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RESEARCH ARTICLE

WHAT SIGNAL ARE YOU SENDING? HOW WEBSITE QUALITY INFLUENCES PERCEPTIONS OF PRODUCT QUALITY AND PURCHASE INTENTIONS[1]

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An electronic commerce marketing channel is fully mediated by information technology, stripping away much of a product's physical informational cues, and creating information asymmetries (i.e., limited information). These asymmetries may impede consumers' ability to effectively assess certain types of products, thus creating challenges for online sellers. Signaling theory provides a framework for understanding how extrinsic cues—signals—can be used by sellers to convey product quality information to consumers, reducing uncertainty and facilitating a purchase or exchange. This research proposes a model to investigate website quality as a potential signal of product quality and consider the moderating effects of product information asymmetries and signal credibility. Three experiments are reported that examine the efficacy of signaling theory as a basis for predicting online consumer behavior with an experience good. The results indicate that website quality influences consumers' perceptions of product quality, which subsequently affects online purchase intentions. Additionally, website quality was found to have a greater influence on perceived product quality when consumers had higher information asymmetries. Likewise, signal credibility was found to strengthen the relationship between website quality and product quality perceptions for a high quality website. Implications for future research and website design are examined.

Keywords: Signaling theory, signals, cues, website quality, eCommerce, perceived quality, credibility, information asymmetries

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Introduction

The emergence of eCommerce has provided a wide range of retailers with a powerful marketing channel (Grandon and Pearson 2004; Jarvenpaa et al. 2000) that can reach consumers throughout the world. With an eCommerce marketing channel, all interactions are technology-mediated, and thus consumers are less able to directly assess a product—to feel, touch, inspect, and sample—resulting in a diminished capacity to judge product quality prior to purchase (Jiang and Benbasat 2004-2005). These channel limitations are accentuated by the nature of the product, *search* versus *experience*, and thus eCommerce may be a more or less effective channel depending upon the type of product (Gupta et al. 2004; Klein 1998). A search product (e.g., book) is characterized as having its quality readily apparent prior to purchase, while the quality of an experience product (e.g., clothing) is typically more difficult to evaluate prior to purchase, yet readily apparent after use (Nelson 1970). Recent eCommerce research has confirmed that consumers are more comfortable buying search products online (e.g., books, airline tickets) as compared to experience products (e.g., wine, stereo equipment) due to the challenges of evaluating experience product attributes indirectly (Gupta et al. 2004).

Online sales continue to increase (Zhang 2006) and are often the fastest growing business segment for traditional retailers, with an increasing number of retailers launching initiatives to sell more complex, high-end products on their websites (Ethier et al. 2006). In particular, the online market for experience products provides a substantial and largely untapped revenue source (Gupta et al. 2004), but represents a challenge for online sellers, as the technology-mediated environment makes it more difficult to convey the experiential attributes associated with such products (e.g., taste, sound, fit). While some researchers are investigating how a virtual product experience (VPE) provided through a Web interface can better convey visual product attributes (Coyle and Thorson 2001; Jiang and Benbasat 2004-2005, 2007; Li et al. 2002), the eCommerce channel remains limited in conveying experiential attributes as compared to a physical store. Thus, eCommerce research and practice may be informed by drawing on consumer behavior applications of signaling theory (Kirmani and Rao 2000; Rao et al. 1999) to explore how cues such as website quality can be used to signal product quality when key product attributes cannot be readily discerned.

Signaling theory has been used to identify and understand the cues (i.e., signals) consumers use to make accurate assessments of quality when faced with limited information about a product (Kirmani and Rao 2000). Common signals used in traditional, offline commerce include brand (Erdem and Swait 1998), retailer reputation (Chu and Chu 1994), price (Dawar and Parker 1994), and store environment (Baker et al. 1994). Among these commonly accepted signals, it has been suggested that store environment possesses a strong parallel to an eCommerce website (Watson et al. 2000), and thus an opportunity exists to extend product quality signaling to an online domain. Given the multitude of online retailers, many of which are unknown to consumers (King et al. 2004), and the challenges of conveying product attributes in a technology-mediated environment, a potentially powerful signal for assessing product quality may be the website itself. This research poses the following question: *Does website quality manifest as an effective signal of product quality within an eCommerce marketing channel?* Based on the qualifying conditions of signaling theory, we further consider: *How do information asymmetries and signal credibility influence the potential relationship between website quality and product quality?*

Signaling theory has been applied in an eCommerce context to investigate how traditional signals (e.g., reputation, warranties, and advertising expense) influence trust and perceived risk with an online retailer (Aiken and Boush 2006; Biswas and Biswas 2004; Wang et al. 2004; Yen 2006). The results suggest that such signals may be more important in an online marketing channel than in an offline one (Biswas and Biswas 2004), given the information asymmetries that can accompany a technology-mediated channel. Website quality, however, has not been theoretically framed and investigated as a signal of product quality. Information Systems research has reported the influence of website quality on trust with an online retailer and purchase intentions (Everard and Galletta 2005; Gregg and Walczak 2008; McKnight et al. 2002), and some research has considered how website quality influences brand-related perceptions (e.g., Gwee et al. 2002; Lowry et al. 2008). An examination of website quality as a signal of product quality can contribute to our theoretical understanding of how website quality influences the online shopping experience, as well as inform website design.

This paper reports on a series of experimental studies that examine the efficacy of signaling theory for predicting how website quality, asymmetries of information, and signal credibility influence perceptions of product quality and, subsequently, online purchase intentions. We first present and synthesize the signaling theory literature, and then frame website quality as a signal of product quality within a research model that depicts the moderating effects of asymmetries of information and signal credibility. The research design and analysis for three experimental studies are described, and the paper concludes with a discussion of implications for theory, practice, and future research.

Signaling Theory

Signaling theory has been studied extensively in disciplines such as finance (Benartzi et al. 1997; Robbins and Schatzberg 1986), management (Certo 2003; Turban and Greening 1997), and marketing (Boulding and Kirmani 1993; Kirmani 1997; Kirmani and Rao 2000; Rao et al. 1999) as a framework for understanding how two parties (e.g., buyer and seller) address limited or hidden information in precontractual (prepurchase) contexts. From a consumer perspective, signaling theory has been applied to understand how consumers assess product quality when faced with information asymmetries (Kirmani and Rao 2000). A *signal* is a cue that a seller can use "to convey information credibly about unobservable product quality to the buyer" (Rao et al. 1999, p. 259). Signaling theory has been applied in such contexts because it focuses on precontractual information problems and specifies the conditions under which the theory is applicable (i.e., information asymmetries before and after purchase, signal credibility). Broader theories such as agency theory address both pre- and post-contractual information problems (Bergen et al. 1992) and are less specific about qualifying conditions, while more narrow theories such as source credibility (Grewal et al. 1994; Hovland and Weiss 1951) do not address the nature of signals or information asymmetries.

Signals

A review of the signaling and cue utilization literature highlights why signals are generally *extrinsic to the product* and are more confidently assessed by consumers (i.e., *higher confidence value*). Extrinsic cues are product-related attributes that are not inherent to the product being evaluated, such that changes to these attributes do not alter the fundamental nature of the product (Richardson et al. 1994). Intrinsic cues are product attributes that, if altered, change the fundamental nature of the product (Richardson et al. 1994). Using a personal computer (PC) as an example, price would be an extrinsic cue, and the internal components used in the PC would be intrinsic cues. While consumers use both intrinsic and extrinsic cues to assess product quality, extrinsic cues may be more influential in certain contexts, such as when extrinsic cues are more readily available or more easily understood than intrinsic cues (Dawar and Parker 1994; Zeithaml 1988). Consumers with limited time (Zeithaml 1988) or who have a lower need for cognition (i.e., individuals who are cognitive misers and less apt to engage in elaborative thinking) (Chatterjee et al. 2002), are also more likely to rely on extrinsic cues. As stated earlier, common extrinsic attributes used as signals include brand (Erdem and Swait 1998), retailer reputation (Chu and Chu 1994), price (Dawar and Parker 1994), warranties (Boulding and Kirmani 1993), and store environment (Baker et al. 1994; Bloom and Reve 1990).

Information cues provide utility for consumers based on the predictive value and the confidence value of the cue (Cox 1967). *Predictive value* is defined as "the degree to which consumers associate a given cue with product quality" while *confidence value* is defined as "the degree to which consumers have confidence in their ability to use and judge a cue accurately" (Richardson et al. 1994, p. 29). The internal components of a PC (intrinsic attributes) may be highly predictive of PC quality, but a consumer with less knowledge of PC hardware will be less confident about assessing such attributes accurately. The confidence value assigned to extrinsic attributes, such as price and brand, is generally higher than the confidence value assigned to intrinsic attributes because extrinsic attributes are more easily recognized and processed (Richardson et al. 1994; Zeithaml 1988). Empirical studies have shown that consumers with low product familiarity rely more on extrinsic cues because of their inability to use and judge intrinsic product cues (Rao and Monroe 1988). In summary, when intrinsic product attributes are not readily available or when consumers are not confident in their ability to assess these attributes, consumers will rely more on extrinsic product attributes.

Asymmetries of Information

Asymmetries of information can be further described by *prepurchase information scarcity* and *post-purchase information clarity* (Kirmani and Rao 2000). Prepurchase information scarcity occurs when a consumer cannot access or interpret a product's quality attributes prior to making a purchase. Post-purchase information clarity occurs when a consumer can readily assess the quality of a product immediately after purchase or use. For example, the online purchase of a clothing item can have a high level of prepurchase information scarcity, as the consumer cannot physically inspect or try on the clothing prior to purchase. After receiving and wearing the item, however, the consumer can have high post-purchase information clarity because the fit and durability of the product are now readily apparent. This information scarcity and clarity can vary depending upon the nature of the product and the experience of the consumer.

Drawing from the information economics literature, three categories of goods help to distinguish levels of information asymmetry: search, experience, and credence (Darby and Karni 1973; Nelson 1970). A product is said to be a *search* good when it possesses high degrees of both prepurchase and post-purchase information clarity and typically does not require physical examination prior to purchase (e.g., a book).

Conversely, e*xperience* goods possess a high degree of prepurchase information scarcity and often require direct experience or use to ascertain quality (Nelson 1970). The experience gained through product use brings post-purchase clarity enabling consumers to immediately assess whether or not they purchased a high-quality product. *Credence* goods possess quality attributes that are cost prohibitive to ascertain and therefore cannot be easily assessed either before or after a purchase (e.g., automobile repair) (Darby and Karni 1973). The availability of product information can change based on consumer experience and the marketing channel, making it possible for products to change categories (Klein 1998). For example, in a repeat online purchase of a clothing item, a consumer has direct product experience based on the prior purchase, and the clothing item is now a search good for that consumer. Further, a clothing item categorized as a search good in a traditional store environment, may be better categorized as an experience good in an online marketing channel where prepurchase trial is not available.

Prepurchase information scarcity and post-purchase information clarity are qualifying conditions for signaling theory, as the unavailability of intrinsic product attributes creates the need for extrinsic signals, and post-purchase clarity enables consumers to determine whether or not these signals accurately conveyed product quality. Signaling theory is thus highly applicable to experience goods, which are often characterized by the combination of high prepurchase information scarcity and high post-purchase information clarity.

Signal Credibility

A signal is said to be credible when some wealth, investment, or reputation will be forfeited by the seller if they send a false signal and sell a low-quality product (Boulding and Kirmani 1993; Ippolito 1990). A warranty is one example of a credible signal. If a seller provides a low-quality product with a warranty, the seller will incur repair or replacement expenses when buyers make warranty claims. A seller of high-quality products will not incur these same warranty costs. The wealth or asset that will be forfeited from sending a false signal is often referred to as a bond, or form of insurance to the buyer that the seller will provide a high-quality product. Signal credibility, also referred to as bond credibility, is a key theoretical condition for a signal to be an effective mechanism for conveying high product quality. High signal or bond credibility occurs when consumers believe that the seller made a significant investment by sending a signal and the investment is at risk if a false signal is sent. A false signal is thus prohibitively expensive for a seller of low-quality products. Information economists refer to such a distinction as a *separating equilibrium*, as only sellers with high-quality products can afford to send a high credibility signal, enabling buyers to distinguish between sellers of high and low quality products (Boulding and Kirmani 1993). Conversely, a *pooling equilibrium* occurs when the benefits from sending a false signal outweigh the signal costs (Bergen et al. 1992).

In order for a separating equilibrium to occur, the consumer must recognize the investment or potential loss associated with signals such as reputation, advertising expense, warranty repairs, product price, and the cost of a high-end store environment. They must also believe that this investment (i.e., bond) is at risk if the signal is false. For example, a restaurant may charge a high price to signal hamburger quality, but the signal will only be credible if the restaurant is subject to loss (e.g., loss of repeat business and bad word of mouth) for selling a low quality hamburger. A restaurant in a busy, downtown area may be penalized for poor hamburger quality because the business relies on repeat visitors and referrals, but a roadside restaurant on a highway may be less affected by repeat visitors and referrals, making the reputational investment less vulnerable. When faced with low signal credibility, an individual can no longer assume that the signal is indicative of quality (Boulding and Kirmani 1993). Thus signaling theory is most applicable when the consumer perceives that the seller has made a substantial investment in sending a high quality signal and that this investment is at risk if the signal is false.

Signaling Outcomes

Signaling theory has been applied across various disciplines to understand how one party can signal quality to another, less-informed party, providing the necessary information for a transaction or exchange to be completed. The desired outcome in a signaling framework is for the signal to reduce the information gap, assuring the less-informed party (e.g., buyer) that they are selecting a good-quality product or service (Bloom and Reve 1990). The ultimate goal of signaling is to positively influence desired outcomes such as perceived quality (e.g., of the product, service, job applicant, stock, etc.) and behavior (e.g., purchase intentions, hiring intentions, etc.). In a consumer context, a review of the empirical research on signaling theory shows that the vast majority of studies focus on product or service quality as a key outcome with some studies also addressing uncertainty reduction, brand or organization quality, and purchase intentions.[2]

A summary of the qualifying conditions and attributes of the key constructs in signaling theory along with examples is pro-

[2]See Kirmani and Rao (2000) for a review of prior empirical research related to signaling theory from the marketing discipline.

Table 1. Signaling Theory Constructs

	Signal	Asymmetries of Information	Signal Credibility	Signal Outcome
Description	• Informational cues • Extrinsic to entity of interest • High confidence value	• Asymmetries exist • Prepurchase information scarcity • Post-purchase information clarity	• Signal involves some investment (bond) • Investment (bond) must be vulnerable • Subjective	• Improved quality perceptions • Reduced asymmetries • Completed exchange or transaction
Examples	• Price • Advertising • Warranty • Brand • Store environment	• Experience products and services (e.g., clothing, food, automobile)	• High investment or cost with future revenue dependent on repeat purchases and referrals • High cost of repairs or replacement under warranty	• Product/service quality • Brand quality • Reduced uncertainty • Trust • Purchase or transaction intention

vided in Table 1. In the next section, we apply signaling theory to the eCommerce marketing channel by considering website quality as a potential signal of product quality and address how asymmetries of information and signal credibility are manifested in this technology-mediated channel.

Applying Signaling Theory to B2C eCommerce

The IT-mediated nature of eCommerce offers organizations numerous advantages (e.g., access to more consumers, increased availability, information accessibility) but it also comes with some inherent challenges. Current technological capabilities of eCommerce limit sellers' ability to convey intrinsic product attributes (e.g., taste, smell, touch, fit, etc.) (Grewal et al. 2004). Prepurchase product trial and direct product experience are a means for presenting consumers with intrinsic cues of product quality in a traditional offline environment (Smith and Swinyard 1983), but these in-store experiences are not as readily available in an online environment (Grewal et al. 2004). Consumers also encounter more unknown retailers in an online environment (Cook and Luo 2003; Delgado-Ballester and Hernandez-Espallardo 2008; Grewal et al. 2003), creating a greater need for these sellers to differentiate themselves and to address consumers' increased perceptions of risk. Consequently, sellers using an eCommerce marketing channel must leverage informational cues or *signals* that facilitate a consumer's ability to make accurate quality assessments about its products (Pavlou et al. 2007), particularly with products that have more experiential attributes being offered by unknown retailers.

Given the asymmetries of information present in the eCommerce marketing channel, we propose a research model of website quality as a signal of product quality as shown in Figure 1. A review of the relevant IS literature suggests two streams of research that are applicable to our study— applications of signaling theory in an IS context and studies of website quality—which we now summarize.

Signaling theory has been successfully applied in IS and eCommerce marketing research, supporting the applicability of this theory to an IS context. A summary of these studies is provided in Table 2 and reveals gaps in the literature for understanding (1) how website quality functions as a signal, and (2) how this signal influences perceptions of product quality. As shown in Table 2, most marketing signaling studies in an eCommerce context have investigated how traditional signals (e.g., reputation, warranties, advertising expense, etc.) influence trust, risk, and purchase intentions with an online vendor (Aiken and Boush 2006; Biswas and Biswas 2004; Wang et al. 2004; Yen 2006). In a few studies, website quality is described as a signal (Gregg and Walczak 2008; Kim et al. 2004) or included as a relevant factor (Gwee et al. 2002; Pavlou et al. 2007), but the qualifying conditions of asymmetries of information and signal credibility have not been investigated.

The omission of perceived product quality as a signaling outcome is also revealed in Table 2. Referring back to the seminal signaling research in marketing, the primary focus was to understand how signals affect a consumer's perception of the product that was being evaluated. A key theoretical distinction in framing website quality as a signal is to describe how signal credibility and asymmetries of information influence the relationship between a signal and perceived product quality. While some eCommerce signaling research has focused on the quality of an online service (Gwee et al. 2002), product quality has been largely overlooked.

Many eCommerce studies have focused on website quality as a determinant of trust, usability, and online behavioral inten-

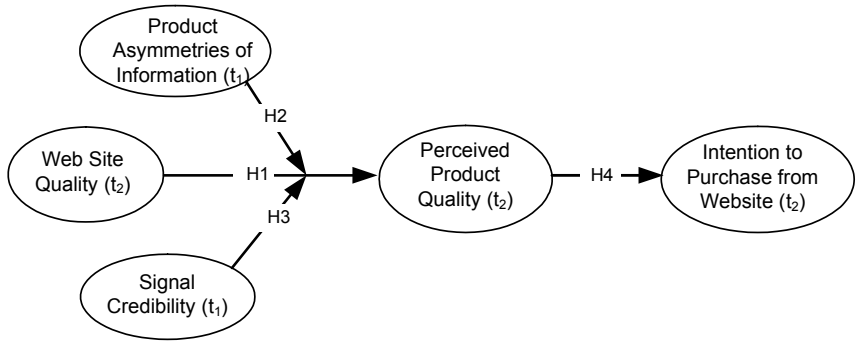

Figure 1. Research Model

tions without applying signaling theory (e.g., Collier and Bienstock 2006; Everard and Galletta 2005; Fang and Holsapple 2007; Lee and Kozar 2006; Loiacono et al. 2007; Lowry et al. 2008). Most of these studies have not addressed perceived product quality and do not differentiate between the extrinsic cues provided by the website and the intrinsic attributes of the product or vendor conveyed on the website. Measures of website quality often assess the product information conveyed on a website (e.g., information quality, accuracy, etc.), in addition to non-product-related website attributes (e.g., ease of use, entertainment, visual appeal, etc.) (Kim and Niehm 2009). While some research has considered how website quality influences brand image and awareness (e.g., Lowry et al. 2008), the website quality research stream has similarly not emphasized the influence on product quality. Signaling theory can provide new insight for eCommerce research as website quality can be conceptualized as an extrinsic cue and considered separately from the intrinsic product information conveyed on the website. Given the unique challenges associated with an eCommerce marketing channel, we argue that signaling theory is an appropriate theoretical lens for understanding how and why website quality influences perceptions of product quality. The following sections present our research hypotheses.

Website Quality as a Signal of Product Quality

A website can serve as a signal of product quality similar to how a store environment (e.g., Baker et al. 1994) serves as a signal of product quality. When consumers have incomplete information about product quality (i.e., a lack of intrinsic cues), they make inferences about product quality based on extrinsic cues that are readily available and easily evaluated (Zeithaml 1988). We now theoretically frame website quality as a signal of product quality by describing how it (1) is extrinsic to the product and (2) has a high confidence value with consumers, making it a good heuristic for assessing product quality.

Websites can convey intrinsic product attributes (such as written product features, pictures, and virtual product experiences) as well as extrinsic product-related attributes (such as price, brand, and website quality attributes). Just as stores have fine furnishings and décor, websites have attributes (e.g., visual appeal, navigability, security, response time, etc.) that can influence perceptions of product quality. These website quality attributes can function as a signal, influencing consumers independent of the intrinsic product attributes conveyed on the website. Website quality is extrinsic to the products sold on the web site, as a low quality website does not change the inherent attributes of a product being offered online, (e.g., a low quality website can offer high-quality products). Varying levels of website quality have been shown to influence online purchase intentions while conveying the same intrinsic product information (Everard and Galletta 2005), suggesting that website quality does independently influence consumer perceptions.

The confidence value of a signal reflects the consumers' ability to assess an informational cue with certainty and accuracy (Cox 1967). Consumers are generally more confident in their ability to assess extrinsic product-related attributes than intrinsic product attributes because extrinsic cues can be evaluated without any expertise or knowledge of the product (Richardson et al. 1994). Past research has demonstrated that consumers can readily assess website quality, as evidenced by measurement instruments such as WebQual (Loiacono et al. 2007) and SiteQual (Yoo and Donthu 2001). In fact, consumers have demonstrated a high degree of confidence in assessing certain aspects of website quality, with one study demonstrating that the visual appeal of a website is often assessed in less than one second (Lindgaard et al. 2006). These findings provide support for the assertion that con-

Table 2. Review of Empirical eCommerce/Information Systems Signaling Research

Authors	Signal	Other Factors	Dependent Measure(s)
Aiken and Boush (2006)	• Trustmarks • Objective-source ratings • Advertising investments	• Internet experience • Undermines	• Trust (affective, behavioral, and cognitive)
Biswas and Biswas (2004)	• Retailer reputation • Advertising expense • Warranties	• Product type (offline versus online)	• Perceived risk (performance, financial, and transaction)
Bolton et al. (2008)		• Competition • Network (strangers, partners)	• Online trust • Trustworthiness • Market efficiency
Chu et al. (2005)	• Infomediary reputation • Manufacturer, retailer brand		• Online purchase intention
Durcikova and Gray (2009)	• Knowledge validation process	• Gender, experience • Knowledge sourcing	• Knowledge quality • Knowledge contributions
Gregg and Scott (2006)	• Online reputation systems (feedback ratings)		• Fraud prediction/reduction
Gregg and Walczak (2008)	• E-image (business name, auction website attributes)	• Product type (used versus new)	• Willingness to transact online • Price premium
Gwee et al. (2002)	• Advertising intensity	• Value-added features • Innovation • Website quality	• Service quality of search engine and e-mail providers • Brand knowledge, equity
Hoxmeier (2000)	• Software preannouncements (delivery date credibility, software reliability/features)		• Vendor reputation, credibility • Vendor dependence • Software investment
Kim et al. (2004)	• Reputation • Website quality (information quality and system quality)	• Structural assurance • Service quality	• Trust in online store • Customer satisfaction
Kimery and McCord (2006)	• Third party assurance seals		• Seal familiarity
Pavlou et al (2007)		• Trust, social presence • Website informativeness • Product diagnosticity • Purchase involvement	• Information asymmetry • Fears of seller opportunism • Privacy, security concerns • Actual purchases and intentions
Song and Zahedi (2007)	• Trust signs (third party seals) • Health infomediary reputation	• Propensity to trust • Positive experiences • Structural assurance • Information quality • System quality	• Trusting beliefs • Risk beliefs • Integrity of health infomediary • Intention to use health infomediary
Su (2007)	• Price • Retailer reputation (rating) • Correlation with brand credibility	• Objective product information	• eRetailer choice strategy (expected value, brand seeking, price aversion)
Venkatesan et al. (2006)	• Retailer service quality	• Market competition	• Online product pricing strategy
Wang et al. (2004)	• Seal of approval • Return policy, awards • Security/privacy disclosures		• Trust • Willingness to provide information • Book-marking intentions
Yen (2006)	• Third-party endorsements • Presence of physical store • Clarity of warranty		• Perceived risk • Online purchase intention

sumers exhibit high levels of confidence in assessing website quality, and thus are more likely to use it when assessing product quality.

Consumers turn to signals such as store environment because they actively search for information processing "shortcuts" or heuristics that may help them assess product quality when faced with incomplete product information (Baker et al. 1994). Extrinsic cues are more important to consumers when evaluating experience goods because extrinsic cues are more readily available and easier to evaluate than intrinsic cues (Zeithaml 1988). In an online environment, website quality is said to be a critical element for online vendors due to the additional information asymmetries that are often inherent to an IT-mediated environment (Pitt et al. 1999). When the consumer has limited information about the product, website quality should influence perceived product quality because website quality is observable throughout the online shopping experience and easily evaluated, making it the most available heuristic for consumers to assess. Given that extrinsic attributes often serve as surrogates for intrinsic product attributes (Zeithaml 1988), we expect website quality, as an extrinsic attribute with high consumer confidence value, to influence consumer perceptions of product quality. Thus, we offer the following hypothesis:

H1: Perceptions of website quality positively affect a consumer's perception of product quality.

Product Asymmetries of Information in an eCommerce Context

Asymmetries of information are a qualifying condition for the application of signaling theory to an eCommerce context. Most buyer and seller exchanges are characterized by the seller having more product information than the buyer (Bergen et al. 1992), and this imbalance can be accentuated in a technology-mediated environment (Jiang and Benbasat 2004-2005). Signaling is most effective when product asymmetries of information consist of a combination of *prepurchase information scarcity* and *post-purchase information clarity* (Kirmani and Rao 2000), which aligns with the asymmetries associated with an experience good. In an online environment, a product may be perceived as more of an experience good than a search good due to the technology mediation. Thus, the eCommerce marketing channel meets the requirement of having asymmetries of information.

Given the existence of some degree of product information asymmetries, consumers will rely on a combination of product information (i.e., intrinsic attributes) and signals (i.e., extrinsic attributes) (Richardson et al. 1994) when evaluating the quality of an online product. The interplay between product information and signals is dependent on the availability of intrinsic product attributes (Zeithaml 1988). Narrow or low product information asymmetries (i.e., more product information is available) imply that a consumer has reliable knowledge of product quality, thus signals will have a lesser impact on perceptions of product quality. Broad or high product information asymmetries (i.e., less product information is available) imply that a consumer is uncertain of product quality, thus signals will have a greater impact on perceptions of product quality (Biswas and Biswas 2004). When product information asymmetries are high, consumers will place more emphasis on extrinsic product-related attributes (signals) to compensate for the lack of product information. Thus, the following hypothesis is proposed:

H2: Product asymmetries of information moderate the influence of website quality on a consumer's perception of product quality; that is, the quality of a website will have a greater, positive effect on consumer perceptions of product quality when asymmetries of information are higher as compared to when asymmetries are lower.

Signal Credibility and Website Quality

Signal credibility is another qualifying condition of signaling theory in that a signal must be perceived by a consumer as being credible in order to have a positive effect on product quality. The credibility of a signal is determined by whether or not the consumer perceives that the seller stands to lose something should the signal prove to be false (i.e., bond vulnerability). With website quality as a signal, credibility would be determined by whether or not consumers perceive that the development and maintenance of a *high quality website* requires significant expense and that future/repeat sales are at risk if product quality is poor. As a credible signal, website quality should create a separating equilibrium (i.e., separating the high-quality sellers from low-quality ones).

Similar to signals such as advertising and brand name,[3] a seller makes an upfront investment in a website and this expense is incurred regardless of whether or not a sale occurs. The seller hopes to recoup this investment through future sales. As previously discussed, consumers can readily assess

[3]Signals such as advertising and brand name are considered sale-independent, default-independent signals because the seller has incurred these expenses upfront regardless of whether any products are sold (Kirmani and Rao 2000). Other signals such as coupons, price, and warranties differ (i.e., sale-contingent, default-contingent) in that expenses are incurred (or revenues are at risk) only during the transaction or in the future.

the quality of a website (Loiacono et al. 2007; Yoo and Donthu 2001) and thus can infer the relative investment necessary to develop a high quality commercial website. The costs of developing and maintaining a high quality commercial website are not trivial (Simpson 2005), and low quality websites are still commonplace on the Internet (Flanders 2009). As a result, a separating equilibrium for website signal credibility is likely to occur because consumers can easily discern between commercial websites of high and low quality, similar to how consumers can discern the differences between high and low quality store environments. Recognition of the seller's investment in the website does not require any complex calculations or knowledge of the seller's margin or market share; instead, consumers can observe that a website is of high quality and infer that the seller needs future sales to recoup this investment.[4] Electronic word of mouth helps to insure that online sellers are penalized for sending false signals, as online consumers readily share their opinions with others through e-mail, online referrals, and blogs, and impact future sales (Reichheld and Schefter 2000).

Signaling research suggests a moderating effect of signal credibility such that a more credible signal should have a stronger effect on perceived product quality than a less credible signal (Boulding and Kirmani 1993). Signals with no credibility should have little effect or possibly a negative effect on perceived quality, as consumers realize that the signal is meaningless and may see the seller as being dishonest (Boulding and Kirmani 1993). Given website quality as a signal, if consumers believe that a high quality website is expensive and requires significant expertise, then a high quality web site should strongly influence perceived product quality, as only high quality sellers could afford (through future sales) to make such an investment. If consumers were informed, however, that a good quality website is only modestly expensive, the signaling influence on perceived product quality would be reduced as the signal's ability to differentiate among sellers has been reduced. In summary, the strength of the relationship between website quality and perceived product quality increases with the perceived credibility of the website quality signal. Thus, we offer the following hypothesis:

H3: Signal credibility moderates the influence of website quality on a consumer's perception of product quality; that is, the quality of a website will have a greater, positive effect on consumer perceptions of product quality when signal credibility is higher as compared to when signal credibility is lower.

Perceived Product Quality and Purchase Intentions

While the IS literature has focused on constructs such as trust, usefulness, enjoyment, and website quality as determinants of online purchase intention (Gefen et al. 2003; Koufaris 2002; McKnight et al. 2002; Palmer 2002; Van der Heijden et al. 2003), there is both theoretical and empirical support that document the influence of perceived product quality on purchase intentions. The theory of reasoned action includes *attitude* as a key determinant of behavior or behavioral intention, with the behavior specified in terms of a behavioral action (e.g., purchase or buy) involving a target object (e.g., product) in a certain context and time frame (e.g., eCommerce marketing channel, sometime in the future) (Ajzen and Fishbein 1980). An attitudinal measure of the target object (e.g., perceived product quality) is thus likely to influence behavioral intentions with that target object. This theoretical relationship has been supported in empirical marketing research in which the attitudinal factor of perceived product quality is found to have a strong relationship with purchase intentions (Boulding and Kirmani 1993; Dodds et al. 1991; Rao et al. 1999). An opportunity exists to investigate the causal link between perceived product quality and behavioral intention in an online environment, and to better understand how website quality signaling can ultimately influence online purchase intentions. Thus, we offer our final hypothesis:

H4: The perceived quality of a product will positively affect a consumer's intention to use a website to purchase the product.

Next, the research method used to test these hypothesized relationships is discussed.

Research Method and Analysis

Three experimental studies were conducted to test the proposed research model as summarized in Table 3. Study 1 was a preliminary study designed to examine the viability of website quality as a signal of product quality and to report on

[4]Signaling theory has been criticized for requiring consumers and businesses to have knowledge of the sellers' margins, market share, and market size in order to evaluate the investment made by a seller (Kirmani and Rao 2000). Consequently, some signals, such as coupons, price, and warranties, may require consumers to have a more advanced understanding of the sellers' business. However, upfront expenditures such as websites, advertising, and brand, are more easily evaluated in general, and can be evaluated relative to other sellers.

Table 3. Summary of Experimental Studies

	Study 1	Study 2	Study 3
Design	6 × 1 lab experiment	2 × 2 lab experiment	2 × 2 lab experiment
Focus	• Instrumentation validity • Website quality as signal	• Product information asymmetries	• Signal credibility
Variables Manipulated	WSQ	WSQ PAI	WSQ SC
Variables Measured	WSQ PPQ PAI BI SC	PPQ BI	PPQ BI
Analysis Method	PLS*	ANOVA/Regression	ANOVA/Regression
Hypotheses Tested**	H1, H4 (all were supported)	H1, H2, H4 (all were supported)	H1, H3, H4 (all were supported)

WSQ: Website quality; PAI: Product asymmetries of information; SC: Signal credibility; PPQ: Perceived product quality, BI: Website purchase Intentions

*PLS was used in Study 1 in order to validate the survey measures of all constructs and the second order formative representation of WSQ. ANOVA was used in Studies 2 and 3 to assess the effect of experimental treatments on PPQ, and regression was used to assess the mediating effect of PPQ.

**An alpha protection level (i.e., probability of a Type 1 error) of 05 was used for hypotheses testing in all studies.

measurement model validity.[5] Study 2 focused on the effect of product asymmetries of information when manipulating website quality as a signal of product quality. Study 3 focused on the effects of signal credibility. First we describe the experimental domain and measures and then present the three studies.

Experimental Domain

The same experimental domain, a hypothetical tote bag retailer named *totebags.com*, was used for all studies. Website treatments were created to support a realistic set of consumer tasks, namely searching, selecting, and purchasing products. Tote bags and the related accessories (e.g., straps, cell phone and iPod holders) were selected for these studies as they are experiential products and considered to be more conducive to signaling as compared to search and credence products (Kirmani and Rao 2000; Zeithaml 1988). Tote bags are a moderate form of experiential product, as more complex products with a greater number and variety of intrinsic product attributes would be more difficult to evaluate prior to purchase. In addition, tote bags were a very relevant product for the primary subject pool as the majority of the subjects use tote bags of some form. Product information from an actual tote bag retailer, Timbuk2, was used to populate the website. To control for any effects that could be attributed to the brand, any subjects who were familiar with Timbuk2 were excluded from the studies. In addition, any subjects that reported being familiar with the hypothetical online retailer (totebags.com) were excluded. All interface treatments included the exact same product information, such as product images and descriptive information such as size, color, and so on, to control for any potential confounds associated with intrinsic product information cues.

Measures

All measures were adapted from existing, validated scales whenever possible and are provided along with the scale anchors and sources in Appendix A. Website quality was conceptualized as a second-order formative construct formed by the four, first-order dimensions of security, download delay, navigability, and visual appeal. Overall website quality (WSQ) was measured by three reflective items, and the four website quality dimensions were each measured with three reflective items with all items adapted from existing scales.[6] While there are many known determinants/dimensions of website quality (e.g., Loiacono et al. 2007), we selected

[5]Given that all three studies were controlled experiments with homogenous subject pools (i.e., student subjects), Study 1 was also replicated with a heterogeneous subject pool to increase generalizability and to address any concerns with common method bias. Additional details are provided with Study 1 and in Appendix F.

[6]Further discussion of the conceptualization and measurement of website quality is provided in Appendix C.

security (Koufaris and Hampton-Sosa 2004; Zhang et al. 2001), download delay (Galletta et al. 2004; Rose and Straub 2001), navigability (Palmer 2002), and visual appeal (Tractinsky et al. 2000; Van der Heijden and Verhagen 2004), as these dimensions are well-documented in the website quality literature (Kim et al. 2002; Loiacono et al. 2007; Valacich et al. 2007). These dimensions can also be manipulated while providing the same product information, whereas manipulations of other website quality characteristics, such as informational fit-to-task, tailored information, and on-line completeness (e.g., Loiacono et al. 2007) would inadvertently alter the intrinsic product information provided.

No existing measures for product asymmetries of information (PAI) or signal credibility (SC) were found in the literature as past research has operationalized these constructs via experimental manipulation or controls without accompanying manipulation check measures. Reflective measures for both of these constructs were developed based on signaling theory and the prior literature. PAI was measured to assess an individual's degree of prepurchase information scarcity related to the product of interest, and thus was operationalized as whether a consumer had any prior information or experience with products offered on totebag.com. Prepurchase information scarcity is a subjective factor that can vary based on an individual's prior product experience (Klein 1998). SC is a *general* assessment of the costs/investment necessary to develop and maintain a high-quality, commercial website and was operationalized as whether high-quality, commercial websites, in general, require significant costs, thus providing a separating equilibrium as described by Bergen et al. (1992). Both PAI and SC were measured prior to any exposure to the experimental website.

The measures for perceived product quality (PPQ) were adapted from prior signaling research (Boulding and Kirmani 1993; Kirmani 1990, 1997; Rao et al. 1999) and framed using specific product quality attributes (e.g., durability) (Garvin 1987). Consistent with past research in eCommerce, the behavioral intention (BI) construct was measured using items that assess a subject's likelihood to use a website to purchase a product(s) (Loiacono et al. 2007; Van der Heijden and Verhagen 2004). Measures of computer playfulness and online purchasing experience were also included along with demographic measures for age and sex.

Study 1

Study 1 assesses construct validity and examines the viability of WSQ as a signal of product quality. This section describes the experimental design and data analysis for this preliminary study.

Study 1: Treatments

A total of six different interface treatments were developed to provide variation in WSQ as described in Table 4, while providing the same product information. WSQ was manipulated by varying the four WSQ characteristics of security, download delay, navigability, and visual appeal at two levels, high (fast) and low (slow). The rationale behind using these four characteristics was not to offer an exhaustive list of WSQ characteristics, but to infuse broad variability across the treatments. Two of the treatments (A and F) represented very high and very low quality websites by providing high or low levels of all four characteristics, while the remaining four websites (treatments B through E) provided high levels of one characteristic in combination with low levels of the remaining characteristics.[7] Screen shots of these interfaces are provided in Appendix B. All six interfaces were used in Study 1, while only the very high and very low quality websites (A and F) were used in Studies 2 and 3.

Security was manipulated via the policy statements on the websites along with the inclusion of both the Truste® and Verisign® certification seals on the high security site. Download delay was manipulated by introducing a 4-second delay for any action taken by the user on the slow website. The website's navigability was manipulated through the inclusion/omission of certain convenience features such as a shopping cart. Finally, visual appeal was manipulated by varying the use of colors (e.g., backgrounds) and graphics (e.g., color tabs for product selection). Additional details on the manipulations along with the screen shots are provided in Appendix B.

PAI was controlled in this study by using a fictitious organization (i.e., totebags.com) and by excluding subjects that had owned or come into contact with a Timbuk2 totebag product. SC was not manipulated in this study but was measured as a control variable.

[7]A fractional, factorial design (six treatments) was used instead of a full, factorial design ($2 \times 2 \times 2 \times 2 = 16$ treatments) as the goal of this preliminary study was to validate the measures and conceptualization of the WSQ construct (second-order, formative) rather than to test the interactions of the dimensions. The fractional design represented the main effects of the four WSQ dimensions (high levels of one WSQ dimension with low levels of the remaining dimensions), in addition to the two extreme treatments with very high (low) levels for all four WSQ dimensions. This design resulted in a lower sample size while creating sufficient variance in the four WSQ dimensions to enable us to validate the WSQ construct. The design did not, however, enable us to assess the possible confounding effects of interactions among the dimensions.

Table 4. Study 1: Website Treatments

Treatment	Security	Download Delay	Navigability	Visual Appeal
High Quality – A	High	High	High	High
B	High	Low	Low	Low
C	Low	High	Low	Low
D	Low	Low	High	Low
E	Low	Low	Low	High
Low Quality – F	Low	Low	Low	Low

Study 1: Subjects

The subjects for this study were undergraduate students enrolled in an introductory management information systems course at a public university in the United States. A total of 240 subjects (40 for each interface treatment) participated in the experiment, with 50.4 percent being female and an average age of 20.14 (ranging from 18 to 35). Subjects received course credit for participating, and participation was voluntary with alternative options for course credit provided.

Study 1: Experimental Procedures

The study took place in a controlled laboratory setting. Subjects were randomly assigned to one of the six interface treatments. A task sheet was distributed that guided the subjects through the study (see Appendix B). The first step on the task sheet was to complete a pre-survey that measured PAI and SC, and that collected various demographic data such as gender, age, number of online purchases, familiarity with Timbuk2 products, and computer playfulness. The second step provided the subjects with the website address for the experimental treatment and required the subjects to complete a series of exercises designed to fully expose the subjects to the website content and features. Finally, a post-survey was administered that measured WSQ, PQ, and BI.

Study 1: Data Analysis

Descriptive statistics, manipulation checks, and construct validation results are presented in Appendix C, Tables C1 through C5. Manipulation checks were conducted using ANOVA in SPSS 15.0 for the four website quality dimensions and were found to be significant. Overall WSQ was found to significantly differ across the two high quality and low quality website treatments with means of 2.82 and 7.13, respectively, on a nine-point scale.[8] Data analysis, including construct validation and hypotheses testing with structural equation modeling (SEM), was conducted using PLS-Graph 3.0. PLS-Graph was selected for data analysis as it is a component-based SEM application that inherently supports the modeling of formative constructs (Gefen et al. 2000).

Construct Validation: Validation of the research model, including analysis of convergent and discriminant validity, is considered a necessary precursor to any hypothesis testing (Gerbing and Anderson 1988). WSQ was modeled as a second-order formative construct formed by the four, first-order reflective constructs of security, download delay, navigability, and visual appeal. The three reflective items measuring overall WSQ enabled us to use a multiple indicator multiple causes (MIMIC) model approach to assess the appropriateness of our WSQ conceptualization (Diamantopoulos and Winklhofer 2001; MacKenzie et al. 2005).

As all constructs and sub-constructs in the model had reflective indicators, we first followed the recommended guidelines for assessing PLS factorial validity with reflective constructs (Gefen and Straub 2005). All constructs showed good reliability with composite reliability scores ranging from .8 to .97, exceeding the recommended threshold of .7 for internal consistency (Nunnally 1967). Convergent validity was assessed by examining item loadings and the average variance extracted (AVE) for each construct. All measurement items loaded significantly on the designated construct (p-values < .001) and each construct had an AVE greater than .6, exceeding the minimum threshold of .5 (Fornell and Larcker 1981). Discriminant validity was assessed by examining the item loadings and crossloadings, and by conducting an AVE analysis. All items loaded strongly on the related construct and were at least an order of magnitude higher than any cross-loadings (Gefen and Straub 2005). A more stringent form of AVE analysis was applied with the AVE for each construct (rather than the square root of the AVE) being greater than the correlations with other constructs (Gefen and Straub 2000). These discriminant validity assessments suggest that the model constructs differ. Some of the higher cross-loadings and construct correlations are further discussed in Appendix C.

[8] With the other four treatments, where one WSQ dimension was high and the other three dimensions were low, only one treatment (E, high visual appeal) was significantly different than the low quality treatment.

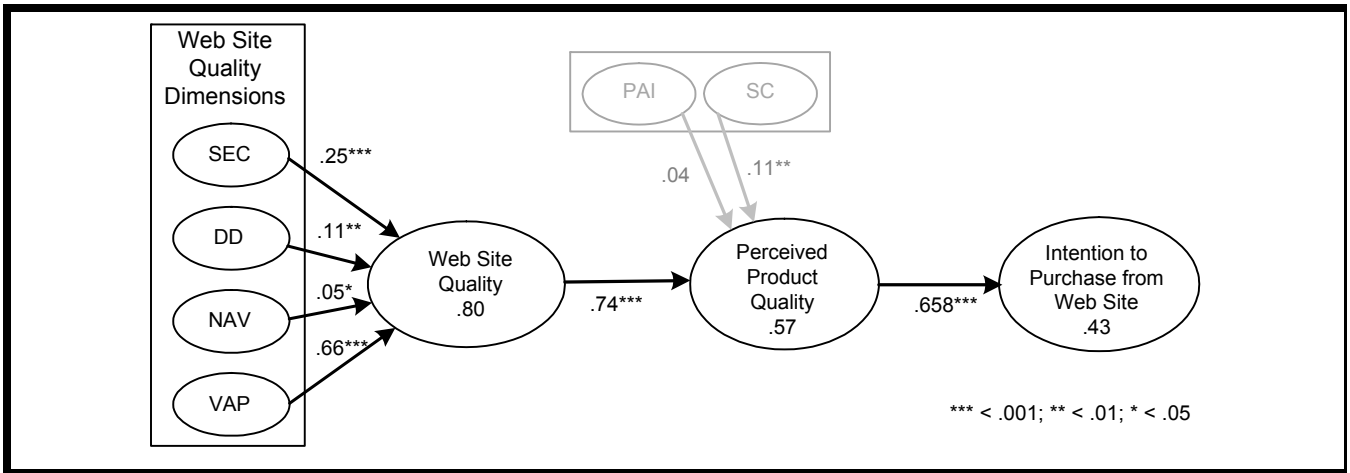

Figure 2. Study 1: Structural Regression Model Results

We assessed the validity of WSQ as a second-order, formative construct based on formative measurement guidelines (Centefelli and Bassellier 2009; Petter et al. 2007) by (1) assessing multicollinearity among the first-order constructs, (2) examining the path weights and correlations for the first-order constructs, and (3) conducting a redundancy analysis. The results, described in Appendix C, support our representation of the four dimensions forming overall WSQ. All path weights were significant as shown in Figure 2 and the four, first-order constructs explained 80 percent of the variance in the overall WSQ construct, as measured reflectively by three general, WSQ items. Of the four dimensions, visual appeal had the largest effect on WSQ, followed by security, download delay, and navigability. The results suggest that the three reflective items measuring overall WSQ are "symmetrical and egalitarian" (Campbell 1960, p. 548) to the construct formed by the four WSQ dimensions. As a result, we use the three-item reflective measure as a manipulation check for the high and low website quality treatments in Studies 2 and 3.

Common Method Bias (CMB): An assessment for CMB was conducted for Study 1 given that all of the variables included in the structural regression model were measured through self-reported survey items. Harman's single factor test was first conducted by running an exploratory factor with all variables included (Podsakoff et al. 2003). A single factor did not emerge from the unrotated solution, suggesting that CMB was not high. Second, a common method factor was included in the structural regression model (Podsakoff et al. 2003) using a PLS approach documented in the literature (Liang et al. 2007; Vance et al. 2008). Additional details and the results are reported in Appendix D. Using this assessment, only 5 of the 30 paths from the common method factor were significant, providing supporting evidence that the study results were not due to CMB. Further, WSQ, PAI, and SC are experimentally manipulated in Studies 2 and 3, with only PPQ and BI operationalized through self-reported survey responses. All hypotheses are tested in Studies 2 and 3 with only PPQ and BI subject to CMB, providing additional evidence that the study results are not due to CMB.

Hypothesis Testing: The structural regression model shown in Figure 2 was used to test the hypothesized relationships addressed in Study 1 (full results are presented in Appendix E, Table E1). WSQ had a significant effect on PPQ (p-values < .001), supporting H1, and PPQ had a significant effect on BI (p-value < .001), supporting H4. PAI and SC were included in the model to assess construct validity but not for hypotheses testing, as these variables are manipulated and tested for hypothesized interactions in Studies 2 and 3. Signal credibility had a significant effect on PPQ (p-value < .01), with an overall mean of 6.85 on a nine-point scale, supporting our premise that commercial websites are viewed as a significant investment and a credible signal. PAI did not have a significant effect on PPQ with an overall mean of 3.40 on a nine-point scale, supporting the high asymmetries of information present in the study.[9] None of the control variables (i.e., computer playfulness, sex, age, online purchasing experience) had a significant effect on perceptions of WSQ.

WSQ Dimensions: As shown in Figure 2, visual appeal had the largest effect on overall WSQ, followed by security, download delay, and navigability. Supplementary analysis was conducted to assess the relative influence of the WSQ

[9]PAI was measured on a nine-point scale where a response of 9 represents high familiarity/experience with the product and 1 represents low familiarity/experience with the product.

Table 5. Influence of WSQ Dimensions on WSQ and PPQ, in Order Ranked by Coefficient Size for WSQ

Perceived (Self-Reported)	WSQ	PPQ
Visual Appeal	.66**	.46**
Security	.25**	.32**
Download Delay	.12**	-.02
Navigability	.05*	.17**
Adj. R^2	80%	60%

** < .001; * < .05

dimensions on PPQ by running a structural regression model with the WSQ dimensions represented as determinants of PPQ, and omitting the second-order construct of overall WSQ. The results (shown in Table 5) mirrored the relative influence of the dimensions on overall WSQ with one exception: download delay did not have a significant effect on PPQ. Visual appeal had the strongest effect on PPQ, followed by security and navigability. These results are addressed in the discussion section.

Replication of Study 1: Study 1 was replicated with a different subject pool to enhance the generalizability of the results, and with a short version of the post-survey (only measuring PPQ and BI), to provide assurance that CMB did not influence the study results. The description of the study and the results are reported in Appendix F. The website treatments produced a similar pattern of responses for PPQ and BI, and H1 and H4 were similarly supported.

Study 2

A 2 × 2 controlled experiment with two levels of WSQ (high, low) and PAI (high, low) was designed to investigate the influence of PAI within a WSQ signaling context, testing H1, H2, and H4. Measured constructs included PPQ and BI as dependent variables, with WSQ and PAI measured for manipulation check purposes. Drawing from the same population as Study 1, a total of 160 subjects (40 for each treatment) participated in this study, with 38.1 percent being female and an average age of 20.5 (ranging from 18 to 29). Participation in this study was again voluntary, with course credit provided upon completion of the study.

Study 2: Treatments

WSQ was operationalized using the two high/low WSQ treatments assessed in Study 1 (interfaces A and F). PAI was operationalized by exposing the subjects in the low PAI treatment to an actual Timbuk2 totebag and strap pad accessory. As the subjects entered the lab, they were given a tote bag to examine for several minutes and were asked to explore various features of the tote bag such as the main compartment, strap, zippers, and outer compartments. After inspecting the bag, the subjects were given additional information on the features and quality of the bag and were told that they would be viewing this same bag on the totebags.com website. Subjects in the high PAI treatment were not exposed to the bag and were excluded from the study if they reported having any experience with Timbuk2 totebags on the survey.

Study 2: Experimental Procedures

Subjects were randomly assigned to one of the four treatment groups in a controlled laboratory setting. Subjects in the low PAI treatment groups were exposed to the totebag and accessories at the beginning of the experimental sessions. The remaining procedures followed the steps used in Study 1, including a pre-survey, experimental website task, and a post-survey.

Study 2: Data Analysis

Descriptive statistics for the individual scale items, manipulation checks, and construct validation results are presented in Appendix D, Tables D6 through D9. Manipulation checks were conducted using ANOVA in SPSS 15.0 for WSQ (high = 6.7, low = 3.1) and PAI (high = 3.5, low = 5.1) and were significant.[10] Construct reliability and validity were assessed and supported using the same procedures conducted in Study 1 with PLS-Graph for comparability.

[10]While the manipulation of PAI was significant, the lower levels of PAI were moderate (5.1 on a nine-point scale) suggesting some asymmetries of information still exist, and thus signaling theory remained applicable at these lower levels of PAI.

Table 6. Study 2: Perceived Product Quality by Treatment

	Higher PAI (Less product information)	Lower PAI (More product information)
Low WSQ	4.17	5.83
High WSQ	6.63	7.03

Table 7. Study 2: Perceived Product Quality Hypothesis Testing with ANOVA

Source	Mean Square	F	p-value	Effect Size (Eta²)
WSQ	135.06	64.51	.000	.293
PAI	42.37	20.24	.000	.115
WSQ × PAI	15.83	7.56	.007	.046

Adjusted R^2 = .360

Table 8. Study 2: Regression/Mediation Analysis for BI

WSQ → BI		WSQ → PPQ		WSQ + PPQ → BI				
β	p-value	β	p-value	WSQ β	p-value	PPQ β	p-value	Mediation
.575	.000	.51	.000	.333	.000	.474	.000	Partial

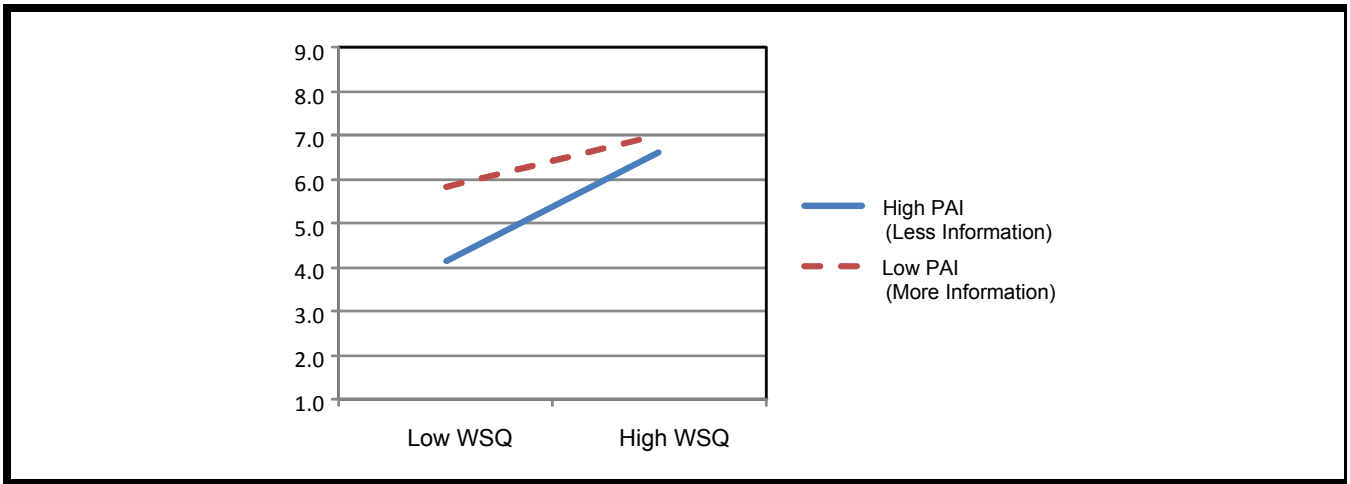

Figure 3. Study 2: Main and Interaction Effects of WSQ and PAI on PPQ

Hypothesis testing was performed in SPSS 15.0 with the results shown in Tables 6, 7, and 8 and in Figure 3. As hypothesized, WSQ had a significant main effect on PPQ, supporting H1, and there was a significant interaction effect with PAI supporting H2. WSQ had a greater effect on PPQ with higher PAI (6.6 – 4.2 = 2.4) than with lower PAI (7.0 – 5.8 = 1.2), and planned comparisons showed that PAI influenced PPQ only when WSQ was low (F = 20.87, p-value < .000). WSQ and PPQ were then regressed on BI to test H4 as shown in Table 8. PPQ significantly influenced BI (.474, p-value <.001) and partially mediated the effect of WSQ on BI, explaining .49 of the variance in BI (adjusted R^2).

Study 3

A 2 × 2 controlled experiment with two levels of WSQ (high, low) and SC (high, low) was designed to investigate the

impact of SC within a WSQ signaling context, testing H1, H3, and H4. Measured constructs included PPQ and BI as dependent variables, with WSQ and SC measured for manipulation check purposes. Drawing from the same population as Studies 1 and 2, there were 160 subjects (40 for each treatment) that participated, with 35.0 percent being female and having an average age of 20.8 (ranging from 18 to 35). Participation in this study was again voluntary, with course credit provided upon completion of the study.

Study 3: Treatments

WSQ was operationalized using the low and high WSQ treatments used in Study 1 (interfaces A and F). Low and high levels of SC were operationalized using two versions of a fictitious *Consumer Report* article (see Appendix B for the articles). One article was intended to decrease the SC of commercial websites by describing the lack of expense required to build and maintain a commercial website, while the other article was designed to increase the SC of websites by reporting the high costs of building and maintaining websites. These articles were adapted from actual *Consumer Reports* articles and were designed to be as realistic as possible.

Study 3: Experimental Procedures

Subjects were randomly assigned to one of the four treatment groups in a controlled laboratory setting. At the beginning of the experimental session, subjects in the low SC treatment groups were given the low SC version of the *Consumer Reports* article while the high SC treatment groups were given the high SC version. The remaining procedures followed the steps used in Study 1, including a pre-survey, experimental website task, and a post-survey.

Study 3: Data Analysis

Descriptive statistics for the individual scale items, manipulation checks, and construct validation results are presented in Appendix C, Tables C10 through C13. Manipulation checks were conducted using ANOVA in SPSS 15.0 for WSQ (high = 6.5, low = 2.8) and SC (high = 7.78, low = 4.4) and were significant.[11] Construct reliability and validity were assessed and supported using the same procedures conducted in Study 1 with PLS-Graph for comparability.

Hypothesis testing was performed in SPSS 15.0 with the results shown in Tables 9, 10, and 11, and in Figure 4. As hypothesized, WSQ had a significant effect on PPQ (p-value < .001), supporting H1, and there was a significant interaction effect with SC supporting H3. WSQ had a greater effect on PPQ with higher SC (6.6 – 4.4 = 2.2) than with lower SC (5.7 – 4.5 = 1.2), and planned comparisons showed that SC influenced PPQ only when WSQ was high (F = 10.64, p-value = .002). WSQ and PPQ were then regressed on BI to test H4 as shown in Table 11. PPQ significantly influenced BI (.571, p-value < .001) and partially mediated the effect of WSQ on BI, explaining .57 of the variance in BI.

Discussion

Three experimental studies were conducted to assess website quality as a signal of product quality under varying levels of information asymmetries and signal credibility, with all hypotheses supported. The hypothesized relationship between website quality and perceived product quality was significant in all three studies, as was the relationship between perceived product quality and online purchase intentions.[12] Product asymmetries of information were investigated in Study 2 and were found to moderate the effect of website quality on perceived product quality, with this relationship being stronger when less product information was available (high PAI). In Study 3, signal credibility was found to moderate the relationship between website quality and perceived product quality, with this relationship being stronger when subjects were told that a significant investment was required to build and maintain a commercial website (high SC). A discussion of these results along with the theoretical and practical implications are provided in the following section.

Website Quality as a Signal

In Study 1, overall WSQ was determined by four WSQ dimensions with visual appeal having the strongest effect on WSQ, followed by security, download delay, and navigability. The literature on cue utilization suggests that information cues that are easily observed and that users can confidently assess will be most influential in assessments of qual-

[11]While the manipulation of SC was significant, the lower levels of SC were moderate (4.4 on a nine-point scale) suggesting that participants still found commercial websites to be a credible signal, and thus signaling theory remained applicable at these levels of SC.

[12]In that all effects were significant at the alpha protection level of .05, statistical power and Type II errors are not issues.

Table 9. Study 3: Perceived Product Quality by Treatment

	Lower Signal Credibility	Higher Signal Credibility
Low WSQ	4.53	4.35
High WSQ	5.73	6.64

Table 10. Study 3: Perceived Product Quality Hypothesis Testing with ANOVA

Source	Mean Square	F	p-value	Effect Size – Eta²
WSQ	121.92	48.54	.000	.237
SC	5.50	2.19	.141	.014
WSQ × SC	11.92	4.75	.031	.030

Adjusted R^2 = .248

Table 11. Study 3: Regression/Mediation Analysis for BI

WSQ → BI		WSQ → PPQ		WSQ + PPQ → BI				
β	p-value	β	p-value	WSQ β	p-value	PPQ β	p-value	**Mediation**
.568	.000	.479	.000	.294	.000	.571	.000	Partial

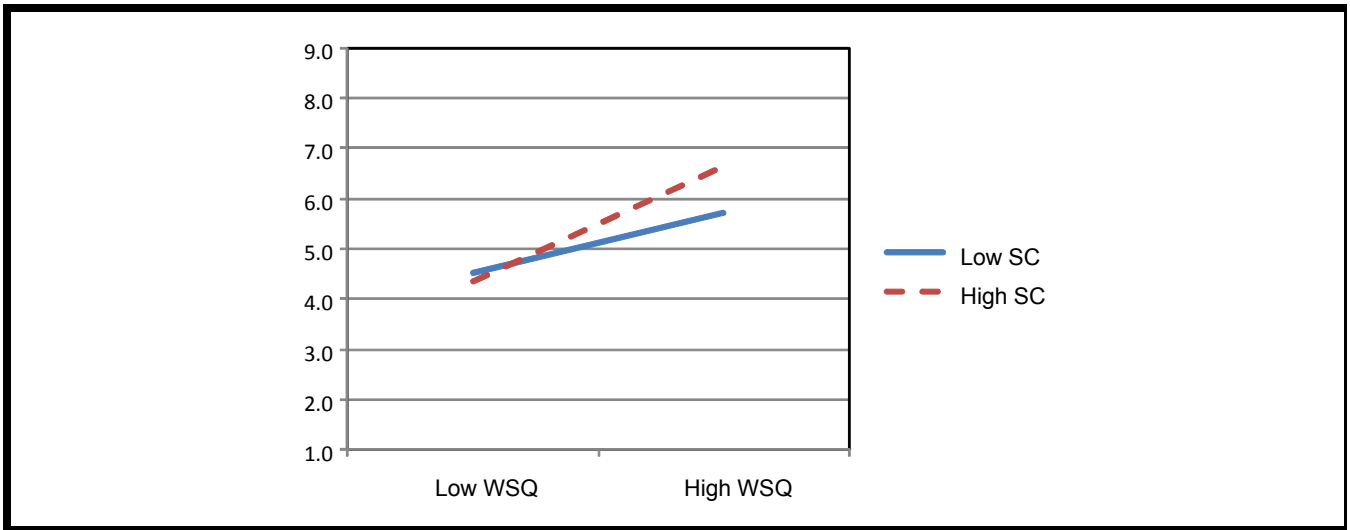

Figure 4. Study 3: Main and Interaction Effects of WSQ and SC on PPQ

ity (Richardson et al. 1994). Studies on user perceptions of websites have shown that the visual appeal of a website can be reliably assessed within 50 milliseconds (Lindgaard et al. 2006), thus it follows that visual appeal has a relatively strong effect on overall WSQ as users can assess visual appeal quickly and with confidence. Visual appeal is also an aesthetic quality of the website, and aesthetics (i.e., representational delight) have been shown to be a dominant component of website quality in more experiential contexts (Valacich et al. 2007; Van der Heijden 2004), such as the one reported in this study.

The relative influence of the WSQ dimensions on PPQ was similar with the exception of download delay having no influence in PPQ. This result can be explained by existing research on download delay. While download delay has been

shown to influence perceptions of the website (Palmer 2002), research has found that it did not influence attitude toward the online retailer (Rose and Straub 2001). Research findings suggest that if the source of a download delay is not identified, users may not attribute the delay to the retailer (Rose et al. 2005), and thus may not consider download delay a signal of product quality.

Further examination of the website quality and product quality perceptions by the six treatments (shown in Appendix C, Table C2) demonstrates a halo effect when all dimensions are of high quality. For example, a comparison of treatments A and E (A: all dimensions were of high quality; E: visual appeal is high while the remaining dimensions are of low quality), provides a striking difference of 1.85 (7.33_A versus 5.48_E) for perceived visual appeal. The manipulation of visual appeal was the same in both treatments, yet participants assessed visual appeal as being much higher when all dimensions were of high quality. This pattern of responses is observed for all of the WSQ dimensions (i.e., security: 6.92_A/5.22_B, download delay: 7.93_A/6.80_C, navigability: 8.20_A/7.12_D). Thus, the perceived quality of a WSQ dimension is influenced by the quality of the other dimensions, with the best perceptions of WSQ and PPQ resulting when all dimensions are of high quality.

Product Asymmetries of Information

Study 2 demonstrated that PAI had both a main effect on PPQ, with higher levels of PAI resulting in lower PPQ, and a moderating effect such that WSQ has a greater effect on PPQ when consumers have less information about a product (higher PAI) as compared to more product information, as predicted. Even when PAI was moderate (the lower PAI condition), high WSQ still made a marked improvement in PPQ (5.83 to 7.03), suggesting that moderate PAI (i.e., not perfectly symmetrical information) results in a reliance on both intrinsic and extrinsic cues. Our results also showed that PAI has a lesser impact on PPQ depending upon WSQ. When WSQ was high, there was only a marginal difference in PPQ between higher and lower levels of PAI, 6.63 and 7.03, respectively, suggesting that a website with high quality extrinsic cues can largely compensate for a lack of product information (intrinsic cues).

Signal Credibility

WSQ was supported as a credible signal of PPQ, with participants in Study 1 reporting that commercial websites required a significant investment (mean of 6.85 on a nine-point scale). In Study 3, the *Consumer Report* manipulations of the investment required for a commercial website increased the perceived investment to 7.78 for the high SC treatment and reduced it to 4.4 for the lower SC treatment, demonstrating that moderate perceptions of SC were maintained even when subjects were informed that the cost of a high quality commercial site was modest by a reputable party.

The results of Study 3 supported the moderating effect of SC, with WSQ having a greater effect on PPQ when SC was higher, but showed no main effect for SC on PPQ. Upon further analysis of the treatment means shown in Table 9, SC was found to have an effect on PPQ only when WSQ was high. When WSQ was low, there was no significant difference in PPQ under high and low SC. These findings support the premise that a very poor quality website is not a positive signal, and credibility would not necessarily influence PPQ under such circumstances (Boulding and Kirmani 1993).

Further interpretation of the results for PAI and SC also provide support for the relative importance of these theoretical boundary conditions. In Study 2, PAI had both significant main and interaction effects on PPQ, while in Study 3, SC had only a smaller interaction effect with the same WSQ treatments. The effect sizes reported in Tables 7 and 10 confirm these results as the effect sizes for PAI main and interaction effects are larger than the SC interaction effect size. These findings suggest that information asymmetries are a necessary condition, a first step for applying signaling theory. If satisfied, this condition enables extrinsic cues to serve as signals of product quality when the signal is both credible and of high quality. The benefits of signaling should increase in conjunction with increases in information asymmetries, signal credibility, and the quality of the signal.

Theoretical Contributions

Recent IS research has leveraged the concept of signaling to understand how consumer uncertainty can be mitigated in online exchanges (Pavlou et al. 2007). Our study applies the full theoretical framework of signals to provide a foundation for understanding how website quality alleviates the uncertainty that is often inherent in online product evaluations. Based on the empirical evidence offered in this paper, we conclude that website quality meets the theoretical conditions for being a viable signal of product quality. Specifically, website quality is an informational cue that can be extrinsic to the product and is most effective when two theoretical conditions are met: (1) high product asymmetries of information and (2) high signal credibility. Website quality is particularly salient when the consumer is faced with high asymmetries of information, which we assert to be commonplace in an eCommerce marketing channel, particularly when organizations offer experiential products. From an IS perspective, we posit that signaling theory provides a fresh and

robust theoretical foundation for explaining how and why website quality and its associated characteristics affect online consumer behavior. This research also contributes to the signaling literature by validating website quality as a signal of quality that is distinct from other existing signals such as brand, price, and warranties.

The results from these studies have interesting implications for the virtual product experience literature (Jiang and Benbasat 2004-2005; Li et al. 2002). The basic premise of virtual experience is that if an organization can provide a consumer with website characteristics that afford a sense of telepresence (i.e., being there), consumers will be better able to evaluate the product, resulting in increased intentions to purchase the product or service (Li et al. 2002). The informational cue dichotomy (extrinsic versus intrinsic) may draw an important theoretical distinction between how a consumer perceives a signal versus a virtual experience. In our studies, intrinsic product information was controlled and website quality was isolated as an extrinsic cue and observed to significantly affect the consumer's perception of product quality. The results of our studies pose an interesting question: Does a virtual experience convey intrinsic product cues *or* does it convey extrinsic cues (i.e., signals) that make consumers more confident in what they buy and from whom they buy it? The results from this study point to a need to qualify the theoretical nature of the informational cue being presented to the consumer as well as isolate the impact that these respective cues have on online consumer behavior.

Pragmatic Contributions

The results from these studies have strategic implications for most businesses using the eCommerce marketing channel. First, an intuitive recommendation is that online sellers need to maintain high quality websites as consumers may rely on website quality as an extrinsic signal, using it as a surrogate for perceived product quality in a variety of contexts. These contexts include the marketing of experience products, products that are novel to the consumer, nonhomogenous product assortments (Kamakura and Moon 2009), and whenever consumers have limited time (Zeithaml 1988) or certain personality traits (e.g., low need-for-cognition) (Chatterjee et al. 2002). Interestingly, even when moderate asymmetries of information exist, website quality can serve as a powerful signal, and past research suggests that very low PAI can only be achieved after repeated exposure to the product of interest (Goering 1985).

Second, our research shows that emphasizing one WSQ dimension while neglecting other website quality dimensions may not fully leverage the signaling potential of a website. An online seller that maximizes the visual appeal of the website, but does not provide reasonable levels of the other website quality dimensions, is missing out on a halo effect as shown in our results. For example, the perceived visual appeal of a website was reported as higher when the other extrinsic website quality dimensions were higher.

Third, while an online seller needs to consider the quality of all website dimensions, our research suggests when some dimensions may be worth an additional investment. Depending upon the nature of the product, online sellers may want to focus on specific website quality dimensions. With experience products, the aesthetic or emotional elements of a website (e.g., visual appeal), have been shown to be the most important component of website quality (Pallud 2008; Valacich et al. 2007; Van der Heijden 2004). Online sellers should strive for very high levels of aesthetics with experience products and/or hedonic shopping contexts. In other product contexts, such as big ticket items, sellers may want to consider additional extrinsic signals such as providing clear explanations of security features (Koufaris and Hampton-Sosa 2004).

Fourth, our results also point to the importance of emphasizing extrinsic website quality attributes (i.e., extrinsic product cues) over intrinsic website quality attributes (i.e., intrinsic product cues). Given the challenges of presenting complex products and product packages in an online environment (Kim and Niehm 2009), extrinsic website quality attributes may be enhanced more efficiently than intrinsic website quality attributes, such as tailored information and interactivity (e.g., Jiang and Benbasat 2004-2005, 2007; Loiacono et al. 2007). While these intrinsic website attributes convey relevant product information, these features are expensive to implement and maintain. Additionally, such investments may still not close the information asymmetry gap with complex and experience goods. Given finite website design resources, extrinsic website quality cues could be emphasized over the intrinsic cues, and research suggests that extrinsic cues influence perceptions of intrinsic website attributes (Kim and Niehm 2009; Loiacono et al. 2007). Our study results demonstrated large differences in perceived product quality while intrinsic cues (e.g., product information content) were kept constant. Further, we provided a moderate level of these intrinsic cues, without using more expensive, multimedia views of the product (e.g., zoom-in and zoom-out capability, interactivity, etc.). Yet, subjects perceived product quality to be very high when provided with high quality levels of extrinsic cues. Thus, online sellers should carefully allocate their resources between extrinsic and intrinsic web site quality attributes— should such prioritization be necessary.

Fifth, website quality, by its nature, is extremely fluid and dynamic, which places the onus on the seller to continually

improve the quality of their site because perceived shortcomings in comparison to a competitor's website could result in lost sales, even if the website is perceived to be of adequate quality. Smaller businesses, with fewer resources to invest in a high quality website, may want to consider marketing their products through online marketplaces with partners such as Amazon and eBay, where they can utilize the high quality of the partner's website and marketplace brand, as signals of product quality. Strategic alliances with established, high-quality marketplaces enable smaller e-businesses to send consumers extrinsic signals, without making the up-front and ongoing investment required of a proprietary commercial website. Further, creating a high quality website without considering the quality of the product offering may provide a short-term gain, but is ultimately a losing proposition. Product quality is often revealed soon after the purchase, and an online retailer's reputation and sales can quickly suffer through online word-of-mouth when a low quality product is marketed with a high quality signal.

Finally, consumers perceive a commercial website as requiring a significant investment and thus being a credible signal, but these perceptions can be readily manipulated and enhanced. Online sellers can improve consumers' perceptions of product quality by developing a high quality website and by informing website visitors of the upfront costs and continuing effort required to maintain a high quality site. Online sellers can publicize their initial and ongoing efforts to develop a high-quality commercial website through press releases, blogs, and consumer surveys soliciting feedback on the quality of the website. Website awards and recognition can provide external confirmation of website quality and further strengthen the credibility of websites as a signal of product quality.

Limitations and Future Research

As with all research, this series of studies has some limitations. The three studies used a controlled experimental design with student subjects, potentially limiting the external validity of the study. A replication of Study 1, however, was conducted with nonstudent subjects to improve the generalizability of the study's findings. The results from the replication supported the findings of Study 1, and showed a similar pattern of product quality perceptions and behavioral intentions across the different treatments for these more heterogeneous subjects. Prior consumer research has noted that student subjects provide an appropriate sample when the focus is on controlled theory testing (Calder et al. 1981), and when subjects are familiar with the experimental context (i.e., online shopping) (Gordon et al. 1986). eCommerce research has also shown that online consumers are typically younger and more educated, making university business students a representative sample for this study (Jiang and Benbasat 2004-2005; McKnight et al. 2002). Further research is needed, however, to determine how perceptions of website quality might differ for online consumers of different ages, cultures, and backgrounds.

In our efforts to operationalize website quality as an extrinsic cue, we excluded website quality dimensions that might influence intrinsic product attributes, such as website information quality. This is a limitation of our study, and future research is needed to model both extrinsic and intrinsic website quality dimensions within a signaling context. Also, the same product, totebags, was used in all three studies, thus the applicability of a website quality signal to other product domains needs to be explored. This product was relevant to our subject pool and provided a moderate example of an experience product. Novel products with more experiential attributes should create greater information asymmetries and stronger signaling results. Finally, our study did not test for the potential interaction between PAI and SC, and future research in this area is warranted.

This research provides a theoretical foundation for studying website quality as a signal of quality, creating a new research perspective on website quality that extends existing usability research. We now outline several opportunities for future research on website quality as a signaling phenomenon, including website quality dimensions, signaling effects with virtual experience, and the applicability of eCommerce signaling to online services and search goods.

Future research is needed to more thoroughly explore the dimensions of website quality. Past research has identified numerous website characteristics that may influence perceptions of website quality, and these characteristics may similarly influence perceived product quality. Future studies could manipulate additional characteristics and utilize a full factorial design to investigate the interactions among these characteristics. Such research could better identify the most critical website characteristics from both usability and signaling perspectives.

Also, the core signaling model presented in this paper could be augmented to observe the relative influence of extrinsic website quality cues on perceived product quality when other factors are introduced. One potential extension is to study website quality signaling when other well-accepted signals are manipulated, such as price and brand. Other known determinants of behavioral intentions, such as affective variables (Van der Heijden 2004) and trust (Gefen et al. 2003), could be integrated into the core signaling model as these variables may be influenced by website quality and serve in a mediating role.

Additional research is needed on virtual product experience to understand the mechanism by which this experience influences perceived product quality and purchase intentions. Future studies should isolate the effects of the extrinsic signals provided by the enhanced features of a virtual website environment from the intrinsic product cues delivered through this environment. The separate and additive effect of extrinsic and intrinsic cues has yet to be examined with an online virtual experience.

Finally, there are several future research options for applying signaling in an eCommerce domain. Services are generally accompanied by fewer tangible information cues than products (Lovelock 1983), and online services would be associated with even greater information asymmetries. eCommerce signals could be even more effective in such contexts. Website quality is only one signal that may be effective in eCommerce. Other signals, such as return policies and shipping charges, should be explored. Also, past consumer signaling studies have focused on scenarios where asymmetries of information result from the marketing of experience goods, but research suggests that time pressure and individual differences (e.g., low need-for-cognition) can also create an environment where extrinsic signals are used despite the availability of intrinsic product information. For example, product information for a search good may be readily available, but time pressure and individual differences may increase the information search costs for some consumers. Research suggests that many consumers shop online as a way to reduce travel and shopping time (Rohm and Swaminathan 2004). A signaling framework may be appropriate in these contexts as consumers look for an efficient shopping experience and quick, easily processed cues of product quality.

Conclusion

In this research, signaling theory has been applied to website quality as a potential signal of product quality. The results from this study found that, indeed, website quality does affect consumers' perceptions of product quality. Future research will help identify the key factors that affect how consumers perceive and interpret website quality as a means for making product quality assessments when faced with high asymmetries of information. Signaling theory provides a useful theoretical foundation for understanding the inherent value of website characteristics and how they can help organizations better manage their online consumer interactions. These findings provide a solid foundation for future investigations and practical insights for designing B2C eCommerce websites.

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MIS Quarterly

RESEARCH ARTICLE

WHAT SIGNAL ARE YOU SENDING? HOW WEBSITE QUALITY INFLUENCES PERCEPTIONS OF PRODUCT QUALITY AND PURCHASE INTENTIONS

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Appendix A

Measures

Note: All items were measured with nine-point scales. Most were anchored with strongly disagree – strongly agree unless noted with an asterisk (*) and described below.

Security (Pavlou 2001)	
sec1	I am confident that the information I provide during my transaction will not reach inappropriate parties during storage in this retailer's databases.
sec2	I believe inappropriate parties cannot deliberately observe the information I provide during my transaction with this web retailer during transmission.
sec3	In my opinion, inappropriate parties will not collect and store the information I provide during my transaction with this web retailer.
Download Delay (Loiacono et al. 2007, Response time)	
dd1	When I use this website, there is very little time between my actions and the website's response.
dd2	The website loads quickly.
dd3	The website takes very little time to load.
Navigability (Salisbury et al. 2001)	
nav1	Navigating these web pages is easy for me.
nav2	I find that my interaction with this website is clear and understandable.
nav3	It is easy for me to become skillful at navigating the pages of this website.

Visual Appeal (Loiacono et al. 2007)	
vap1	The website is visually pleasing.
vap2	The website displays visually pleasing design.
vap3	The website is visually appealing.
Web Site Quality (adapted from Everard and Galletta 2005) *Items 1, 3 anchored with a semantic differential scale of very low quality, very high quality	
wsq1	Overall, how would you rate the quality of this website?
wsq2	All in all, I would rate the Totebags.com website as being of high quality.
wsq3	How would you rate the overall quality of the Totebags.com website?
Asymmetries of Information (new scale)	
pai1	I have a good idea of what the PRODUCTS (e.g., totebags, accessories, etc.) offered at Totebags.com look and feel like.
pai2	I have sufficient information about the PRODUCTS (e.g., totebags, accessories, etc.) offered at Totebags.com to evaluate them effectively and accurately.
pai3	I possess adequate knowledge about the PRODUCTS (e.g., totebags, accessories, etc.) offered at Totebags.com
Signal Credibility (new scale)	
sc1	Designing and maintaining a high quality commercial website takes significant effort and expense.
sc2	When I see a high quality commercial website, I assume that an organization must invest a lot of time and money to design and maintain it.
sc3	The design and maintenance of a high quality commercial website requires an organization to make a significant financial investment.
Product Quality (adapted from Boulding and Kirmani 1993; Rao et al. 1999)	
pq1	I perceive the PRODUCTS (e.g., totebags, accessories, etc.) offered at totebags.com to be durable.
pq2	Totebags.com PRODUCTS (e.g., totebags, accessories, etc.) appear to me to be well crafted.
pq3	I perceive the PRODUCTS (e.g., totebags, accessories, etc.) offered at totebags.com to be of high quality.
Behavioral Intention (adapted from Loiacono et al. 2007; Van der Heijden and Verhagen 2004) *All items anchored with a semantic differential scale of very unlikely – very likely	
bint1	Suppose you were in the market for a tote bag. How likely would you be to purchase a tote bag though this website?
bint2	Suppose you were in the market for a tote bag. How likely would you be to do business with Totebags.com via its website?
bint3	If you were in the market for a tote bag, what is the likelihood that you would use this website to purchase the tote bag?
Control Variables	
Computer Playfulness (Webster and Martocchio 1992) Items were anchored with strongly disagree – strongly agree. The following questions ask you how you characterize yourself when you use computers	
cp1	Playful
cp2	Flexible
cp3	Creative
Online Purchase Experience How many purchases have you made via the Internet?	

Appendix B

Experimental Materials

Interface Manipulations and Screenshots

WSQ Dimension	Manipulation Explanation		Sample Screen Shots	
	Low	High	Low	High
Security	A brief and conservative privacy/security policy is presented via the **Security & Privacy** link. For instance, the company reserves the right to sell and distribute customer information without explicit permission from the consumer. Also, NO security seals such as Truste® and Verisign® are present on the website	An extensive and assuring privacy/security policy is presented via the **Security & Privacy** link. For instance, consumers are assured that information is secure and not distributed without explicit permission. Also, security seals such as Truste® and Verisign® are present on the website.		
Download Delay	A 4-second download delay is coded into the design of the website. Users wait 4 seconds to access any page on the website.	No download delay coded into the design of the website.	N/A	N/A
Navigability	Less efficient and inconvenient design specifications are incorporated into the website. For example, users are forced to access a separate page when viewing a particular product color combination making. information gathering and navigability more cumbersome. Also, users are forced to re-enter the product information during the checkout process.	More efficient and convenient design specifications are incorporated into the website. For example, users can view various product color combinations on the same screen, making information gathering and navigability more efficient. Also, users are able to add a product to a shopping cart for later viewing/checkout.		
Visual Appeal	Unprofessional and unattractive aesthetics are used in the design of the website.	Professional and attractive aesthetics are used in the design of the website.		

Experimental Task Sheet: Website Assessment for Totebags.com

Part 1

Mary/Bob is a 21-year-old college student with a part-time job. She/He owns an older tote bag that is a little worn and isn't exactly the latest style. She/He has recently bought a new cell-phone and needs to purchase a cell-phone holster that she/he can use along with the bag. Mary/Bob plans to spend no more than $20 for the purchase of this new accessory and would like to get it ordered ASAP. After ordering her/his cell-phone holster, Mary/Bob would like to browse around the website to see if she/he can find something to replace his/her old, worn-out tote bag. Also, she/he wouldn't mind finding something that would conveniently store her/his MP3/iPod device. After work, Mary/Bob browses a tote bag retailer's website to (a) purchase her/his cell phone holster and (b) browse around and look for a new bag and an MP3/iPod case.

- Go to the following site and complete the survey: **http://.....research.com/pre/**
- Please type in the following URL and press ENTER: **http://.....research.com/v1/**

Part 2

When considering which website to buy from, Mary/Bob is mostly concerned about the security associated with it, the features that are provided to help with order processing, and the interface presentation. Please help Mary/Bob in determining whether he should make the purchase at this website. Below is a list of items that will help you in assessing the website. Please perform and check off each action as you go through the list.

		Check
1.	Make sure you are viewing the Totebags.com home page and that you've expanded the Internet Explorer window.	
2.	Click on **Accessories** on the top menu.	
3.	Click on the **Cell Phone Holster**.	
4.	Preview the cell phone holster in AT LEAST THREE different colors.	
5.	Pick a color that you like and add it to your shopping cart by clicking on **Add to Cart**. Once you're done, click **Close**.	
6.	You will now look at available bags. Click on **Messenger** on the top menu.	
7.	Click on a bag of your choice by clicking the **View** link.	
8.	Click on the **Open the bag**, **Front Pocket**, and **Features** links.	
9.	Preview AT LEAST THREE different color combinations.	
10.	Click on **Messenger** on the top menu again and click on a DIFFERENT bag of your choice by clicking the **View** link.	
11.	Preview AT LEAST THREE different color combinations.	
12.	Pick ANY bag you like and add it to your shopping cart by clicking on **Add to Cart**.	
13.	You will now select an iPod case. Click on **Accessories** on the top menu.	
14.	**Click on the iPod Case.**	
15.	Preview the iPod case in AT LEAST THREE different colors.	
16.	Pick a color that you like and add it to your shopping cart by clicking on **Add to Cart**. Once you're done, click **Close**.	
17.	Before checking out, you want to review the customer service information provided on the website. Click on **Service** at the top of the page.	
18.	Now, click on **Security & Privacy** and read the provided information.	
19.	You are now ready to checkout. Click on **Shopping Cart** on the top menu	
20.	Click **Check Out** (bottom of page).	
21.	Enter your **Billing Address**, **Email**, and **Shipping Address** and then click **Continue**.	
22.	Enter your Student ID no. (e.g. 12345678) as the **Coupon Number** and click **Continue** (bottom of pg).	
23.	At this point, you can close the window.	

Please go to **http://.....research.com/post/** to complete a survey related to this website.

Consumer Reports Articles

These articles were used only in Study 3.

Article Used in High SC Treatment

Business Brief

The eCommerce Interface: A Significant Investment

According to recent research, the costs associated with developing and maintaining a commercial website are not trivial. In fact, the investment is so significant, that eCommerce sales, on average, need to grow at a rate of 28% per year to recoup the initial development and ongoing maintenance costs. A survey of 250 eTailers was administered, which produced some interesting insights.

The human resource costs, typically web development expertise, have risen 22% each of the past 5 years. In addition, eTailers noted a serious shortage of competent web developers, which suggests that the dramatic increase in these labor costs will continue.

Further, hardware and software costs are significant. The licensing fees for web development software have increased 15% each of the past 5 years. Hardware costs such as web servers and backup facilities account for 23% of the average operating budget for an eCommerce website.

Industry analysts say that the results from this survey make an important point – Namely, a quality website represents a significant investment on the part of the organization, which must be recovered over a long period of time. Further, recovering such an investment requires that the organization attract and retain customers who will also provide positive word-of-mouth to potential customers. In short, the organization is in it for the long run….

Article Date: January, 8th 2008

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Article Used in Low SC Treatment

Expert • Independent • Nonprofit
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Business Brief

The eCommerce Interface: Surprisingly Affordable

According to recent research, the costs associated with developing and maintaining a commercial website are surprisingly low. In fact, the investment is so small, that eCommerce sales, on average, need to grow at a rate of less than 1% per year to recoup the initial development and ongoing maintenance costs. A survey of 250 eTailers was administered, which produced some interesting insights.

The human resource costs, typically web development expertise, have seen an average decrease of 8% each of the past 5 years. In addition, eTailers noted the relative affordability and plentiful supply of talented web developers.

Further, hardware and software costs are relatively insignificant. The licensing fees for web development software have decreased 11% each of the past 5 years. Hardware costs, such as web servers', have seen a sharp decrease downward over the past 3 years.

Industry analysts say that the results from this survey make an important point – Namely, a seemingly high quality website does NOT represent a significant investment on the part of the organization and can often be recovered over a short period of time. Further, recovering such an investment does not necessarily require that the organization attract and retain long-term customers. In short, website visitors beware….

Article Date: January, 8th 2008

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Appendix C

Descriptive Statistics and Validation by Study

Study 1: Descriptive Statistics and Validation

Table C1. Study 1: Descriptive Statistics

Item	Min	Max	Mean	Std. Dev.	Item	Min	Max	Mean	Std. Dev.
sec1	1	9	4.47	2.723	pai1	1	9	3.26	2.331
sec2	1	9	4.59	2.637	pai2	1	9	3.53	2.272
sec3	1	9	4.48	2.563	pai3	1	9	3.40	2.209
dd1	1	9	4.79	2.718	sc1	1	9	7.10	1.417
dd2	1	9	4.68	2.766	sc2	2	9	6.98	1.369
dd3	1	9	4.79	2.715	sc3	1	9	6.45	1.610
nav1	1	9	7.20	1.626	ppq1	1	9	5.09	1.942
nav2	1	9	6.65	1.907	ppq2	1	9	5.08	1.997
nav3	1	9	7.22	1.581	ppq3	1	9	4.71	2.139
vap1	1	9	4.12	2.555	bi1	1	9	3.16	2.389
vap2	1	9	4.16	2.519	bi2	1	9	3.26	2.421
vap3	1	9	4.05	2.557	bi3	1	9	3.22	2.416
wsq1	1	9	4.08	2.350	cp1	1	9	6.23	1.758
wsq2	1	9	3.82	2.436	cp2	2	9	6.81	1.436
wsq3	1	9	3.98	2.274	cp3	2	9	6.58	1.680

sec = security, dd = download delay, nav = navigability, vap = visual appeal, wsq = perceived website quality, pai = product asymmetries of information, sc = signal credibility, ppq = perceived product quality, bi = behavioral intention, cp = computer playfulness

Table C2. Study 1: Treatment Descriptive Statistics

	Interface Treatments					
	A	B	C	D	E	F
Perceived (self-reported)	H-Sec H-DD H-Nav H- VAP	H-Sec L-DD L-Nav L- VAP	L-Sec H-DD L-Nav L-VAP	L-Sec L-DD H-Nav L- VAP	L-Sec L-DD L-Nav H- VAP	L-Sec L-DD L-Nav L- VAP
SEC	6.92	5.22	3.94	3.43	3.89	3.68
DD	7.93	3.52	6.80	3.69	3.52	3.08
NAV	8.20	6.20	6.64	7.12	7.31	6.66
VAP	7.33	2.81	3.15	3.02	5.48	2.88
WSQ	7.13	2.95	3.38	2.77	4.69	2.82
PAI	3.63	3.54	3.07	3.27	3.43	3.47
SC	6.79	6.96	6.93	6.64	6.83	6.93
PPQ	6.70	5.00	4.25	4.31	5.37	4.13
BI	5.97	2.70	2.47	2.23	3.14	2.78

Manipulation checks were performed by first running an ANOVA for each of the four web site quality treatments (security, download delay, navigability, visual appeal) where the treatment was the independent variable and the dependent variable (DV) was the scale measuring perceptions of that treatment. The respective scales are provided in Appendix A. As shown below, the manipulations were significant with a p-value < .001. A more rigorous form of manipulation check was also performed as recommended by Perdue and Summers (1986) by running ANOVAs in which all four treatments were included as main effects and the dependent variable was the scale measuring perceptions of each treatment. This approach was used to insure that each treatment effect remained significant in the presence of the other treatments. The results, provided below, show that each web site quality treatment had a significant effect on the related web site quality perceptions even in the presence of the other treatments.

Table C3. Study 1: Manipulation Checks

ANOVAs with One Treatment and One DV	Perceived Security		Download Delay		Perceived Navigability		Perceived Visual Appeal	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Security (high/low)	**56.83**	**.000**						
Download Delay (fast/slow)			**250.81**	**.000**				
Navigability (high/low)					**22.20**	**.000**		
Visual Appeal (high/low)							**172.55**	**.000**
ANOVAs with Four Treatments and One DV	**Perceived Security**		**Download Delay**		**Perceived Navigability**		**Perceived Visual Appeal**	
	F	**Sig.**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**
Security (high/low)	**36.39**	**.000**	1.65	.201	.91	.341	1.78	.184
Download Delay (fast/slow)	4.43	.036	**193.62**	**.000**	1.36	.245	6.73	.010
Navigability (high/low)	.29	.590	3.83	.052	**11.86**	**.001**	4.42	.037
Visual Appeal (high/low)	3.81	.052	1.65	.201	19.03	.000	**125.06**	**.000**

Table C4. Study 1: Loadings and Cross-Loadings

	WSQ Dimensions (1st order constructs)				WSQ (2nd order)	PAI	SC	PPQ	BI	CP
	SEC	DD	NAV	VAP						
sec1	**.939**	.421	.281	.444	.573	.105	.069	.517	.569	.025
sec2	**.949**	.464	.338	.425	.579	.103	.038	.584	.579	-.033
sec3	**.962**	.466	.310	.512	.658	.050	.052	.596	.636	-.027
dd1	.467	**.938**	.360	.449	.539	-.019	.079	.408	.440	.010
dd2	.462	**.962**	.401	.441	.539	.015	.041	.407	.422	.004
dd3	.413	**.931**	.390	.383	.482	-.011	.046	.368	.422	-.018
nav1	.236	.373	**.897**	.298	.339	.047	-.080	.307	.259	.074
nav2	.372	.401	**.918**	.497	.510	.124	-.045	.511	.386	.076
nav3	.277	.331	**.904**	.324	.362	.110	-.024	.403	.284	.091
vap1	.483	.474	.410	**.977**	.843	.048	.006	.660	.691	.033
vap2	.494	.433	.404	**.979**	.834	.044	.018	.670	.681	.079
vap3	.429	.398	.383	**.946**	.785	.050	.017	.640	.615	.062
wsq1	.608	.535	.441	.816	**.978**	.034	.000	.711	.756	.009
wsq2	.624	.537	.438	.833	**.981**	.047	.042	.737	.792	.045
wsq3	.635	.548	.431	.845	**.981**	.063	.038	.739	.773	.069
pai1	.071	.008	.123	.010	.021	**.868**	.020	.046	.056	.164

Table C4. Study 1: Loadings and Cross-Loadings (Continued)										
	WSQ Dimensions (1st order constructs)				WSQ (2nd order)					
	SEC	DD	NAV	VAP		PAI	SC	PPQ	BI	CP
pai2	.096	.006	.092	.031	.030	**.910**	-.027	.056	.095	.121
pai3	.074	-.027	.064	.088	.079	**.902**	-.041	.083	.071	.100
sc1	.022	.058	-.028	-.018	-.010	-.003	**.849**	.098	-.008	.015
sc2	.032	-.010	-.062	.004	.018	-.021	**.886**	.118	.002	-.030
sc3	.091	.105	-.053	.050	.062	-.024	**.869**	.128	.032	.066
ppq1	.465	.349	.430	.531	.591	.019	.143	**.896**	.513	.114
ppq2	.559	.399	.405	.663	.724	.092	.103	**.941**	.640	.104
ppq3	.627	.411	.416	.688	.747	.080	.122	**.940**	.658	.062
bi1	.606	.417	.326	.655	.766	.085	.001	.622	**.969**	.073
bi3	.633	.474	.339	.676	.779	.091	.014	.646	**.983**	.105
bi4	.601	.441	.339	.681	.775	.068	.014	.652	**.985**	.091
cp2	.014	.002	.040	.086	.068	.116	.006	.085	.113	**.671**
cp5	-.028	.036	.081	.024	.017	.104	.021	.085	.050	**.821**
cp7	-.010	-.040	.081	.037	.020	.115	.016	.067	.059	**.824**

Table C5. Study 1: Construct Correlations, Reliabilities, and AVEs												
	CR	AVE	SEC	DD	NAV	VAP	WSQ	PAI	SC	PPQ	BI	CP
SEC	.965	.903	**.950**									
DD	.961	.890	.474	**.943**								
NAV	.933	.822	.326	.407	**.907**							
VAP	.978	.936	.485	.450	.412	**.967**						
WSQ	.986	.960	.635	.551	.446	.848	**.980**					
PAI	.923	.799	.090	-.005	.104	.049	.049	**.894**				
SC	.902	.754	.056	.059	-.055	.014	.027	-.019	**.868**			
PPQ	.947	.857	.596	.418	.450	.679	.744	.069	.132	**.926**		
BI	.986	.959	.626	.454	.342	.685	.790	.083	.010	.653	**.979**	
CP	.817	.600	-.012	-.002	.088	.060	.042	.143	.019	.101	.092	**.775**

Note: Square root of AVE shown on diagonal, CR = composite reliability, AVE = average variance extracted

Discussion of Loadings, Cross-Loadings, and Correlations

An examination of Table C4 shows that all items load strongly on the related construct and are at least an order of magnitude higher than any cross-loadings (Gefen and Straub, 2005). Table C5 shows that the AVE for each construct (rather than the less stringent square root of the AVE) is greater than the correlations with other constructs (Gefen and Straub, 2000). While these results support the discriminant validity of the model constructs, some higher cross-loadings and construct correlations exist with the WSQ construct (measured by the overall, three reflective items and shaded in Table C4), which is not unexpected given the central role of this second-order construct and the strength of some of the relationships in the structural regression model. We also assessed the level of multicollinearity among the constructs by regressing all measured variables on behavioral intention and found that the variance inflation factors (VIF) were all less than 6, substantially lower than the threshold of 10 that is generally recommended (Petter et al. 2007). A lower VIF threshold is recommended specifically for formative items and was met as further discussed below.

The analyses conducted in Studies 2 and 3 (and also the replication study described in Appendix F) do not use the self-reported, overall measure for WSQ or the measures of the WSQ dimensions (SEC, DD, NAV, VAP). Two treatments varying WSQ (high/low) are used instead and measures of WSQ are used for manipulation check purposes only. Studies 2 and 3 provide similar support for the hypothesized relationship between WSQ and PPQ. In addition, we considered alternative representations of WSQ that do not utilize the overall three-item measure, as described below, and found similar results.

Validation of WSQ as a Second-Order Formative Construct

As previously mentioned, WSQ was modeled as a second-order formative construct formed by the four, first-order reflective constructs of security, download delay, navigability, and visual appeal. Three reflective items measuring overall WSQ enabled us to use a multiple indicator multiple causes (MIMIC) model as depicted in Figure C1.

The reflective measures for the four WSQ dimensions and for overall WSQ were analyzed earlier in this appendix and found to exhibit both convergent and discriminant validity. We assessed the validity of WSQ as a second-order, formative construct based on formative measurement guidelines (Cenfetelli and Bassellier 2009; Petter et al. 2007), by (1) assessing multicollinearity among the first-order constructs, (2) examining the path weights and correlations among the first-order constructs and the second order construct, and (3) conducting a redundancy analysis.

Multicollinearity was first assessed using the variance inflation factors (VIF) generated in SPSS when regressing the means of visual appeal, security, download delay, and navigability on overall WSQ. The VIFs ranged from 1.320 to 1.551, well below the 3.33 threshold (Diamantopoulos and Siguaw 2006). While all path weights between the first-order constructs and the second-order construct were significant (shown in Figure 1), the path weight for navigability was small (.05, t-statistic 1.90). In accordance with guidelines for formative measurement, we considered the relative and absolute contributions of the first-order constructs. While the path weight (i.e., relative contribution) shown in Figure 1 was small, the bivariate correlation between navigability and overall WSQ demonstrates a stronger absolute relationship at .446 (shown in table C5). Thus, we retained navigability in our model. Finally, we conducted a redundancy analysis as shown in Figure C2 (see examples in Cenfetelli and Bassellier 2009; Mathieson et al. 2001). We created formative and reflective WSQ constructs in PLS and examined the strength of the relationship between them. The formative WSQ construct was measured using the latent variable scores for the first-order constructs as formative indicators. The reflective WSQ construct was measured using the three reflective, overall WSQ items. The path weight of .894 between the two constructs suggests that the formative items provide good coverage of WSQ.

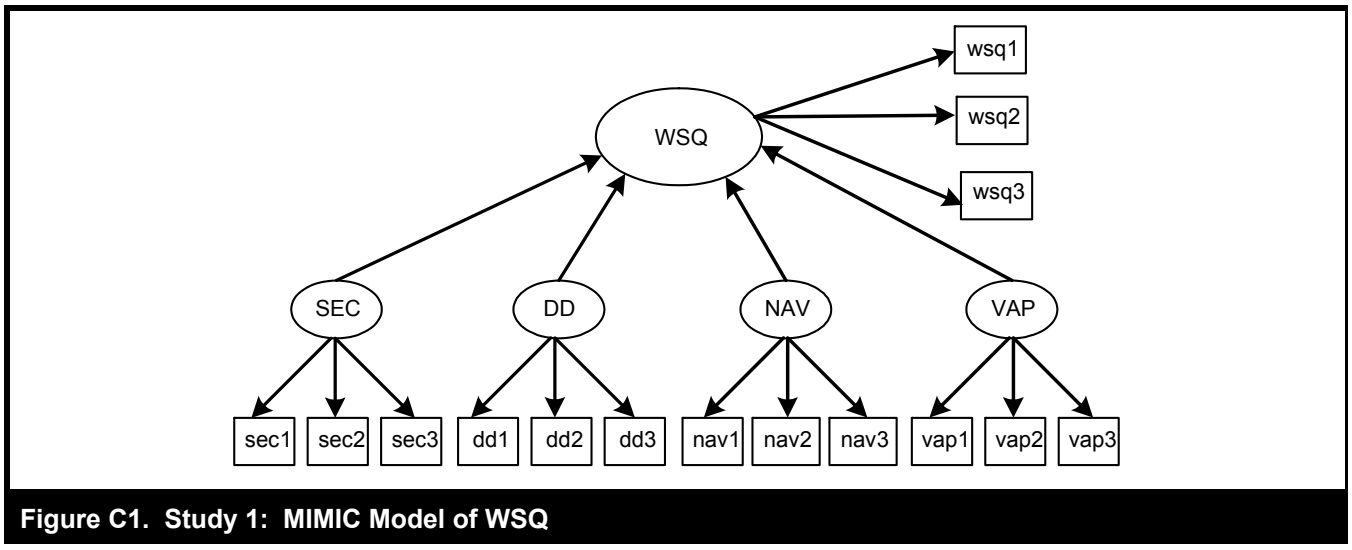
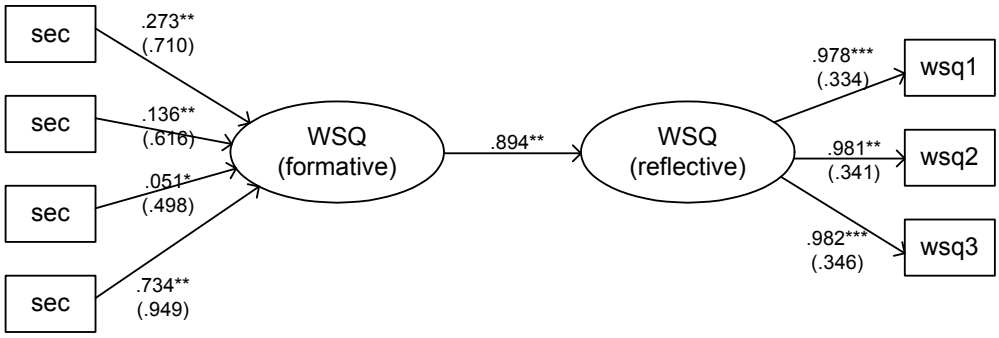


Figure C1. Study 1: MIMIC Model of WSQ



**< .001; * < .05
For formative items, the path weight is the top number, while the loading is the bottom number. For reflective items, the loading is the top number, while the path weight is provided below.

Figure C2. Study 1: Redundancy Analysis

Alternative Representations of WSQ

Study 1 provides validation for the representation of WSQ as a second-order, formative construct, formed by four, first-order reflective dimensions, as previously described. The four WSQ dimensions were treated as formative because these dimensions do not share similar content, do not necessarily covary, and do define or form overall WSQ as a second-order construct (Jarvis et al. 2003; Petter et al. 2007). Higher cross-loadings and correlations were noted with the overall WSQ construct (measured by three, overall reflective items), and thus we ran a couple of alternative formative models that did not require the use of the overall, three-item measure of WSQ to further confirm our results.

In one model, we represented WSQ as a second-order formative construct using the repeated indicator approach (Chin et al. 2003) and thus did not include the three overall WSQ items as reflective measures of the second-order construct. In a second model we represented WSQ as a first-order formative construct and used the latent variable scores generated in PLS for the four WSQ dimensions as formative indicators of WSQ (as described in Gefen and Straub 2005; Vance et al. 2008). In both of these models, similar path weights were obtained for the relationships between WSQ → PPQ (.72, .76) and PPQ → BI (.66, .66), while the higher cross-loadings and correlations among constructs were eliminated as the three-item overall measure of WSQ was not included.

WSQ Measurement and Future Research

Several of the measures used in our study were based on the WEBQUAL scale (Loiacono et al. 2007), an adaptation of SERVQUAL, and thus are subject to some of the criticisms of SERVQUAL.[1] SERVQUAL is a multidimensional scale measuring service quality which was developed in the marketing literature (Parasuraman et al. 1988; Parasuraman et al. 1991). The scale development process for SERVQUAL was somewhat atheoretical with the five dimensions of service quality (tangibles, reliability, responsiveness, assurance, and empathy) determined through reliability and factor analysis exercises. SERVQUAL was criticized for this development process and for the instability of the dimensions and items across industries (e.g., Brown et al. 1993; Carman 1990). An information systems measure of service quality was developed using the same five dimensions (Pitt et al. 1995) and faced these same criticisms due to similar inconsistencies across industries and countries with the IS SERVQUAL measure (Kettinger et al. 1995; Pitt et al. 1995) . More recent studies of service quality have tried to integrate divergent views and conceptualize the construct hierarchically with an overall service quality construct formed by dimensions and sub-dimensions, but modifications are still required based on industry-specific contexts (Brady and Cronin 2001).

The WEBQUAL scale was developed with twelve dimensions to measure user perceptions of website quality (Loiacono et al. 2007). Other measures of website quality with different dimensions have also been employed in the IS literature (e.g., Kim et al. 2002). Similar to SERVQUAL, inconsistencies with the dimensions have been found with the WEBQUAL instrument (Loiacono et al. 2007), and research

[1]WEBQUAL does not assess the gap between quality expectations and perceptions and thus is not subject to the difference score criticisms levied against SERVQUAL.

suggests that the relevant dimensions of website quality may vary based upon the nature of the task (e.g. experiential/hedonic, utilitarian) (Valacich et al. 2007). Research has shown that aesthetic features (e.g., visual appeal) are a more dominant component of website quality in experiential or hedonic contexts. Theory-based research is needed to develop an integrated conceptualization and measurement instrument for WSQ and to propose when different dimensions are more relevant. Recent research on formative measures notes that when multiple formative indicators or dimensions are measured, insignificant path weights for some dimensions are likely to result (Cenfetelli and Bassellier 2009). Instrument validation across different tasks and contexts is needed to insure that dimensions are not discarded due to insignificance in one context.

Study 2: Descriptive Statistics and Validation

Table C6. Study 1: Descriptive Statistics and Validation

	Minimum	Maximum	Mean	Std. Deviation
wsq1*	1	9	4.95	2.475
wsq2*	1	9	4.84	2.498
wsq3*	1	9	4.86	2.433
pai1*	1	9	4.41	2.424
pai2*	1	9	4.34	2.206
pai3*	1	9	4.12	2.193
ppq1	1	9	5.99	1.833
ppq2	1	9	5.99	2.003
ppq3	1	9	5.77	2.053
bi1	1	9	4.29	2.672
bi2	1	9	4.36	2.665
bi3	1	9	4.28	2.635

wsq = perceived website quality, pai = product asymmetries of information, ppq = perceived product quality, bi = behavioral intention
*These measures were used for manipulation check purposes only

Manipulation checks were performed by first running ANOVAs for both web site quality treatment and the product asymmetry of information treatment where the treatment was the independent variable and the dependent variable (DV) was the scale measuring perceptions of that treatment. The respective scales are provided in Appendix A. As shown below, the manipulations were significant with a p-value < .001. A more rigorous form of manipulation check was also performed as recommended by Perdue and Summers (1986) by running ANOVAs in which the two treatments were included as main effects and the dependent variable was the scale measuring perceptions of each treatment. This approach was used to insure that that each treatment effect remained significant in the presence of the other treatments. The results, provided below, show that both the web site quality treatment and the product asymmetry of information treatment had a significant effect on the related perceptions even in the presence of the other treatment. As an alternative manipulation check for WSQ we also conducted analysis using an index comprised of the average scores for the four WSQ dimensions (SEC, DD, NAV, VAP) and obtained similarly significant results for the manipulation of WSQ.

Table C7. Study 2: Manipulation Checks

ANOVAs with One Treatment and One DV	Perceived Web Site Quality		Perceived Asymmetries of Information	
	F	Sig.	F	Sig.
Web Site (high/low)	204.42	.000		
PAI (low/high)			27.01	.000
ANOVAs with Two Treatments and One DV	**Perceived Web Site Quality**		**Perceived Asymmetries of Information**	
	F	**Sig.**	**F**	**Sig.**
Web Site (high/low)	**207.24**	**.000**	.20	.653
PAI (low/high)	.01	.921	**26.81**	**.000**

Table C8. Study 2: Loadings and Cross-Loadings		
	PPQ	BI
ppq1	**0.89**	0.48
ppq2	**0.93**	0.65
ppq3	**0.94**	0.64
bi1	0.63	**0.97**
bi2	0.64	**0.99**
bi3	0.62	**0.98**

Table C9. Study 2: Construct Correlations, Reliabilites, and AVEs				
	CR	AVE	PPQ	BI
PPQ	.943	.847	**.920**	
BI	.987	.963	.643	**.981**

Note: Square root of the AVE is shown on diagonal in bold.
CR = composite reliability, AVE = average variance extracted

Study 3: Descriptive Statistics and Validation

Table C10. Study 3: Descriptive Statistics				
	Minimum	Maximum	Mean	Std. Deviation
wsq1*	1	9	4.71	2.511
wsq2*	1	9	4.52	2.592
wsq3*	1	9	4.63	2.524
sc1*	1	9	6.15	2.563
sc2*	1	9	6.45	2.110
sc3*	1	9	5.71	2.590
ppq1	1	9	5.34	1.780
ppq2	1	9	5.48	1.975
ppq3	1	9	5.12	2.161
bi1	1	9	3.79	2.563
bi2	1	9	3.88	2.572
bi3	1	9	3.85	2.551

*These measures were used for manipulation check purposes only.

Manipulation checks were performed by first running ANOVAs for both web site quality treatment and the signal credibility treatment where the treatment was the independent variable and the dependent variable (DV) was the scale measuring perceptions of that treatment. The respective scales are provided in Appendix A. As shown below, the manipulations treatments were significant with a p-value < .001. A more rigorous form of manipulation check was also performed as recommended by Perdue and Summers (1986) by running ANOVAs in which the two treatments were included as main effects and the dependent variable was the scale measuring perceptions of each treatment. This approach was used to insure that that each treatment effect remained significant in the presence of the other treatments. The results, provided below, show that both the web site quality treatment and the signal credibility treatment had a significant effect on the related perceptions, even in the presence of the other treatment. As an alternative manipulation check for WSQ we also conducted analysis using an index comprised of the average scores for the four WSQ dimensions (SEC, DD, NAV, VAP) and obtained similarly significant results for the manipulation of WSQ.

Table C11. Study 3: Manipulation Checks				
ANOVAs with One Treatment and One DV	**Perceived Web Site Quality**		**Perceived Signal Credibility**	
	F	**Sig.**	**F**	**Sig.**
Web Site (high/low)	**187.23**	**.000**		
SC (low/high)			**225.21**	**.000**
ANOVAs with Two Treatments and One DV	**Perceived Web Site Quality**		**Perceived Signal Credibility**	
	F	**Sig.**	**F**	**Sig.**
Web Site (high/low)	**189.54**	**.000**	.20	.655
SC (low/high)	2.95	.088	**224.07**	**.000**

Table C12. Study 3: Loadings and Cross-Loadings		
	PPQ	**BI**
ppq1	**0.91**	0.64
ppq2	**0.94**	0.64
ppq3	**0.93**	0.69
bi1	0.67	**0.97**
bi2	0.70	**0.99**
bi3	0.72	**0.98**

Table C13. Study 3: Construct Correlations, Reliabilities, and AVEs				
	CR	**AVE**	**PPQ**	**BI**
PPQ	.947	.857	**.926**	
BI	.987	.961	.711	**.980**

Note: Square root of the AVE is shown on diagonal in bold.
CR = composite reliability, AVE = average variance extracted

Appendix D

Common Method Bias Analysis

Common method bias (CMB) was assessed by including an unmeasured latent method construct (ULMC) in the structural regression model using a PLS approach documented in the IS literature (Liang et al. 2007; Vance et al. 2008). Because PLS does not allow items to load on more than one construct and does not generate random error statistics, the individual items are first converted to single indicator constructs as further described in Liang et al. (2007). An ULMC is then added to the model and paths are drawn from this method factor to the single indicator constructs. Finally, a structural regression model is run and the paths from the substantive factors and the method factor to the single indicator constructs are evaluated. The results from this analysis (below) show that all of the original factor loadings (from the measurement items to the related latent construct) remained significant as did the hypothesized paths in the structural regression model. Only 5 of the 30 paths from the ULMC to the measurement items were significant and were substantially smaller in magnitude than the corresponding loading to the related latent construct, providing further evidence that the study results were not due to CMB.

	Items	Factor Path/Loading (Orig. sample)	Factor Squared Loading (R^2)	T-statistic	Method Path/Loading (Orig. sample)	Method Squared Loading (R^2)	T-statistic
Security	sec1	0.98	0.97	**41.44**	-0.06	0.00	1.47
	sec2	0.96	0.92	**41.27**	-0.02	0.00	0.47
	sec3	0.91	0.82	**36.89**	0.07	0.01	**2.63**
Download delay	dd1	0.92	0.84	**36.00**	0.03	0.00	1.01
	dd2	0.96	0.92	**65.11**	0.01	0.00	0.36
	dd3	0.96	0.91	**40.13**	-0.04	0.00	1.50
Navigability	nav1	0.95	0.90	**41.87**	-0.10	0.01	**3.60**
	nav2	0.84	0.70	**37.85**	0.14	0.02	**5.83**
	nav3	0.93	0.87	**35.78**	-0.05	0.00	1.95
Visual appeal	vap1	0.98	0.95	**47.33**	0.01	0.00	0.48
	vap2	1.00	1.00	**40.62**	-0.02	0.00	0.59
	vap3	0.98	0.95	**26.24**	0.01	0.00	0.17
Web site quality	wsq1	1.06	1.12	**25.80**	-0.09	0.01	1.95
	wsq2	0.95	0.90	**24.64**	0.03	0.00	0.80
	wsq3	0.93	0.87	**26.29**	0.05	0.00	1.45
Product asymmetries of information	pai1	0.87	0.76	**35.95**	-0.01	0.00	0.30
	pai2	0.91	0.83	**65.27**	0.00	0.00	0.03
	pai3	0.90	0.81	**54.16**	0.01	0.00	0.37
Signal credibility	sc1	0.85	0.72	**27.61**	-0.02	0.00	0.52
	sc2	0.89	0.79	**54.60**	-0.02	0.00	0.58
	sc3	0.87	0.75	**33.90**	0.04	0.00	1.06
Product quality	ppq1	1.06	1.13	**25.85**	-0.20	0.04	**3.84**
	ppq2	0.91	0.82	**22.85**	0.04	0.00	1.07
	ppq3	0.83	0.68	**23.62**	0.14	0.02	**3.61**
Web site purchase intentions	bint1	0.99	0.98	**35.06**	-0.03	0.00	0.79
	bint2	0.95	0.91	**43.02**	0.04	0.00	1.40
	bint3	0.99	0.99	**55.00**	-0.01	0.00	0.42
Computer playfulness	cp1	0.67	0.45	**11.29**	0.04	0.00	0.82
	cp2	0.82	0.68	**30.98**	-0.01	0.00	0.28
	cp3	0.83	0.68	**36.12**	-0.02	0.00	0.53

t-statistics in bold are significant, p-value < .05.

Appendix E

Structural Regression Model Results

Table E1. Study 1: PLS Structural Equation Model Results

Dependent Variable	Independent Variable	R^2	Beta	t-statistic
BI		.43		
	PPQ		.66***	18.64
PPQ		.58		
	WSQ		.74***	25.00
	PAI		.04	.75
	SC		.11**	2.35
WSQ		.80		
	Security		.25***	5.87
	Download Delay		.11***	2.91
	Navigability		.05*	1.90
	Visual Appeal		.66***	16.40
	Computer Playfulness		.01	.20
	Gender		.03	1.14
	Number of Online Purchases		.02	1.08

***significant at .001, **significant at .01, *significant at .05
Control variables are in *italics*.

Appendix F

Replication of Study 1

This replication study used an experimental design with same six interfaces employed in Study 1to address the issues of generalizability and common method bias. Given that studies 1, 2, and 3 use the same, homogenous subject pool (i.e., undergraduate students), a more heterogeneous sample was used in this replication. Further, this study was designed to address common method bias (CMB) concerns with Study 1 in which multiple constructs were measured in the pre and post surveys. The number of constructs measured through self-reporting survey items was reduced in this study as CMB can be an issue when data are collected at the same time, using the same method (e.g., survey), with similar question formats (Podsakoff et al. 2003). CMB is particularly problematic when independent and dependent variables are measured in the instrument (e.g., WSQ and PPQ).

Subjects

A snowball sampling technique (i.e., chain-referral) (Coleman 1958) was used to access a more heterogeneous, older set of subjects. This technique has been commonly used in marketing research (Mick 1996) and in prior information systems research (Lapointe and Rivard 2005). A convenience sample of undergraduate students (seed participants) enrolled in an introductory management information systems course was asked to recruit nonstudent subjects (e.g., family and off-campus friends). A total of 240 subjects (40 for each treatment group) participated in the experiment, with 51.3 percent being female and an average age of 36.33 (ranging from 18 to 81). Limitations in the use of snowball samples have been noted in the literature (e.g., Erickson 1979; Heckathorn 1997), and thus we followed procedures to minimize the potential bias of this sample. Participation in the study was strictly voluntary, and the seed participants (undergraduate students) received course credit for each completed survey submitted on their behalf (with a limit of three submissions). The seed participants were instructed not to discuss

the study with the subjects that they recruited. Responses were filtered by IP address, and any responses that were submitted using a campus IP address were excluded to prevent the seed participants from forging responses or recruiting one another.

Experimental Procedures

This study was administered outside of a controlled laboratory setting and only included an abbreviated post-survey (no pre-survey). Subjects were first assigned to visit one of the six interface treatments (without completing a pre-survey) and were prompted to execute the series of steps specified on the experimental task sheet. Next, the subjects completed a brief post-survey that included measures of only PPQ and BI, and questions regarding age, sex, number of online purchases, and familiarity with Timbuk2 products.

Data Analysis

Descriptive statistics for PPQ and BI by treatment are provided in Table E1. Consistent with the Study 1 results, the WSQ treatments resulted in similar changes to PPQ. Manipulation checks for WSQ could not be conducted as WSQ measures were not included on the survey. An ANOVA was run in SPSS 15.0 with WSQ as a treatment variable (high, low, interfaces A, F) and PPQ as the dependent variable, resulting in a significant relationship ($p < .0001$), supporting H1. WSQ and PPQ were then regressed on BI to test H4 as shown in Table E2. PPQ significantly influenced BI (.57, p-value < .001) and partially mediated the effect of WSQ on BI (Baron and Kenny 1986), explaining .52 of the variance in BI (adjusted R^2).

Table E1. Replication of Study 1: Treatment Descriptive Statistics

	Interface Treatments					
	A	B	C	D	E	F
Perceived (Self-Reported)	H-Sec H-DD H-Nav H- VAP	H-Sec L-DD L-Nav L- VAP	L-Sec H-DD L-Nav L-VAP	L-Sec L-DD H-Nav L- VAP	L-Sec L-DD L-Nav H- VAP	L-Sec L-DD L-Nav L- VAP
PPQ	6.90	5.13	5.18	5.03	5.75	4.36
BI	5.72	3.66	2.59	2.98	3.89	2.73

Table E2. Replication of Study 1: Regression/Mediation Analysis for BI

WSQ → BI		WSQ → PPQ		WSQ + PPQ → BI				
β	p-value	β	p-value	WSQ β	p-value	PPQ β	p-value	Mediation
.595	.000	.680	.000	.207	.000	.570	.000	Partial

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