Communicating Art, Virtually! Psychological Effects of Technological Affordances in a Virtual Museum

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Museums lean heavily on recent developments in communication technologies to create an authentic experience for online visitors of its galleries. This study examines whether three specific affordances of communication technology—customization, interactivity, and navigability—can provide the personal, social, and physical contexts, respectively, that are necessary for ensuring an enjoyable museum experience. A 2 (presence vs. absence of customizable gallery) × 2 (presence vs. absence of live-chat with others) × 2 (presence vs. absence of 3D navigational tool) between– subjects factorial experiment (N = 126) found that although each affordance is associated with distinct psychological benefits (customization with sense of agency and control, interactivity with reciprocity, and navigability with perceived reality), combining them on the same interface tends to undermine these benefits. In addition, power usage moderates the effectiveness of each affordance on the interface. Theoretical and practical implications are discussed.

1. INTRODUCTION

Museums all over the world are incorporating interactive technologies to engage both physical and virtual visitors. Whereas exhibits in physical museums are becoming increasingly interactive (Chang, 2006; Kray & Baus, 2003; Kuflik et al., 2011; Sharples, Lonsdale, Meek, Rudman, & Vavoula, 2007), those in virtual museums use a ariety of tools to afford an authentic museum experience to online visitors. Users are not simply exposed to images of all the exhibits but are now able to navigate through the museum halls and view artworks just as they would when they walk around a physical museum. Designers of museum websites are deploying affordances of modern communication media technologies to create a virtual experience, rather than simply treating the site as an online brochure to advertise current and upcoming art exhibitions.

In recent years, a wide variety of new technological tools have enabled people to experience art in an alternative but easily accessible way. For instance, individuals can discover masterpieces located in museums around the world by visiting three-dimensional (3D) virtual museums, and they can even create their own art collections based on their preferences (Smith, 2011). These advanced museum websites not only offer unlimited geographical access to art appreciation but also afford richer art appreciation through unique and novel features of communication technology.

However, science has not yet caught up with the deployment of these tools. As new applications and tools become available, virtual museums have tended to incorporate them, but it is unclear how, if at all, they contribute to user experience of the site. For example, Sylaiou, Mania, Karoulis, and White (2010) found that when web-based museums display objects using augmented or virtual reality techniques, users perceive the objects as more real and find the experience more appealing. Although the study demonstrated a correlation between presence and enjoyment

of museum objects, the mechanisms by which augmentation leads to psychological presence are unclear. Nash, Edwards, Thompson, and Barfield (2000) identified several medium-related factors of mediated environments, such as the interaction techniques employed, motion, depth, and avatar use, that might play a role in affecting virtual presence. However, the empirical evidence for these factors is sparse, with authors calling for more research on user experience of tools used in virtual environments. An understanding of the effectiveness of interface tools can go a long way in building theories of media psychology pertaining to all virtual spaces that go beyond museums.

Do different tools afford different experiences? Are some classes of tools geared toward addressing specific psychological needs of visitors? In general, how do various tools come together, under theoretically meaningful categories, to create a satisfying experience for visitors? We approach these questions by drawing on the typology of factors proposed for a "contextual museum experience" (Falk & Storksdieck, 2005) and investigate how three specific affordances of modern online media (i.e., customization, message interactivity, and navigability) can serve to provide the three contexts (personal, social, and physical) deemed necessary for a satisfying outcome.

2. BACKGROUND LITERATURE

The following section first discusses the three factors (personal, sociocultural, and physical) that determine the quality of offline museum experiences. Then, the three corresponding technological affordances (customization, message interactivity, and navigability) and their roles in providing satisfactory virtual museum experiences are reviewed. However, as Nash et al. (2000) pointed out, individual differences among users can critically determine the success of tools. Therefore, the moderating role of power usage (i.e., the degree of acquired mastery of web interfaces) is considered. This literature review not only advances scholarly understanding of virtual museum experiences but also provides suggestions for designing virtual museums.

2.1. Museum Experience

A museum is not simply a repository of art and artifacts. Theory and research suggest that the success of a museum lies in the way it produces an enjoyable experience to its visitors. As Falk and Storksdieck (2005) pointed out, the experience of visiting a museum is "a complex phenomenon situated within a series of contexts" (p. 745). It is a contextually determined experience, with one's personal background and social milieu interacting with the physical design of the exhibition space. Three factors associated with the museum experience— personal, social, and physical—are considered to be particularly determinative of the quality of one's museum experience (Falk & Dierking, 1992, 2000).

The personal factor of museum experience refers to "the sum total of personal and genetic history" that an individual brings into a situation (Falk & Storksdieck, 2005, p. 745). One's prior knowledge, experience, and prior interest in a museum, as well as the degree of choice and control over the museum experience, are all important determinants of the quality of museum experience. Ideally, when a visitor plays an active role by estimating his or her preexisting level of knowledge, constructing his or her own goals for the visit, and making his or her own decisions about the visiting process, the quality of the visitor's museum experience is maximized.

Museum experience also depends on social interaction with other people. The museum experience tends to be "socioculturally situated" (Falk & Storksdieck, 2005, p. 746). Indeed, when people visit a museum, they are usually accompanied by their social groups, such as friends and family. A vast body of research demonstrates that the quality of museum experience is highly correlated with visitors' degree of interactions and collaborations with their social group (Borun, Chambers, Dritsas, & Johnson, 1997; Crowley & Callanan, 1998; Ellenbogen, 2002; Falk & Storksdieck, 2005; Schaubel, Banks, Coats, Martin, & Sterling, 1996). Quality of museum experience can be also optimized when visitors communicate with a museum guide or use audio-aid materials, which could be an alternative to social interactions with one's companions during a museum visit (Crowley & Callanan, 1998; Falk &

Storksdieck, 2005; Wolins, Jensen, & Ulzheimer, 1992).

Last, the physical environment of the museum itself can influence visitors' experience with art. Falk and Storksdieck (2005) found that such factors as lighting, climate, displayed exhibitions, and objects could make a difference to the museum experience. In particular, an environment that enables visitors to freely navigate through its halls, hallways, and galleries turns out to be a strong determinant of the quality of museum experience (Falk & Storksdieck, 2000).

As such, these three dimensions determine the quality of museum experiences and help us understand visitors' museum experience by considering all aspects of a museum visit, from the physical architecture of the spaces to the mental architecture of individual visitors and the social architecture of the interactions among visitors during the visit. However, these three factors of museum experience have thus far been applied only to designing and analyzing real, offline museums. In adapting this view to virtual museums, it is important to consider how the technology of the medium can help incorporate personal, social, and physical factors of remote, online visitors.

2.2. Technology in Museum Website

Even before the construction of modern-day virtual museums on the web, Falk and Dierking (2000) predicted that "technologies can have the potential to positively impact visitor meaning making, by enabling visitors to customize their experiences to meet their personal needs and interests" (p. 747). The degree of choice and control over the appreciation process is known to impact the quality of museum experiences (Falk & Storksdieck, 2005). In a real, offline museum setting, people can freely choose paintings they want to appreciate and thereby control the whole process of art appreciation, including the route they take to tour the museum and the amount of time they spend. Similarly, in a virtual, online museum, users could be provided the freedom to control their actions and the process of art appreciation by leveraging the various technological features available these days for constructing interactive websites. In particular, features that provide the affordance of customization allow users to tailor both form and content of a system based on their needs and preferences (Sundar & Marathe, 2010). Users are able to not only choose the way they navigate the website but also create their own collection by gathering their favorite artworks, as well as adding their own comments about the artworks to the collection.

In terms of the sociocultural factor associated with museum experience, one might argue that the nature of the virtual museum website is not the same as that of the regular art museum that people visit in the real world. When people go to a museum, they are usually accompanied by family and friends. However, in a virtual museum, users tend to interact with the website on their own and are therefore physically isolated from others experiencing the same collection of art. But there are several tools of message interactivity available in modern communication media to overcome this barrier, the most common one being live chat. The live chatting feature has become an integral part of social media platforms, especially on entertainment-related websites such as Hulu.com, a subscription service that provides streaming video of television programs and movies. Given the fact that synchronous communication is cherished in the era of social media (Shiu & Lenhart, 2004), live chatting can fill the void of social interaction on a virtual museum website. In other words, live chatting can allow users to share their thoughts and emotions about the content with other users while they are browsing a website for art appreciation. This exchange of information, knowledge, and emotions among website users, especially among those who view the same artwork, can serve to provide the online equivalent of the social context needed for a satisfying museum experience.

Last, the quality of visitors' experience in a museum depends on their interaction with the physical environment of the museum. An obvious concern with virtual museums is the lack of a tangible experience with physical artifacts. But they attempt to make up for it by embedding 3D technology in their websites so that online visitors get a sense of the physical housing of the exhibits rather than simply flipping through them. In the virtual space of a 3D museum website, users can move around by using the navigability features available on the site. Navigability affordances allow users to take actions in the virtual museum gallery of the website, and virtually touch objects, so that they perceive themselves as "being there" in the actual museum (Sundar, 2008a).

Customization as personal factor. The technological affordance of customization epitomizes the notion of "active user." In the Web 2.0 media landscape, users can readily assert their power in diverse ways and thereby show their distinctiveness. For instance, users can individualize all kinds of information on news portals, from choosing the way they display content to specifying and filtering content based on their own preferences (Marathe & Sundar, 2011a). Video games also allow users to create their own avatar to represent themselves. With personal broadcasting media such as blogs and microblogs (e.g., Twitter), online users can even function as an "information source" to others.

These diverse systems of modern media technology make users feel as if they are the source of their content by providing them with an opportunity to assert their power via gatekeeping content, as well as controlling the flow of information in the interface. In particular, features related to customizing information on the site can serve to enhance users' sense of agency, which refers to "the degree to which the self feels that he/she is a relevant actor" (Sundar, 2008b, p. 61). In other words, by making users modify an interface through specifying their preferences to make it more personally relevant, and by letting them become a source of information for themselves (i.e., self as source), customizable features imbue in users a sense of agency (Marathe & Sundar, 2011a). Indeed, given the function of customization, individuals can distinguish themselves from others, as well as manipulate performance of devices to increase their efficiency. Thus, by giving users control over the interface, customization contributes to a higher sense of agency. Customizable functions also offer unlimited opportunities to exercise free choice. By affording the exercise of free choice, customization allows individuals to think about their background, their own tastes, likes and dislikes. In this way, customization can permit each user to incorporate her or his individual preferences to their online experience (Marathe & Sundar, 2011a).

Users' control over the performance of the interface is another hallmark of customization. Sense of control, which refers to "the belief that you are responsible for the outcome of a given situation" (deCharmes, 1968, p. 313), can be imbued by forcing a system to wait until the user initiates actions, because users will be able to predict all activities occurring on the interface (Marathe & Sundar, 2011b; Sundar, Marathe, & Kang, 2009). In general, the more a person controls interactions through a given customization option, the higher the level of control that she or he feels (Marathe & Sundar, 2011a).

Previous studies have documented a wide range of outcomes of customization, such as attitudes toward the website, absorption, behavioral intention to revisit, and the level of satisfaction with the website (Gao, Rau, & Salvendy, 2009; Sundar, Xu, & Bellur, 2010). The agency model of customization (Sundar, 2008a) contends that the action of serving as a source itself fosters involvement with content because it forces the users to think about content in personal terms. Furthermore, the model states that the experience of perceiving oneself as the center of the interaction serves to positively influence one's attitudes toward the interaction, in part because the resulting content reflects one's identity. In addition, the more freedom the user has during his or her interactions with the interface, the more the user is satisfied with the website (Botti, McGill, & Iyengar, 2003). Therefore, the following hypothesis is proposed for testing the role of customization in a virtual museum website.

H1: The presence of customization in a virtual museum website will lead to greater levels of (a) sense of agency, (b) perceived control, (c) positive attitudes toward the website, and (d) behavioral intention.

Message interactivity as sociocultural factor. The reason why most modern communication technologies are called "interactive" is because they allow users to have an interaction, or back-and-forth communication, with others. Although many scholars have explicated interactivity (e.g., McMillan & Hwang, 2002; Stout, Villegas, & Kim, 2001), Sundar (2007) defined one dimension of interactivity as a threaded sequence of message exchanges that follows "the principle of contingency," whereby a response is contingent upon the preceding message as well as those that come before it (Sundar et al., 2010, p. 2253). Although such conceptualizations of message interactivity emerged from asynchronous computer-mediated communications (e.g., Rafaeli, 1988; Rafaeli & Sudweeks, 1998),

they should be applicable to the context of live chatting as well. When Hoffman and Novak (1996) developed the model of interpersonal and computer-mediated communication, they articulated the importance of the reciprocal flow of the message transmission between consumers, which was analogous to Rafaeli's (1988) definition of message interactivity. In particular, they highlighted the uniqueness of person-to-person message exchange via technological affordances such as "teleconference, face-to-face group meetings and online live chat rooms" (p. 52). In addition to satisfying the core requirement of reciprocal message exchanges, live chatting offers seamless interaction. As Liu (2003) pointed out, interactivity lies not simply in exchanging reciprocal messages but also in a user's capability to control the conversation and the speed of the interaction. Given its real-time nature, live chatting meets all these criteria for message interactivity and is arguably more interactive than discussion boards and other tools of asynchronous communications.

As a form of social media, live chatting can also facilitate a feeling of interacting with other people during a common online experience that is shared via the media but without physical copresence. In this way, live chatters in interfaces such as Hulu.com are able to re-create coviewing experiences even when they are watching media alone. This kind of a psychological sense of others during a mediated experience is called social presence. Formally, social presence is defined as "degree of salience of the other person in a mediated communication and the consequent salience of their interpersonal interactions" (Short, Williams & Christie, 1976, p. 65). So and Brush (2008) found that the inclusion of a live chat function in a collaborative learning interface led to greater social presence and satisfaction with the learning. Because it is natural for individuals to experience social interactions while visiting a museum, presence of another user and interacting with him or her would likely increase their enjoyment of the virtual museum visit (Galani & Chalmers, 2004).

Furthermore, museum experience is not a one-time experience. After visiting a museum, visitors usually continue their appreciation of the artworks by searching for information about artworks or artists, and/or discussing their views with others. This suggests that live chatting allows users to fulfill not only the visiting experience itself but also the postvisit experience.

Previous studies have suggested consistent positive outcomes from the synchronous communications that go beyond social presence. A live chat format produced greater sense of participation, information exchange, and belongingness in an e-learning context (Hrastinski, 2008). In addition, Sundar et al. (2010) documented that message interactivity achieved through live chatting could promote greater involvement or engagement in content, thereby leading positive attitudes toward and greater satisfaction with the website. Assuming that the process of art appreciation is a form of learning and engagement in which users can obtain knowledge about artwork in addition to performing affective appraisal, we propose our second set of hypotheses:

H2: The presence of live chat in a virtual museum website will lead to greater levels of (a) perceived reciprocity, (b) perceived social presence, (c) perceived synchronicity, (d) positive attitudes toward the website, and (e) behavioral intention.

Navigability as physical factor. In the real world, navigation is often linked to a compass or a map for finding the way to reach a destination. Such "wayfinding" has been brought into the cyberspace and virtual world too, along with metaphors such as "cyberspace" for the Internet, bridging the virtual and the real. Navigation is commonly defined as an attribute of the user in a mediated environment (Herndon, van Dam, & Gleicher, 1994; Jul, 2004). It is viewed as psychological behavior (Jul, 2004), locomotion behavior (Chen & Stanney, 1999), or as a combination of the two (Herndon et al., 1994). On the other hand, the affordance of navigation, called "navigability," is an interface attribute residing in the technology, referring to the capability afforded by the interface to allow user transportation from one location to another (Sundar, 2008a). Balakrishnan and Sundar (2011) classified navigability into two subconstructs: traversibility, meaning the "affordance to travel large distances in a virtual environment as a function of (a) environmental constraints and (b) steering control" (p. 168), and guidance, which refers to "the affordance that

facilitates wayfinding" (p. 169) by way of information scaffolding. Furnas (1997) specifically explored "view traversability" (measured by viewpoint motion-control techniques) afforded by the interface for effectively traveling through large data structures.

A variety of techniques have been developed to maximize the function of navigability in the 3D realm and thereby would boost users' experience by helping them view existing information that is critical for completion of certain tasks (e.g., Couture, Colle, & Reid, 2005; Darken & Patterson, 2001; Tan, Robertson, & Czerwinski, 2001). The key mediator that explains this effect of navigability is spatial presence (Balakrishnan & Sundar, 2011). Navigability can influence users' sense of being present in the virtual environment, which is crucial for designing virtual reality interfaces. Research on navigability as a cause of spatial presence mainly focused on physical navigability through a 3D virtual environment such as Google map street view. Eckmann, Yu, Boult, and Kessler (2001) showed that participants who were given the task to navigate through a virtual building for training purposes had greater spatial presence than those who only read the building's blueprint for the task. This greater level of spatial presence led to greater levels of enjoyment and immersion.

Literature suggests that spatial presence is highly correlated with perceived reality. When an individual experiences spatial presence, determined by perceived action possibilities and the degree of location awareness in the virtual environment, she or he is likely to feel a sense of "being there" (Balakrishnan & Sundar, 2011). Therefore, perceived reality is considered "an inherent aspect of spatial presence" (Balakrishnan & Sundar, 2011, p. 182). Several studies have found that 3D technology leads to positive attitudes and satisfaction of a user's experience in the area of education (Jones, Morales, & Knezek, 2005; Stieglitz, Lattemann, & Fohr, 2010).

H3: The presence of a 3D navigation tool in a virtual museum will lead to greater levels of (a) spatial presence, (b) perceived reality, (c) positive attitudes toward website, and (d) behavioral intention.

It must be noted, however, that a 3D tool is a double-edged sword in that it can lead to negative evaluations if it is not implemented well. Usability is a key determinant of the ability of 3D virtual technology to make or break an immersive experience. Usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (Nosper, Behr, Hartmann, & Vorderer, 2005, p. 2). Thus, the degree to which the technology enables the user to complete intended goals, given reasonable and appropriate expenditure of effort, determines perceived usability of the technology (Nosper et al., 2005). When it is not usable, it can create disorientation. Prior research suggests that high navigability in a virtual museum might lead to confusion among users about what actions to perform, and therefore reduce its effectiveness (Lepouras, Katifori, Vassilakis, & Charitos, 2004). Therefore, support for H3 is contingent upon perceived usability of the 3D navigation tools on the interface. Therefore, it is important to ascertain visitors' perception of usability of the navigability functions in this specific interface.

RQ1: How does the presence of 3D navigation tool affect the perceived usability of a virtual museum website?

Another open question is the degree to which the 3D navigation tool will affect the effectiveness of the other affordances of interest in this study. It is uncertain how well all three of the technological affordances—customization, live chatting, and 3D navigation tool—come together to optimize user experience of a virtual museum website. Therefore, we propose the following research question for study.

RQ2: Are there interaction effects among three different technological affordances on psychological outcomes related to user experience of a virtual museum website?

Even though a vast body of research has documented the beneficial effects of these modern media affordances on psychological outcomes such as attitudes and behavioral intentions, there is research reporting null effects on

attitudes (Coyle & Thorson, 2001). Sundar, Kalyanaraman, and Brown (2003) also found that a moderate level of interactivity produced more desirable outcomes than a high level of interactivity. These mixed results suggest a potential moderator that might alter the effectiveness of interactive features on the interface (Liu & Shrum, 2002). Indeed, previous literature has shown that the degree to which one acquires mastery of web interfaces based on prior experiences, expertise, and efficacy, that is, the extent to which one is a "power user," moderates the psychological effects of various manifestations of interactivity (Burigat & Chittaro, 2007; Liu & Shrum, 2002; Sundar & Marathe, 2010).

In testing this moderating effect of users' experience with web interfaces in the context of interactive advertising, Liu and Shrum (2002) found that, in the high-involvement condition, greater interactivity of the interface led to more positive attitudes toward the website and the brand among experienced users compared to inexperienced ones, whereas in the low-involvement condition, inexperienced users were more favorable toward the website and the brand than experienced users when they used the highly interactive website.

This finding is consistent with the core theoretical proposition of the elaboration likelihood model (Petty & Cacioppo, 1986) in that a website with more interactive features leads users, especially inexperienced users, toward peripheral processing, a cursory judgment of content using available heuristics (e.g., the more interactive a website is, the better; Sundar, 2008a), under conditions of low involvement. Thus, the interactive features may have resulted in a directly positive evaluation of the website and the brand. However, this tendency was relatively weak among experienced users because the influence of website interactivity as a peripheral cue was probably tempered by prior experience. On the other hand, in the high-involvement condition, the greater interactivity may have burdened cognitive capacity for systematic processing among users with less technological expertise and experience. In contrast, this burden of greater interactivity was probably not felt by more experienced users, because they possess the knowledge and skills required to manage such interactive interfaces (Liu & Shrum, 2002). Along the same lines, previous studies have documented that experienced users, or "power users," prefer technological affordances requiring better skills (Sundar & Marathe, 2010) and performed better (i.e., less time to complete search task) in a 3D virtual environment than inexperienced users (Burigat & Chittaro, 2007). By the same token, in the present study, availability of three different technological affordances could make a difference in users' psychological reactions, as a function of their power-user status. Thus, we propose the following hypothesis.

H4: The technological affordances of customization, live chatting and navigability in a virtual museum site will lead to more positive psychological outcomes among power users than nonpower users.

3. METHOD

3.1. Design and Participants

We employed a 2 (presence vs. absence of customizable gallery) × 2 (presence vs. absence of live-chat with others) × 2 (presence vs. absence of 3D navigational tool) fully crossed factorial between-participants controlled laboratory experiment, with participants' level of power usage (i.e., expertise, experience, and efficacy in using technology) as a moderating variable, to answer our research questions and test our hypotheses. All participants ($N = 126$) at a large U.S. university were randomly assigned to one of eight versions of the same virtual-museum website, varied systematically to investigate the three independent variables (Table 1). The majority of the participants were female (71%) and Caucasian (74%). The average age was 21.3 ($SD = 3.39$).

TABLE 1
Number of Study Participants in Each Experimental Condition

	No Navigability	Navigability
No customization		
No live chat	15	15
Live chat	15	15
Customization		
No live chat	18	15
Live chat	15	17

3.2. Stimulus

A virtual version of New York City's Museum of Modern Art (MoMA), available through Google Art Project (http:// www.googleartproject.com/), was used as the test website for this study. The website enables users to view a number of artworks, mainly paintings from various museums around the world, using a variety of interface tools. We operationalized navigability by instructing participants to visit the museum using either the 3D virtual exploration function on the site ("presence of 3D tool" condition; see Figure 1) or engage in traditional browsing by using drop-down menus ("absence of 3D tool" condition; see Figure 2). In the 3D tool condition, 3D navigation worked by clicking the Explore the Museum tab located on the site. This then opened the virtual tour page, where participants were able to view the inside of MoMA. By clicking the arrows located on the floor of the museum, participants could navigate through the room and view the different paintings at MoMA. Second, customization was operationalized by instructing participants in the "customization-presence" condition to create their own art collection by gathering paintings that they found interesting while browsing/exploring the museum (Figure 3). Participants first clicked the Create an Artwork Collection button on the site and were then able to add artworks to their collection under an assigned Google account. Last, message interactivity was tested by either presence or absence of one-to-one live-chatting function to talk about paintings and artists. The researcher asked participants to initiate live chatting with another user (i.e., a confederate of the experiment) who also viewed the same paintings for about 10 min (Figure 4). Because the website was not equipped with a one-to-one live- chatting function, we used Google Talk, a downloadable chat application, which shared the computer screen. While chatting, participants expressed their views and discussed the artwork shown on this site. The main roles of the confederate were to (a) ask participants' feelings and thoughts on artworks and (b) respond to participants' comments on the artworks (e.g., "I agree with your thoughts"). By restricting confederate's roles in chatting, we were able to keep the content of the chat constant across all participants. Experiment administrators closely monitored all the participants and restricted them to the use of specified functions in the different conditions during the sessions.

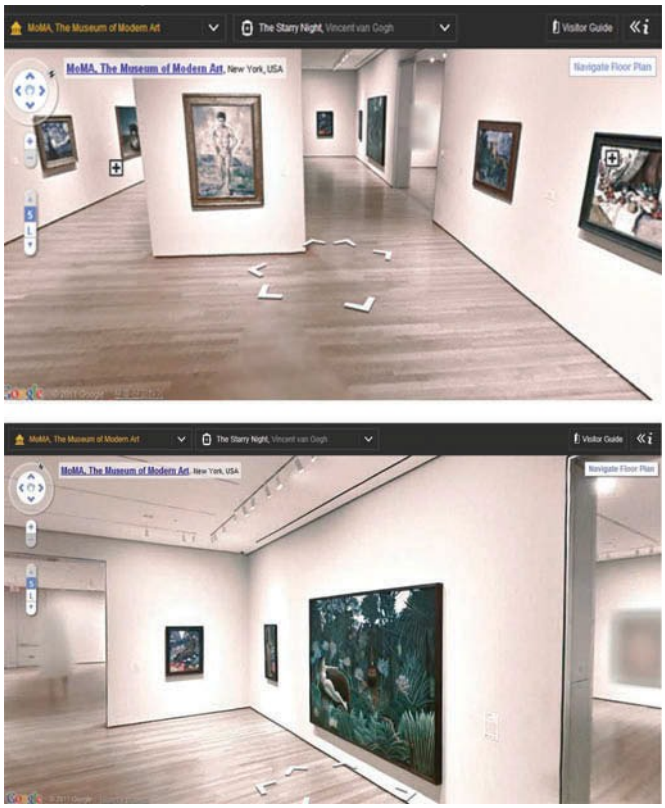


FIG. 1. Screen capture of 3D virtual exploration function on the experimental website.

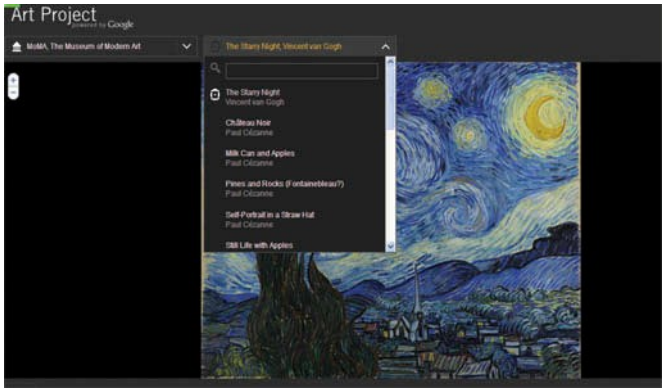


FIG. 2. Screen capture of drop-down menus on the experimental website.

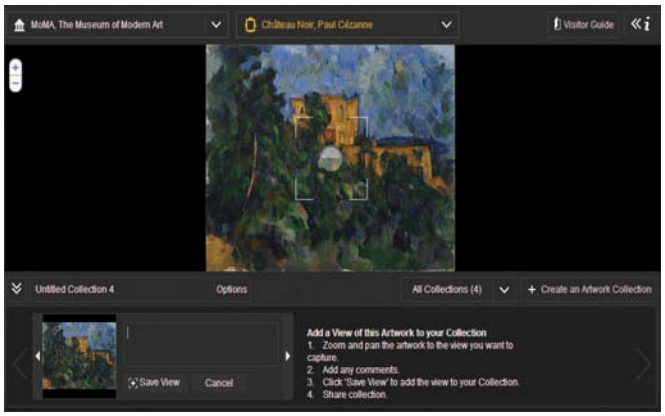


FIG. 3. Screen capture of customization function on the experimental website.

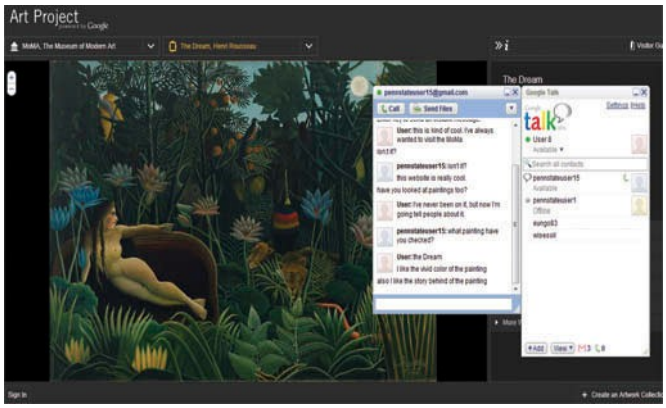


FIG. 4. Screen capture of live-chat function on the experimental website.

3.3. Procedure

Participants were assigned to one of the laptops in a media lab and informed about the general procedure of the experiment. Participants were told that they would find three paintings in MoMA from the Google Art Project website and to select one of the paintings as their recommendation for the art council at school, which was a fake organization created for the study. Upon their agreement to participate, they filled out the pre-questionnaire measuring level of power usage, prior interest in art, and general media usage habits. They then watched a video tailored to direct them to affordances that are specific to their assigned condition. The video tutorial included the exact procedure for participants to follow and instructions for the experimental task that they should complete for the session. The tutorial for each condition began with a short introduction about the website—Google Art Project—and provided step-by-step instructions for finding paintings on the website using voiceover and visual image aids. It instructed participants to select one of three paintings (i.e., *The Dream, Milk Can and Apples*, or *Château Noir*) as their recommendation for the art council. After the tutorial, they explored the stimulus museum website to complete the task. Participants who were assigned to the live chat condition logged in GTalk application using account information provided by the researchers and chatted about paintings with another user available on the GTalk list, which was a confederate, for 10 min. Although the live chat application was not embedded in the actual interface of the virtual museum website used for the study, both the museum website and chat application were hosted by the same company, providing museum users a nearly seamless experience while chatting with other users (i.e., confederates) via GTalk. Participants performed the chatting task after viewing all three paintings (rather than during their viewing) in order to prevent potential confounding effects from conversations with the confederate

(whereby they might obtain information that goes beyond a mere discussion of the artworks, such as cues about using the affordances on the site). Furthermore, if the chat and viewing were held simultaneously, it would be difficult to control the total time spent for the task and the lag between conversations during chatting across the experimental conditions. After the completion of the recommendation task, the participants were asked to fill out a questionnaire containing the aforementioned dependent measures.

3.4. Measures

Manipulation checks were conducted by asking participants to rate their perceptions of the existence of each technological affordance using a 9-point Likert scale, ranging from *strongly disagree* to *strongly agree*. Participants were asked to indicate their level of agreement with statements which suggested that they "could walk around the gallery room in MoMA" (navigability manipulation), "could create their own art collection" (customization), "could communicate with an intelligent being" (message interactivity), and "could have a conversation with a real person" (message interactivity).

Sense of agency and sense of control were measured to ascertain the effect of customization. First, 25 items on a 9-point scale, obtained from Stavrositu and Sundar (2008) and Kim and Sundar (2009), were used for participants to rate their sense of agency. Based on the result of an exploratory factor analysis, two factors were created: 10 items for sense of agency toward thoughts and life ($\alpha = .88$) and seven items for voice and action ($\alpha = .88$). Eight items were dropped due to cross-loadings. Sense of control was assessed with six items from Sundar and Marathe (2010) to test participants' perception of their control over interactions with the website ($\alpha = .85$)

To assess the effect of one-to-one live chatting, the study assessed *perceived reciprocity, synchronicity*, and *social presence*. Perceived reciprocity was measured via nine items on a 9-point Likert scale (Liu, 2003; $\alpha = .92$). To assess perceived synchronicity, five items on a 9-point Likert scale, adapted from Liu (2003), were used (i.e., the site processed information very quickly; interaction occurring in this site is very fast; I was able to interact in this site without any delay, etc.; $\alpha = .86$). Last, social presence was also measured with five items on a 9-point Likert scale (Gefen & Straub, 2003; $\alpha = .94$).

Spatial presence, perceived reality, and *perceived usability* were assessed to test the effect of 3D virtual museum exploration. Spatial presence was operationally defined as "mediated situation awareness" (Nosper et al., 2005, p. 2). In particular, this study measured spatial presence with two subconstructs developed by Vorderer et al. (2004): five items for measuring the awareness of physical location ($\alpha = .94$), and five items for the awareness of possible action ($\alpha = .93$). Perceived reality was measured by asking participants how much their experience with the virtual museum website seemed like a real visit to the museum, using eight items on a 9-point Likert scale, adapted from Balakrishnan and Sundar (2011; $\alpha = .92$). Last, seven items on a 9-point Likert scale by Brooke (1996) were used to assess participants' perceived usability. The participants were asked to indicate their perceptions of the ease of using the technological functions on the website ($\alpha = .81$).

As overall outcomes of participants' entire interaction with the website, this study measured their *attitudes and behavioral intention to use the website*. Attitudes toward the website were assessed on a 9-point scale (anchored by *describes very poorly* and *describes very well*) with 12 adjectives ($\alpha = .88$; Sundar, Xu, Bellur, Oh, & Jia, 2011). For behavioral intention, five items on a 9-point Likert scale (Sundar et al., 2011) were employed ($\alpha = .88$).

Power usage was measured with 12 items derived from the literature (Marathe, Sundar, Bijvank, van Vugt, & Veldhuis, 2007) capturing participants' likability of, skills for, and dependence on technologies ($\alpha = .81$). Power usage was retained as a continuous variable in all analyses, but those scoring on the high end are referred to as "power users" and those scoring on the low end as "nonpower users." The study also measured *prior involvement in art* with three items to control the base line of the topic involvement among participants ($\alpha = .87$). Complete

items of the measures can be found in the appendix.

4. RESULTS

4.1. Manipulation Checks

A series of independent samples t tests with the manipulation-check items showed statistically significant differences in manipulations of navigability, customization, and message interactivity, respectively. Participants in the navigability condition were more likely to perceive that they could move around the gallery room (M_{3D} = 8.21, SE_{3D} =.25, n = 62) than those in the no-navigability condition ($M_{\text{no 3D}}$ = 6.67, $SE_{\text{no 3D}}$ = .24, n = 64), $t(124) = 4.47$, $p < .001$. Participants in the customization condition were more likely to perceive that they were able to create their own art collection ($M_{\text{customization}}$ = 8.72, $SE_{\text{customization}}$ = .19, n = 65) than those in the no-customization condition ($M_{\text{no customization}}$ = 6.23, $SE_{\text{no customization}}$ = .20, n 61), $t(124) = 9.00$, $p < .001$. Finally, participants' perception of the degree to which they felt like they were communicating with an intelligent being, $t(124) = 8.31$, $p < .001$ ($M_{\text{no chat}}$ = 4.44, $SE_{\text{no chat}}$ = .27, n = 64; M_{chat} = 7.69, SE_{chat} = .28, n = 62), and with a real person, $t(124) = 12.19$, $p < .001$ ($M_{\text{no chat}}$ = 3.06, $SE_{\text{no chat}}$ = .26; M_{chat} = 7.60, SE_{chat} = .27), were both significantly different between conditions with and without live-chatting functionality.

4.2. Effects of Technological Affordances on Psychological Variables

A multivariate analysis of covariance with art topic involvement as a covariate showed a significant main effect for chatting, Wilks's Λ = .42, $F(16, 94) = 7.85$, $p < .01$, and significant interaction effects for navigability and customization, Wilks's Λ = .77, $F(16, 94) = 1.78$, $p < .05$; navigability and power usage, Wilks's Λ = .74, $F(16, 94) = 2.06$, $p < .01$; and customization and power usage, Wilks's Λ = .71, $F(16, 94) = 2.32$, $p < .01$, on all the psychological outcomes considered together.

Main effects of three types of technological affordances. Subsequent univariate analyses showed that participants in the live chatting condition scored significantly higher on reciprocity, $F(1, 109) = 83.63$, $p < .001$ ($LSM_{\text{no chat}}$ = 4.40, $SE_{\text{no chat}}$ = .19; LSM_{chat} = 7.00, SE_{chat} = .21), and social presence, $F(1, 109) = 22.52$, $p < .001$ ($LSM_{\text{no chat}}$ = 4.76, $SE_{\text{no chat}}$ = .26; LSM_{chat} = 6.62, SE_{chat} = .29), than their counterparts who did not engage in live chatting. Therefore, the results supported H2a and H2b. Hypotheses predicting main effects of the other two technological affordances—(a) customization: sense of agency – life and thought, $F(1, 109) = 1.29$, $p = .26$; sense of agency – voice and action, $F(1, 109) = .40$, $p = .53$; sense of control, $F(1, 109) = .03$, $p = .86$; attitudes toward the website, $F(1, 109) = .00$, $p = .97$; behavior intention, $F(1, 109) = .91$, $p = .34$, and (b) navigability: spatial presence, $F(1, 109) = .17$, $p = .68$; perceived reality, $F(1, 109) = .00$, $p = .93$; attitudes toward the website, $F(1, 109) = .79$, $p = .38$; behavior intention, $F(1, 109) = .16$, $p = .69$—were not supported, in part because they were involved in significant interactions, as described next.

Interaction effects of three types of technological affordances. The univariate analyses yielded several interaction effects. First, we found a significant interaction between message interactivity (i.e., live chat) and customization on sense of control, $F(1, 109) = 10.86$, $p < .01$; usability, $F(1, 109) = 9.59$, $p < .01$; and attitudes, $F(1, 109) = 4.82$, $p < .05$. Specifically, customization increased sense of control in the absence of live chat but decreased sense of control in its presence (Figure 5). In addition, when participants used either customization function or live chatting function, they scored higher on perceived usability than when they used both functions or neither (Figure 5). The same pattern was observed for attitudes toward the website (Figure 5).

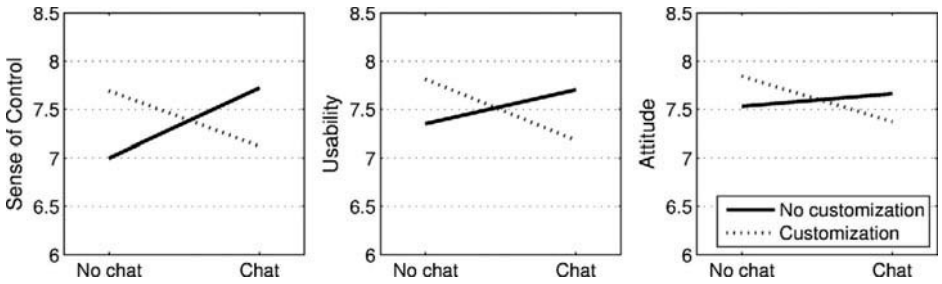
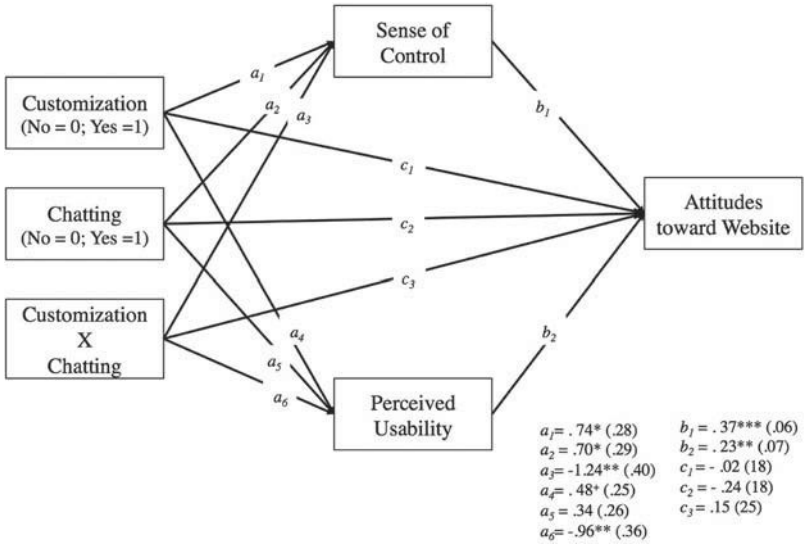


FIG. 5. Interaction effects between live chatting and customization on (a) sense of control, (b) perceived usability, and (c) attitude.

To flesh out these findings of the interaction effects of customization and chatting conditions, mediated moderation testing was performed using 5,000 samples of bootstrapping with PROCESS macro (Hayes, 2013). The mediated moderation analysis allowed the current study to achieve two purposes. First, it helped the study discover theoretical mechanisms of whether sense of control and perceived usability mediated the relationship between the interaction of two technological affordances and attitudes toward the website. Second, if two mediators of interest indeed mediated the relationship, the mediated moderation analysis would specify how the mediation effects are linked to which combination of the two affordances in interaction terms. Results of the analysis showed that both mediators yielded indirect effects of highest order interaction (sense of control: –.4564, *SE* = .1830, lower limit confidence interval [LLCI] = –.9083 – upper limit confidence interval [ULCI] = –.1701; perceived usability = –.2219, *SE* = .1127, LLCI = –.5221 – ULCI = –.0549). Specifically, sense of control mediated the relationship between customization (i.e., presence) and attitudes toward the website only when the live-chat option was absent ($a_3b_{1no\ chatting}$ = .2722, *SE* = .1229, LLCI = .0772; ULCI = .5707). On the other hand, perceived usability appeared as a significant mediator between customization (i.e., presence) and attitudes toward the website in both cases of live-chat absence ($a_6b_{2no\ chatting}$ = .1105, *SE* = .0695, LLCI = .0114; ULCI = .3005) and its presence ($a_6b_{2chatting}$ = –.1113, *SE* = .0722, LLCI = –.3086; ULCI = –.0113). These conditional indirect effects through perceived usability indicated that when the live-chat option was available along with the customization tool in the website, participants showed negative attitudes toward the website through perceived usability whereas customization without the live-chat option led to positive attitudes toward the website (Figure 6).



- Standard errors are in parentheses.
- Topic involvement was entered as a covariate in the model.
- $^{+}p < .10$. $*p < .05$. $**p < .01$. $***p < .001$.
- Indirect effect of highest order interaction via sense of control = −.4564, *SE* = .1830, LLCI = −.9083 – ULCI = −01701.
    - Conditional indirect effects via sense of control
      a_3b_1*(no chatting)* = .2722, *SE* = .1229, LLCI = .0772; ULCI = .5707;
      a_3b_1*(chatting)* = −.1842, *SE* = .1129, LLCI = −.4471; ULCI = .0088.
- Indirect effect of highest order interaction via perceived usability = −.2219, *SE* = .1127, LLCI = −.5221 – ULCI = −.0549.
    - Conditional indirect effects via perceived usability
      a_6b_2*(no chatting)* = .1105, *SE* = .0695, LLCI = .0114; ULCI = .3005;
      a_6b_2*(chatting)* = −.1113, *SE* = .0722, LLCI = −.3086; ULCI = −.0113.

FIG. 6. Path coefficients of the moderated mediation model for sense of control and perceived usability.

Second, an interaction effect between navigability and live chatting on perceived reality revealed that the 3D virtual museum exploration served to enhance perceived reality only in the absence of live chat. However, the chat function served to increase perceived reality of the museum experience in the absence of the 3D navigational tool, $F(1, 109) = 4.25$, $p < .05$ (Figure 7).

Third, an interaction effect between navigability and customization on perceived sense of control, $F(1, 109) = 4.91$, $p < .05$, showed that in the presence of customizable tool, participants showed higher sense of control regardless of whether they used the 3D tool. However, when participants did not create their own collection, participants who used the 3D tool rated the site lowest on sense of control (Figure 7).

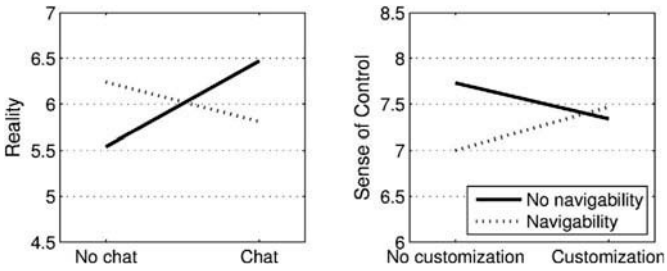


FIG. 7. Interaction effects between navigability and live chatting on (left) perceived reality and (right) between navigability and customization on sense of control.

4.3. Moderating Effects of Power Usage on Psychological Variables

Main effects of power usage. The analyses showed that power usage had main effects on sense of agency over one's life's course and thoughts, $F(1, 109) = 4.71$, $p < .05$, and over voice and action, $F(1, 109) = 11.52$, $p < .001$. As power usage increased, sense of agency over all aspects also increased. In addition, perceived reality, $F(1, 109) = 4.16$, $p < .05$, increased with increase of power usage. In other words, power users were more likely to perceive the website to be realistic than nonpower users. Furthermore, as power usage increased, perceived usability, $F(1, 109) = 7.86$, $p < .01$, and sense of control, $F(1, 109) = 13.21$, $p < .001$, also increased. This result implies that power users have a tendency to perceive the website as easy to control. Similarly, higher levels of power usage yielded more positive attitudes toward the website, $F(1, 109) = 7.08$, $p < .01$.

Interaction effects of power usage and technological affordances. In addition, power usage moderated the relationships between technological affordances and psychological outcomes. Among participants who did not experience live chatting, those with higher power usage levels showed higher sense of agency over life's course and thoughts, $F(1, 109) = 6.05$, $p < .05$ (Figure 8), and over voice and action, $F(1, 109) = 5.94$, $p < .05$ (Figure 8). In addition, interaction effects between navigability and power usage on perceived synchronicity revealed that participants with higher levels of power usage were more likely to perceive the website as being fast, $F(1, 109) = 3.91$, $p = .0503$ (Figure 9) when they used the 3D navigational tool. However, those with lower levels of power usage showed more positive perceptions of the speed of the website in the absence, rather than presence, of the 3D tool.

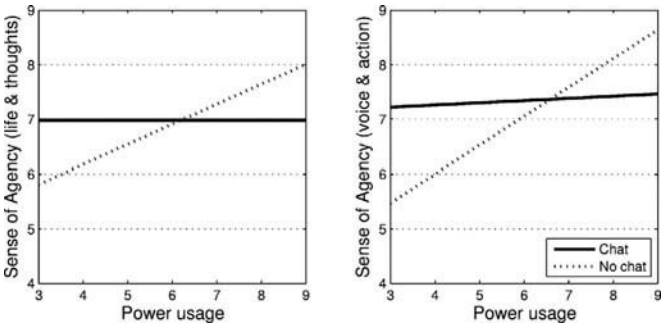


FIG. 8. Interaction effect between live chatting and power usage on (left) sense of agency over life and thoughts and (right) voice and action.

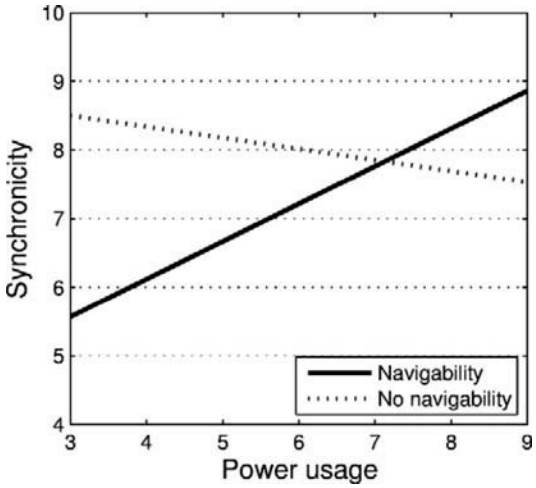


FIG. 9. Interaction effect between navigability and power usage on perceived synchronicity.

Furthermore, customization, live chatting, and power usage were involved in a three-way interaction effect on behavioral intentions to use the website in the future, $F(1, 109) = 4.89$, $p < .05$. In the absence of the customizable tool, participants with higher power usage showed more positive change in behavioral intention if live chat was not present, whereas those with lower level of power usage showed more positive change in behavioral intention in the presence of live chat. However, in the presence of customizable tool, as power usage increased, behavioral intention increased regardless of the presence/absence of live chat (Figure 10). In addition, a significant three-way interaction effect between navigability, message interactivity and power usage on perceived synchronicity, $F(1, 109) = 4.34$, $p < .05$, suggested that in the absence of the 3D tool, participants with higher power usage scored higher on perceived synchronicity when live chat was present. In the presence of the 3D tool, those with the higher level of power usage scored higher in the absence of live chat, whereas participants with the lower level of power usage showed higher score on perception of synchronicity in the presence of live chat (Figure 11). Thus, H4 is partially supported.

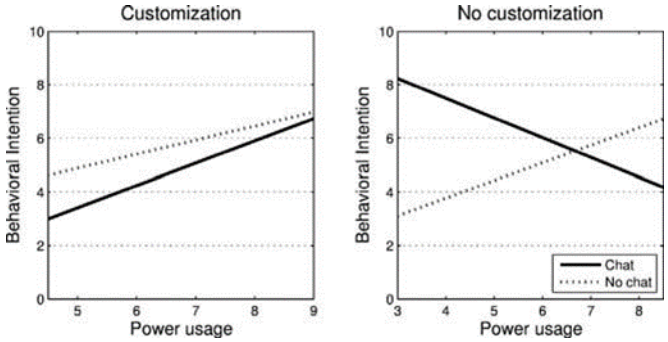


FIG. 10. Three-way interaction between effect among customization, live chatting, and power usage on behavioral intention.

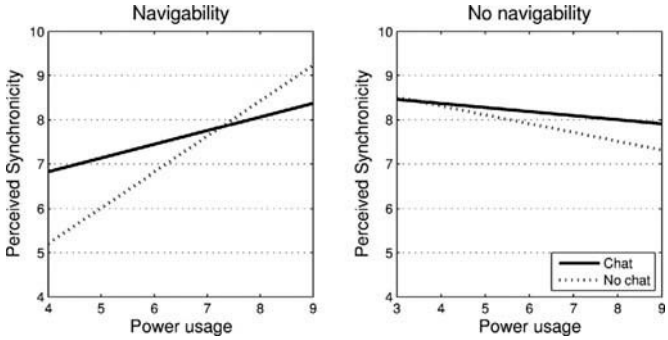


FIG. 11. Three-way interaction effect among navigability, live chatting, and power usage on perceived synchronicity.

Given that perceived synchronicity and behavioral intention showed a significant positive correlation ($r = .36$, $p < .05$), the overall negative effect of live chatting among power users might have influenced their reduced desire to visit the website. A summary of important findings is listed in Table 2.

TABLE 2
Summary of Significant Findings

	Technological Affordance	Psychological Outcomes	Direction
Main effect	Live chat	Perceived reciprocity	Presence > absence
		Perceived social presence	
	Power usage	Perceived reality	Power user > non-power user
		Perceived usability	
		Sense of agency	
		Attitudes	
Two-way interaction effect	Live chat Customization	Perceived usability	Either customization or live chat >
		Sense of control	Both functions or neither
		Attitudes	
	Live chat	Perceived reality	Either 3D navigation or live chat >
	3D navigation		Both functions or neither
	Live chat	Sense of agency	• Live chat:
	Power usage		Power user = non-power user
			• No live chat
			Power user > non-power user
	3D navigation Power usage	Perceived synchronicity	• 3D navigation:
			Power user > non-power user
			• No 3D navigation:
			Power user < non-power user
	3D navigation	Sense of control	• Customization:
	Customization		3D navigation = No 3D navigation
			• No customization:
			3D navigation < No 3D navigation
Three-way interaction effect	Live chat	Behavioral intention	• Customization
	Power usage Customization		Live chat = No live chat (power user)
			Live chat < No live chat (non-power user)
			• No customization
			Live chat < No live chat (power user)
			Live chat > No live chat (non-power user)
	Live chat	Perceived synchronicity	• 3D navigation
	Power usage		Live chat < No live chat (power user)
	3D navigation		Live chat > No live chat (non-power user)
			• No 3D navigation
			Live chat > No live chat (power user)
			Live chat = No live chat (non-power user)

5. DISCUSSION

Our manipulation checks provide strong statistical support to the operationalization of three key affordances in a virtual museum website. Using the 3D navigational tool seems to encourage a spatial exploration of the site while

assembling one's own art collection and live chatting over Google Talk epitomize the notion of customization and message-interactivity, respectively. Given recent developments in web technology, these are relatively simple tools that can be used by human-computer interaction researchers to operationalize the concepts of navigability, customization, and message interactivity in a number of different content domains. For example, the role of these affordances in disseminating information could be studied by testing them on a news website, their role in aiding learning could be examined in a distance-learning website, and so on.

However, the effect of our operationalizations of these affordances on online visitors' experiences is anything but straightforward. Although live chatting contributed to perceived reciprocity and social presence, the 3D navigational tool seems to undermine users' sense of control over the interface. On the other hand, the enhancement in perceived reality of the museum experience caused by the 3D tool was hindered by the inclusion of live chat in the study protocol, although the live chat itself promoted the greatest level of perceived reality. In sum, there appears to be a conflict between the navigability and message interactivity tools on specific aspects of user experience.

Theoretically, this calls into question the validity of the assumption that more is better. Although independently message interactivity and navigability may be desirable for certain outcomes, they may cancel each other out when deployed together on an interface. It is well known that message interactivity comes with a navigational burden already (Sundar et al., 2003), so adding a navigability tool perhaps burdens the user's cognitive capacity even more. This is particularly the case when the two tools require users to switch back and forth. As described earlier, our stimulus site required participants to operate two separate tools (i.e., customization in the main website and live chatting in a separate application) simultaneously, thus calling for multitasking.

The increased complexity caused by the constant switching between the main website and the chat application in a separate pop-up window probably impacted psychological outcomes. Indeed, Oviatt, Coulston, and Lunsford (2004) addressed the potential constraints of performing tasks when the interface design is complex. This "extraneous complexity" (p. 129), rather than the difficulty of the tasks themselves, would hinder a user's ready acquisition of necessary information from the interface because of demands on working memory. Therefore, the user would have to expend additional, conscious energy to operate the affordances, just like the need for extra concentration on the road when driving while talking on the phone. Such extra effort would signal a departure from normal use of the affordances and, in this case, may have therefore served to break the social presence induced by live chatting and the perceived reality induced by the 3D tool.

From a design standpoint, these findings argue against the common tendency among site developers to keep on adding more features. The deployment of affordances has to be strategic, keeping in mind the specific objectives of the site. For example, if social presence is important for a particular site, then the focus should be on building an interactive tool for users to engage without being distracted by other competing affordances, especially those that require navigation. If, however, it is important for a site to have both message interactivity and navigability tools, then the design implication emerging from our study is that site designers have to integrate their functions on the interface so that users can seamlessly switch between them, thereby minimizing the navigational burden due to multitasking.

A similar set of interaction effects between live chat and customization suggests the need to avoid overwhelming the user. When users are faced with the task of customizing as well as chatting, they tend to downgrade the usability of the site, which seems to impact their overall attitude toward the site. Moreover, although it is well known that customization imbues a sense of agency and control, when customization is offered along with live chat it obviously hindered one's sense of control (Figures 5, 7, and 8). Such interference from the combination of two affordances also yielded negative experience of usability among the participants. In theoretical terms, this means affordances that involve introspection and self-expression are likely to lead to a richer agentic experience and capability of controlling the interface for the user, whereas those involving interactions with other users serve to break down user's

sense of control over the interface. Thus, a technological affordance that allows users to interact with others while browsing virtual galleries might be useful just for the sake of a higher degree of social presence but nothing more. A practical implication of these findings is that not only does the site design have to be goal driven but the goals ought to be realized through tools that best achieve them and, perhaps most important, tools serving other goals better be avoided. This will make for a narrower range of affordances on the site, but it will certainly address the primary goals of the site. It is interesting to note that power usage moderates the negative effects of greater message interactivity on psychological outcomes. The increased complexity caused by multitasking with different types of technological affordances did not hinder power users' positive experience with the website, because they have enough ability to readily adapt to the complex design of the website interface. Thus they do not need to invest extensive cognitive effort for using several tools. As our finding showed, individuals with greater experience in using technologies showed more positive perception of the speed of the website with 3D navigation tool (which required more cognitive resources and skills due to its low usability).

Furthermore, the three-way interaction effects revealed that in the presence of the customization tool, as power usage increased, behavioral intention increased regardless of the presence/absence of live chat, whereas in the absence of customization, power users showed more positive change in behavioral intention in the absence, rather than presence, of live chat. In the presence of customization, power users do not care one way or another about the live chat feature, but in the absence of customization they clearly do not appreciate the live chat functionality. This may signal a loss of personal agency, in that the live chat feature implies listening to others' opinions about the artworks in the museum. In the customization condition, this loss is compensated by the provision of the ability to create one's own idiosyncratic art collection.

These findings imply that each affordance transmits a unique cue that is capable of triggering a cognitive heuristic about the essential characteristics of the site (Sundar, 2008a), which may resonate with the needs and aspirations of certain users. Although it is true that user evaluations are based on their experiences with the various affordances on the site, our findings suggest that users carry a mental signature for each affordance. That is, the sheer presence of customizable tool can serve to yield positive outcomes such as attitudes and behavioral intentions among power users by eliciting positive thoughts or heuristics about customization functions (e.g., if there is a customization tool on the interface, the interface allows users to be an active content gatekeeper) from their schemata. Indeed, Sundar and Marathe (2010) demonstrated that power users prefer customizable tools that allow them to serve as active content gatekeepers, in part because it imbues a strong sense of agency. On the other hand, the presence of chatting functions seems to be a negative cue for power users, probably because it undermines their agency by providing a voice to other users. Our findings are that when live chat function was absent, individuals with higher levels of power usage showed a higher sense of agency, which led to a more positive evaluation of the website. Thus, a design implication is the better integration of cues transmitted by various affordances on the interface, especially for power users. For instance, live chat could be designed to help power users exert their control and power by offering diverse customization options such as free choice of chatting partner or profiling options while exploring the museum website. Such creative efforts will better integrate the various affordances to the interface and hence avoid their cross-purposes from diminishing the overall value of the site.

Unlike power users, non–power users evaluated the museum website more positively when they had more options for interacting with the site. Assuming equal levels of task involvement—presumably moderate—without measuring it, this finding is consistent with that of Liu and Shrum (2002) in that the sheer presence of technological affordances acted as a heuristic cue affecting non–power users' evaluation on the website. However, these findings should be interpreted with the caveat that the cues communicated by one affordance may not always be consonant with those communicated by other affordances. Therefore, their effects on heuristics may not necessarily cumulate in the same direction.

6. LIMITATIONS AND CONCLUSION

This study has several limitations. First, the live chat function was not embedded within the main website, so it might have interrupted users' interaction with the artworks while they were using the website, which may have affected the overall findings. Second, this study used an undergraduate sample to explore the effects of three different technological affordances in a virtual museum; therefore, using a synchronous live chatting feature or a 3D navigation tool may not be very challenging for them. But given that museum visiting is a generic experience across generations, these functions may hinder the user experience of the older generation, especially those who are not experts in using advanced technological functions. Last, this study focuses on the beneficial effect of a live-chat function in that it can facilitate the social context (which is one of the three main contexts for a museum experience suggested by Falk and Storksdieck, 2005). However, visiting a museum can also be considered as an event that takes place in silence, thereby allowing individuals to contemplate artworks and reflect on their own thoughts as they relate to the exhibited artworks. Furthermore, some might argue that social interaction usually happens with friends or acquaintances rather than strangers in a real museum. Thus, chatting with unknown users to share their thoughts about artworks might be different from what is usually expected in a real setting. In this context, a live-chat tool may not be an appropriate choice for users to engage in such appreciation compared to authentic museum experiences, although live chatting with strangers is a common occurrence on the web. Thus, for future study, it would be beneficial to compare the effects of synchronous communication tools such as a live-chat function with asynchronous tools such as a discussion board that can give users room for temporal flexibility for appreciating artworks in silence and socially.

In conclusion, although the three dominant affordances of websites successfully operationalize the personal, social, and physical contexts that constitute a museum experience, it is important to remember that their integration in an online site is quite tricky, given the theoretical complexity of the psychological responses to affordances discovered in this study. Aside from considerations of multitasking (which will burden visitors, especially those who are not power users, with additional cognitive and navigational activities), one has to recognize the need to identify the signals and experiences triggered by each so that we can avoid conflicting gratifications and create a meaningfully integrated visit.

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APPENDIX

A. Measurement Item List

Spatial Presence (1 *strongly disagree*; 9 *strongly agree*) *Awareness of physical location*

I had the feeling that I was in the middle of the action rather than merely observing.

I felt like I was a part of the environment in the virtual museum.

I felt like I was actually there in the environment of the virtual museum.

I felt like the objects in the virtual museum surrounded me.

It was as though my true location had shifted into the environment in the virtual museum.

It seemed as though I myself was present in the environment of the virtual museum.

I felt as though I was physically present in the environment of the virtual museum.

It seemed as though I actually took part in the action of the virtual museum.

Awareness of possible action

I felt like I could jump into the action.

I had the impression that I could act in the environment of the virtual museum.

The objects in the virtual museum gave me the feeling that I could do things with them.

I felt like I could move around among the objects in the virtual museum.

The objects in the virtual museum gave me the feeling that I could do things with them.

I had the impression that I could reach for the objects in the virtual museum.

It seemed to me that I could have some effect on things in the virtual museum, as I do in real life.

It seemed to me that I could do whatever I wanted in the environment of the virtual museum.

Perceived Reality (1 *strongly disagree*; 9 *strongly agree*) The experience from the virtual museum seemed real to me.

In my opinion, the quality of the images in the virtual museum was very good.

What I saw in the virtual museum was similar to what I have seen in the real world.

What I experienced in the virtual museum was congruent to other experiences in the real world.

I felt that I "was" physically in the virtual museum. The virtual objects in the site were real.

I felt that I "went into" the virtual museum.

My interactions with the virtual museum seem natural to me, like those in the real world.

Perceived Usability (1 *strongly disagree*; 9 *strongly agree*) I think I would like to use this site frequently.

I find the site unnecessarily complex (reverse coded). I thought the site was easy to use.

I would need the support of a technical person to be able to use this site (reverse coded).

I thought there is too much inconsistency in this site (reverse coded).

The various functions in this site are well integrated. Most people will likely learn to use this site very quickly. I find the site very cumbersome to use (reverse coded).

I feel like I needed to learn a lot of things before I could get going with this site (reverse coded).

Sense of Agency (1 *strongly disagree*; 9 *strongly agree*) *Sense of agency toward thoughts and life*
I feel a deep sense of self-awareness.
I feel like I have sharpened my thinking skills. I can control some aspects of my life.
I have come to know things about myself I was not aware of before.
I feel a sense of control over my life. I am able to cope with my problems. I feel autonomous.
I feel independent. I am self-directed.
I pay attention to my thoughts.
Sense of agency for voice and action
I feel I have control over my own voice. I can assert myself.
I feel I have a distinct voice.
I feel I have control over my actions. I feel like I can exercise my free will.
I feel like I can access information that is appropriate for me.
I feel confident about asserting myself.
Sense of Control (1 *strongly disagree*; 9 *strongly agree*)
I was able to control my interaction with the interface of the site.
The environment of the site was responsive to the actions that I initiated (or performed).
During my interaction with the site, I was able to make choices freely.
I was free to decide how I visited the site. My interactions with the site seemed natural.
I felt in charge of my experience with the site.

Reciprocity (1 *strongly disagree*; 9 *strongly agree*) The site enabled two-way communication.
The site enabled concurrent communication.
It was difficult to offer feedback to other visitors in the site (reverse coded).
The site made me feel that it wanted visitors to listen to each other.
The site gave the visitors the opportunity to talk with each other.
The site gave the visitors the opportunity to offer feedback to each other.
The site was interpersonal. The site enables conversation. The site is interactive.

Synchronicity (1 *strongly disagree*; 9 *strongly agree*) The site processed information very quickly.
Interaction occurring in this site is very fast.
I was able to interact in this site without any delay.
When I interacted with the site, I felt I was getting instantaneous information.
The site was very slow in responding to my actions.

Social Presence (1 *strongly disagree*; 9 *strongly agree*) There is a sense of human contact in the site.
There is a sense of personalness in the site. There is a sense of sociability in the site. There is a sense of human warmth in the site.
There is a sense of human sensitivity in the site.

Absorption (1 *strongly disagree*; 9 *strongly agree*)
Time appeared to go by very quickly when I was browsing the website content.

I lost track of time when I was browsing the website content.
I spent more time on the website content than I had intended.
While browsing the website content, I was able to block out most other distractions.
While browsing the website, I was absorbed in what I was doing.
While browsing the website content, I was immersed in what I was doing.
While browsing the website content, my attention did not get diverted.

Attitudes Toward the Website (1 *describes very poorly*; 9 *describes very well*)
Organized, good, unique, high quality, user-friendly, novel, cool, coherent, confusing (reversed-coded), sophisticated, attractive, appealing

Perceived Satisfaction (1 *strongly disagree*; 9 *strongly agree*) I'm satisfied with the performance of the site.
I'm pleased with the experience of using the site.

Power Usage (1 *strongly disagree*;9 *strongly agree*)
I think most of the technological gadgets are complicated to use.
I make good use of most of the features available in any technological device.
I have to have the latest available upgrades for 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.
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. I would feel lost without information technology.

Prior Involvement (1 *strongly disagree*; 9 *strongly agree*) I am generally interested in the topic of art.
Art is a personally relevant topic for me. I actively seek information about art.