responses were related to my earlier input”, “I felt that the website carefully registered my responses and gave feedback based on the information I entered” and “The messages I received on the website were based on my previous inputs” with a Cronbach’s alpha = 0.87. These measures were adapted from Sundar et al., (2012a).
(b) Perceived interactivity: One of the key dimensions along which perceived interactivity has been defined and measured is the extent to which media systems provide scope for two-way communication. Based on the work by McMillan and Hwang (2002) and Liu (2003), four items were adapted to form a scale of two-way communication. Some examples of items included in the scale are “The site enabled simultaneous communication”, “The site was effective in gathering my feedback”, “The site enabled two-way communication” and so on with Cronbach’s alpha = 0.63.

(c) Perceived relevance: Based on Wells’ (1989) ROI (Relevance, Originality and Impact) copy-testing system, as cited in Thorson and Zhao (1997), six items measuring perceived relevance were employed. The statements asked participants to rate their responses on a scale of -4=Describes very poorly to +4=Describes very well, on items such as “The messages conveyed by the site are important to me”, “The site talked about something that concerns me, personally”, “The site gave me information that is personally relevant to me” and so on. These six items were combined to form a perceived relevance measure (Cronbach’s alpha = 0.87).

(d) Site Impressions: Participants’ impression toward the website as a result of the Q&A interaction were measured with the help of twelve semantic differential items (on a 9-point scale). An exploratory factor analysis with Oblimin rotation revealed three factors with eigenvalues greater than 1.0. Oblimin rotation was adopted for all factor analyses in this study because, as Morrison (2009) notes, the default rotation method present in most statistical software packages (i.e., Varimax rotation) is problematic in communication studies where factors are likely to be correlated with one another (McCroskey & Young, 1979 as cited in Morrison, 2009). Hence, imposing orthogonality via the Varimax
rotation may not be appropriate. Therefore, scholars (Costello & Osborne, 2005; Morrison, 2009) recommend using oblique rotation methods, such as Oblimin, which take into consideration the correlation between factors. While determining factor loadings, a value of 0.50 or higher was used as the criterion (Costello & Osborne, 2005; Tabachnick & Fidell, 2001).

The first factor under the Site Impressions variable referred to (d)(i) perceived intelligence of the site with the following four items combined “Ignorant—Knowledgeable”, “Irresponsible—Responsible”, “Unintelligent—Intelligent” and “Foolish—Sensible” (Cronbach’s alpha = 0.88). The second factor was labeled (d)(ii) perceived warmth and it included the following four items “Unfriendly—Friendly”, “Cold—Warm”, “Impersonal—Personal” and “Unsocial—Social” (Cronbach’s alpha = 0.82). The third factor was (d)(iii) perceived humanness with three items combined “Machine-like—Human-like”, “Unnatural—Natural” and “Artificial—Life like” (Cronbach’s alpha = 0.90). These measures on site impressions were adapted from Powers and Kiesler (2006) and Kim and Sundar (2012).

Table 1: *List of mediators*

<table>
<thead>
<tr>
<th>Mediators</th>
<th>Reliability index (Cronbach’s alpha)</th>
<th>Scale Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a). Perceived contingency</td>
<td>0.87</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(b). Perceived interactivity</td>
<td>0.63</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(c). Perceived relevance</td>
<td>0.87</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(d) (ii) Perceived warmth</td>
<td>0.82</td>
<td>9-point semantic differential</td>
</tr>
</tbody>
</table>
Dependent Variables

The final outcome measures used in the study are classified under the following categories (i) cognitive responses (ii) attitudes toward the website and the content (iii) intentions to perform preventive health behaviors and behavioral intentions toward the site (iv) perceived susceptibility and severity of health risks (v) user engagement with the site (vi) perceived social presence and (vii) user satisfaction with the interaction (See Appendix D for a list of all the dependent measures used in the study). Figure 7 below illustrates these classifications.

Figure 7: Summary of dependent variables in the study

(I) Cognitive responses: Question-asking, content of questions asked and their format (close or open-ended), form an important part of patient-physician interaction (Davis, Koutantji & Vincent, 2008; Roter & Hall, 2004). A focus group study with
patients in a heart-disease risk group showed that websites, which provide individuals with a list of questions to ask their physicians increases patient involvement in the process. One of the reasons these authors cite is because such premeditated and targeted questions can help them make the most of their face-time with the physician after a long wait for the consultation (Stevenson, Kerr, Murray & Nazareth, 2007). In a usability study that looked at consumers' evaluation of health information on the Internet (Oermann & Pasma, 2001), nearly 87.9% of individuals indicated that they would recommend the "Questions to Ask your Doctor" feature to others. Based on such evidence about the importance of this outcome measure in medical care interactions, participants were instructed to create a list of questions that they would like to ask their doctors. Specifically, the question was phrased as: “The next time you go for a general physical check-up, what are some questions that you would like to ask your Doctor? Please list these questions in the space below”. Open-ended responses for this question were used as measure of participants’ cognitive response. Apart from the “Ask your Doctor” question, participants were also asked to list any functions or features that they remembered from their interaction with the site and list any additional feedback that they would like to offer (also in the form of open-ended responses).

(IIa) Website Attitudes: Items measuring the attitude towards the website were measured with fifteen items such as appealing, useful, high-quality, cool, imaginative, and so on. Factor analysis showed that this variable was composed of two factors. The first factor was termed (IIa1) website appealing, composed of seven items such as useful, positive, likable and so on. The second factor was termed (IIa2) website exciting
composed of six items such as fun, interesting, imaginative and so on. Both factors had a Cronbach’s alpha of 0.93.

(IIb) Content Attitudes: Participants were asked to indicate their attitudes toward the health information content (on a scale of -4=Describes very poorly to +4=Describes very well) on a list of 12 adjectives such as believable, accurate, comprehensive, concise, informative and so on. Factor analysis showed that there were three factors under this construct. The first factor labeled (IIb1) Content Quality composed of three items: believable, accurate and precise (Cronbach’s alpha of 0.91). The second factor labeled (IIb2) Content Enjoyment included four items: boring (reversed), enjoyable, lively and interesting (Cronbach’s alpha of 0.80). The third factor was composed of two items—insightful and informative—that was combined into a factor labeled (IIb3) Information Value with a Pearson’s r of 0.62, p < .05. The measures for both content and website attitudes were adapted from Sundar (2000) and Sundar et al. (2010; 2012a; 2012b).

Table 2: Factors under attitude measures

<table>
<thead>
<tr>
<th>Attitudes</th>
<th>Reliability index (Cronbach’s alpha)</th>
<th>Scale Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(IIa) Website Attitudes</td>
<td></td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(IIa1) Website appealing</td>
<td>0.93</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(IIa2) Website exciting</td>
<td>0.93</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(IIb) Content Attitudes</td>
<td></td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(IIb1) Content Quality</td>
<td>0.91</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(IIb2) Content Enjoyment</td>
<td>0.80</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
<tr>
<td>(IIb2) Information value</td>
<td>0.62 (Pearson’s r)</td>
<td>- 4: Describes very poorly to + 4: Describes very well</td>
</tr>
</tbody>
</table>

(IIIa) Behavioral Intention: Participant’s intention to perform preventive health behaviors in the future, such as monitoring one’s exercise, diet, safer sex behaviors, etc. were measured with eight items based on measures adapted from Rimal and Real (2003)
and Armitage and Conner (1999). Example of some of the items from this scale are

*Future Health Behavior (FHB)*: “How likely are you to eat more fruits and vegetables?”, “How likely are you to exercise regularly?”, “How likely are you to discuss HIV status with your partner?”, “How likely are you to practice safer sex?” and so on. Participants rated their response on a 9-item scale ranging from -4=Very unlikely to +4=Very likely. When factor analyzed, there were two distinct factors with future health behaviors pertaining to safer sex behaviors (four items) forming one factor (FHB-F1) with a Cronbach’s alpha = 0.78; and future health behaviors pertaining to diet and exercise (three items) forming the second factor (FHB-F2) with a Cronbach’s alpha = 0.77.

*(IIIb) Health Information Exchange (HIE)*: Apart from likelihood measures, the extent to which participants would want to know more about the health topics discussed in the Q&A, and the extent to which they would discuss these health issues with their friends was measured as a way to capture potential health information exchange behaviors. There were seven items that were a part of this scale that factor analyzed into two factors. The first factor (HIE-F1) pertained to health information exchange and contained four items on diet and exercise such as “I would like to know more about the topic of diet and nutrition”, “I would discuss the topic of nutrition and exercise with my friends” and so on (Cronbach alpha = 0.89). The second factor (HIE-F2) was made up of three items that referred to health information discussions on the topic of safer sex and sexually transmitted infections with examples such as “I would like to know more on the topic of safer sex practices”, “I would discuss the topic of HIV and AIDS with my friends” (Cronbach alpha = 0.88).
(IIIc) Website behavior intention (Web BI): Additionally, behavioral intention as it suggests user-engagement with the website itself was measured with six items such as “I would bookmark this website for future use”, “I would recommend this website to others”, “I would forward this website to my acquaintances” and so on based on Hu and Sundar (2010). This scale had a reliability coefficient of 0.97 (Cronbach’s alpha).

Table 3: Factors under behavioral intention measures

<table>
<thead>
<tr>
<th>Behavioral Intentions</th>
<th>Reliability index (Cronbach’s alpha)</th>
<th>Scale Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(IIIa) Future health behavior (FHB)</td>
<td>0.78</td>
<td>- 4: Very unlikely</td>
</tr>
<tr>
<td>FHB-F1 (Safer sex and STIs)</td>
<td>0.77</td>
<td>+ 4: Very likely</td>
</tr>
<tr>
<td>FHB-F2 (Diet &amp; Exercise)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(IIIb) Health Information Exchange (HIE)</td>
<td>0.89</td>
<td>- 4: Strongly disagree</td>
</tr>
<tr>
<td>HIE-F1 (Diet &amp; Exercise)</td>
<td>0.89</td>
<td>+ 4: Strongly agree</td>
</tr>
<tr>
<td>HIE-F2 (Safer sex and STIs)</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>(IIIc) Website Behavioral Intention (Web BI)</td>
<td>0.97</td>
<td>- 4: Extremely unlikely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ 4: Extremely likely</td>
</tr>
</tbody>
</table>

(IV) Risk perception: From risk communication literature, Weinstein (1999) notes, that individuals need to know three aspects to be able to say they understand or comprehend the risks they face. They need information about (a) “the nature and likelihood of potential ill effects”, (b) “the risk factors that modify their susceptibility” and (c) “the ease or difficulty of avoiding harm” (p. 15). Thus, three measures of perceived severity and susceptibility were measured in this study. A percentage scale adapted from Lerman et al. (1995) was employed to measure participants’ susceptibility likelihood, labeled (IVa) percentage susceptibility, with the following question stem: “Out of 100%, what do you think are your chances of being diagnosed with the following health conditions?” The health conditions indicated were obesity, diabetes, heart disease,
anxiety disorder, sleep disorder, HIV and sexually transmitted infections, other than HIV. The online survey tool allowed individuals to indicate their response by moving a sliding scale from 0% to 100%. When combined, the scale had a reliability of 0.67 (Cronbach’s alpha).

Further, (IVb) relative susceptibility to above mentioned health conditions were measured by asking: “Compared to most people my age, I understand that my risk of being diagnosed with the medical conditions below, are” -4=Extremely low to +4=Extremely high.

(IVc) Perceived severity measures asked participants to indicate their agreement toward ten statements on a 9-point ‘Strongly disagree—Strongly agree’ scale. Examples from the ten health statements were “Obesity can be more deadly than most people realize”, “HIV infection is more serious than most people realize”, “Healthy eating is under my control”, “HIV infection can be a serious condition that can kill” and so on. These relative susceptibility and perceived severity measures were adapted from Rimal and Real (2003). When averaged, both scales had good reliability indices with Cronbach’s alpha of 0.87 and 0.66, respectively. The relative susceptibility measure showed two factors, upon factor analysis. The first factor, dealt with relative susceptibility to three health conditions (obesity, diabetes and heart disease). These were averaged to form a scale (Cronbach alpha = 0.85) and the second factor was a combination of two items pertaining to HIV and other STI susceptibility (Pearson’s r = 0.94, p < .001).
User engagement: The variable of user-engagement was measured in the form of participants’ level of psychological absorption that was captured with 15 measures adapted from Agarwal and Karhana (2000). These were submitted to a factor analysis with Oblimin rotation that identified three factors. The first factor included six items that tapped into (Va) fun and enjoyment factor. It included items such as “I had fun interacting with the site”, “Interacting with the site provided me a lot of enjoyment”, “Interacting with the site excited my curiosity” and so on with Cronbach’s alpha = 0.94. The second factor tapped into (Vb) immersion in the interaction. This factor involved four items in the form of “I lost track of time when I was interacting with the site”, “While I was interacting with the site, I was able to block out most other distractions”, “While I was interacting with the site, I was absorbed in what I was doing” and “While I was interacting with the site, my attention did not get diverted” (Cronbach’s alpha = 0.88). The third factor was the (Vc) amount of control composed of two items “I felt in control while I was browsing the site” and “I felt that I had no control over my interaction with the site (reversed)” with a Pearson’s r = 0.50, p < .001. Participants rated their responses on a 9-point scale of -4 = Strongly Disagree and +4 Strongly Agree.
(VI) Perceived social presence: The extent to which users perceive the presence of another communication partner in the form of perceived social presence can have profound impact on communication outcomes (Biocca, Harms & Burgoon, 2003; Lee, Peng, Jin and Yan, 2006; Short, Williams & Christie, 1976; Skalski & Tamborini, 2007). Based on measures adapted from Lee et al. (2006) this study measured one dimension of perceived social presence via five items in the form of “How much did you feel you were interacting with an intelligent being?”, “How much did you feel you were in the company of an intelligent being?”, “While interacting with the site, how vividly were you able to mentally imagine the source of the voice?” and so on with a reliability of 0.89 (Cronbach’s alpha).

(VII) User satisfaction: Patient-physician communication literature has emphasized the importance of consultation satisfaction that patients report, after having met their doctor. Baker (1990) observes that satisfaction with medical consultation is a reflection on the quality of medical care offered and received, which apart from satisfaction with the professional aspect also includes other dimensions such as patient’s interpersonal relationship and length of consultation. Given the Q&A format of the interaction contained in the study website and the wide range of health topics discussed, this study adapted five items from Baker’s (1990) questionnaire which included items such as “I am totally satisfied with my interaction with the site”, “Some things about my interactions with the site could have been better”, “I thought the site took notice of me as a person” and so on with a Cronbach’s alpha =0.79.
Control variables

Prior to participants’ exposure to the study stimulus, a pretest questionnaire gathered information on demographic variables of interest such as participant’s gender, age, academic standing, sexual orientation, and ethnicity. This section also collected information about participants’ use of new media technologies (e.g., hours spent on the Internet, email, texting, etc). Further, this initial questionnaire also gathered data on three control variables. The rationale for including these covariates and the measures used are discussed below.

Preference for Online Social Interaction (POSI). In the context of studies on problematic Internet use, Caplan (2003) has identified a strong tendency in some individuals who prefer interacting with others online, instead of face-to-face communication contexts. This POSI variable can be pertinent, especially in the examination of message based interactive exchanges that occur between users and the system. It could be argued that users who score on the higher end of the POSI scale may respond more favorably to online discussions and interactions, like the Q&A task in this
study. Thus, in order to control for this innate tendency to choose online interactions over non-mediated exchanges, the study used this variable as a covariate. The POSI scale consisted of a total of six items with examples such as “I prefer communicating with other people online rather than face-to-face”, “My relationships online are more important to me than many of my face-to-face relationships”, “I am willing to give up some of my face to face relationships to have more time for my online relationships” and so on (Cronbach’s alpha = 0.78).

Social Extraversion. Apart from POSI, a related psychological construct in everyday life—degree of extraversion or introversion—was also used as a control variable in this study. It could be argued that POSI might be more situational, depending on the media context in question (e.g., Internet or video games), however a more stable personality trait, like extent of extroversion or introversion can also dictate how exposure to online mediated interactions can affect individuals (Correa, Hinsley & de Zuniga, 2010). Since the format of the interaction in the study’s Q&A task included the conversational tone manipulation (presence or absence of verbal turn-taking cues), statistically controlling for the level of extraversion seemed like a source of variance that could be captured via a reliable measure of personality traits. Thus, a total of eight items from the Pittsburgh Social Extraversion-Introversion and Emotional scale (Bendig, 1962) was used to measure the level of extraversion. Items included statements like "I usually take initiative in making new friends”, "I am inclined to keep in the background on social occasions (reversed)", "I like to mix socially with people" and so on (Cronbach’s alpha = 0.81).
**General Health Beliefs:** Some of the earliest theories of health communication such as the Health Belief Model (Becker, 1974) or the Theory of Reasoned Action (Fishbein & Ajzen, 1975) have shown that individuals’ preexisting attitudes and health beliefs influence their subsequent intentions to perform protective health behaviors. Ajzen and Timko (1986) distinguish the effects of everyday health beliefs, which we normally rely on in our daily lives, as opposed to specific health beliefs that are geared toward concrete action plans and behavioral goals. These authors argue that preexisting beliefs tend to be poorly correlated, and/or may have no significant correlations with any of the predicted outcomes. Yet, accounting for these global health attitudes and beliefs could reveal a portion of the variance that is not explained by the main independent variables in the study. Therefore, assessing preexisting health beliefs can function as a control measure to reduce some of the error variance. With this objective in mind, the study measured attitudes toward general health and safety behaviors with the help of ten items in the form of sentences such as “Maintaining good health is important to me”, “I think it is worthwhile to keep track of my exercise behavior”, “I believe regular physical activity will be beneficial to me” and so on. Responses to these items were combined to create a scale of general health beliefs (Cronbach alpha= 0.68).

Table 6: List of covariates

<table>
<thead>
<tr>
<th>Covariates</th>
<th>Reliability index (Cronbach’s alpha)</th>
<th>Scale Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a). Preference for Online Social Interaction</td>
<td>0.78</td>
<td>- 4: Strongly disagree</td>
</tr>
<tr>
<td>(b). Level of Extraversion</td>
<td>0.81</td>
<td>+ 4: Strongly agree</td>
</tr>
<tr>
<td>(c). General health beliefs</td>
<td>0.68</td>
<td>- 4: Strongly disagree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ 4: Strongly agree</td>
</tr>
</tbody>
</table>
Procedure

The study was conducted over a three-week period in the Media Effects Research Laboratory. Five 17-inch Macbook Pro laptop computers were used for data collection purposes. The study website was designed to function on the Google Chrome browser. The front-end of the health Q&A interface was created using HTML, CSS and Adobe Fireworks tools. An open source database, MySQL was used to store all the question and answer data used in the health Q&A dialogue. This data was extracted asynchronously from the server using the server-side scripting language PHP in combination with the JavaScript library, jQuery. Asynchronous Javascript and XML (AJAX) programming was used to create an unobtrusive back and forth communication between the user and the web server. Quick Time Pro software was used to capture screen activity (video-only) when participants browsed the stimulus website. Participants were informed that only the visual screen activity would be captured and no personally identifying information about them would be recorded. This information was also present in the Informed Consent document. Participants were recruited based on announcements made in various classes. Those who chose to volunteer used an online sign-up sheet to select a date and time that would be convenient for them to come to the computer lab. After participants arrived at the lab, they were asked to go through the Informed Consent document and sign their consent to participate, if they chose to do so. They were given a copy of the Informed Consent document for their records. Prior to participants’ arrival to the lab, the researcher prepared the laptops by opening up hyperlinks to the pretest questionnaire and to the stimulus website. Participants were randomly assigned to one of the six experimental conditions. After the Informed Consent procedure, the participants
were asked to complete the online pretest questionnaire. This pretest questionnaire contained measures for the moderating and control variables described above. After completing the pretest, participants were instructed to browse the website containing the health message Q&A interaction.

In all six versions of the website, participants started with an introduction page that briefly conveyed the purpose of the website, which was to act as a tool to inform participants about everyday health risks that they may face as college students. This page assured participants that all their responses would be kept confidential and would be used only for research purposes. Further, the introduction page also emphasized that the responses from the students will assist the University Health Center to offer better services both to the participants and to other students on campus. These instructions were included as part of the study’s cover story to ensure that participants pay attention to the information being conveyed by the website. The interaction with the stimulus website took approximately 15 to 20 minutes. After this interaction, participants completed the final posttest questionnaire online, which contained the dependent variables in the study. At the end of the Q&A site interaction, all participants were thanked for their participation and were referred to the University Health Center and student counseling services, if they wanted more information about the health topics that were discussed in the study.

**Manipulation Check**

The posttest questionnaire started with manipulation check measures. For the message interactivity variable, a total of eight items were used to see if the display of user interaction history manipulation was psychologically apparent. Items included statements
such as, “The site remembered my actions”, “The actions I performed were clearly
evident on the site”, “The site was transparent in showing the actions I performed”, “The
site remembered the choices I made while interacting with it” and so on. All eight items
were combined to create a scale with a Cronbach’s alpha of 0.79. Manipulation check for
the conversational tone manipulation was checked with a single-item measure, which
asked participants to rate their interaction with the site on a 9-point semantic differential
ranging between “1=Formal to 9=Informal”. The posttest questionnaire, also asked
participants to rate their level of motivation in engaging with the stimulus website on two
dimensions, their level of involvement, “I was involved in the interaction” (0=Not at all
involved to 10=Highly involved) and level of interest “I was interested in the interaction”
(0=Not at all interested to 10=Highly interested), based on measures adapted from
Chaiken and Maheswaran (1994). There were no significant differences on either the
interest or the involvement outcomes across the six conditions.
Chapter 3

RESULTS

Analytical Model

The analyses described below employ a General Linear Model (GLM) with two manipulated independent variables, namely (i) level of interactivity (Low, Medium, High) and (ii) conversational tone (presence or absence of verbal turn-taking cues). The model also includes level of power usage (a continuous, measured variable) as a predictor, followed by interaction terms among the three variables (level of interactivity, conversational tone and power usage). Three covariates—preference of online interaction (POSI), level of extraversion and general health beliefs—were included in this GLM model.

Following the manipulation check results, the study’s findings will be presented in three sections. The first section (Step 1a to Step 1d) will report on the main and interaction effects pertaining to the two manipulated independent variables—level of message interactivity and type of conversational tone—on four main classes of outcomes: attitudes (Step 1a), behavioral intentions (Step 1b), risk perceptions (Step 1c) and user experience (Step 1d). The second section will report on the mediation tests that were proposed, specifically via the paths of perceived contingency (Step 2a), perceived interactivity (Step 2b), perceived relevance (Step 2c) and test of the interactivity effects model (Step 2d). The third section will report on the moderating role of power usage (Step 3a) and effects of the three covariates (Step 3b) examined in the study.
**Message interactivity manipulation check.** A general linear model revealed a significant main effect for the level of message interactivity on the eight-item scale that comprised the manipulation check. As described in the Method section, this measure was used to examine whether the ontological manipulation of message-based interactivity (in the form of the system keeping track of user actions and also displaying a summary of those actions) was psychologically apparent or not. The analysis showed that there was a significant effect $F(2, 157) = 10.67, p < .01$ such that the High interactivity ($M = 8.12, SE = 0.14$) condition evoked a greater perception of the participants’ actions and interaction history being displayed by the system, when compared to the Low ($M = 7.26, SE = 0.14$) and the Medium ($M = 7.36, SE = 0.15$) interactivity conditions. The Tukey HSD post hoc test showed that the High interactivity condition differed significantly from both the Medium and the Low conditions but the latter two were not significantly different from each other.

**Conversational tone manipulation check.** The second manipulation in the study examined the extent to which participants perceived the interaction with the site to be casual and informal. A single-item, 9-point semantic differential scale, with Formal—Informal as the anchors was used for this test. There was a significant one-tailed $t$-test $t(170) = 1.86, p < .05$ showing that participants perceived the interaction with the site to be more informal when verbal turn-taking cues were present ($M = 6.03, SE = 0.24$), when compared to absence of turn-taking cues in the user system dialogue ($M = 5.41, SE = 0.24$).
Section I - Step 1a: Attitudinal outcomes

The following set of hypotheses examined the effect of independent variables on both website and content related attitudes.

H1: Greater levels of message-interactivity will lead to better *attitudes* toward the *website* (H1a) and toward the *content* (H1b).

H10: Presence of an informal conversational tone, will lead to more positive *attitudes* toward the *website* (H10a) and its *content* (H10b).

As can be seen from Table 7, there were no significant main effects or interactions effects for either message interactivity or conversational tone variable on both website attitude factors (*website appealing* and *website exciting*). The same was true for all the three content attitude variables (*content quality*, *content enjoyment* and *information value*). As can be seen from Table 8, the means on all attitudinal evaluations were on the higher end of the 9-point scale demonstrating that in general, participants had favorable evaluations toward the website and its content, regardless of the manipulation of the independent variables. Thus, the hypotheses (H1a&b and H10a&b) predicting significant main effects on attitudinal variables were not supported.

<table>
<thead>
<tr>
<th>Attitudes (Website &amp; Content)</th>
<th>Message Interactivity (MI)</th>
<th>Conversational Tone (CT)</th>
<th>MI x CT interaction</th>
<th>Hypotheses/RQs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing</td>
<td>$F = .12$</td>
<td>$F = .05$</td>
<td>$F = .71$</td>
<td>H1a &amp; H10a</td>
</tr>
<tr>
<td>Website Exciting</td>
<td>$F = 1.54$</td>
<td>$F = .34$</td>
<td>$F = 2.15$</td>
<td>H1a &amp; H10a</td>
</tr>
<tr>
<td>Content Quality</td>
<td>$F = .31$</td>
<td>$F = .76$</td>
<td>$F = .18$</td>
<td>H1b &amp; H10b</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td>$F = 1.29$</td>
<td>$F = .03$</td>
<td>$F = 1.37$</td>
<td>H1b &amp; H10b</td>
</tr>
<tr>
<td>Information Value</td>
<td>$F = 1.40$</td>
<td>$F = .50$</td>
<td>$F = .77$</td>
<td>H1b &amp; H10b</td>
</tr>
</tbody>
</table>

Note: $F$-tests are from GLM analyses.
Section I - Step 1b: Behavioral intention outcomes

The next of hypotheses explored whether either of the two independent variables will have a significant impact on participants’ behavioral intentions. There were three types of behavioral intention variables that were measured in this study. The first one pertains to the likelihood of performing future health behaviors (FHB), the second one examines intention to engage in health information exchange (HIE) and the third one includes website related behavior (Web BI) intentions. Formally, these effects were tested via H2a&b and H11a&b.

H2: Greater levels of message-interactivity will lead to better behavioral intentions toward both preventive health behaviors (H2a) and toward the website (H2b).

H11: Presence of an informal conversational tone, will lead to greater behavioral intentions toward the website (H11a) and its content (H11b).

Table 8: Means and standard deviations on attitudinal outcomes

<table>
<thead>
<tr>
<th>Attitudes (Website &amp; Content)</th>
<th>Message Interactivity</th>
<th>Conversational Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Website Appealing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.04</td>
<td>6.96</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>Website Exciting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.32</td>
<td>5.65</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>Content Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.18</td>
<td>8.25</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.01</td>
<td>5.92</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Information Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.55</td>
<td>7.34</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.17)</td>
</tr>
</tbody>
</table>

Note: TT = Turn-taking cues. Standard errors are presented in parentheses.
As Table 9 suggests, except for a marginally significant influence on one dimension of Future Health Behavior (FHB-F1), there were no significant main effects or interaction effects. Table 10 summarizes the means across different groups.

### Table 9: Main and interaction effects on behavioral intention outcomes

<table>
<thead>
<tr>
<th>Behavioral intentions</th>
<th>Message Interactivity (MI)</th>
<th>Conversational Tone (CT)</th>
<th>MI x CT interaction</th>
<th>Hypotheses/RQs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Behavioral Intention (Web BI)</td>
<td>$F = .31$</td>
<td>$F = .06$</td>
<td>$F = 1.67$</td>
<td>H2b &amp; H11a</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F1)</td>
<td>$F = 2.69^*$</td>
<td>$F = .70$</td>
<td>$F = 1.72$</td>
<td>H2a &amp; H11b</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F2)</td>
<td>$F = 1.83$</td>
<td>$F = .89$</td>
<td>$F = .02$</td>
<td>H2a &amp; H11b</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 1)</td>
<td>$F = .29$</td>
<td>$F = .35$</td>
<td>$F = 1.56$</td>
<td>H2a &amp; H11b</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 2)</td>
<td>$F = .10$</td>
<td>$F = .61$</td>
<td>$F = .62$</td>
<td>H2a &amp; H11b</td>
</tr>
</tbody>
</table>

$^*p < .10$

### Table 10: Means and standard deviations on behavioral intention outcomes

<table>
<thead>
<tr>
<th>Behavioral intentions</th>
<th>Message Interactivity</th>
<th>Conversational Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Web Behavioral Intention (Web BI)</td>
<td>4.53</td>
<td>4.79</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F1)</td>
<td>(0.32)</td>
<td>(0.33)</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F2)</td>
<td>6.96</td>
<td>7.43</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 1)</td>
<td>(0.22)</td>
<td>(0.22)</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 2)</td>
<td>7.49</td>
<td>7.83</td>
</tr>
<tr>
<td></td>
<td>6.98</td>
<td>7.19</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.26)</td>
</tr>
<tr>
<td></td>
<td>5.21</td>
<td>5.27</td>
</tr>
<tr>
<td></td>
<td>(0.31)</td>
<td>(0.31)</td>
</tr>
</tbody>
</table>

Note: TT = Presence of turn-taking cues. Standard deviations are presented in parentheses.

**Future health behavior F1.** Level of interactivity showed a main effect that approached significance $F (2, 157) = 2.69, p = .07$ on the FHB-1 factor (pertaining to safer sex and alcohol consumption behaviors) such that it followed an inverted-V pattern.
Participants in the Medium ($M = 7.43, SE = 0.22$) interactivity condition showed higher intentions of performing health behaviors in the future when compared to those in either the High ($M = 6.72, SE = 0.22$) or the Low ($M = 6.95, SE = 0.22$) interactivity conditions. A post hoc test showed that these differences were not significant across the three conditions.

Section I - Step 1c: Risk perception outcomes

Apart from attitude and conation, the study examined whether either of the independent variables are likely to result in systematic differences on two forms of risk perception outcomes: perceived susceptibility and perceived severity. Susceptibility to health risks was measured as a likelihood estimate ($percentage susceptibility$) and also as a relative estimate, compared to similar others ($relative susceptibility$). The following hypotheses were proposed.

H4: Greater levels of message-interactivity, will lead to increased risk perceptions as reflected in the extent of $perceived susceptibility$ (H4a) and $perceived severity$ (H4b).
H12: Presence of an informal conversational tone, will lead to greater risk perceptions as seen in the level *perceived susceptibility* (H12a) and its *perceived severity* (H12b).

**Table 11: Main and interaction effects on risk perception outcomes**

<table>
<thead>
<tr>
<th>Risk perception</th>
<th>Message Interactivity (MI)</th>
<th>Conversational Tone (CT)</th>
<th>MI x CT interaction</th>
<th>Hypotheses /RQs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Susceptibility</td>
<td>$F = .25$</td>
<td>$F = 1.68$</td>
<td>$F = 1.19$</td>
<td>H4a &amp; 12a</td>
</tr>
<tr>
<td>Relative Susceptibility F1</td>
<td>$F = 1.78$</td>
<td>$F = 4.31^*$</td>
<td>$F = 1.38$</td>
<td>H4a &amp; 12a</td>
</tr>
<tr>
<td>Perceived Severity</td>
<td>$F = 1.02$</td>
<td>$F = 1.27$</td>
<td>$F = .54$</td>
<td>H4b &amp; 12b</td>
</tr>
</tbody>
</table>

* $p < .05$

As Table 11 shows, there was a significant main effect only for the conversational tone variable on *relative susceptibility* outcome pertaining to three health issues: obesity, diabetes and heart-disease, $F(1, 157) = 4.31, p < .05$. The pattern revealed that those in the presence of verbal turn-taking cues ($M = 3.47, SE = 0.25$) condition reported feeling significantly less susceptible than those in the absence of turn-taking cues ($M = 4.19, SE = 0.24$) condition. The result was contrary in direction to what was hypothesized in H12a. Student’s t-test $t(1, 170) = 2.19, p < .05$, confirmed that the difference in the means between the two conditions were significantly different.

**Table 12: Means and standard deviations on risk perception outcomes**

<table>
<thead>
<tr>
<th>Risk perception</th>
<th>Message Interactivity</th>
<th>Conversational Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Percentage Susceptibility</td>
<td>15.55</td>
<td>17.09</td>
</tr>
<tr>
<td></td>
<td>(1.54)</td>
<td>(1.60)</td>
</tr>
<tr>
<td></td>
<td>3.93</td>
<td>4.08</td>
</tr>
<tr>
<td>Relative Susceptibility F1*</td>
<td>6.50</td>
<td>6.65</td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td>(0.31)</td>
</tr>
<tr>
<td>Perceived Severity</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.10)</td>
</tr>
</tbody>
</table>

Note: TT = Presence of turn-taking cues. Standard deviations are presented in parentheses.
Section 1 - Step 1d: User experience outcomes

Two hypotheses predicted that presence of an informal conversational tone is likely to lead to greater perceptions of warmth (H8) and increased user satisfaction (H9). Similarly, research questions RQ2a & 2b tried to examine whether the level of message interactivity is also likely to influence these user experience outcomes. As the *F*-tests in Table 13 indicate, H8 and H9 were not supported. Neither did the level of message interactivity significantly influence these outcomes (RQ 2a&2b).

Table 13: *Main and interaction effects on user experience outcomes*

<table>
<thead>
<tr>
<th>User Experience</th>
<th>Message Interactivity (MT)</th>
<th>Conversational Tone (CT)</th>
<th>MI x CT interaction</th>
<th>Hypotheses /RQs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived warmth</td>
<td><em>F</em> = .08</td>
<td><em>F</em> = .85</td>
<td><em>F</em> = .65</td>
<td>H8 &amp; RQ2a</td>
</tr>
<tr>
<td>Social Presence</td>
<td><em>F</em> = .02</td>
<td><em>F</em> = .96</td>
<td><em>F</em> = 2.58^</td>
<td>RQ3</td>
</tr>
<tr>
<td>Satisfaction</td>
<td><em>F</em> = .63</td>
<td><em>F</em> = .00</td>
<td><em>F</em> = 2.06</td>
<td>H9 &amp; RQ2b</td>
</tr>
</tbody>
</table>

^p < .10

The means in Table 14 demonstrate that the level of perceived warmth and the degree of user satisfaction were nearly the same across all levels of both message interactivity and conversational tone manipulation.

Table 14: *Means and standard deviation on user experience outcomes*

<table>
<thead>
<tr>
<th>User Experience</th>
<th>Message Interactivity</th>
<th>Conversational Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Perceived warmth</td>
<td>6.79 (0.22)</td>
<td>6.89 (0.22)</td>
</tr>
<tr>
<td>Social Presence</td>
<td>5.19 (0.25)</td>
<td>5.12 (0.25)</td>
</tr>
<tr>
<td>User Satisfaction</td>
<td>5.51 (0.21)</td>
<td>5.41 (0.21)</td>
</tr>
</tbody>
</table>

Note: TT = Presence of turn-taking cues. Standard deviations are presented in parentheses.
RQ3 explored whether increased levels of message interactivity is likely to imbue a greater sense of \textit{social presence}. Although there was no significant main effect, as Table 13 shows there was near significant interaction effect $F(2, 157) = 2.58$, $p < .10$ with the two manipulated variables. As Figure 9 below indicates, in the presence of verbal turn-taking cues, participants were likely to report greater social presence in High and Low interactivity conditions. But for participants in the Medium interactivity condition, presence of turn-taking reduced their perceptions of social presence. Instead, these users in the Medium interactivity condition reported feeling greater social presence in the absence of verbal turn-taking cues. RQ4 explored whether perceptions of warmth emerging from the user-system interaction, is likely to mediate the effect of the conversational tone on outcomes listed in H10 to H12. Since there was no significant main effect of the conversational tone variable on perceived warmth outcome (i.e., H8 not supported), the mediation mechanism in RQ4 was not tested further.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{interaction_effect.png}
\caption{Interaction effect on social presence}
\end{figure}
Section II – Step 2a: Role of perceived contingency

The study examines the role of perceived contingency, a psychological outcome that emerged as the result of manipulation of the message interactivity variable. As described in the Method section, contingency as a structural part of the health Q & A interaction was manipulated via the extent to which the back and forth in the dialogue (i.e., the interaction history) between the user and the system would be revealed to the users. Data show that there was a significant main effect $F(2, 157) = 6.04, p < .05$ of the message interactivity variable on perceived contingency such that participants in the High ($M = 7.5, SE = 0.22$) interactivity condition found the site to be most contingent than either the Low ($M = 6.6, SE = 0.22$) or the Medium ($M = 6.51, SE = 0.23$) interactivity conditions (Figure 10). Tukey HSD post-hoc test showed that the High interactivity condition was significantly different from both the Low and the Medium conditions.

Figure 10: Main effect of message interactivity on perceived contingency
The third hypothesis (H3a to H3e) explored whether perceived contingency is likely to mediate the effects of message-interactivity on some of the key outcomes in the study. This study used the bootstrapping approach to test the indirect effects as proposed by Preacher and Hayes (2004) and Hayes and Preacher (2011). As Preacher and Hayes (2004) note, bootstrapping is a nonparametric resampling procedure, which does not assume that a sampling distribution is normally distributed. It is considered to be a computationally intensive procedure because it involves repeated resampling from a given dataset in order to estimate indirect effects, expressed as \(ab\) with \(a\) being the effect from the independent variable to the mediator and \(b\) the effect from the mediator to the dependent variable in each resampled data set. By computing \(ab\) several times, a sampling distribution of \(ab\) is formed and a confidence interval for the indirect (mediation) effect is then constructed. Thus, the bootstrapping technique allows for the direct examination of a null hypothesis that the mediated effect \((ab)\) is zero.

This set of mediation analysis will describe findings that emerged from the MEDIATE macro, which estimates the total, direct and indirect effects of the either single or multiple “X” (causal) variable(s) and also single or multiple mediators in the same model. Additionally, the model allows the independent variable to have either continuous or multi-categorical (nominal) levels. It gives researchers the option of either treating an independent variable as being quantitative (and hence, not apply any dummy coding mechanism). Or, it will allow researchers to specify either “indicator coding” or “sequential coding” mechanisms as explained in Hayes and Preacher (2011). The MEDIATE macro adopted in this study used “indicator” coding, where the Low interactivity condition was considered the baseline. Theoretical reason for adopting
Indicator coding (instead of sequential coding) is that the Low condition had no displays of contingency (i.e., no interaction history). Hence, the Low interactivity condition served as a baseline or ‘control’ condition against which the Medium and High interactivity conditions could be compared. Hence, indicator coding with the Low interactivity condition was used as the baseline. From this baseline, two sets of comparisons were made via dummy variable “D1” that compared Medium with Low interactivity and dummy variable “D2” that compared High with Low interactivity. The SPSS macro used to run this MEDIATE procedure employed 5000 bootstrap samples and a 95% bootstrap percentile confidence interval. Level of power usage, preference for online social interaction, social extraversion and general health belief measures were entered as covariates in the analysis. All coefficients reported from the output are unstandardized and estimated using the ordinary least squares regression method.

As hypothesized in H3a-3e, it was found that perceived contingency did significantly mediate the relationship between levels of interactivity and proposed outcomes, but only for the High-to-Low interactivity (D2) comparison. The total effect of High-to-Low interactivity (D2) comparison tended to be non-significant. The inclusion of perceived contingency as a mediator resulted in positive and significant indirect effects on the set of outcomes listed in Tables 15. These data suggest that greater the visual display of user-system interaction (i.e., High message interactivity), greater the perceptions of contingency, which in turn leads to positive outcomes (regardless of the magnitude and direction of the total effect).
Hence, across the board, perceived contingency as a mediator resulted in positive and significant indirect effects. However, when it was factored out from the IV—DV relationship (i.e., when the direct effect is examined), the interactivity manipulation led to negative impact on some outcomes (numbers marked with # in Tables 15). In these cases, if participants in the High interactivity condition (which featured a greater display of user-system back and forth) did not feel the presence of contingency, then it led to less favorable evaluations of outcomes. As Figure 11 below demonstrates, except for perceived susceptibility (H3d), high levels of message interactivity had a significant

<table>
<thead>
<tr>
<th>D2: High to Low interactivity Comparison</th>
<th>Total Effects: c</th>
<th>Direct Effects: c’</th>
<th>Indirect Effect Bootstrap estimate</th>
<th>Indirect Effect 95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing Web</td>
<td>.07</td>
<td>-.27*</td>
<td>.34*</td>
<td>.12 – .61</td>
</tr>
<tr>
<td>Website Exciting Content</td>
<td>.54</td>
<td>.24</td>
<td>.30*</td>
<td>.08 – .57</td>
</tr>
<tr>
<td>Website Quality Content</td>
<td>-.13</td>
<td>-.32*</td>
<td>.19*</td>
<td>.07 – .32</td>
</tr>
<tr>
<td>Website Enjoyment Information Value</td>
<td>-.46</td>
<td>-.69*</td>
<td>.23*</td>
<td>.07 – .44</td>
</tr>
<tr>
<td>Web BI</td>
<td>-.02</td>
<td>-.27*</td>
<td>.25*</td>
<td>.03 – .58</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F2)</td>
<td>.41</td>
<td>.23</td>
<td>.18*</td>
<td>.03 – .41</td>
</tr>
<tr>
<td>Health Info Exchange (HIE F1)</td>
<td>.01</td>
<td>-.21*</td>
<td>.22*</td>
<td>.05 – .47</td>
</tr>
<tr>
<td>Perceived Severity</td>
<td>.17</td>
<td>.03</td>
<td>.14*</td>
<td>.04 – .28</td>
</tr>
</tbody>
</table>

*p < .05, # Negative direct effect (c’)

Table 15: Indirect effects via perceived contingency
effect via perceived contingency on attitudes (H3a), behavioral intentions (H3b) toward the study site, its content (H3c), and on perceived severity outcomes (H3e).

**Figure 11:** Effects of perceived contingency mediation

**Section II - Step 2b: Role of perceived interactivity**

There was a significant main effect of message interactivity variable on perceived interactivity $F(2, 157) = 5.25, p < .05$ such that those in the Low ($M = 6.26, SE = 0.19$) interactivity condition reported highest level of perceived interactivity than either the Medium ($M = 5.34, SE = 0.19$) or the High ($M = 5.47, SE = 0.19$) interactivity conditions (Figure 12). Hence, the subjective experience of interactivity was contrary to what one might expect (with the Low condition being perceived as most interactive), based on the ontological manipulation of the interactivity variable.
Hypotheses H5a to H5f predicted that perceived interactivity is likely to mediate the effects of manipulated interactivity on attitudes, behavioral intentions and risk perception outcomes. Mediation tests showed that perceived interactivity did mediate the effects of manipulated interactivity on the three classes of outcomes—attitudes, behavioral intentions and risk perceptions—discussed below.

In the case of Medium-to-Low interactivity (D1) comparison, the total effect was non-significant (Table 16). However, when perceived interactivity, was added as a mediator, it resulted in significant indirect effects, but in the negative direction. Hence, lesser the visual display of user-system interaction (i.e., Low message interactivity condition), greater the perceptions of interactivity, which in turn, led to more positive outcomes (Figure 13).

Figure 12: Main effect of message interactivity on perceived interactivity
When the effect of perceived interactivity was statistically controlled, the resultant direct effects were all positive (marked with ^ in Table 16) and in some cases, statistically significant. This suggests that when the influence of perceived interactivity is factored out from the IV—DV relationship, Medium (when compared to Low) interactivity is more likely to result in positive outcomes. However, via the indirect route, it is the Low interactivity condition that is more effective. Thus, via perceived interactivity, Low interactive condition evoked higher perceptions of interactivity (hence, the negative direction, with Low dummy coded as 0 and Medium coded as 1). This in turn had a significant and positive influence on the outcomes listed in Table 16.

Table 16: Indirect effects via perceived interactivity (D1 comparison)

<table>
<thead>
<tr>
<th>D1: Medium to Low interactivity Comparison</th>
<th>Total Effects: c</th>
<th>Direct Effects: c’</th>
<th>Indirect Effect Bootstrap estimate</th>
<th>95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Exciting</td>
<td>.39</td>
<td>.70^</td>
<td>-.31*</td>
<td>-.57 - -.05</td>
</tr>
<tr>
<td>Website Appealing</td>
<td>-.02</td>
<td>.32^</td>
<td>-.33*</td>
<td>-.61 - -.04</td>
</tr>
<tr>
<td>Content Quality</td>
<td>.02</td>
<td>.13^</td>
<td>-.11*</td>
<td>-.23 - -.01</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td>-.03</td>
<td>.25^</td>
<td>-.28*</td>
<td>-.56 - -.05</td>
</tr>
<tr>
<td>Information Value</td>
<td>-.15</td>
<td>.01^</td>
<td>-.16*</td>
<td>-.35 - -.02</td>
</tr>
<tr>
<td>Web BI</td>
<td>.48</td>
<td>.93^</td>
<td>-.45*</td>
<td>-.85 - -.07</td>
</tr>
<tr>
<td>Health Info Exchange (HIE F2)</td>
<td>-.05</td>
<td>.18^</td>
<td>-.23*</td>
<td>-.57 - -.01</td>
</tr>
<tr>
<td>Perceived Severity</td>
<td>.14</td>
<td>.21^</td>
<td>-.07*</td>
<td>-.15 - -.01</td>
</tr>
</tbody>
</table>

*p < .05, ^ Positive direct effect (c’-path)
A similar pattern was found with the High-to-Low interactivity (D2) comparison, with perceived interactivity leading to significant and negative indirect effects. After having controlled for the role of perceived interactivity, there were some positive direct effects (marked with ^ in Table 17). In these cases, taking away the influence of perceived interactivity meant that the High message interactivity condition (through greater display of user-system interaction) had a better chance of evoking positive outcomes. However, when perceived interactivity is introduced as a mediator, it was the Low interactive condition that resulted in significant and favorable outcomes related to attitudes, behavioral intention and perceived risk severity measures, as seen in Figure 14.

Table 17: Indirect effects via perceived interactivity (D2 comparison)

<table>
<thead>
<tr>
<th>D2: High to Low interactivity Comparison</th>
<th>Total Effects: c</th>
<th>Direct Effects: c’</th>
<th>Indirect Effect Bootstrap estimate</th>
<th>Indirect Effect 95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing</td>
<td>.07</td>
<td>.46*^</td>
<td>-.39*</td>
<td>-.66 to -.12</td>
</tr>
<tr>
<td>Website Exciting</td>
<td>.54</td>
<td>.90*^</td>
<td>-.37*</td>
<td>-.65 to -.11</td>
</tr>
<tr>
<td>Content Quality</td>
<td>-.13</td>
<td>-.004</td>
<td>-.13*</td>
<td>-.25 to -.03</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td>-.46</td>
<td>-.13</td>
<td>-.33*</td>
<td>-.60 to -.09</td>
</tr>
<tr>
<td>Information Value</td>
<td>-.40</td>
<td>-.21</td>
<td>-.19*</td>
<td>-.37 to -.05</td>
</tr>
<tr>
<td>Health Info Exchange (HIE F1)</td>
<td>.01</td>
<td>.21^</td>
<td>-.20*</td>
<td>-.48 to -.01</td>
</tr>
<tr>
<td>Health Info Exchange (HIE F2)</td>
<td>.01</td>
<td>.27^</td>
<td>-.27*</td>
<td>-.63 to -.03</td>
</tr>
<tr>
<td>Web BI</td>
<td>-.02</td>
<td>.51^</td>
<td>-.53*</td>
<td>-.94 to -.15</td>
</tr>
<tr>
<td>Perceived Severity</td>
<td>.17</td>
<td>.25^</td>
<td>-.08*</td>
<td>-.17 to -.02</td>
</tr>
</tbody>
</table>

*p < .05, ^ Positive direct effect (c’ path)
Figure 13: Effects of perceived interactivity mediation (D1 comparison)

Figure 14: Effects of perceived interactivity mediation (D2 comparison)
**Section II - Step 2c: Role of perceived relevance**

Based on review of studies done in the realm of tailoring and persuasion in health communication, the role of perceived relevance was examined via hypothesis H14a&b. H14a predicted a linear effect of message interactivity on perceived relevance. This was not supported. Hypotheses 14b examined whether perceived relevance is likely to mediate cognitive responses. In this study, cognitive responses were measured in the form of open-ended responses (*Ask a Doctor*) that participants were asked to come up with, in the form of health-related questions that they would like to ask their physician during their next health check up. Responses to this question were counted for the number of health related issues that participants mentioned. Coding for these thoughts is similar to the procedure followed for thought listing measures that have been studied in the dual process model experiments (Chaiken & Maheswaran, 1994). The open-ended responses were initially categorized into thoughts or questions related to four categories: diet, exercise, HIV and other sexually transmitted infections. Other health issues that were not discussed as part of health Q & A interaction in the site were also coded. For running inferential analyses, thoughts from all the four categories were added up. The measure had a mean of $M = 1.62$ and $SD = 0.99$, with a positive skew. In order to establish intercoder reliability, a random number table was used to select a set of 15 responses, which was eventually coded by two coders, independently. Reliability formula by Holsti’s (1969) method revealed an intercoder reliability of 96.6% calculated as $2M/(Ni+Nj)$, where $M =$ total items agreed upon by both the coders, $Ni =$ total items coder $i$ selected and $Nj =$ total items that were selected by coder $j$. 
There was no significant main or interaction effect with the two independent variables on the outcome of perceived relevance. Hence H14a is not supported. In order to address the mediation hypothesis in H14b, when perceived relevance was entered as a single mediator, there was no significant mediation observed. However, when all the three mediators (perceived contingency, perceived interactivity and perceived relevance) were entered in a mediation macro titled PROCESS (Hayes, 2012), the test showed the presence of a two-step mediation path involving perceived interactivity and perceived relevance. Model 6 in the PROCESS macro (5000 re-samples, 95% bootstrap CI) explores the relative indirect effects of multiple mediator variables that are said to be operating in a sequence. In the case of this analysis, the mediators for the two-step analysis include Perceived Interactivity (M1) \( \rightarrow \) Perceived Relevance (M2), both mediating message interactivity’s effect on cognitive responses.

<table>
<thead>
<tr>
<th>D2: High to Low interactivity Comparison</th>
<th>Total Effects: ( c )</th>
<th>Direct Effects: ( c' )</th>
<th>Indirect Effect Bootstrap estimate (M1 &amp; M2)</th>
<th>Indirect Effect 95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1: (Medium - Low) M1 &amp; M2</td>
<td>.07</td>
<td>.13</td>
<td>-.05*</td>
<td>-.12 to -.01</td>
</tr>
<tr>
<td>D2: (High - Low) M1 &amp; M2</td>
<td>.10</td>
<td>.17</td>
<td>-.06*</td>
<td>-.13 to -.01</td>
</tr>
</tbody>
</table>

*\( p < .05 \)

The data from this test suggest that Low interactivity (as opposed to Medium or High) condition was perceived as more interactive, which in turn had a significantly positive effect on perceived relevance (Figures 15 & 16). In both Medium-to-Low and
High-to-Low interactivity comparisons, the total effects were positive but not significant as seen in Table 18.

**Figure 15:** Two-step mediation on cognitive responses (D1 comparison)

**Figure 16:** Two-step mediation on cognitive responses (D2 comparison)

**Section II - Step 2d: Role of user engagement**

User Engagement. In the study, user engagement was measured with the level of self-reported absorption composed of three factors: *fun and enjoyment, immersion* and *amount of control* over the interaction. There was a marginally significant main effect for the conversational strategy variable $F(1, 156) = 3.90, p = .05$ on the *amount of control* factor such that the presence of verbal turn-taking cues ($M = 5.64, SE = 0.19$) reduced the
amount of control that participants assumed they had, when compared with the absence of verbal turn-taking cues ($M = 6.17$, $SE = 0.19$).

Based on the interactivity effects model (Sundar, 2007), hypotheses H6 & H7 propose tests of two-step mediations via perceived contingency and user engagement on attitudes and behavioral intention outcomes. In order to test this path, MED3C macro with 5000 re-samples (Hayes, Preacher & Myers, 2010) was used as it allows of tests of sequential mediation in the form of $IV \rightarrow M1 \rightarrow M2 \rightarrow DV$. Using OLS regressions, MED3C estimates the total, direct and indirect effects of two mediators (in the order entered) simultaneously. Apart from bootstrap tests of individual paths (one mediator at a time), it also provides bootstrap estimate and 95% confidence intervals for the $M1 & M2$ path together, which can be used to infer the presence of two-step mediation, if the confidence intervals do not contain zero. Similar to the MEDIATE test described above, Low interactivity condition served as a baseline or ‘control’ condition against which the Medium (dummy coded as D1) and High (dummy coded as D2) interactivity conditions could be compared. Since MED3C allows for only one independent variable to be entered at a time, the other dummy coded variable was entered as a covariate in all the analyses. There were four other covariates in the model that included levels of power usage, POSI, extraversion and general health beliefs. Data in Table 19 demonstrate that the MED3C mediation analysis lends support to the message-interactivity path (via perceived contingency and user engagement), as delineated in the interactivity effects model (Sundar, 2007). As seen in Figure 17, these findings were found only for the High-to-Low (D2) interactivity comparison (H6 & H7 are supported).
The two-step mediation path is such that High level of interactivity (greater display of visual back and forth between system and user), led to greater perceptions of contingency (M1), which in turn resulted in greater level of user engagement (M2). These two paths in turn, significantly influenced attitudes and behavioral intentions. Therefore, both perceived contingency and level of user engagement (in that order), served to influence participants’ attitude and behavioral intentions via positive and significant indirect effects. After accounting for these two mediators (i.e., when the direct effect was

<table>
<thead>
<tr>
<th>D2: High to Low interactivity Comparison</th>
<th>Total Effects: ( c )</th>
<th>Direct Effects: ( c' )</th>
<th>Indirect Effect Bootstrap estimate ( (M1 &amp; M2) )</th>
<th>Indirect Effect 95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing</td>
<td>.07</td>
<td>-.10*</td>
<td>.14*</td>
<td>.05 .26</td>
</tr>
<tr>
<td>Website Exciting</td>
<td>.54</td>
<td>.57*</td>
<td>.27*</td>
<td>.09 .49</td>
</tr>
<tr>
<td>Content</td>
<td>-.13</td>
<td>-.28*</td>
<td>.03*</td>
<td>.01 .08</td>
</tr>
<tr>
<td>Quality Enjoyment</td>
<td>-.46</td>
<td>-.46*</td>
<td>.18*</td>
<td>.06 .34</td>
</tr>
<tr>
<td>Information Value</td>
<td>-.40</td>
<td>-.56*</td>
<td>.05*</td>
<td>.01 .11</td>
</tr>
<tr>
<td>Future health behavior (FHB F1)</td>
<td>-.32</td>
<td>-.31*</td>
<td>.06*</td>
<td>.01 .14</td>
</tr>
<tr>
<td>Health Info Exchange (HIE F1)</td>
<td>.01</td>
<td>-.08*</td>
<td>.10*</td>
<td>.02 .22</td>
</tr>
<tr>
<td>Health Info Exchange (HIE F2)</td>
<td>.01</td>
<td>.12</td>
<td>.15*</td>
<td>.04 .32</td>
</tr>
<tr>
<td>Web BI</td>
<td>-.02</td>
<td>.13</td>
<td>.32*</td>
<td>.11 .60</td>
</tr>
</tbody>
</table>

*p < .05, *Negative direct effect (c’ path)
assessed), it was found that the High interactivity condition led to significantly more positive evaluations of how exciting participants considered the website to be (*website exciting*). However, in the absence of perceived contingency and subsequent increase in user engagement, those in the High interactivity condition reported lesser *content enjoyment* and *information value* compared to their counterparts in the Low Interactivity condition (significant but negative direct effects in Table 19).

**Figure 17:** Two-step mediation via perceived contingency & user engagement

**Section III - Step 3a: Role of power usage**

Two research questions in the study (RQ1 & RQ2) explored whether the degree of power usage, an individual difference variable, is likely to moderate the effects of message interactivity. The results are summarized in Table 20 below.
As can be seen from Table 20, the level of power usage was a significant predictor (standardized regression coefficients) on many of the outcome variables. In terms of interaction effects, there was a significant interaction between conversational tone and power usage. The table below summarizes the main and interaction effects of power usage on various outcome variables:

<table>
<thead>
<tr>
<th>Attitudes (Website &amp; Content)</th>
<th>Power Usage (PU)</th>
<th>Message Interactivity (MI) x PU</th>
<th>Conversational Tone (CT) x PU</th>
<th>MI x CT x PU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing</td>
<td>β = .33*</td>
<td>F = .98</td>
<td>F = .001</td>
<td>F = .58</td>
</tr>
<tr>
<td>Website Exciting</td>
<td>β = .43*</td>
<td>F = .14</td>
<td>F = 1.61</td>
<td>F = 1.08</td>
</tr>
<tr>
<td>Content Quality</td>
<td>β = .22*</td>
<td>F = .12</td>
<td>F = 1.21</td>
<td>F = 1.10</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td>β = .29*</td>
<td>F = .78</td>
<td>F = .05</td>
<td>F = .72</td>
</tr>
<tr>
<td>Information Value</td>
<td>β = .26*</td>
<td>F = 2.49^</td>
<td>F = .70</td>
<td>F = .22</td>
</tr>
<tr>
<td>Behavioral intentions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web Behavioral Intention (Web BI)</td>
<td>β = .48*</td>
<td>F = .52</td>
<td>F = 1.29</td>
<td>F = .81</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F1)</td>
<td>β = .21*</td>
<td>F = .62</td>
<td>F = 5.82*</td>
<td>F = 1.79</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F2)</td>
<td>β = .30*</td>
<td>F = .22</td>
<td>F = .00</td>
<td>F = .14</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 1)</td>
<td>β = -.03</td>
<td>F = .05</td>
<td>F = .02</td>
<td>F = .24</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 2)</td>
<td>β = -.26</td>
<td>F = 1.28</td>
<td>F = .11</td>
<td>F = .81</td>
</tr>
<tr>
<td>Risk perception</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage Susceptibility</td>
<td>β = .33</td>
<td>F = 2.73^</td>
<td>F = .02</td>
<td>F = .66</td>
</tr>
<tr>
<td>Relative Susceptibility</td>
<td>β = .18</td>
<td>F = .80</td>
<td>F = .03</td>
<td>F = 2.20</td>
</tr>
<tr>
<td>Perceived Severity</td>
<td>β = .12^</td>
<td>F = .63</td>
<td>F = .01</td>
<td>F = .05</td>
</tr>
<tr>
<td>Cognitive responses</td>
<td>β = .05</td>
<td>F = .46</td>
<td>F = 4.50*</td>
<td>F = .80</td>
</tr>
<tr>
<td>User Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engagement - Fun</td>
<td>β = .30^</td>
<td>F = .21</td>
<td>F = .02</td>
<td>F = 1.61</td>
</tr>
<tr>
<td>Engagement - Immersion</td>
<td>β = .13</td>
<td>F = .81</td>
<td>F = .39</td>
<td>F = .25</td>
</tr>
<tr>
<td>Engagement - Control</td>
<td>β = .43*</td>
<td>F = 1.73</td>
<td>F = .002</td>
<td>F = .20</td>
</tr>
<tr>
<td>Social Presence</td>
<td>β = .18</td>
<td>F = .20</td>
<td>F = .44</td>
<td>F = .05</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>β = .15</td>
<td>F = 1.61</td>
<td>F = .40</td>
<td>F = 1.22</td>
</tr>
</tbody>
</table>

Note: * p < .05, ^ p < .10. The regression coefficients are for power usage as one of the predictors in the general linear model, along with the independent variables, interaction terms and covariates included in that model.

As can be seen from Table 20, the level of power usage was a significant predictor (standardized regression coefficients) on many of the outcome variables. In terms of interaction effects, there was a significant interaction between conversational tone and power usage.
tone and the level of power usage $F(1, 157) = 4.50, p < .05$ (Figure 18). The interaction showed that the degree of question asking (cognitive responses), depends on the individuals’ extent of power usage. Those scoring high on power usage are more likely to ask questions, in the absence of verbal turn-taking cues. However, those scoring low on power usage are likely to ask more questions when verbal turn-taking cues are present as part of the user-system health Q&A interaction.

![Figure 18: Interaction effect on cognitive responses](image)

A similar interaction effect $F(2, 157) = 5.82, p < .05$ between conversational tone and level of power usage was found on the future health behavior (FHB-F1) variable, pertaining to behavioral intentions toward safer sex and alcohol consumption behaviors (Figure 19). Participants scoring higher on the power usage scale showed higher behavioral intentions in the absence of verbal turn-taking cues. However, the addition of verbal turn-taking cues did not make any significant difference on the likelihood of
performing healthy behaviors, regardless of whether participants scored higher or lower on the power usage scale.

Section III - Step 3b: Role of covariates

The study examined the effect of three variables—preference for online social interaction (POSI), extent of social extraversion and general health beliefs—as potential covariates. Controlling for these factors in the general linear model analyses showed that these covariates did not significantly influence or alter the nature of main outcomes discussed above (Sections I to III). Among the three variables, POSI had a significant and negative effect on content quality ($\beta = -0.12, p < .05$) evaluations such that higher the score on preference for online interaction, it was less likely for participants to appreciate the quality of the health Q&A content. The general health belief measure turned out to be a positive and significant predictor of the following health related outcomes: future health behavior (FHB-F2: $\beta = 0.59, p < .001$), health information exchange (HIE-F1: $\beta = 0.53$,}

Figure 19: Interaction effect on future health behavior (FHB-F1)
percentage susceptibility \( (\beta = -2.76, p < .05) \) and perceived severity \( (\beta = .16, p < .05) \). The degree of social extraversion did not have any significant effects.

**Additional Analysis: Phantom Model approach**

The mediating mechanisms via perceived contingency and perceived interactivity seem to follow an intriguing pattern, with the former leading to positive indirect effects and the latter, resulting in negative indirect effects. The data presented in Figures 11, 13 and 14 tested these mediating mechanisms one at a time. But how would these two mediators act together? Would their specific indirect effects cancel each other out? Is that the reason why the total effect is non-significant? The answers to some of these questions emerge from the phantom model analysis (Macho & Ledermann, 2011) discussed below.

More importantly, the purpose of using the phantom model analysis in this study is to compare two specific indirect paths that are also primarily driven by theoretical considerations. The first path, “Path A” is examining the two-step, sequential mediation of perceived contingency \( (M1) \rightarrow \) user engagement \( (M2) \). This theoretical mechanism in Path A is a reflection of H6 & H7 discussed above, as part of the interactivity effects model (Sundar, 2007). The second path, “Path B” is examining the two-step, sequential mediation of perceived interactivity \( (M3) \rightarrow \) perceived relevance \( (M4) \), a mechanism proposed in H14b as part of the elaboration likelihood explanation for understanding the effects of interactive health messages that boost perceptions of personal relevance. Path A is driven by perceived contingency and Path B has perceived interactivity as the starting point. The key point to remember is to that all four mediators \( (M1 \) to \( M4) \) are hypothesized to be operating at the same time, in the same model. The goal of the phantom model, therefore, is to compare Path A and Path B and tell us which of the two
paths (or if both, or if neither of the paths) result in significant indirect effects from the independent variable (dummy coded message interactivity variables) to the dependent variable of interest. Figure 20 helps to further illustrate how the phantom variable approach can help assess and compare specific effects of interest.

![Diagram of structural equation model](image)

**Figure 20**: Illustration of Path A and Path B tested in the phantom model analysis

The phantom model approach (Rindskopf, 1984 as cited in Macho & Ledermann, 2011) allows researchers to compare specific effects (or paths) of interest within structural equation models. The logic of the approach lies in the notion that a specific effect of interest is poised as a “phantom model” that is added to the main, theoretical model under study. The phantom variable is added in the form of an additional latent variable to one of the main variables in the model (e.g., the independent variable). There
are no error terms added to the phantom variable. So the latent variable’s error variance is equal to zero. The next key step in creating this phantom variable is to constrain (or limit) its path coefficient (i.e., path from the latent variable to the main variable in the study). This can be done by matching the path coefficient of the ‘phantom-to-main’ variable path with a specific effect of interest in the main model. To this end, the following steps were performed:

(1) Six latent phantom variables were added to the main model. These phantom variables were labeled M1.P1_, M1.P2_, M1.P3_ and M2.P1_, M2.P2_ and M2.P3_. The underscore after each latent variable follows the convention for labeling phantom variables as delineated by Macho and Ledermann (2011).

(2) As can be seen from Figure 20, these latent variables do not have any error variance attached to them.

(3) The next step after creating these phantom variables was to establish equality constraints. This was done by fixing the specific paths of interest, for e.g., S1 (IV \(\rightarrow\) perceived contingency), S2 (Perceived contingency \(\rightarrow\) user engagement) and S3 (user engagement \(\rightarrow\) DV) to correspond with the path coefficients among one set of phantom variables: M1.P1_, M1.P2_, M1.P3_. Hence, instead of assigning specific (numerical) regression weights, S1, S2 and S3 path coefficients were added that correspond with the respective coefficients of interest in the main model.

(4) A similar procedure was followed for path B with M2.P1_, M2.P2_ and M2.P3_ phantom variables, by adding I1, I2 and I3, respectively, as equality constraints.

(5) After creating this phantom model, bootstrap estimates of indirect effect was obtained, using 5000 resamples and 95% bias-corrected confidence interval. This ability
to obtain bootstrap estimates and confidence intervals of specific indirect effects is one of the advantages of this phantom model approach (Macho & Ledermann, 2011). Results from this bootstrap tests are presented below in Tables 21 & 22.

Table 21: Phantom model analysis testing Paths A & B (D2 comparison)

<table>
<thead>
<tr>
<th>D2: High-to-Low interactivity (Path A)</th>
<th>Beta Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing</td>
<td>0.03*</td>
</tr>
<tr>
<td>Website Exciting</td>
<td>0.05*</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td>0.03*</td>
</tr>
<tr>
<td>Web Behavioral Intention (Web BI)</td>
<td>0.04*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D2: High-to-Low interactivity (Path B)</th>
<th>Beta Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Value</td>
<td>-0.01*</td>
</tr>
<tr>
<td>Web Behavioral Intention (Web BI)</td>
<td>-0.01*</td>
</tr>
<tr>
<td>Future Health Behavior (FHB F1)</td>
<td>-0.01*</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 1)</td>
<td>-0.02*</td>
</tr>
<tr>
<td>Health Information Exchange (HIE 2)</td>
<td>-0.02*</td>
</tr>
<tr>
<td>Cognitive responses</td>
<td>-0.01*</td>
</tr>
</tbody>
</table>

*Two-tailed, Bias-corrected confidence intervals of bootstrap estimates p < .05

The specific effect in Path A, via the perceived contingency \( \rightarrow \) user engagement route, resulted in a significant mediation on website attitudes (website appealing and website exciting), content enjoyment and website related behavioral intention outcomes. In contrast, Path B, led by perceived interactivity \( \rightarrow \) perceived relevance, resulted in specific indirect effects on a different category of outcomes, mostly related to health behavioral intention outcomes (FHB F1, HIE 1 & HIE 2) as seen in Table 21. Path B also showed specific indirect effects on the cognitive responses variable. Website related behavioral intention outcome (Web BI) was significantly influenced by both paths A & B, but as the beta estimates indicate, the magnitude and the direction of these paths are markedly different.
Therefore, these findings support the interactivity effects model (Path A), where the High interactivity condition (with its greater display of structural contingency), resulted in positive indirect effects on both website related attitudes and one content attitude factor (i.e., content enjoyment). This shows that participants were sensitive and responsive to the contingency manipulation in the study site. And further still, this perceived contingency driven path (Path A) also encouraged greater level of user engagement with the website. Therefore, the theoretical explanation from the interactivity effects model helps us understand why higher message interactivity in the system can lead to positive evaluations of the tool itself, and also of the content conveyed through the site. The path via perceived interactivity and perceived relevance, highlight the superiority of the Low interactivity condition (as indicated by the negative sign). This is similar to the findings in Figures 13 and 14, discussed in Section II – Step2b above. The betas for Path B suggest that, overall, the effects via this path are comparatively smaller in magnitude and also different in direction, when compared to the beta estimates of Path A. Additionally, the theoretical mechanism of—perceived interactivity, enhancing perceptions of relevance, and both of them in turn affecting final outcomes—seems to work well with one class of dependent measures, namely, health related behavioral intentions and also the tendency to elaborate (as seen in the cognitive responses outcome). Hence, the phantom model analysis clarified the differences between the two specific indirect effects by highlighting what types of outcomes that these different paths are likely to affect.
Table 22: Phantom model analysis testing Paths A & B (D1 comparison)

<table>
<thead>
<tr>
<th>D1: Medium-to-Low interactivity (Path A)</th>
<th>Beta Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website Appealing</td>
<td>-0.01*</td>
</tr>
<tr>
<td>Website Exciting</td>
<td>-0.02*</td>
</tr>
<tr>
<td>Content Enjoyment</td>
<td>-0.01*</td>
</tr>
<tr>
<td>Web Behavioral Intention (Web BI)</td>
<td>-0.02*</td>
</tr>
</tbody>
</table>

*Two-tailed, Bias-corrected confidence intervals of bootstrap estimates $p < .05$

Table 22 summarizes the phantom model analysis for the Medium-to-Low interactivity (D1 dummy coded variable) condition. When both Path A and Path B were tested for their indirect effect on this Medium-to-Low comparison, only Path A (perceived contingency → user engagement route) emerged with significant indirect effects on website attitude, content attitude and website related behavioral intention outcomes. Hence, even when the level of interactivity is somewhat reduced (i.e., Medium as opposed to High interactivity condition), the theoretical mechanism proposed in interactivity effects model (i.e., Path A) still holds good in explaining why Low message interactivity leads to positive evaluations toward the site.

**Summary of Findings**

Thus far, this section has given the details of how the two manipulated variables (level of interactivity and conversational tone) and one measured moderator (level of power usage) created significant effects and influenced several outcomes related to participants’ interaction with the Health and Wellness Q&A site. The chief findings are summarized below.
**Message interactivity effects.** Manipulation of message interactivity had a significant effect on perceived contingency, one of the chief mediators in the study. As expected, it was found that High interactivity condition led to greater perceptions of contingency (Figure 10). The difference between the Low and Medium interactivity conditions on this variable was not significant. In an interesting pattern, the message-interactivity manipulation had a significant impact on the perceived interactivity variable such that, Low interactivity condition evoked the highest response on the perceptual experience of interactivity (Figure 12). The Medium and High conditions were not significantly different from each other.

The above two findings demonstrate that the outcome of manipulated (or actual interactivity) in the system can be very different from the subjective perception of interactivity. As seen in this data, the pattern for perceived interactivity and for perceived contingency were contradictory such that Low interactivity was the most favored on the outcome of perceived interactivity and High interactivity was the one that evoked the greatest response on the variable of perceived contingency. Perceived interactivity was measured with four items that captured two dimensions—extent of two-way communication and degree of feedback—which the participants felt was offered to them via the Q&A interaction in the site. Perceived contingency, on the other hand, was measured as the extent to which participants thought that the site actively took into account their inputs and gave them responses that were interconnected to prior inputs.

Level of message interactivity also had a marginal, non-linear effect on intentions to perform future health behaviors (diet and exercise). The Medium interactivity condition evoked the highest score on this behavioral intention measure.
**Conversational tone effects.** Presence of a casual conversational tone (i.e., the use of verbal turn-taking cues by the system) made participants feel significantly less susceptible to some forms of health issues such as obesity, heart-disease, diabetes and so on. Conversational tone had a moderating effect ($p < .10$) on the level of interactivity, on the outcome related to perceived social presence. Individuals in both Low and High interactivity conditions felt greater social presence when there were verbal turn-taking cues present. Those in the Medium interactivity condition perceived greater social presence in the absence of turn-taking cues.

The effect of conversational tone was moderated by the level of power usage on intentions to perform future health behavior (safer sex and alcohol consumption) such that presence of turn-taking cues did not make any difference to those who scored either low or high on the power usage scale. But in the absence of turn-taking cues, individuals scoring high on power usage scaled showed greater behavioral intentions than those scoring low on the power usage measure.

Conversational tone significantly influenced the extent to which participants reported as being relatively susceptible to health issues such as diabetes, obesity and heart disease. The presence of verbal turn-taking cues significantly reduced their relative susceptibility. While there was no main effect for either the level of interactivity or the conversational tone variable on the outcome of cognitive responses, a significant interaction effect between level of power usage and conversational tone emerged. Those scoring high on power usage showed increased cognitive response only in the absence of turn-taking cues. The addition of verbal turn-taking cues encouraged question-asking
(cognitive response), only among those users who scored lower on the power usage measure.

**Mediation effects.** Finally, tests of mediation showed that perceived contingency turned out to be a significant mediator of the effect of High-vs-Low interactivity on website and content attitudes and also on measures of behavioral intentions and risk perception. On the other hand, the variable of perceived interactivity also showed significant but negative indirect effects. Even though they both belong to the same class of variables (i.e., mediators), the way they unravel the effects of the manipulated interactivity is very different. The functioning of perceived contingency rests on the availability of higher levels of interactivity (i.e., the High condition) being present (hence, the positive indirect effect). The functioning of the perceived interactivity variable, particularly in this study, depended on the significant effect of the Low interactivity condition. So much so, in both Medium-to-Low and High-to-Low comparisons, it was the Low condition that was significantly better in evoking perceived interactivity, which in turn had a significant and favorable impact on attitudinal, conative and risk perception outcomes.

There were two sets of sequential mediation effects that were significant. The first set of sequential mediation involved perceived interactivity and perceived relevance, and how these variables together mediated the effect of interactivity on cognitive responses. The second set supported the hypotheses and paths predicted in the interactivity effects model (Sundar, 2007). In this case, the effect of message interactivity was mediated by the first step, involving the variable of perceived contingency and the second step,
involving the role of user engagement. These two mediators, in turn, influenced attitudes and behavioral intentions.

In using a test of multiple mediation to reveal underlying theoretical processes, phantom model analyses clearly indicated the robustness of Path A (the interactivity effects model route). For both sets of High-to-Low and Medium-to-Low interactivity comparison, the path led by perceived contingency, followed by user engagement, consistently resulted in a positive impact on attitude and behavioral intention outcomes. The same analysis also suggested the potential to harness the ‘perceived interactivity plus perceived relevance’ route, for meeting more content-related persuasive goals that revolve around health behavioral intention outcomes. Hence, path A bolstered the impact of message interactivity on mostly website or technology related variables, whereas path B fostered more content-oriented, health message goals.

The next chapter will interpret these results in light of the theoretical mechanisms tested and also discuss their practical implications.
The purpose of this study is to explore how (i) the variable of interactivity, manipulated as a structural affordance of an interactive health tool and (ii) the conversational tone, manipulated as part of the messages emerging from the tool, influence users’ cognitions, attitudes and behavioral intentions both toward the medium and the health information presented via the medium.

One of the key contributions of the study lies in highlighting the fact that systematic manipulation of the level of message interactivity (as a structural affordance of the health Q&A tool) not only has a significant influence on overall user perceptions and evaluations. But more importantly, such theory-driven changes at the level of the technological medium can alter users’ perceptions about the content that is being conveyed through interactive systems. To illustrate this further, it must be noted that the study did not manipulate the degree of health risks being conveyed in the health Q&A dialogue. But as the data show, those in the Medium interactivity condition (Figure 8) were more likely to show higher intentions of performing future health behaviors. Additionally, if the system displayed verbal turn-taking cues, it reduced perceptions of relative risk susceptibilities. Hence, even though health information was kept constant across all the six experimental conditions, the data show that subtle changes in the design of interactivity features (or affordances) and the way in which content is delivered, hold the potential to engage and involve users with health information that is being conveyed.
This ability to draw users into preventive health messages and guidelines—even as they casually explore the interactive features a tool has to offer—is what makes the use of interactive health tools a promising venue for pursuing clinical and behavioral-change interventions.

**Distinguishing manipulated and perceived interactivity**

One of the main goals in the study has been to take a closer look at the interactivity variable in general, and that of message-based interactivity, in particular. Conceptually and operationally, message interactivity was treated not only as a structural property of the medium, but also as a part of the user-system dialogue. A disproportionate amount of studies on the interactivity variable has examined the effects of modality-related features (e.g., addition of multimedia), the so-called functional or ‘bells and whistles’ view (Sundar et al., 2003). Even though there have been some studies in the past (Burgoon et al., 2000a; Sundar et al., 2003; Wise et al., 2006) that have explicitly examined the link between such structural contingency and perceptions of contingency, there is still scarcity of recent empirical data that can shed more light on this underlying theoretical link (Walther et al., 2005a). So much so, even after two decades since Rafaeli’s (1988) exposition of the *two-way, reactive and interactive* continuum, there is no clear pattern of what the antecedents and outcomes are when interactivity is operationalized via the principle of contingency and how it translates psychologically in the minds of the users. This study addresses this gap by not only operationalizing the contingency principle at the level of the interface (visual display of back and forth) but also examines the effects of *perceived contingency* that emerged as a significant mediator
on several key outcomes related to participants’ attitudes, behavioral intentions and risk perception outcomes.

Another key contribution, surrounding the operation of the interactivity variable that this study highlights is the psychological differences between perceived contingency and perceived interactivity. At the ontological level, the study manipulated interactivity in the form of an explicit visual display of the threaded back and forth interaction that occurred between the participants and the system. Thus, the site in the High interactivity condition showed users their entire interaction history. Hence, it is no surprise that this ontological manipulation resulted in greater perceptions of perceived contingency, which was measured as the extent to which users psychologically felt that the system kept a record of all their actions and further still, that the system carefully took into account their previous responses before giving them tailored output. Hence, the findings on the perceived contingency variable validated this ontological manipulation such that those in the High interactivity condition perceived the site to be the most contingent, when compared to either the Low or the Medium interactivity conditions. What is surprising, however, is how this ontological manipulation of interactivity resulted in an exact opposite pattern of finding, with respect to the perceived interactivity variable. The two figures (Figures 10 & 12 in Chapter 3) bear testimony to the fact that perceived contingency and perceived interactivity are psychologically two distinct outcomes, and that they behave very differently, even though they emerge from the same independent variable, i.e., manipulated message interactivity. If the High interactivity condition was considered the most contingent (Figure 10), it was the Low interactivity condition that users perceived as being the most interactive (Figure 12).
In order to understand the above finding better, it would be apt to remind ourselves how the variable of perceived interactivity was measured in this study. The measure consisted of four items that tapped into the perceptual experiences of two-way communication and the opportunity to provide feedback (Liu, 2003; McMillan & Hwang, 2002) that users felt during their interaction with the site. Contrary to expectations, the data pattern revealed that perceptions of interactivity was the highest among those in the Low interactivity condition, with the Medium and High conditions scoring significantly lower than the Low condition. Given that the study site was designed to mimic a Q&A health dialogue (with a chat or SMS/texting-like appearance), the defining qualities of interactivity in users’ minds may very well have been the extent to which they thought the site gave them an opportunity to engage in a two-way dialogue. The Low interactivity condition was devoid of all other cues except for the back and forth represented by the Q&A chat bubbles. Hence, lesser visual display of the interaction (i.e., less “clutter”) in the Low interactivity condition may have been more conducive in encouraging users to form richer perceptions of interactivity in their minds. This potential to imagine richer, one-on-one interactions could have been the reason why participants in the Low interactivity condition scored significantly higher on the perceived interactivity measure, than either the Medium or the High interactivity conditions. The additional cues for contingency in both the Medium (a message box reminding users what their chosen response was) and High (display of the entire conversation thread) interactivity conditions may have distracted users from the unhindered, two-way back and forth that was more obvious in the Low interactivity condition. In the Medium and High interactivity conditions, the added bonus of contingency displays may have resulted in
users thinking that the system was doing ‘more of the talking’ and hence, their role was limited to simply choosing answer responses and waiting for the system to present the next message. Thus, the system making its presence felt (with more contingency cues) perhaps may have dampened perception of two-way communication. Although, this conceptualization of a two-way transaction is precisely what Rafaeli (1988) would term as occupying the very low end of the interactivity continuum, empirically, it appears that two-way communication is associated with very high perceptions of perceived interactivity.

The interpretation above must be understood with a few caveats surrounding the measurement of perceived interactivity in this study. There were four items that measured this concept, with two of the items tapping into the concept of “two-way” or simultaneous communication and the other two concerning the ability to give “feedback” aspect. As the explication of the interactivity concept in the literature review (Chapter 1), the concept of interactivity is highly multidimensional and the four-item measure used falls short of capturing other dimensions of interactivity such as greater amount of choice, responsiveness, active user control and so on. Limitations surrounding the measurement of the perceived interactivity concept urges researchers to approach more of a “bottom-up” (Bucy, 2004, p. 376) approach in garnering various other dimensions of the concept that emerge from actual subjective experiences of the users. Leiner and Quiring (2008) propose a new research design, in the form of “use-identified meaning” (p. 146) to develop a scale of perceived interactivity that is based on subjective responses and experiences of what users consider to be interactive, based on their functional use of the term in their everyday lives. Methodologically, this could be achieved by asking study
participants to come up with ways to describe their perceptions of their activity surrounding interactive media use. Using thought-listing and open-ended response categories, such an inductive technique will allow researchers to come up with a more valid measure of perceived interactivity that is closer to what the study users in the sample are likely to employ. Thus, what designers and researchers may construe as being interactive, a priori, may not match with perceptions of what users consider as being interactive. Further still, with plenty of variance in the nature and composition of the sample (age, education, power usage or technological competence variables, etc), measures of perceived interactivity, when studied in this bottom-up fashion is very likely to change from one set of studies to another.

Based on this, one could argue that interactivity rests mainly in the imaginary abilities of the user. But, theorizing solely on such imaginary perceptions can be misleading and further still, much less helpful in promoting future design and product development goals. If interactivity is measured purely at the perceptual level, it becomes difficult to empirically pin down as to what element of the interactive tool led to heightened user perceptions of interactivity. If the purpose of theory-driven examination of interactive media is to fulfill needs and goals that exist in applied settings, then, looking at user perceptions alone may not be enough. It becomes critical for the researcher to be able to explain what structural properties and features of interactive media behave in the way they do. While in the past, several scholars have debated and promoted the influence of perceived interactivity (the subjective psychological experience) as being more powerful (Bucy, 2004; Liu, 2003; McMillan & Hwang, 2002; Wu, 2005), over and beyond the effects caused by actual or manipulated interactivity, the
findings from this study demonstrate that they can lead to highly divergent findings. In doing so, they reiterate the need to consider and measure the effects of both actual interactivity and perceived interactivity in the same study design, as shown in more recent theoretical debates (Sundar, 2004, 2007) and empirical demonstrations on this topic (Kalyanaraman & Sundar, 2006; Tao & Bucy, 2007; Thorson & Rodgers, 2006). Thus, findings from this study add to the growing body of evidence that we need to not only treat interactivity both as an affordance that is situated in the medium, but also account for its psychological effects that emerge from either sheer perceptions of what is possible (i.e., potential for interactivity) and also the psychological evaluations that emerge from actual use of those affordances (Sundar & Bellur, 2010).

Specifically, in the context of data from this study, it was evident that manipulated interactivity had a significant effect on both perceived contingency and on perceived interactivity. But the pattern was dissimilar. Further, this dissimilarity also affected how these two variables caused significant indirect effects. On one hand, perceived contingency positively boosted the effect of High interactivity (in comparison to the Low condition) and led to positive indirect effects on attitudes, behavioral intentions and participants’ risk perceptions. Thus, higher the interactivity, greater the perception of contingency, and more positive the end results. On the other hand, perceived interactivity led to a series of negative, indirect effects such that it was the Low interactivity conditions (compared to both Medium or High), which resulted in greater perception of interactivity, which in turn affected final outcomes. Hence, via the perceived interactivity route, a ‘less is more’ pattern emerged on participant’s attitudes, behavioral intentions and risk perceptions. Further, the phantom model analysis also
showed that the specific indirect paths led by these two mediators (Figure 20),
significantly differ from each other on the type of outcomes they affect, their magnitude
and direction of influence. Just this contradictory pattern of both direct and specific
indirect effects provides sufficient warrant to treat the effects of manipulated interactivity
and perceived interactivity as two separate phenomena. And further still, to consider the
role of perceived contingency as well, in the case of studies that manipulate message-

based (Sundar, 2007) or contingency-driven (Sundar et al., 2003) interactivity as an
affordance.

Effects of conversational tone

Apart from examining the effects of structural affordances of interactivity,
another key objective in the study has been to examine whether verbal messages coming
from the system could trigger perceptions of humanness. Based on findings from the
computers as social actors paradigm (Reeves & Nass, 1996) in the HCI literature and also
social information processing theory (Walther, 1992) in CMC settings, the study
hypothesized that the conversational tone displayed by a system, in the form of casual
and informal turn-taking cues, is likely to trigger social scripts and enhance perceptions
of warmth, friendliness and other positive interpersonal evaluations toward the site.
While there were no significant main effects on the perceived warmth variable, nor any
mediation effects seen via this concept, the conversational tone manipulation did result in
some interesting interaction effects. One of the evaluations of humanness is reflected in
the degree of perceived social presence outcome. A near-significant interaction (Figure 9)
showed that those in the Low and High interactivity conditions perceived greater social
presence when the system’s dialogues contained verbal turn-taking cues. Thus, the
informal conversational tone was appreciated more in conditions where either (a) there were no displays of contingency (Low interactivity) or (b) when the turn-taking cues were well-integrated into the rest of the contingent conversation (High interactivity condition). Participants in the Medium interactivity condition preferred not to have any turn-taking cues at all, if they were to report any sign of social presence. The manipulation of the degree of contingency in the Medium interactivity condition throws additional light on this finding. When the system’s responses appeared as a plain reminder—that is, not as part of the main conversation (like in the High interactivity condition), and was also bereft of a chat-bubble or dialogue-box appearance—the system’s presence (as opposed to a social presence) became more prominent. Thus, an increased machine-like feeling may have starkly contrasted the use of verbal turn-taking cues by the system, and thereby, resulted in lowered perceptions of social presence in this condition. It is very likely that participants may have relied on a “machine-heuristic” (Sundar, 2008b), where the automated and ‘canned’ feedback coming from a computer could have reduced the presence or the possibility of there being an intelligent social actor. Thus, a design recommendation coming from this finding is that the human-like backdrop of verbal turn-taking cues cannot be allowed to jar with very machine-like responses from the system. If interactional information in the form of an informal dialogue and verbal turn-taking cues are to be designed, they need to be part of a larger whole of more meaningful back and forth (like in the High interactivity condition) or, not be present at all (like in the Low interactivity condition).

Another explanation for this increased “machine-ness” comes from studies done in the context of dialogue management in Interactive Voice Response systems (IVRs).
Zue and Glass (2000) observe that there are three types of user-system exchanges that can occur, based on the extent to which the system generating the dialogue leads the conversation. One is "system-initiative or directed-dialogue transactions", where the computer is fully in-charge of the interaction and expects users to provide responses to a fixed set of questions. The second type is a "user-initiative" dialogue that gives users a lot of flexibility in what they say to the system. A third type is a “mixed-initiative” system in which “both the user and the computer participate actively to solve a problem interactively using a conversational paradigm" (p.1166). In this study, contingency in the health Q&A dialogue, along with the timing and presentation of the verbal turn-taking cues were completely controlled by the computer. Hence, the study stimulus fell under the “system-initiated” dialogue category. This could also explain why both the Medium and High interactivity conditions were considered to be a lot less interactive than the Low interactivity conditions where the system’s guided dialogue management might not have been as obvious. If the system did offer greater flexibility to participants for providing more feedback, that is, if it were to be designed more as a “mixed-initiative” system, then perhaps, the counter-intuitive perceived interactivity finding (Low condition being perceived as most interactive) may not have occurred. Therefore, conversational systems that are especially geared toward collaborative activities, such as patient-physician dialogue, need to be designed with a “mixed initiative” scenario in mind.

In other findings, the conversational tone manipulation interacted with participant’s self-reported extent of power usage. The general pattern was that if participants scored highly on power usage, they preferred not to have any turn-taking cues. Whereas those who scored low on the power usage scale seemed to benefit with the
presence of verbal turn-taking cues coming from the system. For instance, participants scoring high on power usage reported greater intentions of performing future health behaviors when there were no turn-taking cues. Introduction of the turn-taking cues made it more of a level playing field where participants reported nearly the same likelihood of performing preventive health behaviors, irrespective of where they fell on the power usage scale. However, those scoring low on power usage reported greater intentions when turn-taking cues were present. Similarly, the extent to which participants were likely to ask more health questions to their doctor depended on their level of power usage and the conversational tone. Those with higher scores on power usage showed greater amount of thinking (questions-asking) but only when there were no verbal turn-taking cues present. However, those scoring low on power usage benefited by the presence of turn-taking cues, since this feature prompted them to ask more questions (i.e., think more). Thus, the informal conversational tone seems to aid those who are less proficient with technology use. High power users, on the other hand, seem to react adversely to the casual conversational tone of the system, perhaps because they see through the artificiality of machine-generated conversational tone. Another possibility is that the heavily system-guided turn-taking cues serve to challenge their competence as a human interactant, given that it reduced users’ perceptions of control. A sense of control over their interactions with technology is what power users thrive on (Sundar & Marathe, 2010; Marathe & Sundar, 2011). Thus, since the presence of turn-taking responses reduced users’ sense of control, those scoring high on power usage preferred not to have this feature at all. Regardless of power usage differences, the presence of turn-taking cues seemed to significantly reduce perceptions of relative susceptibility, especially toward
health conditions related to diabetes, heart disease and obesity. Hence, an informal conversational tone is likely to make participants feel less vulnerable to some forms of health risks. Thus, if the objective of an online health tool is to reduce perceptions of risk, using a casual and friendly conversational tone in the message can help achieve this goal.

**Limitations**

The study’s findings have to be interpreted in light of restraints and limitations. To begin with, the nature of the health issues discussed (diet, exercise, alcohol consumption, drugs, safer sex behaviors, etc) were geared toward preventive health behaviors that were designed with college-aged adults in mind. While information on these preventive health behaviors could be pertinent to other sections of the population as well, there may be other chronic health conditions (e.g., diabetes, cancer, heart diseases, etc) that a different segment of at-risk population (older adults with family history of chronic diseases), would like to learn more about. Thus, although the health issues discussed in the Q&A were pertinent to a college student sample, it may not generalize to other demographics, especially those who may be at high-risk for chronic and acute health issues. There have been studies for instance, from the CHESS project (Hawkins et al., 1997) that have used interactive tools as interventions for women with breast cancer risk or with high-risk HIV populations. These studies have uncovered other attributes of interactive technologies (e.g., an active online discussion forum), which have made an impact on the quality of life of those affected. In future research, it will be interesting to test the same manipulated variables—message-interactivity and use of an informal conversational tone—in the context of different set of health issues and with a more diverse sample.
In addition, the response options that the interactive health tool provided to the users (see Appendix A) as part of the health Q&A task, was limited in its scope. For instance, on a question related to how often they tend to eat out in restaurants, participants had to choose from a limited set of response choices such as “not too often”, “sometimes” and “very often”. This small range of response options is not entirely valid in capturing or quantifying various lifestyle choices and behaviors that individuals adopt in their everyday lives. Although, the study was able to capture a perceptual response ranging from too little to too much, in terms of quantifiable actions and behaviors, these response options were rather narrow in scope and may have appeared artificial to the study participants. Hence, in future studies, there is need for greater precision and quantification in measuring some of these everyday health behaviors and outcomes.

Another limitation in the study comes in the form of absence of voice modality in the Q&A dialogue. More than a limitation, this presents an opportunity to add one more type of multimedia (voice-based output) as a follow-up research project. It could be argued that the manipulation of the conversational tone variable could have resulted in other set of findings, had there been a voice component with which the tone of what was conveyed in the turn-taking responses could have made a difference. Studies from the CASA paradigm (Nass & Lee, 2001) have shown that individuals indeed attribute personality and also apply gender stereotypes to machines that can generate spoken dialogue. This combination of verbal language, plus key vocal features (intonation, rhythm, stress) was not tested in this study and hence, will serve as a venue for future research. The absence of voice modality could also explain why there were no significant effects on the perceived warmth variable and why it did not turn out to be a potential
mediator. It could be argued that discerning affect, emotion or valence of thoughts would be easier with voice-based output. It was beyond the scope of this study to manipulate level of affect or type of emotion in the health Q&A interaction. But this does not rule out the potential that interactive health tools possess, to effectively display affect and thereby, result in a set of new outcomes on health risk perceptions, attitudes and behaviors.

Along the same lines, while it was not under the scope of this research to look at the role of non-verbal turn-taking behaviors (e.g., head nods and direction of gaze) and the role of anthropomorphic cues in the form of agents and avatars, there are already studies in this direction (Bickmore & Cassell, 2005; Cassell et al, 1999; Kim & Sundar, 2012) that are examining the effects of these variables, in health communication contexts. The work so far, on these embodied conversational agents, has focused on the details and nature of the interaction (for instance, effects of propositional and interactional cues studied by Cassell et al, 1999). But, these studies have not deconstructed the concept of interactivity, nor have they examined the effects of its psychological correlates (e.g., perceived contingency or perceived interactivity) as variables of interest. Therefore, while the current study is limited in its scope in not considering the role of agents and avatars, it identifies ways in which the key theoretical issues and the independent variables examined here can be adapted and studied in other stimulus settings.

**Theoretical implications**

One of the primary aims of this study is to add to the empirical base of research that has explicitly tested the effects of message-based interactivity driven by the principle of contingency. While several studies have been and continue to be carried out on the variable of interactivity, operationalized mainly in the form of functional features on the
website, this study marks a departure in operationalizing interactivity via contingency both at the structural and at the content level. Apart from extending the examination of the contingency principle to the HCI realm, the data support the message-interactivity path as delineated in the interactivity effects model (Sundar, 2007), where the influence of the ontological manipulation of message interactivity relies closely on the extent of perceived contingency. As was seen in Figure 11, perceived contingency turned out to be a significant mediator. Further still, one of the unique contributions of the study also comes from the insight revealed by the data that perceived contingency and perceived interactivity are two psychologically distinct constructs, even though they are both triggered by the same independent variable, i.e., manipulated message interactivity.

Another attempt at extending the scope of the extant body of work on interactivity studies is with the focus on semantic or text-based interactivity that was seen via the conversational tone manipulation in this study. While this variable did not have any significant direct effects as hypothesized, it nevertheless recognizes the need to make space for affect and emotion related concepts within the interactivity framework. Apart from well-defined structural properties, the concept of interactivity needs to be tested for the presence of any affect related variables that could further unravel the workings of the interactivity phenomena. This holds particularly true while studying outcomes such as risk perceptions that are by definition, influenced by affect or emotions such as fear, worry, anxiety and so on as demonstrated in the studies on the affect heuristic (Alhakami & Slovic, 1994; Slovic & Peters, 2006; Slovic, Finucane, Peters & MacGregor, 2007) and studies on cancer worry (Hay, Buckley & Ostroff, 2005; Watson et al. (1999). By the same token, models and theories of health communication and risk perception also ought
to account for the role of the interactivity variable, apart from their traditional focus on message, user and source characteristics. The two-step mediation effect with perceived relevance demonstrated how, just the variable of perceived relevance by itself, was not sufficient to influence participant’s extent of elaboration. It was only when the model took into account the role of perceived interactivity as well that there was a significant indirect effect on cognitive responses (Figure 15 and Figure 16). This finding has implications for studies in interactive health communication that adopt the tailoring approach. All participants in this study received tailored responses; hence, there was no significant main effect of interactivity on the extent of perceived relevance. However, the moment participants perceived the experience to be interactive, they also had enhanced perceptions of relevance to the material that was tailored for them. Hence perceived interactivity whetted the appetite for tailored messages, which by itself was a constant factor in the study. Thus, this relevance-amplifying capacity of perceived interactivity provides more testable propositions in the health communication domain.

**Practical implications**

How do the findings from this study guide better design of interactive health tools? For a start, data show the need to segment users on the basis of their power usage skills. This key moderator qualified the effects of both the variables examined in this study. Apart from focusing on individual differences, one of the key implications for designers is that the display of contingent interactions, when the threaded back and forth between the system and the user is visually displayed, it is not only psychologically apparent, but it is also likely to lead to more favorable evaluations (such as better attitudes toward the site and its content). Hence, it is important for users to able to see
how the system (a) actively took into account their actions and prior input, and (b) the extent to which they thought that the information being given to them was tailored exclusively for them, based on their prior responses. These cues to contingency need not be elaborate. As the current study shows, simple textual messages and reminders of prior user actions and choices are powerful enough to psychologically trigger perceptions of contingency. When these cues to contingency and the verbal turn-taking cues were present, participants showed better evaluations if such features were integrated into the overall design and course of the interaction. Stand-alone reminders that were not part of the main interaction (i.e., the Q&A dialogue) were likely to trigger negative evaluations (as was the case in Medium interactivity condition, which was ranked similar to the Low interactivity condition on the perceived contingency outcome). Thus, while designing contingency cues, especially with spoken dialogue and conversational interfaces, designers need to ensure that machine-like and human-like cues on the interface do not contradict each other.

On several accounts, users preferred the simple design found in the Low interactivity condition. One of the chief reasons for this, as seen in some of the open-ended remarks about the interface, had to do with the resemblance to an existing chat and SMS service on cellular phones. Close to 30% of the participants mentioned that the design of the Health Q&A appeared very similar to popular chat and texting interfaces. This familiarity and the immediate back and forth nature of the Q&A could have jointly contributed to the Low interactivity condition being perceived as the most interactive. Hence, designing interfaces that follow the usability principles (Nielsen & Molich, 1990) of aesthetic and minimalist design, along with consistency (familiarity with other similar
interfaces) is likely to result in positive evaluations and user engagement outcomes. The benefits of highly interactive interfaces (as seen in the High-to-Low interactivity comparisons in mediation tests) become evident only when other underlying psychological principles (e.g., perceived contingency, interactivity, relevance and user engagement) are taken into account.

**Conclusion**

In sum, it would be an understatement to say that the variable of interactivity occupies a place of prominence in communication studies. Yet, there is no theory of interactivity that can explain or predict how this variable works with a consistent set of antecedents, correlates and outcomes. With a few existing testable frameworks (Bucy & Tao, 2007; Burgoon et al., 2000a; McMillan, 2002; Sundar, 2007) scholars are continuing to add to the empirical basis. Findings from such attempts hold the key to the development of a predictive and falsifiable theory of interactivity effects, in the long run.

When evaluating effectiveness of health technologies, stopping at examination of attitudinal and behavioral metrics alone is not sufficient. Instead, we need to be able to tie the outcome of interest to specific features of health technology (Klasnja, Consolvo & Pratt, 2011). Hawkins et al. (1997) describe this as a “perpetual prototyping approach” (p. 82). These scholars reiterate the need to start with building small features that enhance the interactivity potential (or affordances) in the system, and then continually test them, and revise them based on such testing. Such perpetual prototyping, combined with more summative evaluations will help us understand the how interactive health technologies can be harnessed for meeting present and future healthcare goals.
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### Appendix A: Content in the Health Q & A Tool

<table>
<thead>
<tr>
<th>1. High Fat food</th>
<th>SYSTEM RESPONSE</th>
<th>USER RESPONSE</th>
<th>VERBAL TURN-TAKING CUES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How often do you eat food that is high in fat? For example, red meat, fried foods, full-fat dairy products?</td>
<td>1a. Very often</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Food high in saturated and trans fat can increase risk of heart disease, obesity, colon cancer, and breast cancer, among others. • You could choose from unsaturated fats, such as olive oil, nuts, avocados, salmon and other unsaturated fats.</td>
<td>1b. Sometimes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Food high in saturated and trans fat can increase risk of heart disease, obesity, colon cancer, and breast cancer, among others. • You could choose from unsaturated fats, such as olive oil, nuts, avocados, salmon and other unsaturated fats.</td>
<td>1c. Not very often</td>
<td></td>
</tr>
<tr>
<td>other unsaturated fats.</td>
<td>Let’s move on to the next question.</td>
<td></td>
<td></td>
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<td>------------------------</td>
<td>-----------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Fruits and Vegetables</strong></td>
<td>Do you eat 5 to 9 servings of fruits and vegetables each day? (One serving is equal to a medium-sized apple; 1 cup leafy vegetables, ½ cup raw or cooked vegetables.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fruits and vegetables are not only low in calories, they are also filled with antioxidants and essential nutrients. • Eating fruits and vegetables can protect your eyes, skin and heart.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2a. Very often</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fruits and vegetables are not only low in calories, they are also filled with antioxidants and essential nutrients. • Eating fruits and vegetables can protect your eyes, skin, heart and overall health.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2b. Sometimes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fruits and vegetables are not only low in calories, they are also filled with antioxidants and essential nutrients. • Eating fruits and vegetables can protect your eyes, skin, heart and overall health.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2c. Not very often</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Grain consumption</td>
<td>On an average day, which of the following are you most likely to eat?</td>
<td>OK, so moving along.</td>
<td></td>
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<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------</td>
<td>---------------------</td>
<td></td>
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<tr>
<td></td>
<td>• Whole grains provide many nutrients, including dietary fiber, several B vitamins and minerals.</td>
<td>3a. Whole grain bread, whole grain pasta, and whole grain cereals (for example, whole wheat, brown rice or oat bran)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Continue including more whole grains in your diet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Refined grains lack in dietary fiber, iron, and many B vitamins and minerals.</td>
<td>3b. Refined grains such as white bread, white pasta, and sugared cereals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Consider including more whole grains in your diet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Portion size</td>
<td>How full do you feel at the end of a meal?</td>
<td>Here is another question.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• At the end of a meal, you should feel &quot;just right&quot; or comfortably satisfied.</td>
<td>4a. Still hungry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Not eating enough can cause you to feel tired, irritable, weak or unenergetic.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Measure the size of bowls, cups, and plates you usually use. This can help you choose sensible portions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• At the end of a meal, you should feel &quot;just right&quot; or comfortably satisfied.</td>
<td>4b. Just right or satisfied</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Measure the size of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bowls, cups, and plates you usually use. This can help you choose sensible portions.</td>
<td>4c. Stuffed or heavy</td>
<td></td>
<td></td>
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<td>---</td>
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<td></td>
</tr>
</tbody>
</table>
| • At the end of a meal, you should feel "just right" or comfortably satisfied.  
• Overeating causes you to feel "stuffed", "overloaded", "heavy" or "groggy.  
• Measure the size of bowls, cups, and plates you usually use. This can help you choose sensible portions. | 5. Dairy Products  
How often do you include dairy products (e.g., milk, yogurt, cheese, etc) in your diet?  
• Continue eating dairy as part of your diet everyday.  
• Dairy products provide many health benefits, especially improved bone health as they are an excellent source of calcium and vitamin D.  
• You can choose from fat-free, low-fat or lactose-free options.  
• Try eating dairy as part of your diet everyday.  
5a. I eat dairy products everyday  
5b. I eat dairy products on most days | Alright, how about the next one. |
**6. Protein products**

How often do you include protein products (e.g., meat, poultry, beans, lentils, etc) in your diet?

- Try to include some dairy as part of your diet everyday.
- Dairy products provide many health benefits, especially improved bone health as they are an excellent source of calcium and vitamin D.
- You can choose from fat-free, low-fat or lactose-free options.

<table>
<thead>
<tr>
<th>5c. I eat very little (or no) dairy products.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK, coming up next.</td>
</tr>
</tbody>
</table>

- Continue eating a variety of protein foods.
- If you are vegan or vegetarian, include beans and peas, soy products, nuts and seeds.
- Choose lean cuts of meats and poultry.

<table>
<thead>
<tr>
<th>6a. I eat protein products everyday.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6b. I eat protein products on most days.</td>
</tr>
</tbody>
</table>
160 everyday.
• If you are vegan or vegetarian, include beans and peas, soy products, nuts and seeds.
• Choose lean cuts of meats and poultry.

| 6c. I eat very little (or no) protein products. |
|---|---|

7. Eating out

How often do you tend to eat out for meals?

<table>
<thead>
<tr>
<th>7a. Very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating out frequently can pose many health risks.</td>
</tr>
<tr>
<td>Restaurant food typically contains excessive amounts of fat and salt.</td>
</tr>
<tr>
<td>Restaurant portion sizes are also generally larger than what you would eat at home.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7b. Sometimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating out sometimes may not pose many health risks.</td>
</tr>
<tr>
<td>Restaurant food typically contains excessive amounts of fat and salt.</td>
</tr>
<tr>
<td>Restaurant portion sizes are also</td>
</tr>
</tbody>
</table>

Alright, now let’s talk about eating out.
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>161</td>
<td>generally larger than what you would eat at home.</td>
</tr>
<tr>
<td>• Not eating out regularly reduces your health risks.</td>
<td>7c. Not very often</td>
</tr>
<tr>
<td>• Restaurant food typically contains excessive amounts of fat and salt.</td>
<td></td>
</tr>
<tr>
<td>• Restaurant portion sizes are also generally larger than what you would eat at home.</td>
<td></td>
</tr>
<tr>
<td>OK, so let’s look at the next question.</td>
<td></td>
</tr>
<tr>
<td>8. Weight Loss</td>
<td>Would you like to lose weight?</td>
</tr>
<tr>
<td>• Maintaining an appropriate weight is essential for health and wellbeing.</td>
<td>8a. Yes</td>
</tr>
<tr>
<td>• Talk to a health professional to know more about your ideal body weight and how to maintain it.</td>
<td></td>
</tr>
<tr>
<td>• Maintaining an appropriate weight is essential for health and wellbeing.</td>
<td>8b. No</td>
</tr>
<tr>
<td>• Talk to a health professional to know more about your ideal body weight and how to maintain it.</td>
<td></td>
</tr>
<tr>
<td>OK, let’s talk about exercise.</td>
<td></td>
</tr>
<tr>
<td>9. Moderate Activity</td>
<td>In a usual week, do you do MODERATE activities such as brisk</td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>walking, bicycling, or anything else that causes some increase in breathing or heart rate?</td>
<td></td>
</tr>
<tr>
<td>• Physical activity guidelines recommend 30 minutes of moderate aerobic activity (e.g., brisk walking, slow dancing or slow biking, etc.) for at least five days a week.</td>
<td>9a. Yes</td>
</tr>
<tr>
<td>• You can break it up into three 10-minute sessions of activity throughout the day.</td>
<td></td>
</tr>
<tr>
<td>• Physical activity guidelines recommend 30 minutes of moderate aerobic activity (e.g., brisk walking, slow dancing or slow biking, etc.) for at least five days a week.</td>
<td>9b. No</td>
</tr>
<tr>
<td>• You can break it up into three 10-minute sessions of activity throughout the day.</td>
<td></td>
</tr>
<tr>
<td>OK, so here’s the next question.</td>
<td></td>
</tr>
<tr>
<td>10. Vigorous Activity In a usual week, do you do VIGOROUS activities such as running, aerobics, or anything else that causes large increases in breathing or heart rate?</td>
<td></td>
</tr>
<tr>
<td>• 15 minutes of</td>
<td>10a. Yes</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| **10. Vigorous Aerobic Activity** | vigorous aerobic activity, for at least 5 days a week, can improve your cardiovascular fitness.  
• Talk to a health professional if you have questions about your cardio program. |   |
| **10b. No** |   |   |
| **15 minutes of vigorous aerobic activity, for at least 5 days a week, can improve your cardiovascular fitness.  
• Talk to a health professional before starting any cardio program.** |   |   |
|   | **10b. No** |   |
| **11. Strengthening** | In a usual week, do you do STRENGTHENING exercises such as sit-ups, push-ups or lifting weights? |   |
| **11a. Yes** |   |   |
| **It is recommended that you strengthen your muscles at least 2 days a week.  
• Work on different parts of the body—your legs, hips, back, chest, stomach, shoulders, and arms.** |   |   |
| **11b. No** |   |   |
| **It is recommended that you strengthen your muscles at least 2 days a week.  
• Work on different parts of the body—your legs, hips, back, chest, stomach,** |   |   |
| **11b. No** |   |   |

Alright. Next up.
shoulders, and arms.

This part of the questionnaire will ask you questions about your everyday activities and lifestyle choices that may put you at high risk for sexually transmitted infections like HIV. Please answer honestly. The responses you provide will allow us to give you the best possible information. Your responses will be kept confidential and will be used for research purposes only. Click on the NEXT button to proceed.

12. HIV Knowledge

How would you rate your knowledge of HIV and the behaviors that increase your risk for infection?

Knowing about HIV risk factors is important. It can help you reduce your risk and also help educate others who may be at risk.

12a. High knowledge

Knowing about HIV risk factors is important. It can help you reduce your risk and also help educate others who may be at risk.

12b. Some knowledge

Knowing about HIV risk factors is important. It can help you reduce your risk and also help educate others who may be at risk.

12c. Little to No knowledge
### 13 HIV Testing

<table>
<thead>
<tr>
<th>Have you ever been tested for HIV?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Knowing your HIV status is an important part of maintaining your health.</td>
</tr>
<tr>
<td>• Talk to a health professional if you have questions about the testing procedure and how to interpret the results of the test.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13a. Yes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>13b. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Knowing your HIV status is an important part of maintaining your health.</td>
</tr>
<tr>
<td>• Talk to a health professional to know more about testing procedure and how to interpret the results of the test.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13c. Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Knowing your HIV status is an important part of maintaining your health.</td>
</tr>
<tr>
<td>• Talk to a health professional to know more about testing procedure and how to interpret the results of the test.</td>
</tr>
</tbody>
</table>

### 14 Sex

<table>
<thead>
<tr>
<th>How many sexual partners have you had</th>
</tr>
</thead>
</table>

<p>| OK, now here’s another question. |</p>
<table>
<thead>
<tr>
<th>Partners in the last 6 months?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Not engaging in any sexual practices eliminates the risk of sexual transmission of HIV. • Engaging in safer sex practices with one sex partner poses lesser risks. • Engaging in unsafe sexual practices with multiple partners can lead to higher risk of HIV transmission.</td>
<td>14a. None</td>
</tr>
<tr>
<td>• Engaging in safer sex practices with one sex partner greatly reduces your risk of exposure to HIV. • Engaging in unsafe sexual practices with multiple partners can lead to higher risk of HIV transmission.</td>
<td>14b. One</td>
</tr>
<tr>
<td>• Engaging in unsafe sexual practices with multiple partners increases your risk of exposure to HIV. • Engaging in safer sex practices with one sex partner poses lesser risks.</td>
<td>14c. More than one</td>
</tr>
<tr>
<td>• Engaging in unsafe sexual practices with multiple partners can lead to higher risk of HIV transmission. • Engaging in safer sex practices with one sex partner poses lesser risks.</td>
<td>14d. Unsure</td>
</tr>
</tbody>
</table>

OK. Coming up next…
<table>
<thead>
<tr>
<th>15 Discuss HIV status</th>
<th>Do you discuss HIV status with your current sex partner(s)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• It is important to know your partners’ health.</td>
<td></td>
</tr>
<tr>
<td>• Learn as much as you can about HIV and safer sex practices. This will help in having conversations with your partner(s).</td>
<td>15a. Yes</td>
</tr>
<tr>
<td>• It is important to know your partners’ health.</td>
<td></td>
</tr>
<tr>
<td>• Learn as much as you can about HIV and safer sex practices. This will help in having conversations with your partner(s).</td>
<td>15b. No</td>
</tr>
<tr>
<td>For LOW, if Q15 = a</td>
<td>This information may not be relevant to you right now. But, in the future, if you choose to be sexually active, learn as much as you can about your partner’s HIV status and safer sex practices.</td>
</tr>
<tr>
<td>Alright. Moving along to the next question…</td>
<td></td>
</tr>
<tr>
<td>16 Alcohol use</td>
<td>How often do you drink alcohol?</td>
</tr>
<tr>
<td>• Heavily drinking can negatively influence how people make decisions. It can harm their health and safety.</td>
<td></td>
</tr>
<tr>
<td>• Staying away from alcohol or drinking in moderation is less</td>
<td>16a. I never drink alcohol.</td>
</tr>
</tbody>
</table>
likely to create risky situations.

<table>
<thead>
<tr>
<th>16b. I occasionally drink alcohol.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Heavy drinking can negatively influence how people make decisions. It can harm their health and safety.</td>
</tr>
<tr>
<td>• Drinking alcohol in moderation is less likely to create risky situations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16c. I frequently drink alcohol.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Heavy drinking can result in situations where people make decisions that can hurt their health and safety.</td>
</tr>
<tr>
<td>• Drinking alcohol in moderation is less likely to create risky situations.</td>
</tr>
</tbody>
</table>

17. Alcohol and Sex

<table>
<thead>
<tr>
<th>How often do you have sex (anal, vaginal or oral) while drunk?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• When you are not under the influence, it is possible to ensure that you are following safer sex practices.</td>
</tr>
<tr>
<td>• By not combining sex and alcohol, you are more protected against risk of sexually transmitted infections.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17a. Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>17b. Sometimes</td>
</tr>
<tr>
<td>• When you are not under the influence, it is possible to ensure that you are following safer sex</td>
</tr>
</tbody>
</table>

OK, let's see, now:
<table>
<thead>
<tr>
<th>169</th>
<th>• By not combining sex and alcohol, you are more protected against risk of sexually transmitted infections.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>17c. Often</td>
<td>• When you are not under the influence, it is possible to ensure that you are following safer sex practices.</td>
<td></td>
</tr>
<tr>
<td>17d. Unsure</td>
<td>• By not combining sex and alcohol, you are more protected against risk of sexually transmitted infections.</td>
<td></td>
</tr>
<tr>
<td>17e. Not Applicable</td>
<td>This information may not be applicable to you right now. However, as a general health and safety measure, not combining sex and alcohol can protect most individuals against risk of sexually transmitted infections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Let’s go on to the next question.</td>
<td></td>
</tr>
<tr>
<td>Injecting drugs</td>
<td>Have you ever injected recreational drugs (heroin, cocaine, speed, etc.)?</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>18a. No, I have never injected recreational drugs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Not injecting drugs is less likely to put a person at risk for HIV and other blood-borne infections.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If at any point you think you may be at risk, talk to a health professional about it.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Injecting drugs can increase a person’s risk factor for HIV or other blood-borne infections, but not sharing needles helps to reduce that risk. |
| • If at any point you think you may be at risk, talk to a health professional about it. |
| 18b. Yes, I have injected recreational drugs, but I never shared needles. |

| Sharing needles carries high risk of HIV transmission and other blood-borne infections. |
| • If you think you may be at risk, talk to a health professional about it. |
| 18c. Yes, I have injected recreational drugs, and I have shared needles. |

| Injecting drugs and sharing needles carries high risk of HIV transmission and other blood-borne infections. |
| • If you think you may be at risk, talk to a health professional about it. |
| 18d. Unsure |
19. Body piercings | Have you ever had any body piercings? | OK. Let’s talk about body piercings now.
---|---|---
19a. No, I do not have any body piercings. | • Not having any body piercings reduces the risk for blood-borne diseases from this activity. • If you plan to get any body piercings in the future, be sure to use materials that are not shared with others. | 19a. No, I do not have any body piercings.
19b. Yes, I have had one or more body piercings, but none of the piercing equipment was shared with others. | • Not sharing piercing equipment reduces the risk for blood-borne diseases from this activity. • If you plan to get more body piercings in the future, continue to make sure that the materials used are not shared with others. | 19b. Yes, I have had one or more body piercings, but none of the piercing equipment was shared with others.
19c. Yes, I have had one or more body piercings, and piercing equipment was shared with others at least once. | • Sharing piercing equipment increases the risk for blood-borne infections. • If you plan to get more body piercings in the future, make sure that the materials used are not shared with others. • If you think you may be at risk, talk to a health professional about it. | 19c. Yes, I have had one or more body piercings, and piercing equipment was shared with others at least once.
19d. Unsure | • Sharing piercing equipment increases | 19d. Unsure
the risk for blood-borne infections.
- If you plan to get body piercings in the future, make sure that the materials used are not shared with others.
- If you think you may be at risk, talk to a health professional about it.

<table>
<thead>
<tr>
<th>20. Tattoos</th>
<th>Have you ever had any tattoos?</th>
<th>20a. No, I have never had any tattoos.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Not getting any tattoos reduces the risk for blood-borne diseases from this activity.</td>
<td>20b. Yes, I have had one or more tattoos, but needles and ink were never shared.</td>
</tr>
<tr>
<td></td>
<td>• In the future, if you plan to get any tattoos, go to professionals who follow good hygiene.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Not sharing tattoo needles or tattoo ink, reduces the risk for blood-borne diseases from this activity.</td>
<td>20c. I have had one or more tattoos, and needles and ink were shared at least once.</td>
</tr>
<tr>
<td></td>
<td>• If you plan to get any tattoos, go to professionals who follow good hygiene.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sharing tattoo needles and ink can put individuals at risk for blood-borne infections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If you think you may be at risk, talk to a health professional about it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sharing tattoo needles and ink can</td>
<td>20d. Unsure</td>
</tr>
</tbody>
</table>
put individuals at risk for blood-borne infections.

- When getting tattoos, go to professionals who follow good hygiene.
- If you think you may be at risk, talk to a health professional about it.

<table>
<thead>
<tr>
<th>21. HIV Transmission</th>
<th>Have you had (check all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>21a. Oral Sex</td>
<td>• Risk of HIV transmission through unprotected oral sex is much lower than for unprotected vaginal or anal sex. • Unsafe oral sex still carries some risk of HIV and other sexually transmitted infections. • Barrier methods such as latex condoms and dental dams are very effective, though not perfect, in preventing HIV transmission.</td>
</tr>
<tr>
<td>21b. Anal Sex</td>
<td>• Unprotected anal sex is considered high risk for HIV, especially for the receptive partner. • Barrier methods such as latex condoms, female condoms and dental dams are very effective, though not</td>
</tr>
</tbody>
</table>

Just a few more questions remaining now. Talking about safer sex…
<table>
<thead>
<tr>
<th>21c. Vaginal Sex</th>
<th>21d. Unsure</th>
<th>21e. Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unprotected vaginal sex can be a high risk for HIV infection, especially for the female partner. • Barrier methods such as latex condoms, female condoms and dental dams are very effective, though not perfect, in preventing HIV transmission.</td>
<td>• Risk of HIV transmission through unprotected oral sex is much lower than for unprotected vaginal or anal sex. • Unprotected anal sex can be high risk, especially for the receptive partner. • Unprotected vaginal sex can be high risk, especially for the female partner. • Barrier methods such as latex condoms, female condoms and dental dams are very effective, though not perfect, in preventing HIV transmission.</td>
<td>• This information may not be very timely to you right now. But, as a general health and safety behavior, it is important to know that unsafe sex practices carry a high risk of HIV transmission.</td>
</tr>
</tbody>
</table>

For LOW, if Q14 = a.
• For most people, using barrier methods such as latex condoms, female condoms and dental dams are very effective, though not perfect, in preventing HIV transmission.

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Condom use</td>
<td>How often do you and your partner(s) use condoms?</td>
</tr>
<tr>
<td>22a. Always</td>
<td>Consistent and correct condom use greatly reduces your risk for HIV and other sexually transmitted infections.</td>
</tr>
<tr>
<td>22b. Most of the time</td>
<td>Consistent and correct condom use is an extremely effective way to reduce your risk for HIV and other sexually transmitted infections.</td>
</tr>
<tr>
<td>22c. Never</td>
<td>Consistent and correct condom use is an extremely effective way to reduce your risk for HIV and other sexually transmitted infections.</td>
</tr>
<tr>
<td>22d. Unsure</td>
<td>Consistent and correct condom use is an extremely effective way to reduce your risk for HIV and other sexually transmitted infections.</td>
</tr>
<tr>
<td>22e. Not Applicable</td>
<td>• This information may not apply to your current health and lifestyle. • For most people in</td>
</tr>
</tbody>
</table>

Alright, let’s look at the next question now.
general, consistent and correct condom use is an extremely effective way to reduce risk of HIV and other sexually transmitted infections.

<table>
<thead>
<tr>
<th>23</th>
<th>Sex with injection drug user</th>
<th>Have you had sex with a person who has used injectable drugs?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• A person who has used injectable drugs can be at increased risk for HIV infection, especially if he or she shares needles and syringes to prepare drugs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Being aware of your partners’ HIV status and drug use behaviors can reduce your risk of HIV.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If you think you may be at risk, talk to a health professional about it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23a. Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• A person who has used injectable drugs can be at increased risk for HIV infection, especially if he or she shares needles and syringes to prepare drugs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Being aware of your partners’ HIV status and drug use behaviors can reduce your risk of HIV.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If you think you may</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23b. No</td>
<td></td>
</tr>
</tbody>
</table>
be at risk, talk to a health professional about it.

- A person who has used injectable drugs can be at increased risk for HIV infection, especially if he or she shares needles and syringes to prepare drugs.
- Being aware of your partners’ HIV status and drug use behaviors can reduce your risk of HIV.
- If you think you may be at risk, talk to a health professional about it.

<table>
<thead>
<tr>
<th>23c. Unsure</th>
</tr>
</thead>
</table>

24. Sex with HIV positive individual

<table>
<thead>
<tr>
<th>Have you had sex with a person who tested positive for HIV or a person diagnosed with AIDS?</th>
</tr>
</thead>
</table>

- Having sex with a person who has HIV or AIDS can put you at high risk for HIV infection as well.
- If you think you may be at risk, talk to a health professional about it.

<table>
<thead>
<tr>
<th>24a. Yes</th>
</tr>
</thead>
</table>

- Not having sex with a person who is already infected with HIV or AIDS puts you at lowered risk of being infected.
- If at any point, you think you may be at risk, talk to a health professional about it.

<table>
<thead>
<tr>
<th>24b. No</th>
</tr>
</thead>
</table>

OK, coming up next.
- Having sex with a person who has HIV or AIDS can put you at high risk for HIV infection as well.
- If at any point, you think you may be at risk, talk to a health professional about it.

<table>
<thead>
<tr>
<th>24c. Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK, we are close to the finish with one more question.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>25. Sex with MSM individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you had sex with a man who has had sex with other men (MSM)?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>25a. Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men who have sex with men (MSM) have been the population most severely affected by HIV.</td>
</tr>
<tr>
<td>It is important to discuss and be aware of your partner's HIV status.</td>
</tr>
<tr>
<td>If you think you may be at risk, talk to a health professional about it.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>25b. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men who have sex with men (MSM) have been the population most severely affected by HIV.</td>
</tr>
<tr>
<td>It is important to discuss and be aware of your partner's HIV status.</td>
</tr>
<tr>
<td>If at any point, you think you may be at risk, talk to a health professional about it.</td>
</tr>
<tr>
<td>Men who have sex with men (MSM) have been the population most severely affected by HIV.</td>
</tr>
<tr>
<td>It is important to discuss and be aware of your partner's HIV status.</td>
</tr>
<tr>
<td>If at any point, you think you may be at risk, talk to a health professional about it.</td>
</tr>
</tbody>
</table>

25c. Unsure

That's the end of this conversation! Thanks for your time.

If you have additional questions regarding health information, please contact the following centers on campus, for assistance:
- Penn State Student Health Center Resources
  http://studentaffairs.psu.edu/health/ (Phone: 814-863-0774)
- Center for Counseling and Psychological Services (CAPS) at Penn State
  http://www.sa.psu.edu/caps/ (Phone: 814-863-0395)
Appendix B: Health Topic Pretest

A) Please look at the list of health topics below and indicate, how worried you are about health issues mentioned below: (On a scale of 0=Not at all worried to 9=Very worried).

1. Alcoholism / Binge Drinking
2. Caffeine consumption
3. Depression
4. Diabetes
5. Substance Abuse & Drug Use
6. Heart disease
7. Unhealthy Diet (Malnutrition)
8. Meningitis
9. Obesity
10. Sexually Transmitted Diseases (STDs)
11. Sleep Disorders
12. Effects of Stress
13. Sun exposure (harm from indoor/outdoor tanning)
14. Other (Please Specify)
B) From the list below, please let us know what are some health risks that you think you are highly prone toward. That is, compared with other students on campus, you believe there are higher chances of you being affected by it (On a scale of 0=Not at all prone and 9=Highly prone).

1. Alcoholism
2. Anxiety disorders
3. Depression
4. Diabetes
5. Drug Addiction
6. Heart disease
7. Malnutrition
8. Meningitis
9. Obesity
10. Sexually Transmitted Diseases (STDs)
11. Sleep Disorders
12. Stress
13. Skin Cancer (harm from indoor/outdoor tanning)
14. Other (Please Specify)
Appendix C: Pretest Questionnaire

Q1. Please enter YOUR USER ID for the study here. (HINT: Your user ID is the same as the USERNAME or LOGIN that you have been assigned, for the purposes of this study.)

**Power Usage measures**

*Q2. Please indicate your response towards the following statements about technological device/information technology (like email, Internet, cellphone, iPod, GPS, and etc.) use.*

1. I think most of the technological gadgets are complicated to use.
2. I make good use of most of the features available in any technological device.
3. I have to have the latest available upgrades of the technological devices that I use.
4. Use of information technology has almost replaced my use of paper.
5. I love exploring all the features that any technological gadget has to offer.
6. I often find myself using many technological devices simultaneously.
7. I prefer to ask friends how to use any new technological gadget instead of trying to figure it out myself.
8. Using any technological device comes easy to me.
9. I feel like information technology is a part of my daily life.
10. Using information technology gives me greater control over my work environment.
11. Using information technology makes it easier to do my work.
12. I would feel lost without information technology.

**Preference for Online Social Interaction measures**

*Q3. Please indicate your opinion toward the following statements:*

1. I prefer communicating with other people online rather than face-to-face.
2. I feel like I have more control over conversations online than I do in face-to-face conversations.
3. Meeting and talking with people is better when done online than in face-to-face situations.
4. I am willing to give up some of my face to face relationships to have more time for my online relationships.
5. My relationships online are more important to me than many of my face-to-face relationships.
6. I am happier being online than I am offline.
Everyday media use

Q4. Please indicate the degree to which each of the following statements characterizes your online activity. On average, how often do you_____?
Not applicable (1) / Every few months (2) / Every few weeks (3) / 1-2 days a week (4) / 3-5 days a week (5) / About once a day (6) / Several times a day (7)
1. use a computer
2. use the Internet
3. use email
4. instant message system
5. text on your cellphone
6. use Facebook
7. use MySpace
8. use Twitter
9. Blogging services (e.g., Blogspot, WordPress)
10. Live Chat (IM) feature on websites
11. Other Media (Please specify)

Q5. How many hours on average do you spend on the computer on a given day? Please enter in the number format.

Q6. How many hours on average do you spend on the Internet on a given day? Please enter in the number format.

Q7. Please rate the frequency of your use of the following devices. Never = 0 and 10 = Very Often
1. computer
2. Internet
3. Email
4. Instant Message system
5. Texting on your cellphone
6. Live chat function on websites

General Health Beliefs measure

Q8. Please indicate your opinion toward the following statements about everyday health behaviors: (Strongly Disagree = -4 and Strongly Agree = +4)
1. Maintaining good health is important to me.
2. I think it is worthwhile to keep track of my exercise behavior.
3. I think it is important to monitor my diet.
4. I tend to practice good hygiene.
5. I believe regular physical activity will be beneficial to me.
7. I believe that daily physical activity will improve my health.
8. I get flu shots regularly.
9. I think it is important to be aware of risks to health and personal safety.
10. I think it is important to be aware of safer sex practices.
Social Extraversion measures
Q9. Please indicate your opinion toward the following statements about your everyday behaviors: *(Strongly Disagree = -4 and Strongly Agree = +4)*
1. I usually take initiative in making new friends.
2. I am inclined to keep in the background on social occasions.
3. I like to mix socially with people.
4. I am likely to limit my acquaintances to a select few.
5. I like to have many social engagements.
6. I generally prefer to take the lead in group activities.
7. Other people would regard me as a lively individual.
8. I would rate myself as a talkative individual.

Demographics
Q10. What is your age? (Please enter in numbers). For example, if you are 20-years old, just enter the numbers 20 in the box below.

Q11. What is your gender?
1. Male
2. Female

Q12. What race group do you belong to?
White/Caucasian / African American / Hispanic / Asian / Native American / Pacific Islander
Other ______________________

Q13. How would you describe your current sexual orientation?
Bisexual / Gay / Heterosexual / Lesbian / Questioning / Prefer not to answer
Other ______________________

Q14. If you are currently associated with Penn State University, kindly let us know what your academic affiliation is to the University:
Not Applicable / Freshman / Sophomore / Junior / Senior / Graduate Student / Staff
Other (Please specify) ______________________
Appendix D: Posttest Questionnaire

Q1. Please enter your USER ID for the study in the box below.

Q2. The next time you go for a general physical check-up, what are some questions that you would like to ask your Doctor? Please list these questions in the space below:

Q3. If you have any comments or thoughts that you would like to share with us regarding the website that you interacted with please describe them in the space given below.

Q4. Please list any functions or features that you can remember, from the website that you interacted with today.

Message interactivity manipulation check
Q5a. Please indicate your attitudes towards the following statements about the website on a scale of -4 = Strongly Disagree and +4 = Strongly Agree.
1. The site remembered my actions.
2. The site kept track of the steps I took while browsing the site.
3. The actions I performed were clearly evident on the site.
4. The site was transparent in showing the actions I performed.
5. The site contained a summary of all the actions I performed.
6. The site maintained a systematic record of my actions.
7. The site remembered the choices I made while interacting with it.
8. The site gave some smart suggestions based on my input.

Conversational Tone manipulation check
Q5b. Please indicate your responses towards the following statements about the website. Was the site --- (9-point semantic differential)
Formal-----Informal

Q6. Please indicate the extent to which you were, involved in your interaction with the website.
-4 = Not at all involved ------------------------+4 = Highly involved

Q7. Please indicate the extent to which you were, interested in your interaction with the website.
-4 = Not at all interested ------------------------+4 = Highly interested
Site impression measures (9-point semantic differential)

Q8. Please indicate your responses towards the following statements about the website.

Was the site

a) Unfriendly------Friendly
b) Cold-----Warm
c) Impersonal-----Personal
d) Unsocial-----Social
e) Machine-like-----Human-like
f) Unnatural-----Natural
g) Artificial-----Life-like
h) Incompetent-----Competent
i) Ignorant-----Knowledgeable
j) Irresponsible-----Responsible
k) Unintelligent-----Intelligent
l) Foolish------Sensible

Perceived interactivity measures

Q10. Please indicate your attitudes towards the following statements about the website on a scale of -4 = Describes Very Poorly and +4 = Describes Very Well

1. Interaction with the site felt primarily like a one-way communication.
2. The site enabled two-way communication.
3. The site was effective in gathering my feedback.
4. It was difficult to offer feedback to the site.

Perceived contingency measures

Q11. Please indicate your attitudes towards the following statements about the website on a scale of -4 = Describes Very Poorly and +4 = Describes Very Well

1. The website took into account my previous interactions with it.
2. The website’s responses were related to my earlier input.
3. I felt that the website carefully registered my responses and gave feedback based on the information I entered.
4. The messages I received on the website were based on my previous inputs.

Perceived relevance measures

Q12. Please indicate your attitudes towards the following statements about the website on a scale of -4 = Describes Very Poorly and +4 = Describes Very Well

1. The messages conveyed by the site are important to me.
2. Interacting with the site was meaningful for me.
3. The site did not have anything to do with me or my needs.
4. The site talked about something that concerns me, personally.
5. While interacting with the site, I thought about how the topic might be useful to me.
6. The site gave me information that is personally relevant to me.
Social presence measures
Q13. Please indicate your agreement towards the following statements on a scale of 1=Very Little and 10=A lot.
1. How much did you feel you were interacting with an intelligent being?
2. How much did you feel you were in the company of an intelligent being?
3. How much did you feel an intelligent being was responding to you?
4. While interacting with the site, how vividly were you able to mentally imagine the source of the voice?
5. How much attention did you pay to what was being said by the website?

Website attitude measures
Q14. Please indicate how well each of the following adjectives describes the overall WEBSITE that you interacted with on a scale of -4=Describes Very Poorly and +4=Describes Very Well.
Appealing / Useful / Positive / Good / Favorable / Attractive / Exciting / Pleasant
Likeable / High Quality / Interesting / Fun / Cool / Imaginative / Entertaining

User engagement measures
Q15. Please indicate your agreement with the following statements about your interaction with the site on a scale of -4=Strongly Disagree +4=Strongly Agree
1. Time appeared to go by very quickly when I was interacting with the site.
2. I lost track of time when I was interacting with the site.
3. I spent more time in interacting with the site than I intended.
4. While I was interacting with the site, I was able to block out most other distractions.
5. While I was interacting with the site, I was absorbed in what I was doing.
6. I felt that I had no control over my interaction with the site.
7. While I was interacting with the site, my attention did not get diverted.
8. I had fun interacting with the site.
9. Interacting with the site provided me a lot of enjoyment.
10. Interacting with the site bored me.
11. I felt in control while I was browsing the site.
12. While I was interacting with the site, I was immersed in what I was doing.
13. Interacting with the site excited my curiosity.
14. Interacting with the site aroused my imagination.
15. Interacting with the site made me interested in it.

User satisfaction measures
Q16. Please indicate your agreement with the following statements about your interaction with the site on a scale of -4=Strongly Disagree +4=Strongly Agree
1. I am totally satisfied with my interaction with the site.
2. Some things about my interactions with the site could have been better.
3. I am not completely satisfied with my interactions with the site.
4. I thought the site took notice of me as a person.
5. The site was very careful in considering my health information needs.
Percentage susceptibility measure
Q17. Out of 100%, what do you think are your chances of being diagnosed with the following health conditions? (Sliding Scale)

0-----10-----20-----30-----40-----50-----60-----70-----80-----90-----100

- Obesity
- Diabetes
- Heart disease
- Anxiety disorder
- Sleep disorder
- HIV
- Other Sexually Transmitted Infections (excluding HIV)

Relative susceptibility measure
Q18. Compared to most people my age, I understand that my risk of being diagnosed with the medical conditions below, are: (Extremely Low -4 to Extremely High +4)

- Obesity
- Diabetes
- Heart disease
- Anxiety disorder
- Sleep disorder
- HIV
- Other Sexually Transmitted Infections (excluding HIV)

Perceived severity measure
Q19. Please indicate your agreement with the following statements on a scale of -4=Strongly Disagree +4=Strongly Agree
1. Obesity can be more deadly than most people realize.
2. Diabetes is a serious disease that can kill.
3. HIV infection is something that I cannot control.
4. Heart disease is something I cannot prevent.
5. HIV infection can be a serious condition that can kill.
6. Sleep disorders can lead to many health complications.
7. HIV infection is more serious than most people realize.
8. Heart disease can be more serious than most people realize.
9. HIV infection is something I cannot prevent.
10. Healthy eating is under my control.
11. Stress and anxiety disorders can be a serious health issue.
Future health behavior measures

Q20. On a scale from -4 to +4, with -4 being Very Unlikely and +4 being Very Likely, please indicate your responses to the following questions
1. How likely are you to eat more fruits and vegetables?
2. How likely are you to exercise regularly?
3. How likely are you to manage your weight?
4. How likely are you to reduce eating fast food?
5. How likely are you to practice safer sex?
6. How likely are you to watch your alcohol intake?
7. How likely are you to discuss HIV status with your partner?
8. How likely are you to use a condom?

Health information exchange measures

Q21. Please indicate your agreement with the following statements on a scale of -4=Strongly Disagree +4=Strongly Agree.
1. I would like to know more about the topic of diet and nutrition.
2. I would like to know more on the topic of safer sex practices.
3. I would like to know more about the topic of HIV and AIDS.
4. I would like to know more about the topic of physical activity and exercise.
5. I would discuss the topic of nutrition and exercise with my friends.
6. I would like to know more about achieving and maintaining healthy weight.
7. I would discuss the topic of HIV and AIDS with my friends.

Content attitude measures

Q22. On a scale of -4=Describes Very Poorly and +4=Describes Very Well, Please indicate how well the following words describe the HEALTH INFORMATION that you just received from the site. The HEALTH INFORMATION was — Believable / Accurate / Comprehensive / Concise / Boring / Enjoyable / Informative Insightful / Lively / Objective / Interesting / Clear

Website behavioral intention measures

Q23. Please indicate the likelihood that you will perform the following behaviors in the future on a scale of -4=Extremely Unlikely and +4=Extremely Likely.
1. I would bookmark this website for future use.
2. I would recommend this website to others.
3. I would forward this website to my acquaintances.
4. I would visit this website again in the future.
5. I would like to know more about this website.
6. I would like to visit other websites similar to the one that I just browsed.
# Appendix E: Zero-order correlation matrix

Part – 1: Rows #1 Perceived Contingency to #9 Information Value

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15: Per % Susceptible
16: Relative Susceptible
17: Perceived Severity
18: Social Presence
19: User Satisfaction
20: Engagement (Enjoyment)
21: Engagement (Immersion)
22: Engagement (Control)
23: Cognitive Responses
Part – 3: Rows # 19 User Engagement to #23 Cognitive responses

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VITA

Saraswathi Bellur-Thanaveshwara

EDUCATION

- PhD in Mass Communications: Pennsylvania State University, August, 2012
- M. S. in Journalism & Mass Communication: Iowa State University, August 2006
- M. A. in Journalism & Mass Communication: University of Mysore, India, 2002
- B. A. in Journalism, Literature & Psychology: Bangalore University, India, 2000

RESEARCH INTERESTS

- Media Effects
- Human-Computer Interaction & Computer-Mediated Communication
- Health Communication & Technology
- Psychophysiology
- Mass Communication Theory & Research Methods

AWARDS and HONORS

- Dean Douglas Anderson and Claudia Anderson Communications Scholarship
  - College of Communications, Penn State University, Spring 2009
- Dissertation & Teaching Award
  - College of Communications, Penn State University, 2009–2010
- The University Graduate Fellowship
  - College of Communications, Penn State University, 2006–2007

PUBLICATIONS [Recent]


