**Ais This Site Confusing Or Interesting?@  a Perceived Web Site Complexity (Pwc) Scale For Assessing Consumer Internet Interactivity**

Reetika Gupta, Baruch College

Sucheta Nadkarni, University of NebraskaBLincoln

Stephen J. Gould, Baruch College

ABSTRACT - This paper develops a comprehensive conceptualization of the construct, perceived web site complexity. Drawing on the research on stimulus complexity and task complexity, we develop a valid and reliable scale that captures the underlying dimensions of perceived web site complexity. We found two key dimensions underlying perceived web site complexity: structural complexity (comprising range and dissimilarity of structural elements) and interactive complexity (comprising navigational ambiguity and probabilistic hyperlink outcomes). Further, the results confirm that the facets of perceived web site complexity have an inverted-U relationship with telepresence. Finally, telepresence mediates the relationship between complexity and attitudes. We discuss the implications of these results.

# "Is this Site Confusing or Interesting?"
# A Perceived Web site Complexity (PWC) Scale for Assessing Consumer Internet Interactivity

Reetika Gupta, Baruch College
Sucheta Nadkarni, University of Nebraska–Lincoln
Stephen J. Gould, Baruch College

## ABSTRACT

This paper develops a comprehensive conceptualization of the construct, perceived web site complexity. Drawing on the research on stimulus complexity and task complexity, we develop a valid and reliable scale that captures the underlying dimensions of perceived web site complexity. We found two key dimensions underlying perceived web site complexity: *structural complexity* (comprising *range* and *dissimilarity* of structural elements) and *interactive complexity* (comprising *navigational ambiguity* and *probabilistic hyperlink outcomes*). Further, the results confirm that the facets of perceived web site complexity have an inverted-U relationship with telepresence. Finally, telepresence mediates the relationship between complexity and attitudes. We discuss the implications of these results.

## INTRODUCTION

With the growth of the Internet, businesses are spending billions of dollars to add a wide range of sophisticated features such as animated pictures, icons and links at a web site that increase its *complexity*. What effects might this complexity have on the consumer attitudes and intentions at the site? While complex web sites may be more memorable, communicate more information and engage consumers (Beatty, 1998; Hansell, 1998), they can often be difficult to navigate and use (Jarvenpaa and Todd, 1997).

Despite the over-arching significance of perceived web site complexity (PWC), substantive research employing this construct in an online environment is constrained by two major reasons. Current research on complexity in an online environment focuses on Berlyne's (1970) structural view of stimulus complexity, characterized by the range and dissimilarity of the structural elements. However, this characterization does not address the individual–environment interaction, which is critical in an online context. Hoffman and Novak (1996) have highlighted the unique interactive facet of a web site that distinguishes it from other media. Web sites allow instant two-way communication opportunities not possible in traditional media. Drawing on the task complexity literature, we address the interactive facet that is integral to complexity in an online environment. Besides the focus on the number of task inputs one has to process, research on task complexity (Campbell, 1988; Wood, 1986) focuses on the interrelationships between individual actions and task outcomes. We adapt this view to understand how the interrelationships between the individual actions and interactive elements (for example hypertext links) at the web site, contribute to complexity. We argue that PWC stems from the discrepancy between the navigational expectations of the individuals and the outcomes of the interactive features. In essence, complexity of a web site arises from not only the physical arrangement of pictures, text and sound, but also from the interactivity in traversing the web pages. We integrate the stimulus and task complexity literatures to develop a comprehensive framework of PWC.

Second, the absence of a valid and reliable measurement scale capturing the dimensions of PWC has seriously impeded substantive research linking complexity to other constructs of interest. Systematically developed measures will provide quantitative rigor to examining substantive links between PWC and relevant attitudinal constructs, and can help ensure the effective operationalization of PWC in experimental studies. Further, a well-defined complexity scale may allow researchers to classify web sites, provide a basis for manipulating web sites and allow easy comparison of web sites in future studies about this construct.

From a practical perspective, developing a comprehensive understanding of complexity can promote the effective use of the Internet as a marketing communication channel. For example, a clear understanding of the dimensions may help marketers clarify whether complexity makes a site confusing or interesting. A clear understanding of the various facets of complexity will allow marketers to manage complexity more effectively — marketers can tailor the complexity at web sites based on individual goals.

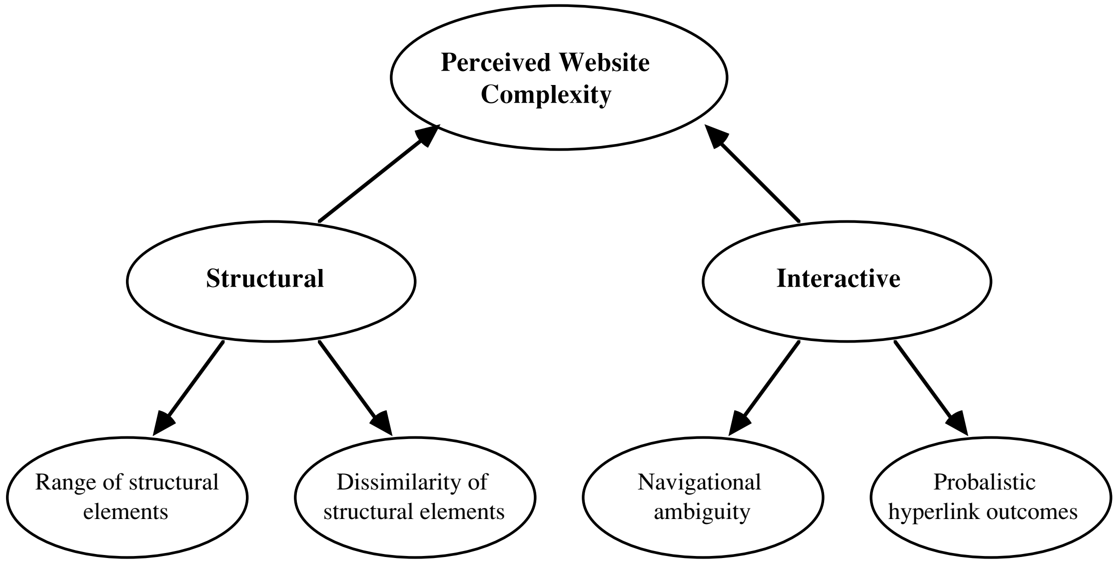
Given these concerns and potential, this paper 1) develops a scale to assess perceived web site complexity (PWC); 2) verifies the scale's underlying latent structure and 3) examines the relationship between PWC, telepresence and attitude.

## COMPLEXITY IN AN ONLINE ENVIRONMENT

In marketing, there have been numerous studies that have conceptualized complexity to investigate its effects on evaluations and intentions. In the sub domain of advertising, researchers have focused on *visual complexity* (Cox and Cox, 1988; Morrison and Dainoff, 1972) — the number of heterogeneous objects and irregularity, and *message complexity in television advertisements* (Thorson, Reeves and Schleuder, 1985) — number of visual features (edits, scene changes, superimposed images, zooms etc) and number of audio units (count of linguistic propositions). In product related studies, researchers have focused on *brand logo complexity* (Janiszewski and Meyvis, 2001) — the complexity and familiarity of brand logo characteristics, and *product design complexity* (Cox and Cox, 2002) — the extent of heterogeneity and irregularity of the shapes and fabrics of the product design. Internet researchers have extended this structural view to manipulate the complexity of a web page by colors and movement (Bruner and Kumar, 2000), number of links, number of graphics, home page length and animation (Geissler, Zinkhan and Watson, 2001). Researchers in a retail environment also uphold this structural view where they contend that physical design and décor elements have a significant impact on consumer behavior (Baker, Parasuraman, Grewal and Voss, 2002; Bitner, 1992). In addition, researchers examining retail store environments have referred to complexity as the uncertainty in the environment (Donovan, Rossiter, Marcoolyn and Nesdale, 1994; Donovan and Rossiter, 1992). Some researchers who have investigated c*omplexity in products and product choice tasks* (Dhar, 1997a, 1997b; Swait and Adamowicz, 2001; Tversky and Shafir, 1992) focus on how individuals have to adapt to the task characteristics.

Most of this research in complexity has their roots in Berlyne's (1960) stimulus complexity. Accordingly, these studies have defined complexity in terms of an individual's perception of the *structure* and *visual pattern* of the stimuli. Berlyne (1960) identified several structural elements of stimulus complexity including amount and heterogeneity of elements, their arrangement and incongruity. In summary, he posits that individuals view a stimulus to be more complex as the number of distinguishable elements is increased.

**FIGURE 1**
Dimensions of Perceived Web site Complexity (PWC)




However, the stimulus-based view, focusing on the number of distinct elements that the individual has to process in an online environment ignores the interactive aspect. In an online environment, consumers mainly navigate through a web site to fulfill various goals of exploring, being entertained, seeking information, buying a product (Rodgers and Thorson, 2000; Coyle and Gould, 2002). In their goal pursuit, individuals need to interpret and adapt to various sophisticated interactive features (for example hyperlinks), which allow individuals to interactively access information and navigate through the environment (Hoffman and Novak, 1996). While such symbolic communication serves as an interactive tool to navigate through the environment; the discrepancy between the navigation expectations of the individuals and outcomes of the interactive features may contribute to the complexity at the web site.

Besides focusing on the number of task inputs one has to process, research on *task complexity* (Campbell, 1988; Wood, 1986) focuses on the interrelationships between individual actions and task outcomes. Wood (1986) contends that task complexity is an aggregate multidimensional construct, which is a linear combination of both the number of task inputs one has to process and the uncertainty between the potential action activities and desired outcomes. We adapt this view to develop a holistic conceptualization of PWC, which addresses both the structural and interactive aspects of complexity that individuals encounter while performing an online task. Based on Wood's theorization, we posit that PWC is a linear combination of the two latent dimensions—structural and interactive. We show this aggregate model of PWC in Figure 1 and discuss the dimensions in the following sections.

### Structural Complexity

Berlyne (1960) proposes that stimulus complexity reflects the range of different structural elements and the irregularity in arrangement. Mehrabian and Russell (1974) too contend that complexity in an environment comprises different structural elements such as ambient conditions, spatial layout; and signage and artifacts. Similarly, literature on task complexity define complexity as the number of distinct information cues that must be perceived and processed in the performance of a task (Wood, 1986). Internet researchers have extended this structural view to manipulate the complexity of a web page by colors and movement (Stevenson Bruner and Kumar, 2000), number of links, number of graphics, home page length and animation (Geissler et al, 2001).

Accordingly we theorize that structural complexity arises from the overall configuration of the various structural elements across the web pages at a web site. The structural elements maybe classified into *content* and *form* (Lang, 1990; Reeves and Nass, 1996) where content based elements essentially comprise the information categories presented and form based elements comprise the various ways the information is presented (text, images, video, audio, animation). Specifically, structural complexity subsumes two subdimensions–the *range* of different structural elements, and the *dissimilarity* of these elements at a web site. In other words, as the range and dissimilarity of the structural elements increase, the structural complexity is increased.

### Interactive Complexity

Interactive complexity arises from the fact that individuals must frequently adapt to changes in the cause-effect chain during the performance of the task (Wood, 1986). In other words, it can be defined in terms of *inexact means-end*—the degree of uncertainty between potential action activities and desired outcomes (March and Simon, 1958). In a navigation environment, the action-outcome uncertainty can be explained by *schema incongruity* (Mandler, 1982). Based on schema research (Sujan and Bettman, 1989), we argue that uncertainty in an online environment arises due to the failure to develop a schema (ambiguous hyperlink) or due to the lack of fit between the schema (expectations based on the hyperlink) and the ensuing webpage. In other words, if the expectations based on the hyperlink do not match to the ensuing webpage, it leads to schema incongruity. In what follows, we outline the two facets of interactive complexity in more depth.

Complexity in the navigation environment is reflected in the *ambiguous* nature of hyperlinks or other obstacles such as unclear procedures to browse the web site. Hyperlinks that connect different web pages enable users to construct interpretations and expectations, and navigate effectively through the web site. When real world objects are represented in a hyperlink, the individuals are likely to find it more meaningful and find it easy to make links between what is shown in the hyperlink and function it is supposed to represent (McDougall, De Bruijn and Curry, 2000). To facilitate the transfer of information, researchers propose the use of realistic metaphors (Steuer, 1992) or natural mapping strategies (Norman, 1990) whereby the individual can form expectations of the outcomes. However, due to technological innovations, hyperlinks today are becoming increasingly ambiguous, not allowing the individual to form expectations of the corresponding destination. In other words, an ambiguous hyperlink increases the interactive complexity of the web site.

The other important facet of interactive complexity is the probabilistic nature between the paths and the outcomes at the web site. In other words, the expectations based on the hyperlink may not match the ensuing web page. For example in the Disney web site that simulates the Disney theme park, the user may expect to access information about a specific Disney landmark by a click on the hyperlink that resembles the real Disney landmark. But, the click may not necessarily take the user to the desired page (Coyle and Thorson, 2001). The hyperlink is therefore probabilistic in nature where the individual action-outcome expectancy is not met. In summary, interactive complexity reflects the degree to which users find the hyperlinks at a web site ambiguous and the expectations based on the hyperlink format incongruous with the ensuing web page.

## RESEARCH METHODS

The research design of this study is based on Bagozzi's (1980) criteria of construct validation — 1) theoretical meaningfulness, 2) observational meaningfulness, 3) internal consistency, 4) convergent validity, 5) discriminant validity and 6) nomological validity.

### Scale Development:

Development of the scales to measure each construct in the model advanced through a series of steps. First, to address the theoretical meaningfulness of the construct we *theoretically* derived 10 items of PWC (see Table 1). Second, to increase observational meaningfulness of these measures (Bagozzi, 1980), we conducted a free association task among 40 subjects (mean age=23, 30% female), which yielded 10 more items. We then grouped the 20 items into the sub-facets of structural and interactive complexity using the Q-sort technique as a way to strengthen construct validity (Anderson and Gerbing, 1981). Third, we gave out a pilot questionnaire based on the 10 theoretical and 10 empirical measures to 30 subjects (business professors, Ph.D. students, web professionals). They evaluated these measures for content, clarity, meaningfulness and ability to measure PWC. We also used item-total correlation and discrimination based on t-statistic to remove redundant items. We removed items with low item-total correlations (2 items: 0.28, n.s. and 0.21, n.s.) and nonsignificant t-statistic (same 2 items: 0.95, and 1.34, n.s.) between the ratings of the top 25th percentile and lowest 25th percentile respondents. Based on these results of the pilot test, we retained 18 items (see Table 1) to test our proposed theoretical model.

### Dimensionality

We administered the scale to 162 undergraduate students at a major midwestern university (67% in the 19-24 age group and 57% male). To ensure that results were not idiosyncratic to student subjects, we replicated this study with 120 nonstudent subjects who visit the local library (25% in the 19-24 age-group and 75% in the 30-60 age-group; 75 males). Thus the total sample consisted of 282 subjects. We randomly assigned the subjects to one of the 48 web sites[1] in a computer laboratory setting and instructed them to surf the web site for 15-20 minutes.

The overall reliability estimate for the 18 item PWC scale was robust (Cronbach coefficient alpha=0.81). We employed confirmatory factor analysis (Bagozzi, 1980) using EQS to assess the convergent, discriminant validity and the internal consistency of the items. We tested three alternative models (other than the null model) to confirm the multidimensionality of PWC (see Results in Table 2). The lack of fit of the one first order factor model confirms the multidimensionality of PWC and provides evidence of discriminant validity for measures of structural and interactive complexity. Similarly, the lack of fit of the two first order orthogonal factor model provides evidence of discriminant validity for measures of range, dissimilarity, probabilistic hyperlink outcomes and navigational ambiguity and suggests the need to create an aggregate factor.

We used a structural procedure (Law, Wong and Mobley, 1998) to test the linear aggregate model of PWC. The seven factor model consisting of four first order factors (range, dissimilarity, probabilistic hyperlink outcomes and navigational ambiguity), two second order factors (structural and interactive complexity) and an aggregate factor (perceived web site complexity) reflects the best fit. These results confirm our proposed theory based dimensionality of PWC.

Table 3 shows the standardized factor loadings of each measurement item and the standardized structural coefficients of each latent variable used to examine the convergent validity of the measures. The factor loadings of the 18 items range from 0.71 to 89, whereas the standardized structural coefficients of the latent factors range from 0.84 to 0.91. These results provide satisfactory levels of convergent validity (>0.70) for the proposed dimensions of PWC.

### Nomological Validity

We illustrate the modeled relationships between web site complexity and two consumer outcomes: telepresence and attitudes. We measured telepresence using the 8-item scale developed by Kim and Biocca (1997). The reliability coefficient associated with this scale for our sample was 0.84. To measure the attitude toward the web site, participants evaluated the web site using three seven-point scales (good-bad, favorable-unfavorable, and like-dislike) (Coyle and Thorson, 2001). The reliability coefficient for this scale for our sample was 0.83. Since individual differences may confound perceived complexity (Wood, 1986), we collected information of relevant individual characteristics including age, education and gender. We calculated a composite measure of familiarity by averaging the z scores of the four measures: familiarity with the web site and product, years of internet experience and weekly use of internet. We used these measures as controls in the regression analyses.

[1] To increase the generalizability of our results, we went through a series of steps to select a wide variety of websites that were different on several features. Initially, we selected 150 web sites which belonged to several product categories, both familiar (for example travel, entertainment, auction and news) and unfamiliar (for example computer hardware ingredients, office software and fertilizers). A cluster analysis that grouped the websites based on form, content and success measures yielded six clusters. We randomly chose eight websites from each cluster based on one guiding criteria: to include about the same number of websites from familiar (4) and unfamiliar (4) product categories.

**TABLE 1**
Measurement scales of Structural and Interactive Complexity

| Construct | Perceived Web site Complexity Measures |
|---|---|
| | Likert Scale |
| Structural Complexity | Range<br>1. Length of text (Stevenson et al 2000)<br>2. Number of background colors (Stevenson et al 2000)<br>3. Number of images (Geissler et al 2001)<br>4. Number of animated images (Stevenson et al, 2000)<br>5. Number of hypertext links (free association)<br>6. Number of information items (free association)<br>7. Number of web pages (free association)<br><br>Dissimilarity<br>8. Clarity between text and images (free task association)<br>9. Dissimilarity of images (free task association)<br>10. Dissimilarity of information items on the web pages (free task association)<br>11. Dissimilarity in the layout of the webpages (free task association)<br>12. Interrelationships between information across webpages (Daft and Lengel, 1986) |
| Interactive Complexity | Navigational ambiguity<br>1. Icons used to browse the web site are not meaningful (Steuer, 1992; McDougall, de Bruijn and Curry, 2000)<br>2. Hyperlinks presented does not allow individuals to form expectations (McDougall, de Bruijn and Curry, 2000)<br>3. Navigation is hindered by banner and pop up advertisements (free task association)<br><br>Probabilistic hyperlink outcomes<br>4. Individual links take you to the desired pages (Palmer, 2002)<br>5. Individual links do not take you to the relevant web pages (Palmer, 2002)<br>6. Uncertainty between pieces of information presented on the website (Daft and Lengel, 1986) |

**Structural Complexity and Telepresence**

Literature on stimulus complexity proposes an inverted-U relationship between perceived complexity of the stimulus and the pleasantness towards the stimulus (Berlyne, 1960). In an online environment, the nature of browsing experience is captured by the telepresence. Telepresence is defined as the mediated perception of the environment where the individual feels present (Kim and Biocca, 1997; Steuer, 1992). We propose that the configuration of structural elements (structural complexity) would have implications for the telepresence experienced by the individual. More specifically, based on the stimulus complexity research (1960); we propose an inverted-U relationship between perceived structural complexity and telepresence. According to Steuer (1992), representational richness of a mediated environment, characterized by the way in which the environment presents the formal features to the senses, influences the telepresence experienced in the environment. This suggests that the wide variety of design and information cues contributing to the structural complexity creates a representationally rich environment for the individual. The use of multiple forms of presentation (text, graphics, animation and videos) is likely to heighten the visual sensory depth of users by richly engaging their visual sense. In turn, this sensory depth immerses users in the web environment, heightening their sense of telepresence at the web site. On the other hand, simple web sites that employ one or a few presentation cues may lack representational richness and sensory appeal, leading to low levels of telepresence among individuals.

However, while an optimal level of structural complexity may engender a representationally rich environment, structural complexity is acceptable only to a certain extent because highly complex web sites may result in an excessive cognitive overload. The use of many diverse cues in presenting information can lead to sensory overload and impede information processing (Klein, 2003). Similarly, the cognitive load theory suggests that processing verbal and visual cues in a multimedia environment is cognitively demanding (Sweller, 1988). This cognitive and sensory overload resulting from high levels of structural complexity can inhibit the telepresence experienced by individuals at a web site (Lombard and Ditton, 1997; Steuer, 1992). This suggests that there exists a medium level of structural complexity where the individual can maximize their sense of telepresence at a web site.

H1a: There will be an inverted U relationship between structural complexity and telepresence at a web site.

**Interactive Complexity and Telepresence**

Schema researchers have shown that consumers perceive moderate levels of incongruity as "interesting and positively valued" (Mandler, 1982). Specifically, "the process of resolving incongruity tends to be rewarding" (Meyers-Levy, Louie, and Curren, 1994) as there is positive affect associated with assimilating incongruous new information into the existing schema. In an online context, high levels of telepresence experienced at the web

**TABLE 2**

Goodness-of-fit Indices for Alternative Models of PWC

| Models | Chi-Square | Chi-square/df | CFI | NFI | RMSEA |
|---|---|---|---|---|---|
| 1. Null | 598.07 | 5.41 | -- | -- | -- |
| 2. One First Order Factor | 316.13 | 2.81 | 0.69 | 0.54 | 0.28 |
| 3. Two First Order Orthogonal Factors | 249.04 | 2.73 | 0.74 | 0.71 | 0.19 |
| 4. Four First Order Factors, Two Second Order and the Aggregate Factor | 141.83 | 1.57 | 0.92 | 0.87 | 0.05 |

**TABLE 3**

Standardized Parameter Estimates and R-squares for the seven factor model of PWC

| Item | Factor Loading | R-Square |
|---|---|---|
| 1. Structural Dissimilarity: Clarity between text and images | 0.88 | 0.77 |
| 2. Structural Dissimilarity: Dissimilarity of images | 0.83 | 0.69 |
| 3. Structural Dissimilarity: Dissimilarity of information items | 0.79 | 0.62 |
| 4. Structural Dissimilarity: Dissimilarity in the layout of web pages | 0.84 | 0.74 |
| 5. Structural Dissimilarity: Interrelationships between information across the web pages | 0.71 | 0.50 |
| 6. Structural Range: Length of text | 0.85 | 0.72 |
| 7. Structural Range: Number of background colors | 0.89 | 0.79 |
| 8. Structural Range: Number of animated images | 0.77 | 0.59 |
| 9. Structural Range: Number of images | 0.78 | 0.61 |
| 10. Structural Range: Number of hypertext links | 0.89 | 0.79 |
| 11. Structural Range: Number of information items at a web page | 0.74 | 0.55 |
| 12. Structural Range: Number of web pages at a website | 0.87 | 0.76 |
| 13. Interactive: Probabilistic hyperlink outcomes: Individual links take you to desired web pages | 0.71 | 0.50 |
| 14. Interactive: Probabilistic hyperlink outcomes: Individual links do not take you to relevant web pages | 0.86 | 0.74 |
| 15. Interactive: Probabilistic hyperlink outcomes: Uncertainty between pieces of information | 0.79 | 0.62 |
| 16. Interactive: Navigational ambiguity: Icons used are not meaningful | 0.82 | 0.67 |
| 17. Interactive: Navigational ambiguity: Navigation is hindered by banner and pop-up advertisements | 0.74 | 0.55 |
| 18. Interactive: Navigational ambiguity: Hyperlinks do not allow one to form expectations | 0.79 | 0.62 |

Statistics for latent variables

| Item | Standardized Structural Coefficients | R-Square |
|---|---|---|
| 1. Range | 0.91 | 0.83 |
| 2. Dissimilarity | 0.84 | 0.71 |
| 3. Probabilistic hyperlink outcomes | 0.87 | 0.76 |
| 4. Navigational ambiguity | 0.85 | 0.72 |

site captures the positive affect due to resolving complexity. We propose an inverted U relationship between interactive complexity and telepresence. In other words, the opportunity to resolve the complexity in case of an ambiguous link or probabilistic hyperlink outcome could be rewarding for the individual. For example, by clicking a hyperlink (Birthdays) at a Gymboree web page, individuals will expect information on details (for example costs, time, party details) about hosting a birthday at a Gymboree location. However, if instead the click takes the individual to a web page that lists the positive experiences of children and their parents (somewhat incongruous information) involved with birthday parties at Gymboree, it represents an (moderate) interactively complex situation. Individuals could have a rewarding experience by resolving this incongruity and assimilating it in their existing schema. However, extremely low levels of interactive complexity represented by congruous web pages are not noteworthy and do not prompt cognitive resolution.

While moderate interactive complexity provides a rewarding experience, very high interactive complexity characterized by unfulfilled expectations poses as a deterrent to the navigation. Coyle and Gould (2002) have shown that unfulfilled expectations impede consumers from following their trajectories toward a goal, leading to negative attitudes. This is consistent with the schema literature that proposes that unresolved ambiguity elicits more negative affect than congruous situations (Meyers-Levy and Tybout, 1989). In other words, in extreme interactive complexity scenarios, since the incongruity remains unresolved, it could lead to negative effects on telepresence at the web site.

H1b: There will be an inverted U relationship between interactive complexity and telepresence at a web site.

**Complexity, Telepresence and Attitude**

While, prior studies (Stevenson et al, 2000; Geissler et al, 2000) have examined a direct relationship between perceived complexity and user attitudes, we propose that telepresence mediates the effects of both structural and interactive complexity on attitude towards the web site. Researchers have distinguished web sites from other static media as they provide a real and direct experience to the individual (Hoffman and Novak, 1996). This experience captured by the telepresence leads to attitudinal and behavioral outcomes at a web site (Coyle and Thorson, 2001; Klein, 2001). In other words, if complexity induces a high telepresence, it would lead to more favorable attitudes and vice versa. We therefore hypothesize that telepresence will mediate the relationship between complexity and attitude towards the web site in case of both structural and interactive complexity.

H2a: Telepresence mediates the effects of structural complexity on attitudes

H2b: Telepresence mediates the effects of interactive complexity on attitudes

**Nomological Validity Results**

We tested the nomological validity of PWC using the mediator regression procedure. We used three separate equations to test the mediating role of telepresence in the relationship between perceived complexity and user attitude as shown in Table 4. In the first equation, we entered the control variables, followed by structural and interactive complexity and finally, we entered structural and interactive complexity square terms. In the first equation, the significant negative structural ($p<0.01$) and interactive complexity ($p<0.01$) square terms point to an inverted-U relationship between the two facets of complexity and attitude. In the second equation, we tested the curvilinear effects of structural and interactive complexity on telepresence. As shown in Table 4, the structural ($p<0.01$) and interactive ($p<0.01$) complexity square terms are negative and significant. These results lend support to H1a and H1b that propose a curvilinear relationship between facets of PWC and telepresence. In the final equation, we entered the control variables first, followed by telepresence and finally we entered the independent variables (structural and interactive complexity and their squared terms). Once we enter telepresence, the effect of structural and interactive complexity on attitudes becomes significant, confirming that telepresence mediates the effects of structural and interactive complexity on user attitudes. These results support H2a and H2b.

## DISCUSSION

To promote research on complexity in an online environment, we developed the PWC scale that captures multiple facets of complexity. Our results suggest that two dimensions capture the PWC construct. Moreover PWC has an inverted-U relationship with telepresence. Finally, telepresence mediates the relationship between PWC and user attitudes. In what follows, we discuss the theoretical and managerial implications.

There are four major research implications to our study. First, it suggests that PWC is a multidimensional construct that comprises structural and interactive facets of a web site. This result is especially notable since extant studies have defined complexity in an online environment mainly in terms of the structural elements of a web site (Bruner and Kumar, 2000; Stevenson et al, 2000). Future studies examining complexity in an online environment should consider both the structural and interactive facets.

Second, we propose that two opposing mechanisms underlie the relationship between structural complexity and telepresence. On the one hand, structural complexity provides a representationally rich environment that engages individuals and increases their telepresence experience at the web site. On the other hand, structural complexity inhibits telepresence experience of consumers because processing a wide range of dissimilar information cues may result in cognitive overload. In our study, the interplay of these two opposing mechanisms resulted in an inverted-U relationship between structural complexity and telepresence. An important area for future research is identifying moderating variables that determine which mechanism (representational richness or cognitive overload) gains prominence. A potential moderator may be the nature of online task—searching and browsing (Hoffman and Novak, 1996; Schlosser, 2003). Searchers and browsers differ significantly in terms of the level of cognitive effort they expend in information processing as well as the level of challenge they seek in the process of navigation (Hoffman and Novak, 1996). Searchers place more effort on reaching the goals and devote less cognitive effort to undirected exploration; whereas browsers focus on learning and exploration; seeking higher levels of challenge (Schlosser, 2003). Thus, it is likely that the relationship between structural complexity and telepresence may be different for searchers and browsers.

Third, we found a similar inverted U relationship between interactive complexity and telepresence. This result can be explained by the schema incongruity theory (Mandler, 1982). High interactive complexity leads to unfulfilled expectations that deter the telepresence experience of consumers. However, in moderate interactive complexity, individuals appreciate the opportunity to resolve the incongruity, resulting in higher telepresence experience. An interesting extension of our study would be to investigate the coping mechanisms used by consumers to resolve moderate interactive complexity. For example, since searchers and browsers have different goals and orientations, it is possible that they use different ways of resolving interactive complexity.

**TABLE 4**
Regression results of PWC, telepresence and attitude

| | *(n=282)* | | | | | |
|---|---|---|---|---|---|---|
| Model 1: Complexity → Attitude | B | SE B | β | $\Delta R^2$ | Adj. $R^2$ | F |
| Dependent Variable: *Attitude* | | | | | | |
| Step 1: Initial likeness of the web site | 1.45 | 1.18 | 0.12 | | | |
| Age | 1.05 | 0.99 | 0.09 | | | |
| Level of education | 0.23 | 0.27 | 0.04 | | | |
| Gender[1] | 0.58 | 0.69 | 0.04 | | | |
| Familiarity | 0.18 | 0.01 | 0.28* | 0.09 | | |
| Step 2: Structural complexity | 0.52 | 0.11 | 0.25* | | | |
| Interactive complexity | 0.07 | 0.01 | 0.21 | 0.11* | | |
| Step 3: Structural complexity square | -0.03 | 0.00 | -0.31** | | | |
| Interactive complexity square | -0.01 | 0.00 | -0.34** | 0.14** | 0.28 | 4.29** |
| Model 2 Complexity → Telepresence | B | SE B | β | $\Delta R^2$ | Adj. $R^2$ | F |
| Dependent Variable: *Telepresence* | | | | | | |
| Step 1: Initial likeness of the web site | 0.98 | 1.05 | 0.08 | | | |
| Age | 0.74 | 0.63 | 0.11 | | | |
| Level of education | 0.18 | 0.22 | 0.03 | | | |
| Gender[1] | 0.11 | 0.07 | 0.09 | | | |
| Familiarity | 0.21 | 0.03 | 0.31** | 0.12* | | |
| Step 2: Structural complexity | 0.23 | 0.01 | 0.27* | | | |
| Interactive complexity | 0.02 | 0.00 | 0.22 | 0.09* | | |
| Step 3: Structural complexity square | -0.05 | 0.00 | -0.39*** | | | |
| Interactive complexity square | -0.03 | 0.00 | -0.35*** | 0.11*** | 0.27 | 4.95** |
| Model 3: Complexity → Telepresence → Attitude | B | SE B | β | $\Delta R^2$ | Adj. $R^2$ | F |
| Dependent Variable: *Attitude* | | | | | | |
| Step 1: Initial likeness of the website | 0.73 | 0.65 | 0.13 | | | |
| Age | 0.28 | 0.24 | 0.09 | | | |
| Level of education | 0.09 | 0.13 | 0.03 | | | |
| Gender | 0.06 | 0.05 | 0.07 | | | |
| Familiarity | 0.04 | 0.00 | 0.21 | 0.03 | | |
| Step 2: Telepresence | 0.03 | 0.00 | 0.37*** | 0.15*** | | |
| Step 3: Structural complexity | 0.12 | 0.05 | 0.22 | | | |
| Interactive complexity | 0.97 | 0.64 | 0.15 | 0.07 | | |
| Step 4: Structural complexity square | -0.07 | 0.04 | -0.12 | | | |
| Interactive complexity square | -0.11 | 0.06 | -0.17 | 0.04 | 0.33 | 3.86** |

[1]Gender was represented by a dummy variable: female=0 and male=1
*p<0.05 **p<0.01 ***p<0.001

Finally, researchers can use the PWC scale to evaluate web sites they are constructing as experimental stimuli or for developing and assessing theory in relation to web site categorization and comparability. In this regard, future research should be done applying the PWC's structural and interactive components of web site complexity in conjunction with considerations of cognitive load, richness and navigation. From a managerial perspective, the multi-dimensional nature of the scale, PWC can help marketers to identify specific sources of complexity — is complexity occurring due to the multitude of structural features, the dissimilarity between the features, ambiguous hyperlink or the probabilistic navigation outcomes?

## REFERENCES

Anderson, James C. and David W. Gerbing (1991), "Predicting the Performance of Measures in a Confirmatory Factor Analysis with a Pretest Assessment of their Substantive Validities," *Journal of Applied Psychology*, 76, 732-740.

Bagozzi, Richard (1980) *Causal Methods in Marketing,* John Wiley and Sons, New York.

Baker, Julie, A. Parasuraman, Dhruv Grewal and Glenn B. Voss (2002), "The Influence of Multiple Store Environment Cues on Perceived Merchandise Value and Patronage Intentions," *Journal of Marketing*, 66(2), 120-142

Beatty, Sally (1998), "Companies Push for Bigger On-line Ads," *The Wall Street Journal*, 20 (August), B6.

Berlyne, Daniel E. (1960) *Conflict, Arousal, and Curiosity,* McGraw-Hill, New York.

______ (1970), "Novelty, Complexity and Hedonic Value," *Perception and Psychophysic*s, 8 (November), 279-286.

Bitner, Mary Jo (1992), "Servicescapes: The Impact of Physical Surroundings on Customers and Employees," *Journal of Marketing*, 56(2), 57-72.

Bruner, Gordon C. and Anand Kumar (2000), "Web Commercials and Advertising Hierarchy-of-Effects," *Journal of Advertising Research*, 40 (1& 2), 35-42.

Campbell, Donald J. (1988), "Task Complexity: A Review and Analysis," *Academy of Management Review*, 13 (1), 40-52.

Coyle James R. and Esther Thorson (2001), "The Effects of Progressive Levels of Interactivity and Vividness in Web Marketing Sites," *Journal of Advertising,* 30 (3), 65-77.

______ and Stephen J. Gould (2002), "How Consumers Generate Clickstreams through Web sites: An Empirical Investigation of Hypertext, Schema and Mapping Theoretical Explanations," *Journal of Interactive Advertising*, 2 (2).

Cox, Dena and Anthony D. Cox (1988), "What Does Familiarity Breed? Complexity as a Moderator of Repetition Effects in Advertisement Evaluation," *Journal of Consumer Research*, 15(June), 111-116.

______ and ______ (2002), "Beyond First Impressions: The Effects of Repeated Exposure on Consumer Liking of Visually Complex and Simple Product Designs," *Journal of the Academy of Marketing Science*, 30 (Spring), 119-130.

Daft, Richard L. and Robert H. Lengel (1986), "Organizational Information Requirements, Media Richness and Structural Design," *Management Science*,32 (5), 554-571.

Dhar, R (1997a), "Consumer Preference for a No-choice Option," *Journal of Consumer Research*, 24(September), 215-231.

______ (1997b), "Context and Task Effects on Choice Deferral," *Marketing Letters*, 8(January), 119-130.

Donovan, Robert J., John R. Rossiter, Gilian Marcoolyn and Andrew Nesdale (1994), " Store Atmosphere and Purchasing Behavior," *Journal of Retailing*, 70(3), 283-295.

______ and ______ (1982), "Store Atmosphere: An Environmental Psychology Approach," *Journal of Retailing*, 58(1), 34-58.

Geissler, Gary, George Zinkhan and Richard T. Watson (2001), "Web Homepage Complexity and Communication Effectiveness," *Journal of the Association for Information Systems*, 2 (2), 1-44.

Hansell, Saul (1998), "Selling Soap Without the Soap Operas," *The New York Times*, August, D7.

Hoffman, Donna L. and Thomas P. Novak (1996), "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations," *Journal of Marketing*, 60 (July), 50–68.

Janiszewski, Chris and Tom Meyvis (2001), "Effects of Brand Logo Complexity, Repetition, and Spacing on Processing Fluency and Judgment," *Journal of Consumer Research*, 28 (June), 18-32.

Jarvenpaa, Sirkka and Peter Todd (1997), "Consumer Reactions to Electronic Shopping on the World Wide Web," *International Journal of Electronic Commerce*, (1:2), 59-88.

Klein, Lisa (2001), "The Impact of Category Expertise on Telepresence in Computer-Mediated Environments," *Advances In Consumer Research*, ed. Stephen J. Hoch and Robert J. Meyer, Vol. 28, Provo, UT: Association for Consumer Research.

______ (2003), "Creating Virtual Product Experiences: The Role of Telepresence," *Journal of Interactive Marketing*, 17 (1), 41-56.

Kim, Taeyong and Frank Biocca (1997), "Telepresence via Television: Two Dimensions of Telepresence may have Different Connections to Memory and Persuasion," *Journal of Computer-mediated Communication*, 3 (2).

Mehrabian, Albert and James A. Russell (1974), *An Approach to Environmental Psychology*, Cambridge, MA: MIT Press

Lang, Annie (1990), "Involuntary Attention and Physiological Arousal Evoked by Structural Features and Emotional Content in TV Commercials," *Communication Research,* 17(3), 275-299.

Law, Kenneth S., Chi-Sum Wong, and William H Mobley (1998), "Toward a Taxonomy of Multidimensional Constructs," *Academy of Management Review*, 23(4), 741–754.

Lombard, Matthew, and Theresa Ditton (1997), "At the Heart of it All: The Concept of Telepresence," *Journal of Computer-mediated Communication*, 3 (2).

Mandler, George M (1982), "The Structure of Value: Accounting for Taste," In M. Clark and Susan T. Fiske (Eds.), *Affect and Cognition: The 17th Annual Carnegie Symposium* (pp 3-36), Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

March, James and Herbert Simon (1958), *Organizations,* New York Wiley.

McDougall, Siné J. P., Oscar de Bruijn, and Martin B. Curry (2000), "Exploring the Effects of Icon Characteristics on User Performance: The Role of Icon Concreteness, Complexity and Distinctiveness," *Journal of Experimental Psychology: Applied*, 6 (4), 291-306.

Meyers-Levy, Joan, Therese A. Louie,and Mary T. Curren (1994), "How does the Congruity of Brand Names affect Evaluation of Brand Name Extensions?" *Journal of Applied Psychology*, 79, 46-53.

______ and Alice M. Tybout (1989), "Schema Congruity as a Basis for Product Evaluation," *Journal of Consumer Research*, 16, 39-54.

Morrison, Bruce J. and Marvin J. Dainoff (1972), "Advertisement Complexity and Looking Time," *Journal of Marketing Research*, 9(4), 396-400.

Norman, Donald A. (1990), *The Design of Everyday Things*, New York, NY: Doubleday.

Palmer, Jonathan (2002), "Website Usability, Design and Performance Criteria," *Information Systems Research,* 13(2), 150-167.

Reeves, Byron and Clifford Nass (1996), *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Place,* New York, Cambridge University Press.

Rodgers, Shelly and Esther Thorson (2000), "The Interactive Advertising Model: How Users Perceive and Process Online Ads," *Journal of Interactive Advertising*, Vol 1 (1).

Schlosser, Ann E. (2003), "Experiencing Product in the Virtual World: The Role of Goal and Imagery in Influencing Attitudes Versus Purchase Intentions," *Journal of Consumer Research*, 30 (September), 184-198.

Stevenson, Julie, Gordon C. Bruner and Anand Kumar (2000), "Web Page Background and Viewer Attitudes," *Journal of Advertising Research*, 40 (1&2), 29-34.

Steuer, Jonathan (1992), "Defining Virtual Reality: Dimensions Determining Telepresence," *Journal of Communication*,42 (4), 73-93.

Sujan, Mita and James R. Bettman (1989), "The Effects of Brand Positioning Strategies on Consumers' Brand and Category Perceptions: Some Insights from Schema Research," *Journal of Marketing* Research, 26 (November), 454-467.

Swait, J. and W. Adamowicz (2001), "The Influence of Task Complexity on Consumer Choice: A Latent Class Model of Decision Strategy Switching," *Journal of Consumer Research*, 28 (June), 135-148.

Sweller, J (1988), "Cognitive Load during Problem Solving: Effects on Learning," *Cognitive Science*, (12), 257-285.

Thorson, Esther, Byron Reeves, and Joan Schleuder (1985), "Message Complexity and Attention to Television," *Communication Research*, 12, 427-454.

Wood, Robert .E. (1986), "Task Complexity: Definition of a Construct," *Organizational Behavior and Human Decision Processes*, 37, 60-82.