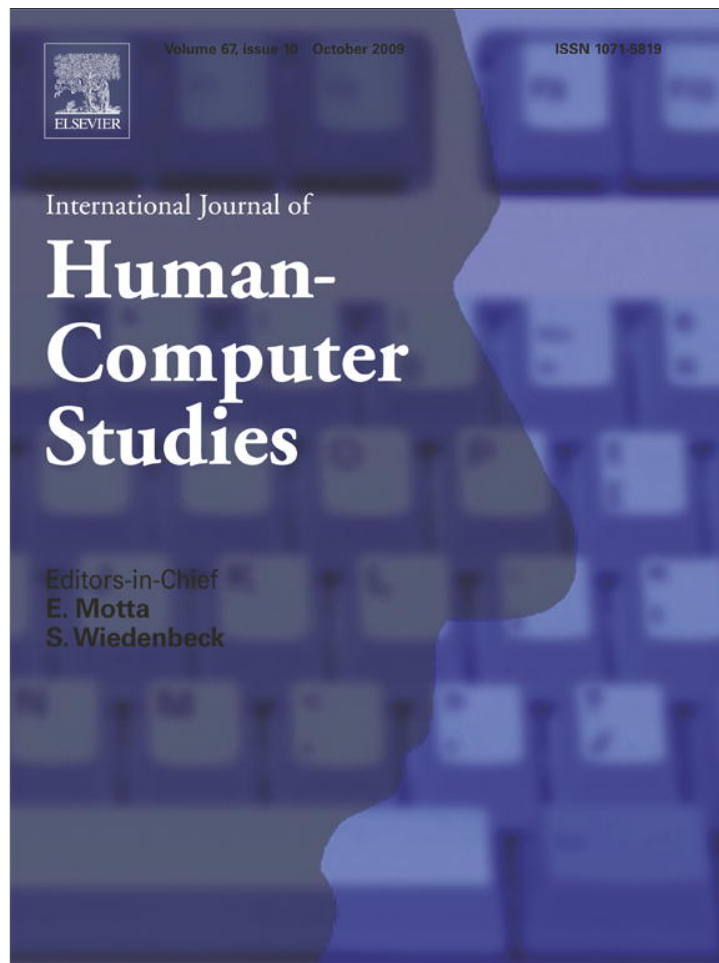


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Perceived interactivity leading to e-loyalty: Development of a model for cognitive–affective user responses [☆]

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Abstract

Novel applications of website interactivity are important to attract and retain online users. In this empirical study five designs for interactivity are examined using different web-poll interfaces. The goal of the investigation is to examine perceived interactivity in a model which includes most commonly tested cognitive elements such as efficiency and effectiveness, but augments this model with the inclusion of a cognitive–affective element for trust, and an affective element of enjoyment. More specifically, a model is created to validate the relationship of perceived interactivity (comprised of user control, user connectedness, and responsiveness of the web-poll application) to efficiency, effectiveness, trust and enjoyment, of the website. In turn, efficiency, effectiveness, trust, and enjoyment are tested for their influence on user behavioral intentions for e-loyalty. All relationships in the model are supported. In addition, exploratory evaluation of qualitative comments is conducted to investigate additional insights between the five web-poll treatments in this investigation. The research confirms the complexity of a model in which cognitive, cognitive–affective and affective elements are present, and advances knowledge on the consequences of perceived interactivity. In addition to theoretical advancements, the research has merit for web designers and online marketers regarding how to enhance interactive online web applications.

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1. Introduction

Despite the potential for interactivity provided by the Internet, little attention has been paid to how interactivity might be more fully utilized (Johnson et al., 2006). Rice (1984) defined interactivity as the capability of a computer-enabled communication system that permits exchange of roles between the sender and receiver in real or delayed time so that communicators have more control over the

structure, pace, and content of the communication. Although interactivity has numerous dimensions, a common theme is that the website successfully provides information to the user, is perceived as responsive, and allows a sense of connection—often with other users. While previous research has aimed to conceptually unravel contributing factors to interactivity, there is relatively little empirical work that systematically examines the consequences of interactivity. There are some exceptions. Jiang and Benbasat (2007) examined interactivity related to purchase intention and intention to return to the website. Johnson et al. (2006) tested the relationship of perceived interactivity to attitude toward the website and involvement. Lee (2005) examined various components of interactivity related to trust. Chen and Yen (2004) sought to determine elements of interactivity that result in website

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quality. Finally, Teo et al. (2003) tested a model in which interactivity resulted in user satisfaction, effectiveness, and efficiency of websites.

In the current investigation we aim to test user perceived interactivity using a web-poll design. Web-polls are meant to solicit quick input/opinions from a web user, which is typically displayed for viewing by other visitors to the site. Simple versions of web-polls are found on various websites with static indicators such as star-ratings, bar graphs or pie charts representing how many people make a choice for a particular product or service. Advanced web-poll designs can have a more interactive element. For example, Ivanov et al. (2006) developed a platform on a website for an herbal antidepressant that allowed users to know through an 'at-a-glance' *X–Y* plot diagram how many other users found the product useful, at what dosages, and for how long. Users could click or 'plot' their current mood onto this interactive canvas, which was essentially a collaborative visualization populated by members of the community. The experience of mapping or externalizing one's subjective experience into a public space, albeit anonymously, was meant to instill a feeling of contribution, a sense of control, and connection to others on the site. For additional information on data representation and web-polls refer to Appendix A.

In a web-poll context, it is expected that user perceptions of interactivity will be represented in a model that includes both cognitive and affective components. As in the example of the mood web-poll noted above, not only will users provide cognitive attributions to the website as to whether or not it is perceived as efficient and effective, but they will also ideally feel an affective connection to the site and a sense of enjoyment from the visit. Related to this cognitive–affective duality of experience, much previous research on IT adoption has primarily a cognitive orientation (Venkatesh et al., 2003). With specific reference to the popular technology acceptance model (Davis, 1989), emphasis has been on constructs such as perceived usefulness or perceived ease of use. More recently, research into website design has recognized the importance of the inclusion of affective elements such as enjoyment (Cyr et al., 2007; Cyr and Head, 2008; Kim et al., 2007; Sun and Zhang, 2006; Tractinsky, 2004; Zhang and Li, 2004). If either or both cognitive or affective components are present then users are more likely to return to the site or to visit it in the future, termed e-loyalty (Cyr et al., 2007; Flavián et al., 2006; Lam et al., 2004).

Related to the preceding, a primary aim of this investigation is to create a model for perceived interactivity that includes both cognitive as well as affective outcomes, with subsequent influence on loyalty. In alignment with Komiak and Benbasat (2006) our overarching theoretical model is derived from the theory of reasoned action (Fishbein and Ajzen, 1975) in which attitudes influence behavioral intention. More specifically, in the development of our research model we draw on work by Lee (2005), who examined interactivity as comprised of various components

such as user control, user connectedness, and responsiveness to the user of an application—now applied in a web-poll context. Perceived interactivity is expected to affect cognitive constructs such as efficiency and effectiveness (as previously considered by Teo et al., 2003). In addition, Komiak and Benbasat (2006) examined adoption of recommendation agents and found that trust in this context has both cognitive and affective elements. In our model we include trust since this represents a mid-range position between purely cognitive and purely affective constructs. Finally, we are interested to examine perceived interactivity related to enjoyment which has been considered an affective component in numerous studies (Childers et al., 2001; Cyr et al., 2007; van der Heijden, 2003).

In sum, the primary goal of this investigation is to validate a model in which both user cognitive and affective responses are examined with respect to interactivity. Specifically, perceived interactivity (modeled as a formative construct that includes user control, connectedness and responsiveness) is proposed to influence *cognitive perceptions* (for efficiency and effectiveness), *cognitive–affective perceptions* (for trust), and *affective perceptions* (for enjoyment). In turn, we validate whether efficiency, effectiveness, enjoyment and trust influence e-loyalty in a web-poll context. A secondary goal is an exploration of five treatments of web-poll designs that vary in complexity and design. The purpose of incorporating different formats of web-poll design is to gain understanding of design elements and any additional insights as they complement our quantitative analysis. Of interest is user experience of each treatment, not only as it contributes to validation of our model, but also concerning design applications and their utility in practice. The examination of various web-poll designs constitutes an investigation of how the IT artifact influences salient beliefs about a website. Benbasat and Barki (2007) note the importance of considering how IT artifacts influence such beliefs, and the need to consider other salient beliefs besides perceived usefulness and perceived ease of use as offered in the current research.

This paper begins with an outline of our theoretical framework and research model. Hypotheses are next developed as derived from previous work in the area of perceived interactivity and related fields, and results of this investigation are presented. The paper concludes with a discussion of the findings for both academics and practitioners.

2. Theoretical foundations and research model

The theoretical framework for this investigation draws from the theory of reasoned action (TRA) in which attitudes influence behavioral intention (Fishbein and Ajzen, 1975). TRA has been extensively used by IS and other researchers to explain IT adoption (i.e. Davis et al., 1989; McKnight et al., 2002; Venkatesh et al., 2003). Based on TRA, an individual's behavior is predicted by his or her intention to perform this behavior. The theory specifies

that intention is influenced by attitudes toward the behavior as well as subjective norms as to whether others who are valued believe the behavior should be performed. As argued by Komiak and Benbasat (2006), when a behavior is voluntary (versus mandatory) and when first-hand experience of a website is available, then it is sufficient to focus on attitude and to omit subjective norms. Further, and in alignment with the present research, it should be noted that Komiak and Benbasat outline that TRA is influenced by attitudes toward a behavior, which is a function of beliefs about consequences of this behavior. This is consistent with other research (i.e. Gefen et al., 2003), and the technology acceptance model (TAM) in which intention to accept or use a new technology is determined by perceived usefulness and perceived ease of use of the technology. In the context of the current investigation, perceived interactivity results in user reactions and beliefs toward the website (such as efficiency, effectiveness, enjoyment, or trust), which in turn influence behavioral intention (e-loyalty).

Further, Ajzen (2001) suggests “a multi-component view of attitude and assumes that evaluations are influenced by cognition as well as affect” (p. 34). In alignment with this view, the original TAM model with a utilitarian emphasis has been augmented to include a “hedonic” component (Childers et al., 2001; Cyr et al., 2007; Cyr and Head, 2008). In previous research this affective or hedonic element is often referred to as enjoyment (van der Heijden, 2003). Further, beliefs such as trust have both cognitive as well as affective characteristics (Komiak and Benbasat, 2004).

To investigate perceived user interactivity in the specific context of a web-poll, a model for e-loyalty is presented in Fig. 1. In a mobile commerce context, Lee (2005) proposed and tested that user control, connectedness, responsiveness, and personalization are elements of interactivity that result in trust and ultimately in intention to use a technology. The first three elements were significant, while personalization was not. In the current study, we build on this earlier work to examine user control, connectedness and responsiveness

as components of interactivity, now tested in a stationary commerce web-poll setting.

Relationships of perceived interactivity to efficiency and effectiveness are based on the work of Teo et al. (2003) and as noted above represent cognitive elements of the model. We add to these cognitively based concepts the cognitive–affective element of trust (as per Komiak and Benbasat, 2006), and the affective construct of enjoyment (Cyr et al., 2007) as outcomes of perceived interactivity. The exogenous variable in our model is loyalty, which is important in e-commerce research (Cyr et al., 2007; Flavián et al., 2006; Gefen, 2002; Lam et al., 2004). More specifically, we are interested to determine if perceived interactivity leads to efficiency, effectiveness, enjoyment, and trust, and that these constructs are precursors to user loyalty. Elements of the model and support for hypothesized relationships are elaborated below.

3. Hypothesis development

3.1. e-Loyalty

Loyalty, or e-loyalty, has been conceived as a “consumer’s intention to buy” from a website, and that consumers will not change to another website (Flavián et al., 2006). In the context of our model, and with reference to the theoretical framework (TRA), e-loyalty represents behavioral intention on the part of the user.

In a business-to-business service context, Lam et al. (2004) tested customer satisfaction to loyalty where loyalty is the patronage of an online vendor, as well as confidence in recommending the vendor. In a study in which website design was investigated as a precursor to e-loyalty across cultures, Cyr (2008) defined e-loyalty as intention to revisit a website, or to consider purchasing from it in the future. Consistent with the preceding, in this investigation e-loyalty is defined as perceived intention to visit or use a website in the future and to consider purchasing from it in the future.

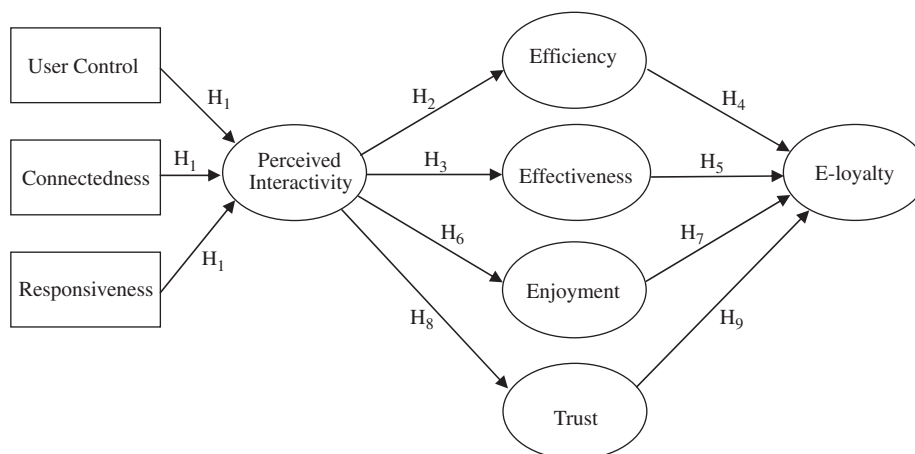


Fig. 1. Proposed research model.

Some researchers have suggested interactivity in online vendor web presence helps to build good customer relations (Ghose and Dou, 1998), and assists to convert site visitors into loyal customers (Berthon et al., 1996). In an investigation of the impact of vividness and interactivity on consumer intentions to return to a website and to purchase products, both antecedent variables were significant (Jiang and Benbasat, 2007). Others have highlighted the importance of interactivity to e-loyalty in e-commerce (Deighton, 1996; Srinivasan et al., 2002; Watson et al., 1998). Srinivasan et al. (2002) examined a variety of antecedents to online customer loyalty including “contact interactivity” and found a significant relationship. However, to date there has been no investigation of e-loyalty in the context of perceived interactivity using web-poll treatments.

3.2. Perceived interactivity

There is no well established scope and definition for “interactivity”¹ (Johnson et al., 2006; Lee, 2005), although the concept is regarded as crucial to successful online marketing (Lee, 2005). Srinivasan et al. (2002, p. 42) operationalize interactivity “as the availability and effectiveness of customer support tools on a website, and the degree to which two-way communication with customers is facilitated”. More specifically, Ha and James (1998) outlined five interactivity dimensions aimed to fulfill communication requirements: (1) playfulness, (2) choice, (3) connectedness, (4) information collection, and (5) reciprocal communication. Chen and Yen (2004) empirically validated Ha and James’ five interactivity dimensions as important predictors of web site quality, and concluded the importance of interactivity in an online environment. Related to issues of access and control, Ku (1992) proposed six interactivity dimensions: (1) immediacy of feedback, (2) responsiveness, (3) source diversity, (4) communication linkages, (5) equality of participation, and (6) ability to terminate. In other work, Dholakia et al. (2000) suggested website interactivity consists of (1) control, (2) responsiveness, (3) real time interactions, (4) connectedness, (5) personalization/customization, and (6) playfulness. In this research our definition of interactivity echoes some of the preceding, and also considers the early definition by Rice (1984) that interactivity permits the user more control over pace, structure, and content. More specifically we define perceived interactivity as allowing the user control and access to information on the site in a variety of ways, which is both personal and responsive.

As already outlined, previous research by Lee (2005) has particular relevance to the current work. Lee identified (1) user control, (2) responsiveness, (3) personalization, and (4) connectedness as important components to interactivity

in a mobile commerce setting. User control refers to the user’s ability to control the information display and content. Responsiveness refers to the site as being able to respond to user queries. Personalization concerns the mobile Internet site that enables the purchase of products and services that are tailored to the user and unique desires. Finally, perceived connectedness refers to whether customers share experiences regarding products or services offered with other visitors to the mobile site. This set of characteristics captures many elements of some of the earlier research as noted in the preceding, and we feel has relevance to a stationary website, with a focus on web-poll design. Lee tested these four constructs and found user control, responsiveness, and connectedness to be significant in a model leading to trust and behavioral intention. Hence we have used these same three constructs in our model, now tested in a new context. Additionally, the current context did not provide web users with an opportunity to tailor the products or services being offered. As such, the personalization dimension of perceived interactivity was not relevant to this study.

In this study, we have conceptualized perceived interactivity as a second-order formative construct. This is in alignment with others who have done work in this domain (such as Johnson et al., 2006). For formative constructs, the direction of causality is from the measures to the latent construct, rather than the other way around (Jarvis et al., 2003). Therefore, we conceptualize variance in perceived interactivity as being caused by changes in the levels of user control, connectedness and responsiveness. For example, a web-poll interface that creates a common bond or connection to other members of the customer community (connectedness) would lead to a perception of that interface being more interactive. It is not the perception of interactivity that would lead to the interface being considered high in terms of connectedness. Interactivity is thus represented as a second-order formative construct formed by the three dimensions of user control, connectedness and responsiveness.

Hypothesis 1. Perceived interactivity is a second-order formative construct, with user control, connectedness and responsiveness as its three constituent components.

3.3. Efficiency and effectiveness

Effectiveness refers to the quality of information provided and can contribute to user perceived value (Ducoffe, 1996; Huizingh, 2000; Keeney, 1999). Efficiency refers to easy search and access of that information (Keeney, 1999). In a study using different levels of interactivity (user–document interactivity, user–system interactivity, machine interactivity, user–user interactivity, and person interactivity) participants were instructed to evaluate an on-line store based on shopping for a new computer system (Teo et al., 2003). Interactivity was tested in relation to both effectiveness and efficiency.

¹For a recent compilation of different definitions of interactivity refer to Johnson et al. (2006).

Results from the Teo et al. (2003) study confirmed that interactivity significantly impacts effectiveness and efficiency ($p < .05$).

Compared to related work in information systems, effectiveness and efficiency are aligned to the technology acceptance model (TAM) as introduced by Davis (1989). Effectiveness has parallels to perceived usefulness (PU), while efficiency is similar to perceived ease of use (PEOU). Benbasat and Barki (2007) also note the strong similarities between these two sets of constructs, and recommend the use of measures beyond TAM (such as effectiveness and efficiency) that serve to expand perceptual measures of the IT artifact. As such, effectiveness and efficiency are of interest as cognitive components of our model.

Building on this work by Teo et al. (2003) in which interactivity has a relationship with effectiveness and efficiency, we now test these relationships in the specific context of web-poll treatments. It would be expected that if the website is perceived as interactive, in that users experience better control and access to website content, then it will be viewed as more effective and efficient. Further, because our definition of interactivity also includes that the information will be personal and responsive, users will have access to prepared information by Web designers as well as be able to read summaries based on the responses of other users. Hence, the following hypotheses are offered:

Hypothesis 2. Higher levels of Perceived Interactivity will predict higher levels of Efficiency of the website.

Hypothesis 3. Higher levels of Perceived Interactivity will predict higher levels of Effectiveness of the website.

Further, efficiency and effectiveness contribute to perceived value by the user. Cyr et al. (2007) examined different levels of social presence (i.e. warmth and sociability) in website design and found significant relationships between perceived ease of use (PEOU) and perceived usefulness (PU) ($p < .001$) and between PU and e-loyalty ($p < .001$). In research examining TAM and e-Services, Gefen and Straub (2003) show a positive relationship between PEOU and PU, and between PU and purchase intentions. Considering the parallels between efficiency and effectiveness and PEOU and PU, we wish to test the relationships of effectiveness and efficiency to e-loyalty in the current web-poll context.

Hypothesis 4. Higher levels of Efficiency of the website will predict higher levels of e-loyalty.

Hypothesis 5. Higher levels of Effectiveness of the website will predict higher levels of e-loyalty.

3.4. Trust

In e-commerce environments numerous researchers have aimed to unravel the complexities of trust (Bhattacharjee, 2002; Casalo et al., 2007; Chen and Dhillon, 2003; Gefen,

2000; Gefen et al., 2003; Koufaris, 2002).² Corritore et al. (2003, p. 740) provided a definition of online trust that includes cognitive and affective elements, with trust encompassing “an attitude of confident expectation in an online situation or risk that one’s vulnerabilities will not be exploited”. Unlike the vendor–shopper relationship established in traditional retail settings, the primary communication interface with the vendor is an information technology artifact, the website. In line with Jarvenpaa et al. (1999), in this research trust refers to consumer confidence in the website and “willingness to rely on the seller and take actions in circumstances where such action makes the consumer vulnerable to the seller” (p. 4). In addition, and related to website design elements, the website is generally trusted.

IT artifacts are the hardware or software that enables tasks and the web poll in the current research is an example of one such artifact. While previous research has examined trust in e-commerce, little research has been conducted on the IT artifact related to consumer trust (Vance et al., 2008). Vance et al. note: “Most trust-related IS literature has viewed the IT artifact simply as an enabling ingredient of online transactions, focusing instead on vendor- or institution-based effects of trust” (p. 73). Although few studies have been focused on the IT artifact and trust, Wang and Benbasat (2005) found that consumers place significant levels of trust in IT artifacts when transacting online. Most of these studies linking the IT artifact and trust have considered the ability of online software-based recommendation agents to increase online consumer trust. In the current investigation we now extend research of the IT artifact and trust to a web poll context.

In one study focused on perceived interactivity on customer trust in mobile commerce, Lee (2005) found interactivity components of user control, responsiveness and connectedness to be significantly related to trust. Building on the work by Lee, we now test whether perceived interactivity will result in trust in a unique web-poll setting. More specifically, in alignment with our definition of interactivity, if users are allowed control and access to information that is both personal and responsive then they are more likely to trust the information. Trust is positioned in our model between cognitive elements of efficiency and effectiveness, and the affective element of enjoyment. As already elaborated, Komiak and Benbasat (2006) found trust to have both cognitive and affective

²A thorough review of trust in offline and online settings is not feasible within the scope of the present paper. However, the reader may wish to refer to Rousseau et al. (1998) for a critique of offline trust, or Gefen et al. (2003) for a summary of online trust. In research in which online trust is the primary focus it is recognized a multi-dimensional construct for trust is most appropriate. Trust may result from a consumer’s belief that an online vendor demonstrates ability, benevolence or integrity (McKnight et al., 2002). Alternately, in studies such as this one when trust is one element included to better understand a more comprehensive user reaction to a website, then trust as a single-dimensional construct has been used (Gefen et al., 2003; Koufaris, 2002).

elements as related to website design, and supports the earlier work by Corritore et al. (2003).

Hypothesis 6. Higher levels of Perceived Interactivity of the website will predict higher levels of Trust.

Related to TRA, the development of trusting beliefs will result in behavioral intention (Gefen et al., 2003; McKnight et al., 2002). It is already established in the literature that consumer trust in a website is fundamental to e-loyalty, including online purchase intentions (Flavián et al., 2006; Gefen, 2000) and willingness by consumers to buy from an online vendor (Flavián et al., 2006; Gefen et al., 2003; Pavlou, 2003). This assumption is now tested in the current investigation with our web poll treatments.

Hypothesis 7. Higher levels of Trust in the website will predict higher levels of e-loyalty.

3.5. Enjoyment

Motivation to engage in online retail shopping has affective as well as cognitive dimensions. As Childers et al. (2001, p. 511) outline, “Web-shopping provides an expanded opportunity for companies to create a cognitively and aesthetically rich shopping environment...” In two separate studies, Childers et al. (2001) found enjoyment to be positively related to attitude towards a website. Childers et al. (2001) specifically note, “Enjoyment is a strong predictor of attitude in the web-shopping context” (p. 526). Similarly, van der Heijden (2003) found enjoyment positively related to attitude toward the use of websites and whether users intended to visit the site frequently.

While we know of no research in which interactivity is tested related to enjoyment, our study is informed by other similar investigations. For instance, Jiang and Benbasat (2007) discovered that vividness and interaction of consumer product displays for a watch and Personal Data Assistant (PDA) resulted in enjoyment and ultimately in positive user intentions to return to a website or to purchase from it. In a study of mobile interfaces used in an e-services shopping environment (Cyr et al., 2006) found that aesthetic dimensions of the interface positively impacted enjoyment ($p < .001$) which in turn affected user loyalty ($p < .001$). Cyr et al. (2007) also found a significant relationship of enjoyment to e-loyalty ($p < .01$) related to perceived social presence of a website.

Extrapolating from the above, we see that sites with interactive product displays or those able to make a connection with the user (as is the case with social presence) result in higher levels of user enjoyment. As such, this could be related to interactivity dimensions of a web poll when users are able to interact with the site by providing information that is incorporated into displays, and which aims to afford connectedness with the user. This results in the final set of hypotheses:

Hypothesis 8. Higher levels of Perceived Interactivity of the website will predict higher levels of Enjoyment.

Hypothesis 9. Higher levels of Enjoyment of the website will predict higher levels of e-loyalty.

4. Research methodology

4.1. Participants

Participants for the study (341) were recruited from two major Canadian Universities (McMaster University and Simon Fraser University). From the 341 participants, 11 did not complete the survey, resulting in a sample size of 330. Walczuch and Lundgren (2004) advocate the use of students for e-retailing research as they have the opportunity to use the Internet for communication and commercial transactions, and are a representative and appropriate sample for such studies. Participant demographics across the five web-poll treatments are presented in Table 1. Virtually all participants (99%) considered themselves experienced in using the Internet, although responses differed as to actual online buying experience (from 1 to 10 years). Most respondents were undergraduates in their second or third year at university. They were recruited by email, and entered in a lottery draw for a \$200 Amazon.com gift certificate in exchange for their participation.

4.2. Task design and treatments

The experimental task consisted of browsing an e-Services website for booking vacation packages. The research design was a one-factorial experiment with five levels of website information visualization (having different web poll designs and rating interfaces) with five independent groups. It was expected that providing different web poll treatments would introduce additional variance in the exogenous variable of our proposed model. Respondents were randomly assigned to the five groups, where each participant was exposed to only one level or condition. The experiment was conducted entirely online, so respondents could complete the study from any computer with an Internet connection. This increased the realism of the task, and facilitated the data collection process.

Respondents were asked to imagine they had just returned from a vacation in Mexico, which they had booked from a fictitious travel planning site, called Travelier.ca. The specific instructions were as follows:

You will be presented with the Travelier.ca vacation planning website. This is not a real website, but has been created for this experiment. It lists a number of resorts in Cancun (Mexico) yet gives details for only two. Imagine you have returned from one of these resorts found on Travelier, and want to view and/or rate its value. Look at the list to get a sense of all the ratings. Then click on one of the two marked resorts, and cast

Table 1
Participant demographic profile for each treatment.

Treatment	Sample (330)	Mean age	Male/female (%)	Years at University	Years shopping on the Internet	Consider self-experienced using Internet (%)
Condition 1	68	20.1	61/39	2.0	2.9	99
Condition 2	65	20.3	55/45	2.3	3.0	98
Condition 3	66	19.8	52/48	2.1	2.8	100
Condition 4	67	20.5	55/45	2.3	2.9	98
Condition 5	64	21.4	51/49	2.5	3.5	100

your vote, as appropriate. Finally, exit the site by clicking GO TO SURVEY. Please take your time completing the survey.

Following the completion of the task (recording their opinion via the web-poll and browsing other users' ratings), respondents completed an online survey (using a 7-point Likert scale) about their experiences on Travelier.ca. In addition to items that measured the various constructs in the proposed model, two open-ended questions were posed at the end of the survey. In one question respondents were asked to explain what they liked about the website, while in the second question respondents were asked how they liked the web-poll and rating features of the website. SurveyMonkey.com software was used to host the surveys, as it offers a rich set of features for questionnaire design and response tracking.

Travelier.ca was designed in terms of content and “look and feel” to resemble typical sites of this category, such as Travelocity.com or Nolitours.com. The features shown in the conditions are typical of features found on such travel planning or vacation booking websites. Each of the five treatments consisted of three web pages, and all conditions featured the same content, differing only in terms of the web-poll interface. More specifically, 10 packages were listed and rated by other ‘hypothetical’ users, but only two offerings from the list were ‘click-able’ for further information. This limitation was imposed to ensure respondents spent a similar amount of time browsing the site, and further ensured the same content was browsed. The web-polls were featured in the follow-up pages for these two offers, and respondents were asked to record their rating of the vacation package they had just reviewed. The interface of the web-poll was consistent with the ratings design on the front page, but was interactive, rather than static.

Interactivity levels differed across treatments in terms of the quality of information visualization afforded to users. A brief description of the five treatments, alongside screenshots, is given in Appendix B.³

³The actual websites used for the experiment are available for browsing on http://www.sfu.ca/~aivanov/tr_1.htm. The number in the URL (1, in this case) designates the treatment, and can be changed to 2, 3, 4, and 5, to browse all five conditions, respectively.

4.3. Measurement validation

A survey was administered after each participant completed the browsing task for the assigned website condition. All items in the survey were constructed as agree–disagree statements on a seven-point Likert scale. The survey appears in Appendix C.

Content validity considers how representative and comprehensive the items are in creating the experimental constructs. To establish content validity, a common method used is a literature review to scope the domain of the construct (Petter et al., 2007). Constructs should draw representative questions (items) from a universal pool (Cronbach, 1971; Kerlinger, 1964). As shown in Appendix C, the survey items used in this research were adapted from previously validated work. Similarly, the Perceived Interactivity formative construct was “based on explicated facets in the theory base” (Petter et al., 2007). Therefore, content validity was established through literature review (Straub, 1989). Further, the entire instrument was pre-tested with a pilot sample of 15 participants who were asked to provide detailed comments on any wording or concept confusion. Slight modifications were made to some item wordings to clarify any potential confusion.

Efficiency, Effectiveness, Enjoyment, Trust and Loyalty are reflective constructs within the proposed model, whereas Perceived Interactivity is a formative construct. For reflective constructs, changes in the measures or items cause changes in the underlying reflective construct whereas a change in a formative construct affects the underlying measurement items (Jarvis et al., 2003). As such, in reflective constructs, the direction of causality is from the construct to the items; but in formative constructs the direction of causality is from the items to the construct.

A PLS approach to confirmatory factor analysis (CFA) was used to assess the psychometric properties of the multi-item scales, as outlined by Gefen and Straub (2005). Table 2 shows the specification of the outer model for reflective and formative constructs. For formative constructs, the focus is on the weights of each measure rather than loadings, which are used to assess reflective constructs (Chin, 1998b). Every item loaded significantly on the construct it was supposed to measure ($p < .001$).

Construct validity for reflective constructs assesses the extent to which a construct measures the variable of interest and whether “the measures chosen ‘fit’ together in

Table 2
Specifications of the outer model.

Construct	Item	Weight/ loading	SE	t-statistic
Perceived interactivity	PI-1	.56	.07	8.42
	PI-2	.62	.07	9.47
	PI-3	.70	.05	13.57
	PI-4	.64	.07	10.02
	PI-5	.60	.06	9.59
	PI-6	.55	.08	7.57
	PI-7	.55	.07	7.66
	PI-8	.67	.06	12.36
	PI-9	.62	.07	9.56
	PI-10	.70	.07	11.10
Trust	T-1	.93	.01	87.56
	T-2	.94	.01	106.66
	T-3	.90	.01	67.45
Efficiency	Effi-1	.86	.02	56.91
	Effi-2	.89	.02	59.15
	Effi-3	.69	.05	13.01
	Effi-4	.73	.03	24.68
Effectiveness	Effe-1	.79	.04	22.34
	Effe-2	.92	.01	82.42
	Effe-3	.92	.01	94.07
Enjoyment	E-1	.93	.01	90.10
	E-2	.92	.01	65.65
	E-3	.95	.01	151.90
	E-4	.92	.01	78.11
Loyalty	L-1	.95	.01	72.28
	L-2	.97	.01	157.19
	L-3	.96	.01	66.40

Table 3
Construct validity criteria for reflective constructs.

Reflective construct	α -value	Composite reliability	AVE
Efficiency	.853	.910	.772
Effectiveness	.810	.876	.641
Enjoyment	.948	.962	.865
Trust	.914	.946	.853
e-Loyalty	.958	.973	.923

Table 4
CFA loadings matrix of reflective constructs.

Items	Constructs				
	Trust	Efficiency	Effectiveness	Enjoyment	Loyalty
T-1	.93	.42	.48	.46	.50
T-2	.94	.40	.44	.45	.49
T-3	.90	.49	.53	.53	.57
Effi-1	.42	.86	.48	.48	.50
Effi-2	.40	.89	.48	.47	.51
Effi-3	.32	.69	.40	.30	.39
Effi-4	.38	.73	.57	.39	.55
Effe-1	.36	.39	.79	.44	.50
Effe-2	.47	.57	.92	.54	.64
Effe-3	.52	.60	.92	.55	.69
E-1	.50	.50	.58	.93	.61
E-2	.43	.46	.49	.92	.60
E-3	.51	.48	.53	.95	.63
E-4	.50	.49	.57	.92	.59
L-1	.54	.57	.67	.65	.95
L-2	.56	.59	.69	.62	.97
L-3	.52	.59	.66	.60	.96

such a way as to capture the essence of the construct” (Straub et al., 2004, p. 388). Table 3 summarizes various construct validity criteria for reflective constructs. Internal consistency is assessed by Cronbach α -values and composite reliability. Cronbach α -values ranged from .810 for Efficiency to .958 for e-Loyalty, which is well past the thresholds recommended by Rivard and Huff (1998) and Nunnally (1978). Similarly, the composite reliability of each reflective construct exceeded the recommended threshold of .7 (Straub et al., 2004). Convergent validity is demonstrated as the average variance extracted (AVE) of all reflective constructs and exceeded .5 (Fornell and Larcker, 1981).

Discriminant validity was assessed for our reflective constructs to ensure that constructs differed from each other. The complete loadings matrix of the reflective constructs is shown in Table 4. When using the PLS CFA method to examine discriminant validity, Gefen and Straub (2005) recommend that the measurement items on their assigned latent variables should be an order of magnitude larger than their loadings on other variables. As evident from Table 4 this criteria is satisfied. As per Fornell and Larcker (1981) the correlations between items in any two constructs should be lower than the square root of the average variance shared by items within a construct. As shown in Table 5, the square root of the variance shared

Table 5
Discriminant validity of reflective constructs.^a

	Efficiency	Effectiveness	Enjoyment	Trust	e-Loyalty
Efficiency	.879				
Effectiveness	.603	.800			
Enjoyment	.582	.519	.930		
Trust	.524	.477	.525	.924	
e-Loyalty	.704	.611	.653	.563	.961

^aDiagonal elements in bold (the square root of AVE) should exceed the inter-construct correlations below and across them for adequate discriminant validity (Fornell and Larcker, 1981).

between a construct and its items was greater than the correlations between the construct and any other construct in the model, satisfying Fornell and Larcker’s (1981) criteria for discriminant validity. In fact, following the suggestion of a more stringent approach, proposed by Gefen et al. (2000) and House et al. (1991), of using the AVEs themselves instead of their square roots across the diagonal renders the same conclusion with respect to discriminant validity. Given the above analysis, the reflective scales showed sufficient evidence of uni-dimensionality, internal consistency, and convergent and discriminant validity to be included in the structural model.

We now turn to the evaluation of our formative construct, Perceived Interactivity. Given the composite nature of formative constructs, there is no requirement that the measures of the construct be highly correlated (Rossiter, 2002). Reliability in the form of very high internal consistency of indicators is actually undesirable for formative constructs (Petter et al., 2007). While reflective construct validation methods (such as AVEs, Cronbach's alpha and composite reliability) are not applicable to the evaluation of formative constructs, such constructs must be examined for multicollinearity since, if the items are too highly correlated, they are essentially measuring the same thing (Bollen, 1989). To ensure that multicollinearity is not present, one can use the variance inflation factor (VIF) statistic, which should be less than 3.3 for formative measures (Diamantopoulos and Siguaw, 2006). Linear regressions were run using the indicators for Perceived Interactivity as the independent variables and the item means of Trust, Enjoyment, Efficiency, and Effectiveness as the dependent variables. Table 6 shows the correlation matrix and VIFs. The highest correlation between items is .757, which is below the .8 limit suggested by Stevens (1996), and VIFs for all Perceived Interactivity items are below the 3.3 limit suggested by Diamantopoulos and Siguaw (2006). Overall, the measurement model can be evaluated as being excellent (Chin, 1998), which is a precondition for the interpretation of the structural model.

4.4. Common methods variance

To test for common methods variance (CMV), we first conducted Harman's single-factor test, which is the most widely known approach for assessing CMV (Podsakoff et al., 2003) and was used in this study. As per Vance et al. (2008), an exploratory factor analysis was run which included all first-order constructs. The unrotated factor solution was examined against Podsakoff et al.'s (2003) assertion that a common methods variance exists if

“(a) single factor will emerge from the factor analysis or (b) one general factor will account for the majority of the covariance among the measures” (p. 889). More than one factor emerged to explain the variance in our analysis, with the first factor explaining 40.7% of the variance, indicating that common methods biases are not a likely contaminant of our results.

A second test for CMV was conducted using the PLS approach outlined and advocated by Liang et al. (2007) and Vance et al. (2008). This approach examines a control for the effects of a latent common method factor. Appendix D provides a detailed description of the procedure. From this analysis, of the 17 paths from the CMV factor to single-indicator constructs, only four were significant. Additionally the average substantively explained variance of the indicators was .81, while the average method-based variance was only .01. Thus, we conclude that the method is not a serious concern for this study.

5. Results

A structural equation modeling (SEM) approach was adopted in our data analysis, as it possesses many advantages over traditional methods, such as multiple regression (see Gefen et al., 2000 for details). The variance-based partial least square (PLS) method was chosen over covariance-based methods, such as LISREL, as PLS is relatively robust to deviations from a multivariate distribution (Gefen et al., 2000) and it is appropriate for testing theories in the early stages of development (Fornell and Bookstein, 1982). The web-poll application is new, as well as the combination of constructs used in the current investigation. Therefore, the PLS method is most appropriate to support the confirmatory and exploratory aspects of this research.

The results of the PLS analysis of the research model shown in Fig. 1, are presented in Fig. 2. As recommended

Table 6
Interactivity–trust/enjoyment/efficiency/effectiveness correlation matrix and VIFs.

	R1	R2	R3	R4	R5	UC1	UC2	CONN1	CONN2	CONN3	VIF
Trust	.245	.247	.323	.266	.302	.303	.341	.387	.330	.362	–
Enjoy	.337	.313	.408	.320	.475	.346	.319	.402	.377	.281	–
Effi	.350	.336	.358	.405	.356	.247	.356	.358	.324	.308	–
Effe	.252	.281	.359	.381	.394	.302	.326	.339	.325	.313	–
R1	1.000	.757	.604	.581	.557	.077	.206	.335	.361	.241	2.776
R2		1.000	.543	.652	.566	.099	.169	.351	.370	.229	2.887
R3			1.000	.639	.628	.290	.361	.294	.315	.246	2.323
R4				1.000	.634	.197	.267	.341	.311	.227	2.381
R5					1.000	.198	.235	.321	.330	.242	2.068
UC1						1.000	.676	.262	.197	.254	1.934
UC2							1.000	.368	.302	.269	2.091
CONN1								1.000	.607	.550	1.906
CONN2									1.000	.581	1.952
CONN3										1.000	1.699

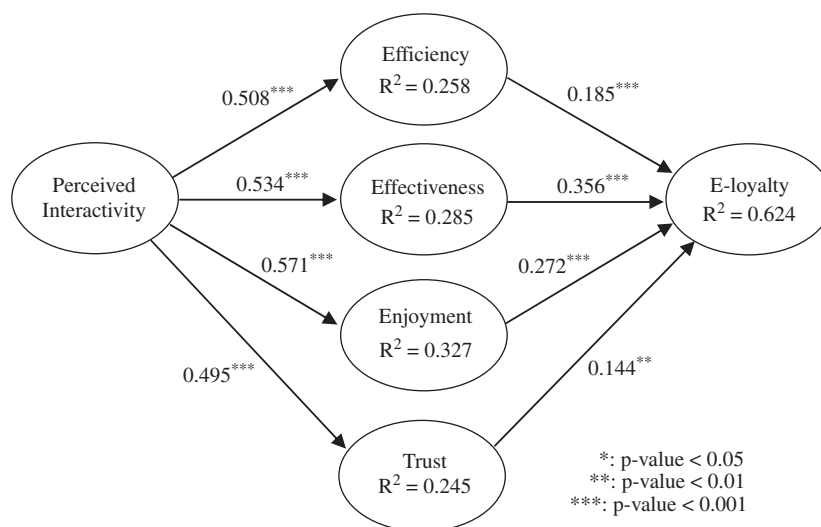


Fig. 2. PLS structural model ($n = 330$).

by Chin (1998), bootstrapping (with 500 sub-samples) was performed to test the statistical significance of each path coefficient using t -tests. All path coefficients of the causal links in our hypothesized model are significant. Since PLS does not generate an overall goodness-of-fit index (as with LISREL), model validity is primarily assessed by examining the structural paths and R^2 values. (Chwelos et al., 2001). Approximately 62% of the variance in the e-loyalty towards websites was accounted for by the variables in the model ($R^2 = .624$). Additionally, the R^2 of all endogenous constructs in the model exceed the 10% benchmark recommended by Falk and Miller (1992). Table 7 summarizes the results of the hypotheses tests.

The above model hypothesized that Efficiency, Effectiveness, Enjoyment and Trust mediate the relationship between Perceived Interactivity and e-loyalty. To test for mediation, the Sobel test was conducted, as recommended by Preacher and Hayes (2004). To do so, a direct path was added to the model of Fig. 2 between Perceived Interactivity and e-loyalty and the significance of the four indirect paths were tested with Sobel's formula. As shown in Table 8, all indirect paths were significant. Additionally, the direct path between Perceived Interactivity and e-Loyalty was insignificant (path coefficient = .037; t -statistic = .79). Thus, it appears that Efficiency, Effectiveness, Enjoyment and Trust fully mediate the relationship between Perceived Interactivity and e-Loyalty.

5.1. Exploratory analysis of qualitative data

Grounded theory (Glaser and Strauss, 1967) was used as the basis for analyzing subjects' responses in the open-ended questions. This is an inductive form of analysis, where the goal is to formulate theory through the gathering and systematic analysis of qualitative data. Qualitative data is analyzed using a three-stage iterative process. In the first stage, respondents' comments are reviewed and open

Table 7
Results of hypotheses tests.

Hypothesis	Supported?
Hypothesis 1: Perceived interactivity is a second-order formative construct, with User Control, Connectedness and Responsiveness as its three constituent components.	Yes. Construct validation demonstrated.
Hypothesis 2: Higher levels of Perceived Interactivity will result in higher levels of Efficiency of the website.	Yes. $t = 9.583^{***}$
Hypothesis 3: Higher levels of Perceived Interactivity will result in higher levels of Effectiveness of the website.	Yes. $t = 11.516^{***}$
Hypothesis 4: Higher levels of Efficiency of the website will result in higher levels of e-loyalty.	Yes. $t = 3.662^{***}$
Hypothesis 5: Higher levels of Effectiveness of the website will result in higher levels of e-loyalty.	Yes. $t = 7.178^{***}$
Hypothesis 6: Higher levels of Perceived Interactivity of the website will result in higher levels of Trust.	Yes. $t = 10.883^{***}$
Hypothesis 7: Higher levels of Trust in the website will result in higher levels of e-loyalty.	Yes. $t = 2.754^{**}$
Hypothesis 8: Higher levels of Perceived Interactivity of the website will result in higher levels of Enjoyment.	Yes. $t = 13.231^{***}$
Hypothesis 9: Higher levels of Enjoyment of the website will result in higher levels of e-loyalty.	Yes. $t = 5.004^{***}$

** p -value < 0.01; *** p -value < .001.

Table 8
Mediation test.

Indirect paths	Sobel test statistic	P
PI → Efficiency → e-loyalty	3.27	.001
PI → Effectiveness → e-loyalty	6.00	.000
PI → Enjoyment → e-loyalty	4.28	.000
PI → Trust → e-loyalty	2.61	.009

coding is used to identify shared characteristics and generate initial descriptive categories. For our analysis, two independent coders performed open coding as well as in vivo coding. In the former, arbitrary labels are used to code the data and in the latter the respondents' exact words are used as the basis for a code. In the second stage of qualitative data analysis, initially identified categories are further scrutinized and integrated into more centralized categories. In the final stage, the use of selective coding allows the synthesis of these centralized categories into overriding themes or concepts (Strauss and Corbin, 1990). Three researchers were involved in this final stage to synthesize centralized categories into the following five main concepts:

- *Aesthetics*: Visual design qualities that lend a sense of attractiveness or pleasant appearance to the website. This concept is encapsulated by codes like 'cute', 'bright', and 'unique design'.
- *Affective property*: Refers to design elements with emotion inciting qualities. The codes 'exciting', 'fun', and 'personal warmth' are examples of affective properties.
- *Functional property*: Elements of website structure including information design, navigation, and layout. Code examples include 'organized', 'informative', and 'lacking detail'.
- *Interactivity*: Elements of the website that give users various opportunities to interact with the site and other users. Examples of codes include 'limited feedback', 'opportunity to view other's opinions', and 'immediate response to rating input'.
- *Trustworthiness*: Refers to the degree users trust the website and its content in making their decisions. This concept is encapsulated by codes like 'credible', 'faked', and 'biased'.

An ANOVA manipulation check revealed that from a quantitative point of view, there were no statistically significant differences between web-poll treatments in terms of perceived interactivity (or any other measured construct). Construct means and standard deviations for the five treatment conditions are shown in Table 9. However, qualitative analysis of open-ended questions revealed some interesting insights. Table 10 summarizes

positive and negative concepts elicited from the open-ended questions across web-poll treatments, as well as provides illustrative quotes from participants. The only positive comments for the control treatment (T1) centered on concepts of aesthetics and functionality. While this treatment provided some customer reviews, it did not allow users to provide input via a web-poll or other mechanism. Comments related to trustworthiness and interactivity only appeared in the negative for this treatment. For the other treatments, which provided different types of web-poll interfaces, positive comments emerged for both trustworthiness and interactivity.

When users were offered opportunities to provide input via a web-poll many of their comments centered on their desire to be afforded additional forms of input to increase credibility. This was particularly evident in the treatments that provided the most complex web-polls (T3: 3 × 3 web-poll matrix; T4: pre- and post-event continuous scale web-polls). Participants in these conditions commented that the web-poll ratings would likely influence their decisions, but strongly encouraged further user input through discussion groups and blogs. It appears that stimulating interaction through advanced web-polls also stimulates the desire for further interaction via other 'more credible' methods. This prominent observation from the open-ended questions can help to explain the lack of significant differences in perceived interactivity between the web-poll treatments. As expected, simple web-poll treatments rated low on the perceived interactivity scale. However, advanced web-poll treatments also rated rather low on the perceived interactivity scale as they stimulated the desire for further interaction, which was not being fulfilled in the experimental treatments due to credibility or other issues.

6. Discussion and conclusions

In this study the outcomes of perceived interactivity were investigated, with subsequent impacts on e-loyalty. The model as developed and tested supports all hypothesized relationships, and confirms the importance of cognitive, cognitive-affective and affective components of interactivity. With reference to our theoretical framework that builds on TRA and TAM, this research offers a new model which

Table 9
Construct means and standard deviations for the five treatment conditions.

	Perceived interactivity		Effectiveness		Efficiency		Enjoyment		Trust		e-Loyalty	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
Condition 1	5.36	.74	5.13	1.15	4.92	1.17	4.84	1.04	4.97	1.20	4.98	1.57
Condition 2	5.31	.70	5.07	1.04	5.10	.87	5.03	1.08	4.82	1.02	5.22	.87
Condition 3	5.28	.91	4.84	1.11	4.87	1.06	5.00	1.19	4.84	1.14	5.05	1.26
Condition 4	5.04	.79	4.83	.91	4.64	1.00	4.84	1.03	4.79	1.01	4.61	1.31
Condition 5	5.13	.87	4.95	1.03	4.82	1.08	4.78	1.01	4.74	1.10	4.94	1.36

Table 10
Summary of qualitative analysis (from open-ended questions).

Web-poll treatment	Positive emerging concepts	Negative emerging concepts
T1	<p><u>Aesthetics</u>: “attractive and pleasant”; “clean and simple”</p> <p><u>Functional</u>: “well laid out”; “easy to find information”; “nicely organized”</p>	<p><u>Aesthetics</u>: “should be more eye-catching”; “people may easily lose their interest in using the website”; “design doesn’t interest me”</p> <p><u>Functional</u>: “didn’t like the lack of detail”</p> <p><u>Interactivity</u>: “needs more interacting with user”; “limited feedback”</p> <p><u>Trustworthiness</u>: “not very trustworthy”; “testimonials may or may not be faked”; “doubts about customer reviews”; “not credible”</p>
T2	<p><u>Affective</u>: “fully grabbed my attention”; “excited to visit the website”; “eye-catching”</p> <p><u>Functional</u>: “easy access to vital information”; “well organized”</p> <p><u>Interactivity</u>: “I like to know what other people’s opinions and thoughts are”; “good to hear other people’s experiences”</p> <p><u>Trustworthiness</u>: “more trustworthy than sites that have no rating features”</p>	<p><u>Affective</u>: “information could have been presented in a manner that felt more personal”</p> <p><u>Functional</u>: “wasn’t that much information available”; “would have been better to present more options on the pole (maybe 5 rather than 3, to be more specific)”</p> <p><u>Interactivity</u>: “no place to enter my own review”; “not very interactive”</p> <p><u>Trustworthiness</u>: “chances of dishonesty in the ratings”; “everyone who visits the website can vote on it ... the results might not be that accurate”; “seemed fake”</p>
T3	<p><u>Aesthetics</u>: “very cute design”; “easy on the eyes”; “visually appealing”; “unique”</p> <p><u>Affective</u>: “makes the customers feel more empowered by allowing them to influence others using the poll system”; “it has a ‘warm’ feeling to it”</p> <p><u>Functional</u>: “the rating feature is useful since it helps people to make decisions”</p> <p><u>Interactivity</u>: “interactive and different”; “keeps me entertained because the website is interactive”</p> <p><u>Trustworthiness</u>: “the rating will totally affect my decision”</p>	<p><u>Functional</u>: “it would be more helpful if there were more ratings”; “the rating system was a bit rigid...I was locked into only a 3 × 3 grid”; “a bit confusing, unclear”; “I don’t really get the difference between a bigger and smaller dot”; “confusing to new users since not everyone may understand the different graphs”</p> <p><u>Interactivity</u>: “need more customer reviews”; “I couldn’t interact with previous customers through a discussion group/blog etc”</p> <p><u>Trustworthiness</u>: “lack of credibility”; “I hate websites where customer feedback is shown ...it’s clear that they have removed any bad comments”; “biased ...people can vote many</p>

Table 10 (continued)

Web-poll treatment	Positive emerging concepts	Negative emerging concepts
T4	<p><u>Aesthetics</u>: “eye-catching”; “very creative”; “very unique”; “stylish and innovative”</p> <p><u>Affective</u>: “puts me in a vacation mood”; “entertaining”; “fun”</p> <p><u>Interactivity</u>: “liked the before and after experience rating”; “increased the interaction and it seems more interesting”; “really enjoyed the customer experience ...allows clients to interact with other users”</p> <p><u>Trustworthiness</u>: “not rated by the company ... people will value the information from people who actually visited those places more”</p>	<p>times if they wish; blog type of setting would probably be more believable”</p> <p><u>Functional</u>: “range is too short”; “confusing”; “not clear”; “would rather just have a simple star feature because it is universal and everyone understands what it means”; “prefer a range from 1 to 10”</p> <p><u>Interactivity</u>: “should be more reviews available for me to view”</p> <p><u>Trustworthiness</u>: “website might be biased”; “only people who have been to the resort should be able to rate it”; “many customers may let one negative experience cloud their judgment of the entire trip”; “credibility of the information is questionable”; “need a review from some official and credible third party organization”</p>
T5	<p><u>Aesthetics</u>: “design is modern/sleek”; “this was much more pleasant to look at than typical polls”</p> <p><u>Affective</u>: “enjoyable”</p> <p><u>Functional</u>: “clear format”; “very easy to use, user friendly”; “informative”</p> <p><u>Interactivity</u>: “liked seeing other peoples’ opinions on the places”</p> <p><u>Trustworthiness</u>: “rating feature was very useful ...decision-making is made easier”</p>	<p><u>Functional</u>: “a further breakdown as to the components that go into the overall vacation rating would be useful”</p> <p><u>Interactivity</u>: “add a place for comments ...instead of only a poll”; “wasn’t much interactivity...just a rating on the overall trip”</p> <p><u>Trustworthiness</u>: “big credibility issues...anyone visiting the website can vote on the web-poll”; “always risk of people filling it out to purposely hurt the ratings”; “as more people participate, it would be more reliable”</p>

not only includes a cognitive component (for efficiency and effectiveness) and an affective component (for enjoyment), but now adds a third cognitive–affective component (trust) related to an IT artifact and leading to e-loyalty. In this instance, three levels of belief expectation result in behavioral intention. As argued by Komiak and Benbasat (2006), our model applies in conditions when behavior is voluntary and when the user has first-hand experience of the task.

In addition to survey data, qualitative comments from participants provide further insights into how interactivity impacts the user. Taken collectively, the study provides new insights into the merits of website interactivity. The treatments employed offer novel applications into information visualization, and as such are useful to both researchers as well as to practitioners.

As set out in the Introduction of this paper, this research achieves the primary goal of examining perceived interactivity (effectively modeled as a formative construct that includes user control, connectedness, and responsiveness) in relation to cognitive perceptions (for efficiency and effectiveness), cognitive-affective perceptions (for trust), and affective perception (for enjoyment). Further, we found that efficiency, effectiveness, enjoyment and trust resulted in e-loyalty. In support of Lee (2005) user control, connectedness, and responsiveness all contribute to a construct for perceived interactivity. Further, we explored five treatments of web-poll design which afford new perspectives on how information can be visualized for and received from the user, and subsequently differences in user reactions to the various conditions. This provides an extension to some of the information display format as advocated by Tufte (1990), and suggests there is considerable room for growth in various forms of visual representations of data in a variety of contexts.

In the following sections both theoretical and practical considerations of this research are discussed, as well as limitations to this work, and future directions for research resulting from this investigation.

6.1. Theoretical and practical contributions

Benbasat and Barki (2007) extend a call for researchers to expand theoretical IT frameworks beyond TAM and to consider artifact design. This research responds to this request and is focused on how design of the IT artifact is able to influence user perceptions. Further, Benbasat and Barki recommend a return to the Theory of Reasoned Action in order to explore antecedents such as artifact design related to the user experience. Our model, based on TRA, successfully supports how web poll design can influence user perceptions and intentions. While we have chosen to examine web polls as a prototype in this research, we propose these findings have application in other areas of HCI and e-commerce.

The current investigation is based on previous studies on interactivity by Teo et al. (2003), Lee (2005) and those studying trust, enjoyment, and loyalty in e-commerce settings (Cyr et al., 2007; Childers et al., 2001; van der Heijden, 2003), as previously outlined. More specifically, this study supports the work by Teo et al. (2003) in that interactivity results in effectiveness and efficiency now tested with web poll designs. In line with previous research on social presence and e-loyalty (Cyr et al., 2007), effectiveness and efficiency of the website were significantly related to e-loyalty. Based on qualitative findings, the

emergent Functional concept adds additional information to support the definition provided by Rice (1984) that interactivity includes the user's ability to have easy access to relevant content, as well as control over that content. In alignment with Davis (1989) ease of use is important. Overall, these findings represent an extension to previous work on design characteristics and e-loyalty to now include interactivity leading to efficiency and effectiveness as a precursor to positive and repeat customer relations.

Further, interactivity results in enjoyment and ultimately e-loyalty. As such, interactivity has a hedonic component, supporting work by Childers et al. (2001) and van der Heijden (2003) now tested with different web-poll treatments. This is further supported in the concepts for Aesthetics and Affective properties emerging from the qualitative data. The visual appeal of the web-poll design seemed to be important not only to elicit positive impressions of the website, but also emotive commentary such as the website was "exciting". To our knowledge, this is the first time perceived interactivity has been linked to enjoyment in website design.

Although there has been considerable work on trust in e-commerce (Casalo et al., 2007; Chen and Dhillon, 2003; Gefen et al., 2003; Koufaris, 2002) it has not focused on interactivity components. Nor has previous research focused sufficiently on the IT artifact related to consumer trust (Vance et al., 2008). Both goals are fulfilled in this study through an investigation in which the relationship of perceived interactivity to trust is supported in a desktop online environment using various web-poll applications. Qualitative comments supported that interactivity seemed central to providing the user with a sense of trust. Having rating features on the website was mentioned to make the website more trustworthy, with the ability to affect a user's decision about a product or service. On the negative side, several users mentioned the ratings may be unreliable or "faked". As such, the vendor or website designer may want to assure users of the credibility of the information offered.

The findings suggest that perceived interactivity has positive effects on the user that ultimately result in e-loyal behavior. Hence, if online web designers and marketers wish to attract and retain customers then enhancement of web features that allow user interactivity is desirable. Treatments 3, 4, and 5 as developed specifically for this study present innovations in web-polling. As such they offer prototypes to designers for how to create new forms of information visualization with interactive components. The applications used in this study offer presentations of data, as well as the ability of the user, to capture data based on assessments by other users. The value of this work goes beyond e-commerce to include applications for other groups such as online communities, social networking and Web 2.0 environments. For instance, the work by Ivanov et al. (2006) involved web-polling on a site for sharing medical information. As with Ivanov et al. (2006) it is quite likely that use of multivariate visualizations as in

this study can potentially serve to engage otherwise low-frequency contributors.

Although five different web-poll treatments were used in this study, there were no statistically significant differences between the treatments in terms of perceived interactivity. Instead, the exploratory qualitative analysis of the various web-poll treatments provides some interesting insights for web developers and proposed areas for future investigation. For example, while perceived interactivity has positive consequences, designers should employ appropriate combinations of interactivity mechanisms to increase credibility. Web-polls, and advanced web-polls in particular, stimulate the desire for interaction and input. Once this desire is activated, users may feel unfulfilled if they are not given an opportunity to interact at different levels. Coupling web-polls with discussion forums and blogs can help to build credibility and fulfillment with the interaction experience. Since this is a new area, and web poll manipulations such as those created for this study are rare or nonexistent, there is much potential for future research to examine levels of interactivity in web-polls or other media as they impact the user.

Also worth noting, explanations regarding how to use the various treatments were not provided to users at the onset of the experiment. Since we did not include these explanations there may have been some confusion among users as to how to use the designs. This could be a contributing factor for why we did not see differences among the treatments and presents a methodological opportunity for future research.

6.2. Research limitations and future directions

A student population was recruited for the study. As with most research in which student participants are used, the findings from this study can be further expanded using

a broader base of Web users. Although it is important to note a student sample is representative and appropriate for e-retailing research since students are frequent users of the Internet for communication and commercial transactions (Walczuch and Lundgren, 2004). In fact, in the current sample 99 percent considered themselves experienced Internet users.

One type of website (for travel planning) was chosen as the basis for experimental manipulations in order to provide a controlled set of conditions for the user. However, the websites offered limited functionality. Additional research could examine the impact of interactivity on real websites and with different types of websites for products as well as for services.

As noted above, users did not perceive the levels of interactivity between the web-poll designs to be statistically different. This occurs despite face validity in that indeed the designs appear quite different, and qualitative analysis that supports perceived differences across the treatments. These discrepant results may result from users who did not consider any of the interfaces to be especially low (i.e. below the midpoint on the scale) for interactivity. In future research, it is suggested a traditional manipulation of the three dimensions of interactivity at high/low levels be conducted to determine if statistically significant differences in the treatment conditions are perceived by users.

To conclude, this research aimed to examine perceived interactivity in a web-poll context. The findings support the utility of interactivity as it positively impacts efficiency, effectiveness, enjoyment, and trust for the user. In turn, e-loyal users are created. It is expected that with more sophisticated tools and applications for the Internet, innovations will be increasingly developed to best engage users with products, services, and other users in online environments.

Appendix A. Data representation and web-polls

Web-polls are used in a variety of contexts from political opinion polls to social networking forums to obtain input from web users, which is then displayed for others visiting the site. The web poll will ideally be useful in terms of information acquisition, as well as be engaging and interactive. However, examples of web-based polling interfaces that employ novel interactive formats are scarce, with most interfaces using a typical bar or pie chart. As Ivanov et al. (2006) suggest, web-polls have evolved very little since the early days of the Web. While simplicity in information display is considered a desirable norm, graphically rich formats are sometimes necessary for visually encoding multi-dimensional data (Tufte, 1990). In the context of interactive applications such as web-polls, there is also the question of how to *capture* this data. Most web-polls still require users to click on the 'radio button'—as in the screenshot from an online news site, shown in the left portion of Fig. A1. Note how the process of data capture in this way is completely separate from that of data visualization. Even star-ratings on sites like Amazon.com when sophisticated algorithms for collaborative filtering are used would hardly be considered highly engaging forms of interactivity.

To illustrate how web-polls can be made more engaging, the mood web-poll example as mentioned in the Introduction is elaborated. This prototype was deployed at an online support group dedicated to the herbal antidepressant. As shown by the right portion of Fig. A1, users are queried with respect to two variables: the number of weeks the user has taken the product, and the level of mood improvement since starting treatment. The third variable, or number of users reporting a particular mood at the given time, was automatically calculated as in a traditional web-poll but indicated here by the size of the visual marker (yellow bubbles). Clicking on any part of this canvas will numerically add the respective user's vote to the

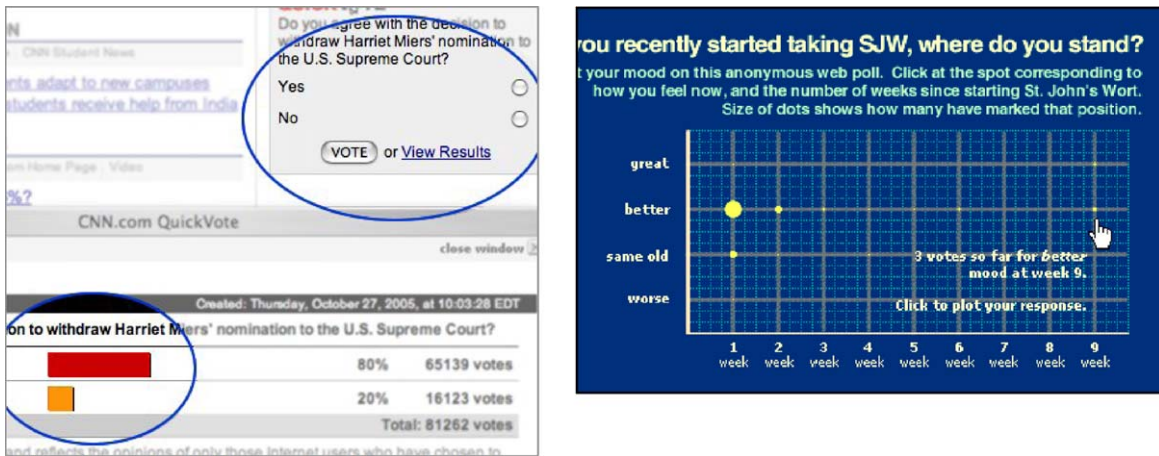


Fig. A1. Basic and enhanced web-polling interfaces.

existing number, while visually enlarging the bubble (indicating the added weight of the vote). The action of user response and visualization happen synchronously—at the same time and same place. Such information displays, argue Ivanov et al. (2006), are similar to the “small multiples” format described by Tufte (1990). The novelty of their application is in the Web context, as here the artifact serves as both a static information display and an interface for information capture. Gone are the ‘radio’ and ‘Vote’ buttons. Users directly *plot* their mood via one-click action, which also visibly alters the state of the visualization, in real-time, and available for others to see.

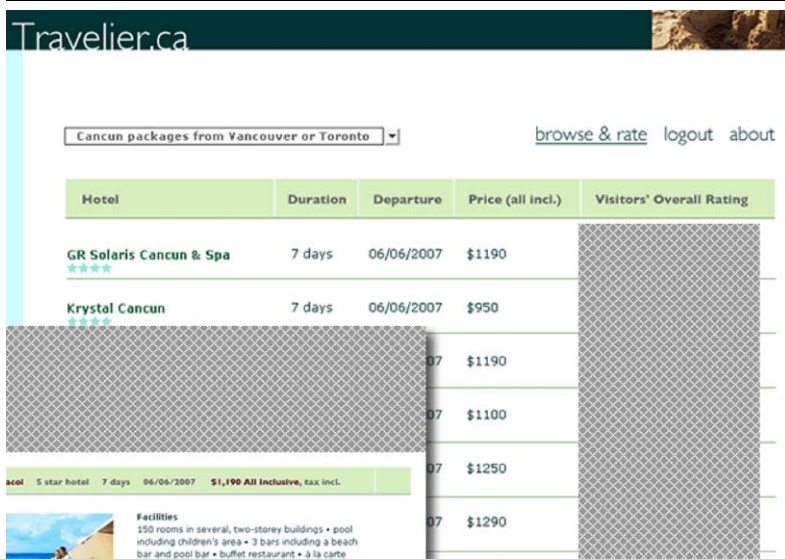
Other research on advanced web-polling systems is scattered. It ranges from Ahamad et al. (1991) who developed an efficient algorithm for finding a given quorum, to Jones et al. (2004) who tested audience voting at the Athens Olympic Games. More relevant to e-commerce contexts, Yu (2004) conducted a usability study of a web page for evaluating package tours, but the interface did not feature any interactive information visualization. In fact, guidance for designing web-polls is limited. However, Salz and Voss (2003) recommend that for web-polls the computation of aggregated results will ideally be performed automatically and presented to users as soon as possible in the same application for increased transparency.

Appendix B. Experimental treatments

A contribution of the current investigation is to create five realistic designs for interactivity in a web-poll context. While some of the treatments have historical precedent, others are innovations in the information visualization field.

Interface design element

Description



The ‘branding’ elements and factual content was common to all treatments, as participants browsed three pages: first, an overview page summarizing 10 packages and ratings. Two of these items were ‘clickable’ and led to two detailed pages with resort descriptions and the actual web-poll.

Grey-striped areas indicate page variation: static ratings on the right side of the overview page, and web-poll treatments on the top of the detailed pages (as in cutout).



T1—Static condition
Overview page with ratings:
 Basic ‘five-star’ display of ratings using ‘feet’ icons.
Detailed page with poll:
 No web-poll on detailed page



T2—Basic bar chart version
Overview page with ratings:
 Three-point scale displayed via horizontal bar charts.
Detailed page with poll:
 Conventional interface with radio buttons.



T3—Metaphor version
Overview page with ratings:
 Bi-variate price/value matrix with bubble size displaying number of votes.
Detailed page with poll:
 Foot-cursor plots one of nine possible value combinations on a ‘sandbox’ grid.



T4—Dynamic version
Overview page with ratings:
 Dual bar chart visualization of ‘before’ and ‘after’ user opinions. Marker saturation and lightness indicate number of votes.
Detailed page with poll:
 Foot cursor icon moves ‘seamlessly’ (via vector Flash graphic) simulating a continuous scale.



T5—Accurate version
Overview page with ratings:
 Five-point scale displayed via horizontal (and granular) bar charts.
Detailed page with poll:
 Users add their vote to chosen stack by precisely adding a bar.

Appendix C. Web poll study (survey items)

Note: Items answered on a 7-point Likert scale from strongly agree to strongly disagree.
 Perceived Interactivity

PI-1 I was in control over the information display format, condition when using this website (user control from Lee, 2005).

- PI-2 I was in control over the content of this website that I wanted to see (user control from Lee, 2005).
 PI-3 Customers share experiences about the product or service with other customers of this website (connectedness from Lee, 2005).
 PI-4 Customers of this website benefit from the community visiting the website (connectedness from Lee, 2005).
 PI-5 Customers share a common bond with other members of the customer community visiting the website (connectedness from Lee, 2005).
 PI-6 The information shown when I interacted with the site was relevant (responsiveness from Johnson et al., 2006).
 PI-7 The information shown when I interacted with the site was appropriate (responsiveness from Johnson et al., 2006).
 PI-8 The information shown when I interacted with the site met my expectations (responsiveness from Johnson et al., 2006).
 PI-9 The information shown when I interacted with the site was suitable (responsiveness from Johnson et al., 2006).
 PI-10 The information shown when I interacted with the site was useful (responsiveness from Johnson et al., 2006).

Trust (Cyr et al., 2007; Gefen and Straub, 2003)

- T-1 I can trust this website.
 T-2 I trust the information presented on this website.
 T-3 I feel this online vendor would provide me with good service.

Effectiveness (Teo et al., 2003)

- EFFE-1 The website increased my awareness of the merits and demerits of the travel spot.
 EFFE-2 The website provided me with relevant information to facilitate my decision.
 EFFE-3 The website helped me to meet my decision-making need.

Efficiency (Teo et al., 2003)

- EFFI-1 I could easily search for information.
 EFFI-2 I was able to access the information I needed quickly.
 EFFI-3 It took little effort to find the information I needed.
 EFFI-4 The website allowed me to make a decision quickly.

Enjoyment (Cyr et al., 2007)

- E-1 I found my visit to this website interesting.
 E-2 I found my visit to this website entertaining.
 E-3 I found my visit to this website enjoyable.
 E-4 I found my visit to the website pleasant.

Loyalty (Cyr et al., 2005; Luarn and Lin, 2003)

- L-1 If this were a real website, it is very likely that I did visit it again in the future.
 L-2 If this were a real website, I did return to it the next time I was looking for travel information.
 L-3 If this were a real website, I would use it again.

Appendix D. Using PLS to assess common methods variance

Podsakoff et al. (2003) outline a statistical approach for assessing common methods variance described as “*controlling for the effects of a single unmeasured latent method factor*” (p. 23). While this method is generally applied to covariance-based SEM approaches (such as LISREL and AMOS), Liang et al. (2007) and Vance et al. (2008) have adapted this technique for PLS implementation. First, we converted each reflective indicator into a single-indicator construct. Second, we linked the original constructs to the new single-indicator constructs. Third, we linked a common methods variance

factor to all single-indicator constructs. Essentially, all major reflective constructs and the common methods factor became second-order constructs. Finally, a PLS bootstrap was executed with 200 resamples.

We examined the coefficients of the two incoming paths for each single-indicator construct, one from its substantive construct and one from the common methods factor. The results for this analysis are shown in Table D1. As per Liang et al. (p. 87), “The square values of the method factor loadings were interpreted as the percentage of indicator variance caused by methods, whereas the square loadings of substantive constructs were interpreted as the percent of indicator variance caused by substantive constructs. If the method factor loadings are insignificant and the indicator’s substantive variances are substantially greater than their method variances, we can conclude that common method bias is unlikely to be a serious concern”. The average of the substantively explained variances shown in Table D1 was .81, whereas the average method-based variance is .01. Additionally, most method factor loadings were not significant (4 out of 17 paths were significant), whereas all substantive factor loading were highly significant. Thus, we contend that the method is unlikely to be a serious concern for this study.

Table D1
Common methods bias path coefficients.

Path	Coefficient	t-Statistic	R ²
Common methods variance factor loadings			
CMV → Effe1	-.21	3.89	.044
CMV → Effe2	.03	.65	.001
CMV → Effe3	.16	4.44	.026
CMV → Effi1	-.01	.09	.000
CMV → Effi2	-.06	1.13	.004
CMV → Effi3	-.10	.72	.010
CMV → Effi4	.17	1.90	.029
CMV → E1	.06	1.40	.004
CMV → E2	-.08	1.82	.006
CMV → E3	-.02	.57	.000
CMV → E4	.04	1.11	.002
CMV → T1	-.05	1.56	.003
CMV → T2	-.10	3.69	.010
CMV → T3	.16	3.49	.026
CMV → L1	.04	1.11	.002
CMV → L2	.02	.67	.000
CMV → L3	-.06	1.18	.004
Substantive constructs factor loadings			
Effectiveness → Effe1	.99	19.72	.980
Effectiveness → Effe2	.89	27.09	.792
Effectiveness → Effe3	.78	24.56	.608
Efficiency → Effi1	.86	17.44	.740
Efficiency → Effi2	.94	22.39	.884
Efficiency → Effi3	.78	6.218	.608
Efficiency → Effi4	.60	7.06	.360
Enjoyment → E1	.88	24.13	.774
Enjoyment → E2	.99	27.77	.980
Enjoyment → E3	.97	34.44	.941
Enjoyment → E4	.88	26.37	.774
Trust → T1	.98	34.23	.960
Trust → T2	1.00	50.46	1.000
Trust → T3	.77	18.22	.593
Loyalty → L1	.92	27.78	.846
Loyalty → L2	.95	30.43	.903
Loyalty → L3	1.00	29.06	1.000

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