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Theoretical Importance of Contingency in Human-Computer Interaction: Effects of Message Interactivity on User Engagement

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Abstract

A critical determinant of message interactivity is the presence of contingency, that is, the messages we receive are contingent upon the messages we send, leading to a threaded loop of interdependent messages. While this "conversational ideal" is easily achieved in face-to-face and computer-mediated communications (CMC), imbuing contingency in human-computer interaction (HCI) is a challenge. We propose two interface features—interaction history and synchronous chat—for increasing perceptions of contingency, and therefore user engagement. We test it with a five-condition, between-participants experiment (N = 110) on a movie search site. Data suggest that interaction history can indeed heighten perceptions of contingency and dialogue, but is perceived as less interactive than chatting. However, the chat function does not appreciably increase perceived contingency or user engagement, both of which are shown to mediate the effects of message interactivity on attitudes toward the site. Theoretical implications for interactivity research and practical implications for interaction design are discussed.

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The concept of interactivity has elicited profound interest among scholars because it signals a fundamental shift in the way messages are handled during the process of communication, from one of *transmission* to that of *exchange*. In a way, interactivity epitomizes the promise of media technologies to capture the essence of interpersonal communication. Historically, concepts of dialogue, mutual conversation, and feedback have dominated theories and models of interpersonal communication, with fervent attempts to incorporate these tenets into mediated communication as and when allowed by developments in interactive technologies. The linear mathematical model of communication by Shannon and Weaver (1949) was extended to include a two-way reciprocal exchange in Schramm's (1954) interactive model of communication. In his model, the source and receiver elements are connected via bi-directional arrows, signifying a conversational partnership that is fundamental to all communication processes. The notion of a "conversational ideal" (Schudson, 1978, p. 323) has existed since the early days of media studies, with mass media attempting to model or mimic the hallmarks of everyday face-to-face conversations among humans—continuous feedback (Goffman, 1967, 1981), multiple modes of communication, spontaneous utterances, and alternating between sender and receiver roles. Scholars in Human-Computer Interaction (HCI) have drawn on the collaborative nature of human communication, especially language-based activities, to offer conversational feedback models for human-system interactions (Brennan & Hulteen, 1995). The common ground theory (Clark & Brennan, 1991; Clark & Schaefer, 1989) proposes that the goal of communication activities is to achieve *grounding* via systematic exchange of information such that two discussants mutually believe that they have understood and conveyed each other's knowledge states (Clark & Brennan, 1991). The common ground theory emphasizes how medium features (or affordances) present various "constraints" on grounding in the form of contemporality, simultaneity, and sequentiality. As Brennan (1998) remarks, " . . . the affordances of a medium impose particular costs on the grounding process and on how grounding shapes the conversations conducted over that medium" (p. 202).

Regardless of whether it is viewed as a cost or a benefit, the affordance of interactivity has been associated with enhanced conversationality and interconnectedness in computer-mediated communications (CMC), via such tools as instant messengers and online bulletin boards. Prior studies (Rafaeli, 1988; Rafaeli & Sudweeks, 1997, 1998) in the context of online message boards have shown that specific attributes of interactivity, such as heightened responsiveness, reciprocity, and threaded message exchanges, can indeed lead to positive outcomes such as greater sociability and sustained user engagement. More recent studies (Wise, Hamman, & Thorson, 2006) have shown similar results in online political forums. All these pertain to CMC situations where both senders and receivers are humans.

However, in HCI, where human users interact with programmed systems such as webpages, automated kiosks, or robots, how do user-to-system message exchanges approach the "conversational ideal" seen in user-to-user dialogue? If responsiveness and reciprocal message exchanges are indeed the hallmarks of interactivity, how can they be achieved in HCI? And, if achieved, how likely are they to affect other communication outcomes such as attitude change and behavioral intentions? Answers to these questions can help enhance our theoretical understanding of the role played by interactivity in HCI while also informing design of interactive interfaces.

The idea of concurrent two-way communication (McMillan & Hwang, 2002) is not new in the interactivity literature. Factors such as the degree of system responsiveness (Heeter, 1989), real-time participation (Steuer, 1992), and extent of reciprocal exchange between senders and receivers (Stromer-Galley, 2000) have been acknowledged and studied as key dimensions of interactivity. However, we do not know exactly which system features (or interface characteristics) are capable of evoking heightened perceptions of feedback and reciprocity in users' minds. Thus, the focus of this study is on interface characteristics (or technological affordances) that are able to convey interactivity in the form of back-and-forth message exchanges between the system and the user.

Sundar (2007) labels this kind of interactivity as "message interactivity" and suggests that it be operationalized in terms of contingency, that is, the system's output is contingent upon the user's input. Across a sequence of back-and-forth exchanges between the two, the system's output is not simply contingent upon the user's immediately preceding input but also upon previous inputs during the course of the interaction. This kind of "a looping mechanism for the transmission and reception of messages" (Sundar, Kalyanaraman, & Brown, 2003, p. 34) is said to imbue a sense of contingency, with users becoming aware of the system's responsiveness. Hence, if a system actively keeps track of users' inputs and displays how its responses (i.e., system output) are tied to users' unique inputs, the greater the user perceptions of contingency. We see several such instances in our day-to-day web-based interactions. For example, e-commerce sites display "most recently searched items" unique to each online customer, based on their previous purchases. Web browsers provide a "history" tab that records and displays all the URLs visited by an individual in a given browsing session. "Breadcrumb" navigation tools display the idiosyncratic path taken by users to reach a particular section of a webpage (Lida, Hull, & Pilcher, 2003; Nielsen, 2007). In each of these instances, the website is trying to convey the interconnectedness of the message exchanges occurring between the system and the user. But, is such contingency psychologically salient? Do users even notice the contingent manner in which systems respond, and if so, does greater perceived contingency result in greater user engagement, more favorable attitudes, and stronger behavioral intentions?

Studies have shown that fragmenting information on a website so that users can access it by following an idiosyncratic path can indeed imbue a sense of interactivity (Sundar et al., 2003), but not to the extent found in dialogue systems that feature one-on-one message exchange. This is perhaps because the system's ability to capture and display interaction history does not quite achieve the mutuality and back-and-forth cadence (seen in human-human exchanges) that underlie user perceptions of interactivity. Therefore, in order to achieve a higher sense of contingency, systems would have to go beyond revealing interaction history and include direct messaging. An example of such a dialogue system is Siri on the iPhone. By conducting a one-on-one message exchange with the user, an iPhone with Siri may be able to achieve higher levels of contingency in interactions than an iPhone that only provides interaction history. In other words, a synchronous one-on-one chatting function is likely to increase the interactivity of a system by significantly boosting its capacity for contingent interactions.

However, the addition of messaging inevitably makes the user orient to the source of message exchange. When a system shows signs of conversation or dialogue, we are less likely to "orient" toward the programmer who designed the system and more likely to respond to it as a meaningful source of communication in its own right. Source orientation is an important determinant of user responses to computers (Sundar & Nass, 2000), with perceived characteristics of sources determining the nature of the interaction. We respond socially toward computers that talk to us, use language, and take on human roles (Reeves & Nass, 1996). Therefore, the degree of contingency perceived during the interaction is not simply dependent on the degree to which the system's responses are contingent upon prior user inputs but also on the perceived responsiveness of the source. When Siri was first introduced, it was common for users to try and test the agent's responsiveness by posing challenging questions because they were orienting to it as an artificial entity (e.g., Subramony, 2011). We would not engage in the same kind of "testing" if Siri were an actual human agent because we assume humans to be fully responsive, as evident from our aforementioned idealization of human-human communication. Therefore, it seems likely that our perceptions of contingency (and, by extension, message interactivity) are dependent on the identity of the source with whom/which we are carrying out the message exchange. Under this argument, if the source is human, then users would perceive a higher sense of contingency than if the source is an automated agent like Siri. However, both these dialogue features would serve to make an interface more interactive than one that simply provides interaction history.

In order to test these possibilities, we conducted an experimental study by systematically varying the level of message interactivity offered in an online movie search site, designed to afford varying levels of contingent, back-and-forth interactions to the user. Five different versions of the site were especially built for this experiment varying in the types and levels of message interactivity afforded. One type of message interactivity explores the variations in the extent to which the site displays the back-and-forth interactions between the system and the user. We consider this the "interaction history" manipulation of message interactivity. This was varied in an ordinal manner as low, medium, and high display of interaction history. A second type of message interactivity was introduced by way of a synchronous chatting function, with two conditions showing variations in the attributed source of interaction (machine vs. human) so that we can empirically test the role played by perceived contingency in determining the effects of message interactivity.

The sections below will first provide an overview of theoretical and operational definitions of message interactivity and perceived contingency adopted and tested in this study. Furthermore, we will briefly review the Computers as Social Actors (CASA) literature (Reeves & Nass, 1996) and studies that have explored the effects of synchronous chatting features. We will also discuss the mediating role of perceived contingency in determining user engagement, as proposed by the interactivity effects model (Sundar, 2007). Given that newer technologies allow us to overlay CMC tools (e.g., synchronous chat) on HCI systems (i.e., websites), we can now perform an empirical assessment and investigate the value added by CMC-like tools in HCI domains. This will not only advance our understanding of the theoretical role of contingency in the effects of interactivity but also provide practical suggestions for designing interactivity in media interfaces.

Message Interactivity and Theoretical Importance of Contingency

Interactivity has been operationalized as a construct having several elements—two-way communication (Jiang, Chan, Tan, & Chua, 2010; Liu & Shrum, 2002; Voorveld, Neijens, & Smit, 2011), multimedia (Ahern, Stromer-Galley, & Neuman, 2000; Coursaris & Sung, 2012), personalization (Wu, 2006), user control (Coursaris & Sung, 2012; Coyle & Thorson, 2001; Cyr, Head, & Ivanov, 2009; Gao, Rau, & Salvendy, 2010; Jiang et al., 2010; McMillan & Hwang, 2002; Steuer, 1992; Voorveld et al., 2011), responsiveness (Coursaris & Sung, 2012; Cyr et al., 2009; Rafaeli, 1988), reciprocal communication (Ha & James, 1998; Jiang et al., 2010), and synchronicity (Liu & Shrum, 2002; Voorveld et al., 2011). Another approach to defining interactivity is to consider interactivity as any type of action possibilities provided by the system (Boczkowski & Mitchelstein, 2012; Jensen, 1998; Liu & Shrum, 2009; Lombard & Snyder-Dutch, 2001). However, simply equating interactivity with action possibilities cannot elaborate what precisely the user can act on and whether these actions carry any psychological importance. This warrants a more systematic investigation of theoretical paths that explain the "how" of interactivity effects. To do so, we examine the path proposed in the interactivity effects model (Sundar, 2007), where perceived contingency is considered the theoretical mediator via which message interactivity influences communication outcomes.

Prior conceptualizations of interactivity (Burgoon et al., 1999; Sundar et al., 2003) have emphasized the role of contingency in web-based communication and have demonstrated how interface features that enable a cumulative response to user input can be used to convey a sense of dialogue and conversationality. Burgoon et al. (1999) consider contingency to be one among the many structural affordances of interactivity that can exert its impact on perceived involvement, mutuality, and individuation in the interaction. Similarly, Sundar (2007) argues that contingency can be designed into a media interface, in order to imbue a sense of back and forth and interconnected interaction necessary for heightened user engagement with the content. Such heightened engagement could in turn lead to other cognitive, attitudinal, and behavioral outcomes.

In fact, Sundar et al. (2003) proposed a "contingency view" of interactivity that is contrasted with the so-called "functional view" (which pertains to functional features, for example, multimedia and other interface tools for user action). The contingency view is concerned with interactivity at the level of messages, with a highly interdependent thread of exchanges (e.g., IM chats) considered more interactive than simple questions and answers (e.g., frequently asked questions [FAQs]). Moreover, this kind of interactivity is theorized to promote systematic, rather than heuristic, processing of content because contingency forces users to be involved in the messages that fly back and forth, thereby promoting greater cognitive effort on the part of the user. Distilling these conceptualizations, Sundar et al. describe contingency as the degree to which the user gets an exclusive response to their active input. These authors argue that it is not just the presence of diverse functional features but also the extent to which they facilitate interconnected message exchanges that enable greater levels of interactivity in media interfaces.

Similarly, Sohn (2011) identifies three dimensions of interactivity: (a) sensory (akin to the availability of multimedia or functional features), (b) behavioral (pertaining to the degree of active user control and ability to modify the interaction process), and (c) semantic dimension. Of the three, the semantic dimension is more pertinent to the conceptualization of the key independent variable in this study, namely, message interactivity. Sohn distinguishes semantic interactivity from the other two types of interactivity by noting two defining features: recognition and mutual involvement.

> If the information is not accidentally encountered, *but provided by the medium recognizing the user*, however, the person is likely to perceive it as interactive . . . What matters in the perception of interactivity, therefore, is not the relevance of information per se, but the way it is obtained—whether it is acquired accidentally or through mutual recognition and involvement. (p. 1328)

Sohn also notes that such semantic interactivity is not entirely dependent on text-based exchanges, but could also occur at the level of symbols, icons, and other non-verbal design features.

Consistent with this logic, we define message interactivity as affordances (i.e., structural features with action possibilities; Norman, 1999) that enable users to interact with the system and/or with another user in a contingent manner to achieve a sense of dialogue (Sundar, 2007). The operationalization of message interactivity from this perspective will be discussed in the next section.

Operationalizations of Message Interactivity

Recent operationalizations of this message-based conceptualization of interactivity for HCI have sought to design contingency in the form of hierarchical hyperlinks that allow users to access information via an idiosyncratic path. For example, Sundar et al. (2003) created three different versions of a political candidate's website that were identical in content but differed in the degree of contingency offered. The low-interactivity version showed all the content on a single, scrollable page. 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. Thus, message interactivity here is not operating at the level of content in messages, but the way in which these messages are organized for information retrieval, contingent upon users' previous action (e.g., clicking on specific hyperlinks). This contingency-based operationalization appeared to capture user perceptions of interactivity, as evidenced by a successful manipulation check.

A similar operationalization of message interactivity in the form of tabs in a multi-layered interactive advertisement was also empirically successful in imbuing a sense of interactivity among users (Sundar & Kim, 2005). Participants in the high-interactivity condition perceived the advertisement to be significantly more interactive than their counterparts in the medium condition, and the latter in turn scored higher than those in the low condition. Moreover, the effects of message interactivity on attitudes toward the advertisement and related persuasion outcomes were positive. For example, participants in the high-interactivity condition showed greater involvement with the advertised product than those in the medium condition, with the latter scoring higher than those in the low condition.

Both studies discussed above (Sundar et al., 2003; Sundar & Kim, 2005) highlight an important distinction between *perceived interactivity* and *perceived contingency.* Based on our operationalization of message interactivity (via the contingency principle), *perceived contingency* operates at the level of threadedness and interconnectedness of message exchange. It is the extent to which users believe system output is based on their prior inputs (Rafaeli, 1988; Sundar et al., 2003). So *perceived contingency* pertains to the *nature* of message exchange (i.e., contingent or not). On the other hand, *perceived interactivity* refers to users' subjective and overall assessment of interactivity in an interaction. This *global* experience of interactivity may operate independently from users' notions of contingency, which is more closely tied to a *specific* (and deliberate) manipulation of message interactivity at the level of message-exchange sequence. Hence, it becomes important to account for both the global (*perceived interactivity*) and specific (*perceived contingency*) perceptions triggered by our message-interactivity manipulation and their subsequent effects on user engagement and allied outcomes. This will also allow us to probe the degree to which perceptions of contingency in an interaction accounts for an overall perception of interactivity in that interaction.

Both structural features—hyperlinks and tabs—used in previous studies (Sundar et al., 2003; Sundar & Kim, 2005) not only provide information to users in a contingent fashion (i.e., based on their particular previous action), they also visually indicate the process of contingency on the interface. Scholars in HCI highlight the importance of displaying "interaction history" of each user with the system. In their work on user activity histories, Pelaprat and Shapiro (2002) suggest employing a "history of use" metaphor for digital objects, and argue that the interaction between a user and a digital object is not just an "ephemeral conversation" that consists of only, for instance, undo and redo buttons (p. 876). Instead, there should be rich, personal history data that can reflect and influence user experience in many ways.

We adopt this notion of interaction history for offering feedback and building contingency in media interfaces. To generate a sense of interconnectedness and dialogue, we operationally define contingency as the extent to which a system (e.g., website) registers the user's input by displaying cumulative interaction history. It can be operationalized via simple navigational aids such as *breadcrumbs* (Lida et al., 2003; Nielsen, 2007). On a website, breadcrumbs constitute a virtual trail that shows users how they got to a section of the site and how they could return to the homepage or move to other parts of the site that they had visited along the way. A thread of this kind of interactive trail not only provides a visual cue that the system is carefully registering the user's input but also communicates to users the contingency in the system's responses to their input (e.g., search results) and the message exchanges preceding each input (e.g., search history). For instance, in an interface of a web directory, a fully contingent browsing history should not only document the entire list of browsed content but also capture the progress in accordance with the steps of the search actions, possibly by nesting the browsing history in a manner that maps the categories and subcategories selected before viewing a specific webpage of desired content.

The idea that "history-enriched digital objects" (Hill & Hollan, 1994) can guide future usage has been an active line of HCI research. For example, Terveen, McMackin, Amento, and Hill (2002) showed that personal history data helped users specify music preferences based on their past listening activity. Other researchers have studied the same notion in the form of "footprints" and argued that it is an inherent human tendency to watch our past behavior, in order to learn what to avoid and what to repeat (Wexelblat & Maes, 1999). In other words, interaction history is not only merely reactive to users' previous inputs, it can be interactive in that it keeps track of the unique pathway that has been constructed by each user. In addition, it can visually indicate how their current and previous interactions with a system are connected to one another. Hence, interaction history in the HCI context is a way of instantiating the looping mechanism, which defines contingency in message-exchange processes.

Therefore, if contingency is indeed a critical component of message interactivity, then footprints, breadcrumbs, and other visualizations of interaction history should serve to not only enhance users' perceptions of contingency in the interface but also enhance perceptions of dialogue and conversationality (Burgoon et al., 1999) afforded by the interface. This is brought about by the constant interchangeability of sender and receiver roles (Rafaeli, 1988)—or in the case of HCI, consistent tracking and display of user input and system output—that evokes a sense of dialogue. Early interactivity studies have emphasized how specific dimensions of interactivity such as reciprocal feedback (Ha & James, 1998), responsiveness (Rafaeli, 1988), mutuality, and involvement (Burgoon et al., 1999) contribute to users' perceptions of interactivity. These dimensions also resonate with the assumptions of common ground theory (Clark & Brennan, 1991) that adopts a similar, collaborative language and *dialogue-based* view of communication. Therefore, given the emphasis on achieving a sense of dialogue through interactivity, we propose that "perceived dialogue" ought to be tested as a distinct outcome of message interactivity.

In sum, we consider message interactivity as the primary independent variable in the study, with contingency being the focal theoretical definition of this concept.

Message threadedness constitutes the operational definition, with a display of interaction history on the interface being the actual operationalization. Further, we consider three sets of user perceptions to be critical for evaluating the success of message interactivity: perceived contingency (psychological verification of the process underlying interactivity), perceived interactivity (an assessment of the degree to which interactivity was achieved), and perceived dialogue (extent to which the desired objective of interactivity was realized). While these are distinct perceptions, the literature reviewed above suggests that all three are important, positive correlates of message interactivity. Therefore, we propose the following hypotheses:

> **Hypothesis 1 (H1):** The greater the amount of interaction history displayed on the interface, the higher the perceived contingency (H1a), perceived interactivity (H1b), and perceived dialogue (H1c).

While the display of users' interaction history provides a good design solution for cueing higher levels of contingency on interfaces, we cannot be so sure of its psychological importance. As Sundar et al. (2003) remarked when revealing their manipulation-check results, perceptions of interactivity tend to be compared against the face-to-face standard. When examining parallels of face-to-face communication in mediated contexts, online chatting applications offer a closer point of comparison. How does the introduction of synchronous chat features influence perceptions of interactivity? Does the potential to engage in a dialogue with another communication partner enhance expectations and/or perceptions of contingency? And, do these perceptions vary based on whether we are interacting with a human or a bot? When examined as an affordance (or a structural feature), how does the addition of synchronous chat—a CMC-like feature—affect user experience in a HCI setting? In order to explore these questions further, we discuss the theoretical rationale for adding the synchronous chat feature to our message interactivity manipulation.

The Power of Live Chat

While some studies demonstrate that organizing online content for contingent delivery of online information can make an interface mimic the message interactivity found in actual one-on-one conversations and thereby produce positive psychological effects, others show that online tools that promise contingent interaction with another communication partner have a positive effect on users as well. For example, Thorson and Rodgers (2006) studied the blog of a political candidate, which featured a hyperlink that would allow users to post public feedback on the blog. Findings showed that the sheer presence of this interactive feature created a beneficial, albeit illusory, effect whereby blog readers imagined that they had the potential for contingent message exchanges, that is, they expected that the blog would allow them to engage in a one-to-one conversation with the political candidate. This translated into more favorable attitudes toward the candidate and higher voting intentions.

Embedding features that enable users to engage in a dialogue with other communication partners, either indirectly or directly, has been shown to have a positive impact on users' attitudes. Cole et al. (2003) propose that animated agents improve HCI and are likely to provide more effective and engaging communication experiences. The value of live chat has been widely tested in e-commerce research. For example, Haubl and Trifts (2000) compared the effectiveness of a recommendation agent and a comparison matrix program, and revealed that discussion with the agent led to greater confidence over final purchase decision. Xu, Benbasat, and Cenfetelli (2010) demonstrated that the use of a live chat agent enhanced users' perceptions of system quality, information quality, and service quality.

The aforementioned positive outcomes of live chat agents can be attributed to the perceived responsiveness coming from a real or imagined source (communication partner) at the other end. Studies in the CASA literature (Nass & Moon, 2000; Reeves & Nass, 1996; Sundar & Nass, 2000) have shown that whenever computers take on social roles typically held by other human beings (e.g., virtual travel agent, voice-enabled navigation guides) and also show ability for verbal output, users tend to respond to such systems as if they are real sources of interaction. While the effects of source orientation have been examined in previous research, what is not clear is the connection between source orientation and perceived contingency. Are users more likely to report greater perceived contingency when they are told that they are interacting with a human source versus an online bot? If there is a difference between the human and chatbot conditions, how does it affect overall user attitudes and experience? Thus, incorporating a live chat feature into a regular web-based user-system interaction will help us identify the underlying theoretical mechanisms (e.g., contingency, responsiveness, source orientation) that drive the effect of synchronous chat features and subsequent interactivity emerging out of such interactions.

During a live chat, users are more confident of the exclusivity of the responses to their personal needs. Some scholars have argued that user perception of interactivity is strongly predicted by how "personal" the message is (Song & Zinkhan, 2008). When message interactivity is operationalized as a display of user-system interaction history, users are aware (to some extent) of the back-and-forth nature of the interaction due to the availability of visual cues (e.g., a log of hyperlinks, with categories and subcategories of information browsed). However, when the system offers a live chat feature, even if the interaction is conducted in the same manner as browsing through a web directory, it is likely to give users a heightened sense of responsiveness and reciprocity. This is because, as discussed above, an affordance such as a live chat feature instantly triggers the perception of a receptive "source" or "listener" at the other end who is ready to register users' responses on a *one-on-one* basis and provide feedback based on their unique, individual inputs, thereby heightening the sense of message contingency, promoting a perception of greater interactivity in the site and contributing to an enhanced feeling of dialogue with the system. We formally test this proposition with the following hypotheses:

> **Hypothesis 2 (H2):** Adding a live chat affordance to interaction history on an interface will increase perceived contingency (H2a), perceived interactivity (H2b), and perceived dialogue (H2c).

Examining the effects of interactive social agents in a health-based persuasion setting, Skalski and Tamborini (2007) found that the use of an interactive agent did lead to increased processing of health messages, mediated by perceived social presence. This raises yet another possible cue for contingency—namely the human identity of the live chat agent. Will the identification of the agent as human (as opposed to a bot) enhance user perceptions of contingency, considering that humans are, in reality, capable of more contingent behaviors? The literature on CASA would argue otherwise because users are shown to mindlessly attribute personality, gender stereotypes, emotions, and evaluations to inanimate computers (Isbister & Nass, 2000; Moon, 2000; Nass & Lee, 2001; Sundar & Nass, 2000). On the other hand, there could be differences in the *degree* of application of social rules when users know that they are interacting with a machine agent rather than a human agent (e.g., Mauldin, 1994). Perceived contingency, dialogue, and interactivity could be higher in the latter case even when actual contingency is the same.

We explore this possibility with the following research question:

Research Question (RQ): Will there be a difference in user perceptions of contingency, interactivity and dialogue when users have a live chat interaction with a Human Agent, compared with a Chatbot?

Perceived Contingency and User Engagement as Mediators

As found in Sundar and Kim (2005) and Sundar et al. (2003), higher message interactivity can induce greater involvement with the content provided by the website and even lead to more positive attitudes toward it (when the navigational load imposed by higher message interactivity is successfully minimized). Buell and Norton (2011) also found that when a travel site displayed a continually changing list of sites and fares being searched by users, they perceived the site exerting more effort contingent to their input, which in turn increased their perceived value of the website.

When a website offers interactive features that actively respond to users' inputs, users are involved in a continual process whereby they make connections between new information offered by the system and the information that they have already read (Tremayne & Dunwoody, 2001). This active cognitive involvement can result in greater feelings of engagement or absorption reported by the user while browsing the website. If message contingency indeed plays a role in this process, then the level of perceived contingency should mediate the relationship between message-based interactivity and user engagement and other attitudinal outcomes. Therefore, we test the following hypothesis:

Hypothesis 3 (H3): Perceived contingency will mediate the effect of message interactivity on user engagement, attitudes, and behavioral intention toward the website.

Furthermore, as an empirical test of the aforementioned interactivity effects model (Sundar, 2007), we propose

Hypothesis 4 (H4): User engagement will mediate the effect of message interactivity on attitudes and behavioral intentions toward the website.

Although previous studies (Sundar et al., 2003; Sundar & Kim, 2005) have tested the link between message-based interactivity and perceived contingency, there is no formal test of the two-step mediation path proposed by the interactivity effects model (Sundar, 2007), with both perceived contingency and user engagement as serial mediators. H3 and H4 above will aid in addressing that gap.

In sum, we operationalize and test five incremental levels of message-based interactivity (Figure 1) that differ in the extent to which they afford contingency.

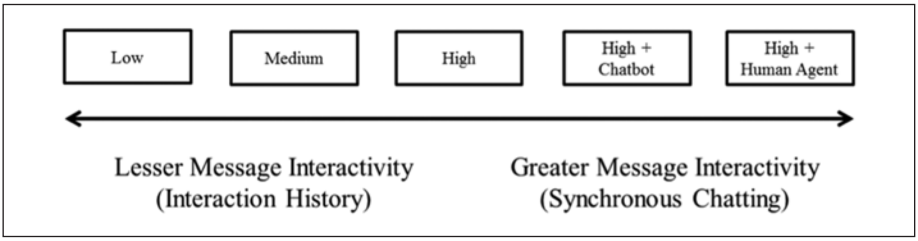

Figure 1. Variations of message interactivity, representing the conceptual basis for the five experimental conditions.

The first three levels of message interactivity—Low, Medium, and High—are distinguished by the amount of interaction history revealed to the user. The fourth and fifth levels test the effect due to the addition of the live chat feature, with two source-orientation manipulations: Human Agent versus Chatbot. The addition of one-on-one direct messaging, by way of live chat, serves to boost the affordance of message interactivity on the site, with Human Agent condition placed slightly above Chatbot condition given its *potential* to offer a greater level of message contingency. To test the effects of interaction history (H1a, H1b, H1c), Low, Medium, and High interactivity conditions will be compared. The effects of adding a live chat affordance (H2a, H2b, H2c) will be tested by comparing the two chat-agent conditions (Human Agent and Chatbot) with the other three conditions that do not have the chat feature. The impact of the humanness of chat agent (RQ) will be investigated by comparing Human Agent condition and Chatbot condition. Finally, the theoretical mechanism by which message interactivity leads to user engagement and attitudinal outcomes (H3 and H4) will be investigated via mediation analyses.

Method

A five-condition, between-subjects lab experiment was conducted to gather data and test our hypotheses and research question. Given our study purpose, we chose this ordinal variation of interactivity instead of a factorial design for the sake of parsimony.

Participants

A total of 110 participants were recruited from undergraduate classes at a large U.S. university. Participants' age ranged from 18 to 45 years old, with an average of 21.24; 29% were male.

Stimulus Materials

Five versions of a search website called "MovieHub" were created especially for this study (Figures 2 and 3)—(i) Low Interactivity, (ii) Medium Interactivity, and (iii) High Interactivity conditions were based on the interaction history manipulation. The High Interactivity condition was overlaid with direct messaging to create two more conditions, featuring live chat with either (iv) a Machine Agent (Chatbot) or (v) a Human Agent.

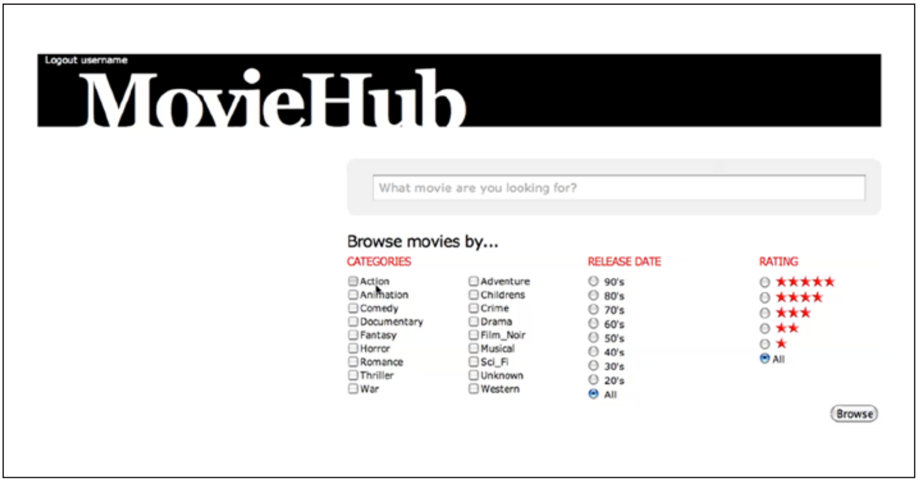

Figure 2. A screenshot of the MovieHub website in low condition.
Note. The movie website offers search and browsing functions (based on categories, release date, and rating).

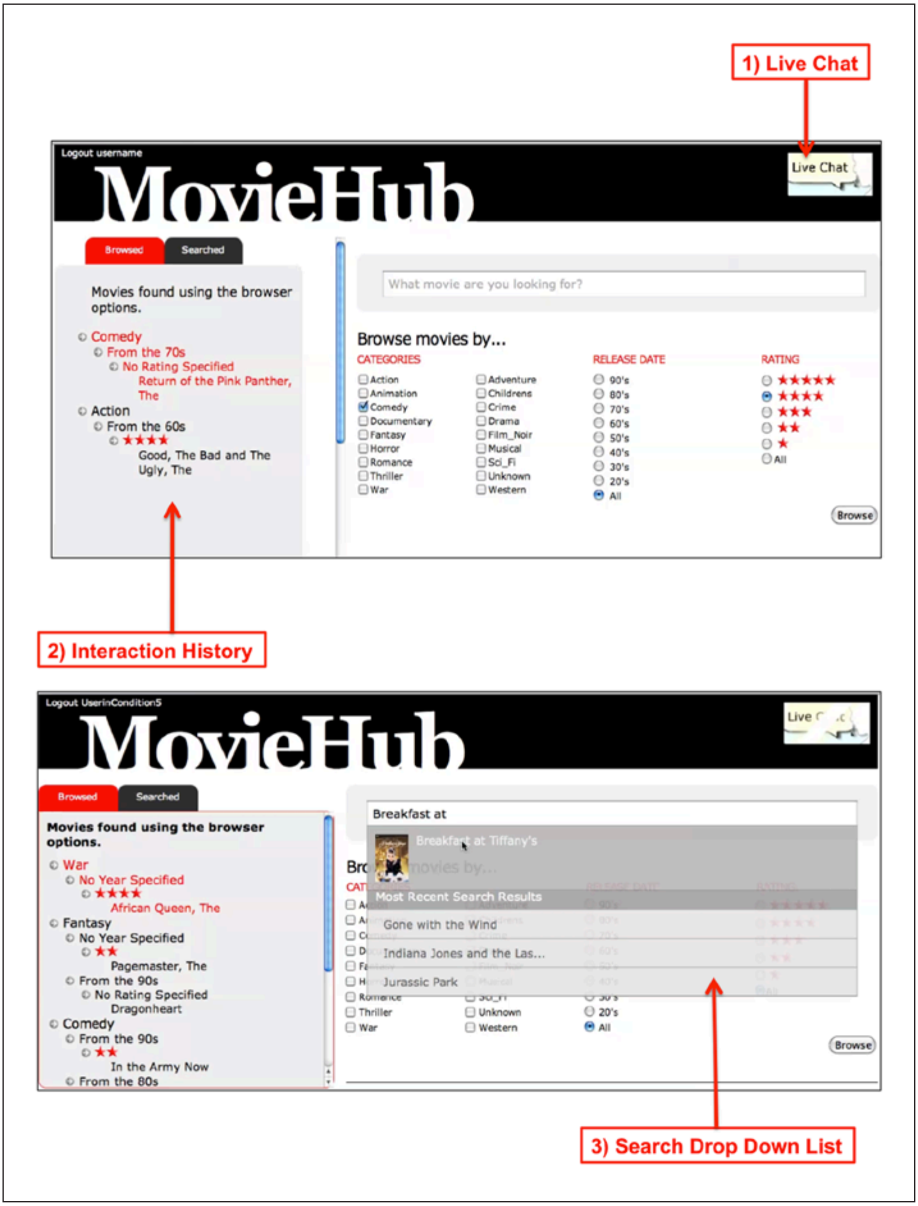

Figure 3. Screenshots of the MovieHub website in high condition with live chat.
Note. In addition to the basic functions in the low condition (in Figure 2), the high condition has (1) the live chat button on the right-hand top-corner of the screen; (2) interaction history displayed on the left, showing recently Browsed and Searched items in two tabs; and (3) the drop-down list under the Search box displaying the recent search results.

Participants were assigned randomly to one of the five conditions: 22 in Low condition, 21 in Medium condition, 20 in High condition, 23 in High + Human Agent condition, and 24 in High + Chatbot condition. The website was introduced as an online directory of classic movies released between 1920s and 1990s, with three major functionalities: (1) browsing through movie directory with layered categorizations (genre, publication year, star rating, title), (2) searching for a movie title, and (3) chatting with an assistant (in Conditions iv and v). After choosing a movie by browsing or searching for a movie title, an IMDb page (one of the most trafficked online databases of information related to movies, http://www.imdb.com/) would open as an overlay window within the main MovieHub site, providing detailed descriptions such as director, cast, and storyline. For those participants in the chatting conditions (iv and v), a "Live Chat" icon was displayed on the right top-corner of the website.

Experimental manipulations. The experimental manipulation across the five levels of message interactivity was situated in the following three features offered by the site. Based on the concept of interaction history discussed earlier, the first feature was the *Browse and Search History tab*. This tool showed the participants a record of their actions, that is, a list of movies that they browsed or searched during their interaction. In the *Low* condition, there was no interaction history revealed. In the Medium and High conditions, the number of user action items in the *browse history* and *search history* tabs differed such that in the *Medium* condition, the *two* most recently browsed and searched movies were shown, whereas in the *High* condition, all the movies that users browsed or searched were displayed. Graphically, these appeared as a list of hyperlinks (with separate tabs for browse and search) on a left navigational bar, in the stimulus home page (Figure 3), featuring an indented visual design to map with the step-by-step browsing action, grouping together inter-related movie titles. In the Medium and High conditions, the recently browsed and searched movies were not just static visual displays. Rather, they provided active hyperlinks for users to go back and revisit the earlier choice of movies that they had searched or browsed. Thus, the display of interaction history was not just an archival function. Nor was it restricted to a simple action-reaction feature. It was fully interactive to the extent that it allowed users to reflect back on their prior actions, and thereby enabled them to actively see the interconnectedness between their present and past searching or browsing behaviors. The only difference between the Medium and High conditions was that the number of steps users could retrace was restricted to just the two most recent searches in the Medium condition, whereas in the High condition, there were no limits. Users could retrace all their prior interactions with the system, hence allowing greater scope for contingency (back and forth).

The second feature to be manipulated was the *Most Recent Search Results* feature located under the search box as a drop-down list. Similar to the Browse and Search History tabs, there was no display of recent searches in the *Low* condition. There *were either two (in Medium)* or *five (High, Human Agent, Chatbot)* most recently searched items displayed in the other conditions. This was designed to reinforce the interactivity manipulation by altering the extent to which the MovieHub site kept track of user actions and conveyed it back to them visually.

The third feature manipulated was the *Live Chat* function, considered the highest form of message interactivity. It was offered in both *Human* Agent and *Chatbot* conditions. Manipulation of human agent versus chatbot was achieved via a textual instruction sheet given to all participants at the beginning of the study. Participants in the Human Agent condition were told to chat with "*Alex, a movie assistant*" (later psychological measures revealed that they automatically perceived the assistant to be human, as expected) and their counterparts in the Chatbot condition were instructed to chat with "*Alex the robot*, an automated movie assistant." In both conditions, participants chatted with the same human confederate who was unaware of the condition to which the participant was assigned, thus ensuring double-blindness. The confederate used the same chatting protocol to communicate with all the participants in the two chatting conditions. Across all the conditions, an automatic text completion function aided participants to easily search a movie of their interest. The auto-completion feature was incorporated in order to enhance the usability of the system and was kept constant across all conditions.

Procedure

The study took place in a lab setting where participants were told that they would be browsing a movie website. First, participants were asked to fill out a pre-test questionnaire that included measures for the control variables. After this, they were shown a set of slides that introduced the functions of the MovieHub website. Participants were asked to suggest two movies to be screened at a classics movie night, as part of an event organized by a fictitious University Movie Club. They were told to use the MovieHub website for making their decisions on which movies to recommend, after they had browsed and searched at least six movies. They were also instructed to think about the options in terms of genre, year of release, and popularity. Participants would then browse, search, or chat with the "MovieHub assistant" if they were in the chatting condition, to come up with their choice of movies. In order to keep the content and the interaction in the three conditions as identical as possible, the script followed by the chat confederate included guidelines for ways in which the confederate would discuss in accordance with the categorizations offered on the website (e.g., genres, popularity, etc.). To control the tone and quality of interaction, each interaction included the same greeting message (e.g., Hi! How may I help you?), same questions to participants (e.g., This movie that you are looking for, is it for a particular purpose [party/date/killing time, etc.])? (What movie genre are you looking for?), and same responses (e.g., I am more than willing to help you find a movie for X [the purpose]!). Each chat session lasted between 5 and 10 minutes. After participants indicated completion of the tasks, they were given a post-test questionnaire that included the outcome measures. The entire study session lasted approximately 45 minutes to an hour. At the end, participants were debriefed, thanked, and given $25 for their participation.

Dependent Measures

The dependent variables examined three classes of outcomes: (i) psychological experience of interactivity and its correlates (perceived contingency, interactivity, and dialogue), (ii) user engagement, and (iii) persuasive effects in the form of attitudes and behavioral intentions. All measures were administered in the form of self-reports, using 9-point Likert-type scales, unless otherwise noted. A manipulation check for interaction history was conducted using eight items: "The site remembered my action," "The site maintained a trace of steps I took while searching/browsing the site," "The actions I performed were clearly evident on the site," "The site was transparent in showing the actions I performed," "The site contained a summary of all the actions I performed," "The site maintained a systematic (orderly) record of my actions," "The site remembered the choices I made while browsing it," and "The site gave some smart recommendations or suggestions based on my input" (M = 6.42, SD = 2.16, α = .95). A manipulation check for Human Agent versus Chatbot condition used three semantic-differential measures (Powers & Kiesler, 2006): "Machine-like and Human-like," "Unnatural and Natural," and "Artificial and Lifelike" (M = 5.92, SD = 2.51, Min = 1, Max = 9, α = .96).

Psychological experience of interactivity and its correlates. Measures for perceived contingency and perceived dialogue were modified and adapted from several studies that have measured the dimension of two-way communication, under the perceived interactivity variable (Detenber, Wijaya, & Goh, 2008; Liu, 2003; Thorson & Rodgers, 2006). *Perceived contingency* contained the following 11 items: "The website's responses were dependent on my browsing/searching history," "The website took into account my browsing/searching history," "The website's responses recounted the relatedness of my earlier inputs," "I felt that the website carefully registered my responses and gave feedback based on the information I entered," "I felt as if the website gave an exclusive response to my actions," "My interaction with the website felt like a continuous thread or a loop," "The website's responses seemed interconnected with each other," "I felt as if the information on the website was well connected to my actions," "The messages I received on the website were based on my previous inputs," "The choice of movies shown by the site were meant exclusively to suit my preference," and "I felt the site considered my unique requests while presenting a choice of movies I could watch" (M = 5.66, SD = 1.85, α = .94). Based on Liu (2003) and Sundar, Bellur, Oh, Xu and Jia (2014), *perceived interactivity* was measured by asking participants to rate the extent to which they thought the MovieHub site was "highly interactive," "enabled two-way communication," "enabled concurrent (simultaneous) communication" and the extent to which their interaction with the MovieHub site "felt primarily like a one-way communication" (reverse-coded) (M = 5.18, SD = 2.17, α = .88). *Perceived dialogue* contained the following 5 items: "I felt like I was engaged in an active dialogue with the website," "My interactions with the site felt like a back and forth conversation," "I felt as if the site and I were involved in a mutual task in selecting movies," "The site responded quickly to my inputs and requests," and "The site was efficient in responding to my activities" (M = 5.00, SD = 2.12, α = .93).

User engagement. User engagement was measured by the level of *absorption* that participants experienced while interacting with the site (Agarwal & Karahanna, 2000). Six items were used to measure absorption: "Time appeared to go by very quickly when I was reading the movie information," "I spent more time on the movie information than I had intended," "While I was interacting with the MovieHub site, I was able to block out most other distractions," "While reading the movie information, my attention did not get diverted," "While I was interacting with the MovieHub site, I was immersed in what I was doing," and "I lost track of time when I was interacting with the MovieHub site" (M = 5.26, SD = 2.00, α = .95).

Persuasive effects of interactivity. Participants' *attitude toward the website* was measured using a 10-item scale (M = 5.48, SD = 2.08, α = .98) eliciting their ratings of the site on these descriptors: "appealing," "attractive," "cool," "high-quality," "exciting," "pleasant," "likeable," "interesting," "fun," and "imaginative" (Sundar, 2000). Two items measured participants' behavioral intention toward the website (Sundar et al., 2014): "I would recommend this website to others" and "I would like to know more about this website" (r = .84, M = 4.68, SD = 2.56).

Covariates

To account for individual differences that are known in the literature to influence the effects of interactivity, power usage, topic involvement, and previous movie website usage were measured in a pre-test questionnaire. *Power usage* was measured via questions derived from the literature (Sundar & Marathe, 2010). A total of 12 items pertained to the degree of participants' liking of technology, their dependence on information technologies, and the extent of—as well as the perceived ease of use—of those technologies: " I think most of the technological gadgets are complicated to use (reverse-coded)," "I make good use of most of the features available in any technological device," "I have to have the latest available upgrades of the technological devices that I use," "Use of information technology has almost replaced my use of paper," "I love exploring all the features that any technological gadget has to offer," "I often find myself using many technological devices simultaneously," "I prefer to ask friends how to use any new technological gadget instead of trying to figure it out myself (reverse-coded)," "Using any technological device comes easy to me," "I feel like information technology is a part of my daily life," "Using information technology gives me greater control over my work environment," "Using information technology makes it easier to do my work," and "I would feel lost without information technology" (α = .72, M = 6.70, SD = 1.00). *Topic involvement* was measured by asking participants to rate 10 items on a 9-point semantic-differential scale—information about movies is unimportant or important, boring or interesting, irrelevant or relevant, unexciting or exciting, means nothing to me or means a lot to me, unappealing or appealing, mundane or fascinating, worthless or valuable, uninvolving or involving, and not needed or needed (α = .93, M = 6.22, SD = 1.52). *Previous usage of movie sites* was measured on a 9-point scale that asked how frequently, from "never" to "very often," they browsed popular movie websites such as IMDB.com, Netflix.com, Rottentomatoes.com, Flixster.com, and Hollywood.com ($M = 2.67$, $SD = 1.36$).[1]

Results

A multivariate analysis of covariance (MANCOVA) was first conducted on all the dependent variables considered together, with the five-level message interactivity (low, medium, high, human agent, and chatbot) manipulation as the independent variable, and three covariates described above. This analysis revealed a significant multivariate effect as a function of the five message interactivity variations, Wilks's $\Lambda = .319$, $F(28, 348) = 4.63$, $p < .001$. Subsequent results reported below emerged from a series of univariate ANCOVAs for each of the dependent variables, with the same independent variable and covariates. Mean differences in significant main effects were assessed with Holm's sequential Bonferroni post hoc comparisons.

Manipulation Check

In order to check whether our manipulations of interaction history were noticed, participants were asked to indicate the degree to which the site remembered and displayed the actions that they had performed before. The difference among the five conditions was statistically significant in the expected direction, $F(4, 104) = 23.75$, $p < .001$, $\eta^2 = .48$. Low ($M = 4.39$, $SE = .34$) and Medium ($M = 4.82$, $SE = .36$) conditions scored significantly lower than the other three conditions—High ($M = 7.86$, $SE = .35$), High with Human Agent ($M = 7.25$, $SE = .33$), and High with Chatbot ($M = 7.72$, $SE = .32$). The manipulation check for human versus chatbot as the chat agent was also successful. Participants in Human Agent condition ($M = 6.61$, $SE = .52$) perceived their chat agent as more human-like, natural, and life-like compared with those in the Chatbot condition ($M = 5.25$, $SE = .51$), $t(45) = 1.86$, $p < .05$, one-tailed, $d = .51$.

Perceived Contingency (H1a and H2a)

The effect of the interactivity manipulation was significant for perceived contingency as well, $F(4, 102) = 5.47$, $p < .001$, $\eta^2 = .17$. According to a post hoc test, participants felt that the website provided more contingent responses in the High + Human Agent ($M = 6.36$, $SE = .35$) condition than in the Low ($M = 4.92$, $SE = .36$) and Medium ($M = 4.52$, $SE = .38$) conditions. They also perceived that High ($M = 6.23$, $SE = .37$) and High + Chatbot ($M = 6.19$, $SE = .34$) conditions showed more contingency than the Medium condition, which scored the lowest. Thus, the amount of interaction history increased perceived contingency as H1a predicted, but the difference was significant only between Medium and High conditions. The differences between the High, High + Human Agent, and High + Chatbot conditions were not significant, which shows that live chat did not add significantly to perceptions of contingency over and beyond what the High condition already afforded by way of displaying interaction history, quite contrary to what H2a predicted.

Table 1. Summary of Message Interactivity Effects.

	Low	Medium	High	High + Chatbot	High + Human Agent
Perceived interactivity	3.49[c]	3.63[bc]	4.95[b]	6.82[a]	6.72[a]
Perceived contingency	4.92[bc]	4.52[c]	6.23[ab]	6.19[ab]	6.36[a]
Perceived dialogue	4.15[bc]	3.92[c]	5.48[ab]	5.92[a]	5.96[a]
User engagement	4.32[b]	4.97[ab]	5.83[ab]	5.21[ab]	5.97[a]
Website attitudes	4.52[b]	4.57[b]	6.00[ab]	6.32[a]	5.89[ab]
Behavioral intention toward website	3.99[a]	3.48[a]	5.10[a]	5.24[a]	5.48[a]

Note. Levels not connected by a letter are significantly different, according to Holm's sequential Bonferroni post hoc comparisons.

Perceived Interactivity (H1b and H2b)

As hypothesized, participants' perceived interactivity of the website was a positive function of the levels of message interactivity in site design, $F(4, 102) = 23.08$, $p < .001$, $\eta^2 = .48$. Post hoc comparisons showed that both High + Chatbot condition ($M = 6.82$, $SE = .32$) and High + Human Agent condition ($M = 6.72$, $SE = .33$) scored significantly higher than the three conditions with only interaction history, thereby supporting H2b. Also, as H1b predicted, the High condition ($M = 4.95$, $SE = .35$) yielded significantly higher score than Low condition ($M = 3.49$, $SE = .34$), with the Medium condition ($M = 3.63$, $SE = .35$) in the middle.

Perceived Dialogue (H1c and H2c)

A significant effect for message interactivity, $F(4, 102) = 6.16$, $p < .001$, $\eta^2 = .20$, showed that those in the High + Human Agent ($M = 5.96$, $SE = .38$), High + Chatbot ($M = 5.92$, $SE = .37$), and High ($M = 5.48$, $SE = .41$) conditions were more likely to feel that they were engaged in an active conversation with the site than those in the Medium ($M = 3.92$, $SE = .39$) condition. Again, the interaction history enhanced their perceived dialogue as H1c predicted, but only the difference between Medium and High condition was significant. The Human Agent and Chatbot conditions were significantly different from both Low and Medium conditions. The differences between the High, High + Human Agent, and High + Chatbot conditions were not significant in the post hoc test (see Table 1). Thus, H2c was not supported. It is interesting to note that the presence of live chat distinguishes the Human Agent and Chatbot conditions from the Low and Medium interactivity conditions, but it does not differ significantly from the High interactivity condition without live chat, suggesting that higher levels of structure-based (interaction history) interactivity is seen as offering about the same amount of dialogue as that found in conversation-based (synchronous chat) interactivity. This is similar to our findings with perceived contingency.

User Engagement

Self-reported measures of absorption also showed a significant difference across the five levels of message interactivity, $F(4, 102) = 2.67$, $p < .05$, $\eta^2 = .10$. Participants reported feeling significantly more absorbed in the High + Human Agent ($M = 5.97$, $SE = .40$) and High ($M = 5.83$, $SE = .43$) conditions compared with the Low condition ($M = 4.32$, $SE = .42$; Table 1).

Website Attitudes

The effect of message interactivity was significant on website attitudes as well, $F(4, 102) = 3.10$, $p < .05$, $\eta^2 = .11$. Those who interacted with the Chatbot ($M = 6.32$, $SE = .41$) showed more favorable attitudes toward the website than those who were in Low ($M = 4.52$, $SE = .43$) and Medium ($M = 4.57$, $SE = .45$) conditions (Table 1).

Behavioral Intention Toward Website

A significant effect was obtained for message interactivity on behavioral intention toward the website, $F(4, 102) = 2.64$, $p < .05$, $\eta^2 = .09$. Those in the High + Human Agent condition showed the highest intention of recommending the site to others and wanting to know more about the site ($M = 5.48$, $SE = .51$). Again, those in the Medium condition showed the least behavioral intentions ($M = 3.48$, $SE = .56$; Table 1).

Mediation Analysis

H3 and H4 proposed mediating effects of perceived contingency and user engagement on attitudes and behavioral intention toward the website. A bootstrapping procedure using Model 6 of the PROCESS macro developed by Hayes (2013) was employed, using 5000 bootstrap samples and bias-corrected and accelerated confidence intervals (CIs). The mediation model was used to test whether the message interactivity affects attitudes and behavioral intention through perceived contingency and user engagement (Figure 4). Dummy coding was used to create four Interactivity variables with the Low condition as the referent group.

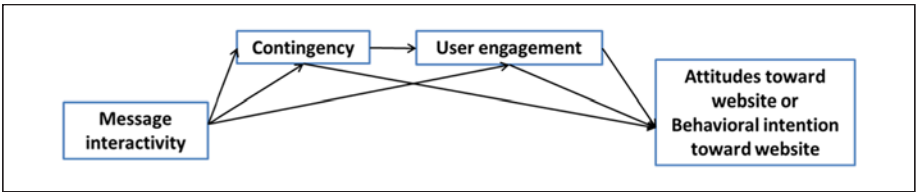

Figure 4. A mediation model tested by bootstrapping method.

First, a significant indirect effect of message interactivity on attitudes and behavioral intention toward website was found with perceived contingency as the only mediator, but not with user engagement as the only mediator. The High, High + Chatbot, and High + Human Agent conditions significantly increased the perceived contingency of the website compared with the Low condition, which in turn led to better attitudes toward website[2] (B_2 = .74, 95% CI = [0.18, 1.46], SE_2 = .32; B_3 = .72, 95% CI = [0.16, 1.42], SE_3 = .32; B_4 = .81, 95% CI = [0.24, 1.57], SE_4 = .34) and greater behavioral intentions (B_2 = .78, 95% CI = [0.20, 1.58, SE_2 = .35; B_3 = .75, 95% CI = [0.17, 1.52], SE_3 = .34; B_4 = .86, 95% CI = [0.24, 1.66], SE_4 = .35). The Medium condition did not yield a significant indirect effect through perceived contingency.

In addition, a significant indirect effect of message interactivity emerged for attitudes and behavioral intentions toward the website when both contingency and user engagement were entered as serial mediators. The High, High + Chatbot, and High + Human Agent conditions enhanced the level of contingency, which in turn produced greater user engagement. This increased level of user engagement was associated with better attitudes (B_2 = .31, 95% CI = [0.08, 0.71], SE_2 = .15; B_3 = .30, 95% CI = [0.09, 0.65], SE_3 = .14; B_4 = .34, 95% CI = [0.12, 0.75], SE_4 = .15) and greater behavioral intention toward the website (B_2 = .41, 95% CI = [0.11, 0.92], SE_2 = .20; B_3 = .40, 95% CI = [0.11, 0.86], SE_3 = .18; B_4 = .46, 95% CI = [0.14, 0.95], SE_4 = .20) compared with Low condition. In contrast, the Medium condition did not yield significant indirect effects through contingency and user engagement on attitudinal outcomes. In sum, participants perceived High, High + Chatbot, and High + Human Agent conditions to be more contingent upon their actions than their counterparts in the Low condition, which led to greater user engagement while browsing the website. The heightened user engagement was, in turn, positively associated with attitudes and behavioral intentions toward the website in the High, High + Chatbot, and High + Human Agent conditions.

Summary

The level of message interactivity, operationalized as the amount of interaction history displayed by the site and the presence of the live chat feature, significantly affected participants' evaluations of the website. Participants rated the site as being most contingent and most absorbing when the highest level of interaction history was combined with a human chat agent. They also felt a greater sense of dialogue in that condition and the other live chat condition (featuring a chatbot) compared with the conditions featuring Low or Medium levels of interaction history (with the Medium condition considered the least conducive for dialogue). They were more willing to recommend the site to others and to know more about the site when it provided a human chat agent. However, they evaluated the site as most appealing when it offered the Chatbot feature. Regardless of humanness, the presence of a chat agent boosted perceived interactivity of the site. Table 1 summarizes these findings.

Finally, a mediation analysis showed that the effect of interactivity on attitudes and behavioral intentions toward the site were mediated by perceptions of contingency and user engagement.

Discussion

Overall, our findings speak to the psychological importance of message contingency. When offered as a structural affordance, contingency-based message interactivity not only engenders greater perceptions of contingency, interactivity, and dialogue but also enhances user engagement. Across our mediation analyses, we found that perceived contingency mediated the effects of message interactivity on user engagement as well as attitudinal outcomes, thus lending empirical support to the interactivity effects model proposed by Sundar (2007). In fact, perceived contingency was found to be quite critical for user engagement with the site, which in turn predicted user attitudes and behavioral intentions toward the site. Our behavioral data suggest that user engagement by message interactivity is different from the sheer amount of interactions: Neither time spent on the website, $F(4, 49) = .67$, $p = .62$, nor the number of searches in the search box, $F(4, 49) = 2.16$, $p = .08$, showed significant differences across conditions. The number of searches had negligible effects on user engagement, $F(1, 48) = .02$, $p = .90$; website attitudes, $F(1, 48) = .24$, $p = .62$; and behavioral intentions, $F(1, 48) = .53$, $p = .46$. Thus, our study suggests that it is the psychological perception of contingency that creates enhanced user engagement, rather than the amount of interactions on the website.

Interaction History Is Key

Aside from providing the first formal empirical test of the theoretical model of message interactivity (Sundar, 2007), a significant contribution of the study is its novel operationalization of message interactivity in the form of interaction history on a search engine site, which yielded consistent psychological responses. In general, versions of the site with a higher level of message interactivity, in the form of interaction history, were rated higher in perceived interactivity, contingency, and dialogue than those with lower levels, lending additional empirical support to the conceptualization of interactivity as a cumulative display of interaction history that takes into account users' prior actions (Burgoon et al., 1999; Rafaeli, 1988; Sundar et al., 2003). By replicating earlier findings with hyperlinks and other medium features (Burgoon et al., 1999; Sundar et al., 2003), our study demonstrates that formal features, such as interaction history, are a psychologically meaningful way of operationalizing contingency in online communication and are as effective as live chat tools that are generally perceived as being more interactive. In other words, it challenges the traditional view of interpersonal communication being the incomparable ideal (Schudson, 1978) and suggests that at least in this particular scenario of movie information seeking, a wisely designed interface feature has the same capacity of imbuing a sense of contingency and inducing user engagement as a live chat tool. This finding can lead to economically efficient solutions to web services where contingent interactions are vital, since a directory of FAQs with a highly interactive browsing history can approximate the sense of dialogue represented by an attentive customer service agent. It also suggests that users are particularly sensitive to interface cues promising, but not fully delivering, a complete interaction history, as was the case with the Medium condition, which scored lowest on perceived contingency and dialogue, compared with both complete absence (Low) and presence (High) of users' interaction history.

This means communication researchers and interaction designers can use interaction history as a convenient way to display and cue a sense of contingency among online users, as long as it can deliver on the promise. A number of online applications, from search and e-commerce sites to social media venues, have the ability to keep track of users' prior activities on their sites as well as other locations on the Internet. Our data suggest that an ongoing provision of this interaction history is likely to affect user attitudes toward the site. The constant visual presence of digital "breadcrumbs" and "footprints" will serve to remind users of the affordance of contingency built into the interactive interface and provide a sense of dialogue and interactivity to their interactions. In this way, our study operationally demonstrates support for the possibility articulated by Stromer-Galley (2004) "that the degree or features of medium interactivity might affect outcome variables of human interaction," (p. 393) that "interactivity-as-product" can indeed influence "interactivity-as-process" (p. 391).

A practical implication for interface design is that interaction history (in the form of *browse and search history tabs* and *most recent searches*) can serve as a means to inform users that the site is actively interacting with them and directly catering to each user as an individual. By increasing user awareness of the contingent nature of HCI, structural affordances (such as the trail of user actions) can help users decide how and how much they are browsing the system. Such informed decisions may indeed help mitigate privacy concerns and other negative effects that occur due to users suddenly discovering the degree to which the system has been keeping track of their prior actions. It can also be a form of self-discovery for users as they learn about their own patterns of online behaviors. In this respect, message-interactivity affordances on interfaces can serve a media-literacy function, as users become partners with the system in negotiating the delicate balance between competing needs for individualized information and protection of user privacy (Robles, Sukumaran, Rickertsen, & Nass, 2006)—a potentially rich area for future research and discovery.

Live Chat Boosts Perceived Interactivity

While providing extensive interaction history served to boost perceived interactivity of the site, the addition of live chat increased it even more (see Table 1), in confirmation of our expectations of the synchronous chat feature scoring higher on perceived interactivity than just a log of interaction history. However, unlike perceived interactivity, perceived dialogue and perceived contingency were not significantly enhanced by the chat feature. Overall, our data demonstrate that rich visualizations of interaction history on the interface can approximate the sense of back-and-forth obtained by interacting with a live chat agent, but user perception of interactivity is still governed by cues relating to a live interaction with a source. In the long term, with advancements in communication technologies, especially with their ability to gather and present conversational threads to users, it is likely that users will begin to perceive ever higher contingency in machines, perhaps even more than they do with humans, given that human agents have cognitive limitations that preclude a comprehensive mental record of prior user actions. But in the short term, and given the task-context (i.e., browsing movie titles), our data suggest that the provision of interaction history on the interface is capable of simulating (if not entirely substituting) the potential for conversation afforded by synchronous chat features. This has implications for the development of conversational agents such as Siri, the virtual assistant on iPhones, in that the tools of interaction history can overcome limitations of chat functionality for ensuring a satisfactory user experience. It also has methodological implications for the study of interactivity, in that layperson perceptions of interactivity are not as useful as their perceptions of contingency and dialogue in predicting user engagement and attitudes toward the interface. It is therefore important to operationalize the concept of interactivity based on its constituent definitional elements (contingency, in this case) rather than on a global self-reported evaluation of perceived interactivity—that interactivity and perceived interactivity could indeed be two different concepts.

Limitations and Directions for Future Research

In light of the ordinal conceptualization of message interactivity, one of the limitations of the study is that we are not able to assess any interaction effects of interaction history and synchronous chat features as two independent factors. For instance, with current data, we are not able to address whether the presence (vs. absence) of chat function varies systematically across different levels of display of interaction history (low, medium, and high conditions), and whether this might affect overall perceptions of interactivity and other outcomes.

Apart from examining chat function as a separate factor of influence, another consideration for future research would be to examine structure-level contingency and content-level contingency as two different factors. The purpose of this study was to closely examine the operationalization and influence of contingency at the level of interface features (interaction history and chat function), without content effects masking this effect. However, as studies in CMC research have shown, exploring cumulative exchange of not only messages but also the meaning behind those messages is likely to add additional insights to the concept of contingency.

Even though we provided theoretical basis and statistical support suggesting that the three affordances of message interactivity (i.e., browse and search history tab, most recent search results, and live chat) could represent the five incremental levels of message-based interactivity, it should be also noted that adding these affordances may not always constitute (or guarantee) a linear increase in message interactivity. Our operationalization of message interactivity across the five conditions is one among several ways in which designers and researchers may choose to embed interaction history on an interface. New media interfaces are constantly changing and evolving. Hence, the manner (e.g., quality or context) in which message-interactivity affordances are implemented is likely to affect individuals' perceptions of interactivity and other psychological outcomes. For example, a poorly designed chat feature may not lead to higher ratings of perceived interactivity than a richly visualized display of interaction history. Thus, the ordering of the message-interactivity affordances noted in this study is dependent on the particular implementation of tools.

Finally, more fine-grained data about user actions on the site (e.g., clicking activity for Browse or Search history buttons)[3] could have provided additional information about the behavioral effects of message interactivity and served to disambiguate effects due to sheer perceptions of the potential for contingency (cue-driven effects) from those due to *actual use* of the browse or search history functions. Future research would do well to distinguish between those perceptions of contingency that are based on cues on the interface (labeled "contingency heuristic" by Sundar, 2008) and those arising from actual use of an interactivity tool providing contingent interactions. We may find a qualitative difference between these two types of perceived contingency, especially in their relative ability to predict user engagement. Such explorations will serve to further clarify the important theoretical role played by contingency in determining the effects of message interactivity on psychological outcomes.

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Notes

1. We also collected behavioral data in the form of time spent on the website (M = 344.82 seconds, SD = 292.41 seconds) and number of searches in the search box (M = 4.68, SD = 2.95) for a portion of our sample (N = 56). Time spent on the website was automatically recorded by log data, and the number of searches was obtained by manually coding for participant interactions with the website that was captured via screen-recording software (QuickTime Player) during the experiment. Participants were informed of the recording prior to their participation.
2. Bootstrapped estimates of the indirect effects are noted as B_2, B_3, and B_4 for High, Chatbot, and Human agent conditions, respectively.
3. In our discussion of behavioral data, we report on findings related to the overall *time spent on the website* and *number of searches* in the search box. This does not include the number of times users clicked on movies (i.e., re-visited their search results) under the Browse and Search tabs. Furthermore, we were able to gather behavioral metrics only for a small portion of our sample. The small size (N = 56) and non-representative (across the five experimental conditions) nature of that data preclude us from making any conclusive inferences pertaining to user behaviors on the study site.

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