The Shifting Range of Optimal Web Site Complexity

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Abstract

Web designers and providers are keenly interested in determining the ideal range of Web site complexity to facilitate user–Web site interactions. Previous empirical findings have sparked a lively debate about whether Web site complexity inhibits or enhances user responses toward the Web site. This paper develops a theoretical framework that posits that complexity effects shift along a sequence of evaluation criteria depending on the overall intensity and type of Web site complexity. The first experimental study confirms the suggested interaction effect of the overall degree of complexity and the sequence of evaluation criteria: the optimum is lower for upstream criteria (e.g., ease of navigation) and higher for downstream criteria (e.g., attitude toward the Web site). The second experiment distinguishes two dimensions of complexity (structural vs. visual) that evoke the antipodal effects underlying the shift in the optimal range of complexity. The paper also outlines avenues for further research and implications for marketing practitioners.

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Keywords: Web site complexity; Web site effectiveness; User–computer interaction; Experiment; Structural complexity; Visual complexity

Introduction

Driven by technological advances such as new data compression algorithms and the rapid growth in network resources, the content and forms of Web sites have been evolving quickly during the past decade (Chen et al. 2011; Deng and Poole 2010). Web designers and managers are equipped with an ever-growing array of features, functionalities and elements that can be integrated into a Web site. While some years ago, most Web sites contained only static text content and few images, today they include sophisticated features, such as animated Java applications as well as audio and video streaming (Germonprez and Zigurs 2005). To facilitate user–Web site interactions, companies, providers and Web designers are greatly interested in understanding how users respond to these increased levels of complexity. However, the academic literature has not sufficiently answered the question of whether Web site complexity inhibits or enhances user responses and communication effectiveness (Nadkarni and Gupta 2007).

Thus far, the few empirical studies on the role of complexity have produced contradictory findings. On the one hand, scholars demonstrate that complex elements of a Web site raise interestingness, which improves a user’s attitude toward the Web site (e.g., Esch and Hardiman 2006). On the other hand, studies show that complex Web sites perturb a user’s attention and, in turn, deteriorate attitude toward the Web site (e.g., Stevenson, Bruner, and Kumar 2000). We argue that Web site complexity evokes positive effects (i.e., complex Web sites are more interesting) and negative effects (i.e., complex Web sites are a source of confusion) at the same time. From a theoretical perspective of cognitive psychology, scholars suggest that the ambivalent effects of complexity result in an inverted U-shaped function (Geissler, Zinkhan, and Watson 2006; left-hand side of Fig. 1). However, the literature reveals a second crucial contradiction that cannot be explained with this notion. When comparing the various measures of Web site performance, the shape of Web site complexity effects is highly inconsistent. The managerial lens of marketing-relevant outcomes looks at complexity effects at different levels of the hierarchy of communication effects. From this angle, Hoffmann, Schwarz, and Mueller (2011) argued that the two effects work in opposite directions along a sequence of evaluation criteria (right-hand side...
of Fig. 1). However, their study failed to consider that intermediate levels of complexity are ideal.

To contribute to a theory of Web site complexity and to provide a more complete explanation of its impact on Web site performance, we claim that a holistic perspective is needed. The present paper argues that a combination and extension of both isolated approaches helps to disentangle the contradictory results that have sparked lively debate. We accordingly suggest that there is no silver bullet regarding Web site complexity. By contrast, the question of whether Web site complexity helps or hurts communication effectiveness critically depends on the primary objective of the company. We expect that the optimal range of complexity varies from rather low for primarily utilitarian criteria (related to the functional aspects of a Web site) to rather high for hedonic criteria (related to pleasure with its use). While the first contribution of the article is to explain and empirically confirm this shift in the patterns of complexity effects, the second is to delve deeper into the underlying processes, constituting a second key boundary condition. Rather than the actual level of complexity, recent works on ad complexity (Pieters, Wedel, and Batra 2010) hint that user responses may be dependent on where the Web site complexity resides.

Until now, the research has primarily examined Web site complexity from a general level, focusing on the overall degree of complexity. These previous approaches do not provide marketers with the necessary knowledge of which adjustments to make. In addition to the content of a given Web site, Web site complexity is a function of both structural and visual complexity (Guo and Hall 2009). We expect that negative complexity effects (confusion) are mainly caused by structural complexity, whereas visual complexity elicits primarily positive effects (interestingness). This paper refines the aforementioned conceptual framework. We incorporate the underlying mechanisms by which Web site complexity operates to shape the user’s responses. More specifically, we reason that the ideal range of complexity shifts because both structural and visual complexity operate in different parts of the hierarchy of evaluation criteria. The relevance of structural complexity’s negative effect decreases along the sequence of evaluation criteria, while that of visual complexity’s positive effect increases. Hence, structural complexity primarily affects the upstream variables’ evaluation criteria pertaining to the utilitarian aspects of a Web site (e.g., ease of navigation). Visual complexity, in contrast, affects the downstream variables pertaining to more hedonic aspects (e.g., enjoyment).

With this in-depth consideration, this research adds several missing pieces to the Web site complexity puzzle. First, we develop a conceptual framework that integrates the cognitive–psychological approach of curvilinear relationships and the marketing-focused model of ambivalent Web site complexity effects along the hierarchy of communication effectiveness. Second, we explain why the optimal range shifts from upstream to downstream criteria by disentangling the effects of different complexity dimensions (Study 2). As a result, we provide guidelines on how to design Web sites most effectively. This paper is the first to demonstrate that marketers not only must be cautious about how complex their Web sites should be, but they also must consider which type of complexity should be increased (and which decreased) to elicit optimal user reactions.

**Conceptual Background**

**Web Site Complexity**

Generally, complexity can be defined as “the amount of variety or diversity in a stimulus pattern” (Berlyne 1960, p 38). The literature on information and communication technology, human cognition and information processing has adapted this concept to Web sites (e.g., Germonprez and Zigurs 2005). Web site complexity can be considered both objective and subjective. Objective complexity refers to the actual number of diverse and distinguishable elements of the Web site, whereas subjective complexity reflects how dissimilar and visually dense the user perceives the Web site to be (Guo and Hall 2009; Krishen and Kamra 2008; Nadkarni and Gupta 2007).

Subjective complexity is usually measured at a global level as the degree to which the user perceives the Web site complex. Objective complexity can also be conceptualized at a global level as the sum of all the different and diverging elements. Geissler, Zinkhan, and Watson (2006) demonstrated that different aspects contribute to complexity, including the amount of information,
number of links, Web site length, number of images, and use of animation. Hence, it is reasonable to distinguish different subtypes of complexity. The literature (e.g., Donderi 2006; Guo and Hall 2009; Hoffmann, Schwarz, and Mueller 2011) suggests three basic components: content, structural and visual complexity. Content complexity refers to the amount of information. This research examines Web site complexity from the scope of design characteristics. Following prior work (e.g., Lavie and Tractinsky 2004; Pieters, Wedel, and Batra 2010), the present paper distinguishes two major types of Web site complexity, namely, structural and visual complexity, because they are crucial to the question of how to communicate given content most effectively. Structural complexity refers to the variation in the arrangement of a Web site’s objects. In an online context, this dimension pertains to how the Web site content is organized and presented (Guo and Hall 2009). It comprises the individual Web site architecture, relationships among subpages and the locations of the links. For example, the more elements there are on a given Web site and/or the more these objects are arranged in an irregular or asymmetric pattern (Cox and Cox 2002), the greater the structural complexity. This type of complexity may be reduced with consistent formatting, easy-to-use links or a clear and intuitive user interface. Visual complexity, in contrast, refers to how visually cluttered the features of a given Web site are (Pieters, Wedel, and Batra 2010; Tuch et al. 2009). The more variation and details there are in the elements of a particular Web site or the more interactive and dynamic these elements are (e.g., graphics, intricate textures, high-resolution images or animations), the greater the visual complexity.

Curvilinear Effect of Web Site Complexity

Previous research has shown that Web site complexity influences a user’s experiences of the Web site (e.g., Deng and Poole 2010; Tuch et al. 2009). Scholars, particularly from the field of marketing, have revealed that Web site complexity not only affects the perception of the Web site but also influences judgments about the provider and its products or services (Bruner and Kumar 2000; Stevenson, Bruner, and Kumar 2000). These prior findings are contradictory, however (Table 1). For example, while some scholars provide evidence that increasing Web site complexity results in more favorable attitudes toward the Web site (e.g., Esch and Hardiman 2006), others find the opposite effect (e.g., Bruner and Kumar 2000). Based on aesthetic theory and early works on complex visual stimuli (Berlyne 1974; Henderson and Cote 1998), Geissler, Zinkhan, and Watson (2006) demonstrated that moderately complex Web sites are optimal for user experiences and effective communication. Web sites must exceed a certain minimum level of complexity to stimulate user enjoyment, which facilitates communication effectiveness. However, the more complex a Web site, the more it is a source of confusion. This, in turn, has a detrimental effect on judgments about the Web site and the provider. For that reason, complexity affects user experiences and communication effectiveness in a curvilinear manner (inverted U-shaped function).

Several approaches, mainly from the field of cognitive psychology and aesthetic judgments, provide a theoretical underpinning for why complexity effects can go in different directions. Research on cognitive effort (e.g., the limited capacity model; Kahneman 1973; Lang and Basil 1998) suggests that an individual’s cognitive capacities are limited. When decoding complex stimuli, users must invest greater cognitive resources, which affect their judgments. Additionally, the processing fluency hypothesis suggests that visual stimuli that are processed more easily evoke positive affective judgments about the stimulus and elicit immediate reactions from the user (Im, Lennon, and Stoeel 2010; Reber, Schwarz, and Winkielman 2004). Such stimuli increase pleasure and, in turn, aesthetic evaluations. Given that users can process less complex Web sites more fluently than highly complex Web sites, the fluency hypothesis supports the notion that consumers may evaluate low complexity is better than high complexity.

Considering the context of online consumer behavior, the present paper mainly builds on Berlyne’s (1974) theory of aesthetic response. The theory originally addressed aesthetic judgments and has been applied successfully to complexity in a Web site context (e.g., Geissler, Zinkhan, and Watson 2006). We focus on Berlyne’s theory because it helps explain the positive and negative effects of Web site complexity. The theory predicts that a receiver experiences more pleasure once the complexity of a stimulus is increased because this stimulus becomes more interesting (= positive effect of Web site complexity). However, when exceeding an optimal level, pleasure decreases with growing complexity because the Web site is more confusing (= negative effect). Accordingly, communication effectiveness is greater at intermediate degrees of complexity. More extreme points on the continuum result in lower performance. In this way, this theory provides an explanation for the empirically determined inversely U-shaped form of the influence of complexity on Web site evaluation.

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Table 1

Previous Studies on the Influence of Web Site Complexity.

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Prior results of research on Web site complexity</th>
<th>Impact of negative/positive effects on the evaluation criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Perceived speed</td>
<td>$-^{a}$</td>
<td>negative effect</td>
</tr>
<tr>
<td>-Ease of navigation</td>
<td>$-^{b}$</td>
<td>negative effect</td>
</tr>
<tr>
<td>-Focused attention/interinterestingness</td>
<td>$-^{c,d}+^{e,f}/n.s.$</td>
<td>negative effect</td>
</tr>
<tr>
<td>-Perceived control</td>
<td>$n.s.$</td>
<td>positive effect</td>
</tr>
<tr>
<td>-Enjoyment</td>
<td>$+^{a,b}$</td>
<td>positive effect</td>
</tr>
<tr>
<td>-Attitude toward the Web site</td>
<td>$+^{a,b}/-^{c,d}/n.s.$</td>
<td>positive effect</td>
</tr>
</tbody>
</table>

Notes. $+/−$: users evaluate complex Web sites more positively/negatively than less complex Web sites ($p ≤ .05$); $∩$: curvilinear influence of Web site complexity on the evaluation criteria; n.s.: no significant relationship.

a Hoffmann, Schwarz, and Mueller (2011).
b Tuch et al. (2009).
c Huang (2003).
e Bruner and Kumar (2000).
h Esch and Hardiman (2006).
i Nadkarni and Gupta (2007).
The contradictory findings that Web site complexity effects are positive or negative can be easily explained with this notion. However, our literature review reveals a second crucial contradiction. Although some authors have considered curvilinear effects, their findings seem to be highly inconsistent when comparing different evaluation criteria (Table 1). For example, for perceived speed and ease of navigation, prior research shows solely negative influences of complexity, whereas for enjoyment and attitude toward the Web site, influences can also be positive.

Obviously, Web site complexity effects are more complex, and we claim that curvilinear patterns alone are insufficient to resolve these contradictory findings. If there is an ideal point of complexity, the question arises of where it is located. Hoffmann, Schwarz, and Mueller (2011) questioned the rather simplistic assumption that the complexity of Web sites has similar effects on all variables along the sequence of evaluation criteria. They demonstrated that less complex Web sites outperform more complex Web sites in terms of perceived speed and ease of navigation. By contrast, low levels of complexity yield significantly less favorable judgments in terms of enjoyment. Consequently, the type of evaluation criteria that companies employ to capture Web site performance may be a key contingency that determines which level of complexity is optimal. To understand the mechanisms of Web site complexity better, we integrate both perspectives. In addition, we further disentangle ambivalent complexity effects by distinguishing different dimensions of Web site complexity.

Evaluation Criteria

To identify the relevant evaluation criteria of Web site performance and to derive how they are interrelated, we adopt the attitude toward the Web site model suggested by Hoffmann, Schwarz, and Mueller (2011), which is based on flow theory (e.g., Novak, Hoffmann, and Yung 2000), and the attitude toward the ad model (MacKenzie, Lutz, and Belch 1986).

The attitude toward the Web site model suggests that users’ attitudes toward the Web site are the pivotal evaluation criteria because attitudinal variables guide their evaluation of the provider and the intention to purchase the provider’s products and services (Bruner and Kumar 2000; Stevenson, Bruner, and Kumar 2000). To explain attitude toward the Web site, the authors build on flow theory in an online context (Hoffman and Novak 2009). Flow is a pleasant state of mind in which an individual is deeply involved in an activity, such as surfing a Web site (Csikszentmihalyi 1977a,b). It has repeatedly been shown that the experience of flow, such as enjoyment, improves attitude toward the Web site (e.g., Hassanein and Head 2007; Huang 2003). In addition, a large body of research identifies engagement (including focused attention and perceived control) as the major driver of enjoyment (e.g., Agarwal and Karahanna 2000; Huang 2006). Prior research further suggests that this core process of flow (engrossment → enjoyment) is guided by online-specific determinants (perceived speed, ease of navigation) (Novak, Hoffmann, and Yung 2000). Against this backdrop, we derive several evaluation criteria that are relevant in the context of our study. The variables range from upstream cognitive evaluations (perceived speed, ease of navigation, perceived control, focused attention) through affective experiences (enjoyment) to downstream business-relevant outcomes (attitude toward the Web site).

Overview of Studies

Building on the integration of the various perspectives on Web site complexity outlined above, we argue that the optimal level of complexity shifts from rather low on upstream variables, such as ease of navigation, to rather high on downstream variables of the sequence of evaluation criteria, such as enjoyment. This assumption is based on the notion that Web site complexity elicits a negative effect of confusion and a positive effect of interestingness. Both effects are important in different ways for the individual evaluation criteria. As we discuss below, we expect that the negative effect is more relevant for upstream criteria, whereas the positive effect is more important for downstream criteria. We then delve deeper into these antipodal effects and analyze which dimensions of Web site complexity drive confusion and interestingness. We distinguish between structural and visual complexity because we expect that structural complexity is predominantly related to confusion and thus evokes a negative effect mostly on upstream variables. Visual complexity, in contrast, is primarily related to interestingness and thus evokes a positive effect on downstream variables.

The paper investigates our focal assumptions in two experiments. We derive hypotheses at the beginning of both studies. The first study focuses on the overall intensity of Web site complexity and tests the assumption that the optimal range of overall complexity shifts along the set of evaluation criteria. In this study, consumers evaluate the Web sites of detergent producers. The second study scrutinizes the antipodal effects of structural and visual complexity. This experiment employs standardized, fictional Web sites as treatments to increase internal validity. Additionally, we change the product category (boat rental service) to contribute to external validity. Furthermore, we employ objective reaction time measures to increase the validity of the dependent variables.

Study 1: Intensity of Web site Complexity

Objective

The aim of Study 1 was to analyze the postulated curvilinear relationship between the level of Web site complexity and user perception and attitude (hypotheses H1a–f). Most importantly, we examined whether the optimal range of Web site complexity rises from upstream to downstream criteria (hypothesis H2).

Hypotheses

Based on Berlyne’s (1960, 1974) complexity theory, we expect that the effect of the intensity of complexity on different evaluation criteria follows an inverted U-shaped pattern. The only exception is perceived speed, which is the user’s implicit
evaluation of waiting time between an action and the response. The faster the Web site reacts, the easier the user can respond and the better (s)he perceives the Web site. For all other upstream and downstream criteria, we expect a curvilinear pattern that develops as a result of the positive effect of increasing interestingness and the negative effect of decreasing comprehensiveness.

First, ease of navigation is a subjective assessment of the cognitive effort the user must invest to orient him/herself on the Web site (Zeithaml, Parasuraman, and Malhotra 2002). Users are prone to evaluate a less complex Web site as easier to navigate (Tuch et al. 2009). Nonetheless, overly simple Web sites offering only a few orientation cues should have detrimental effects on the user’s assessments. If the number of navigation elements is largely limited, (s)he cannot feasibly develop a mental map of the Web site structure (Gwizdka and Spence 2007). Second, perceived control comprises the extent to which the user feels (s)he is in charge of a Web site’s navigation (Novak, Hoffman, and Yung 2000). The user feels able to control the Web environment only when browsing challenges and user abilities are matched (Hoffman and Novak 1996; Massimini and Carli 1995; Venkatesh 2000). The less complex a Web site, the more likely user skills exceed challenges. However, if a Web site employs too many diverse cues to present information, the user feels unable to cope with the Web environment. Third, we expect similar relationships for focused attention on the primary activity. A certain degree of complexity is necessary for centering full attention on the Web site and for eliminating irrelevant perceptions (Srivastava, Shukla, and Sharma 2010). Overly complex Web sites, on the other hand, are confusing, thus discouraging the user from surfing the Web site. Fourth, we expect a curvilinear relationship of complexity and enjoyment. On the one hand, there is a positive relationship between complexity and the sensory richness of a Web site (Hopkins, Raymond, and Mitra 2004). Complex Web sites that employ a wide range of design elements, information and multimedia features engage the visual and auditory senses more deeply than less complex Web sites (Gupta, Nadkami, and Gould 2005). The higher the interestingness of the Web site, the more the user enjoys surfing. On Web sites that are too complex, on the other hand, users may fail to reach the desired goal, which has a detrimental effect. For these reasons, we expect that enjoyment declines only for very extreme levels of Web site complexity. Finally, because enjoyment influences attitude toward the Web site, we expect the same curvilinear relationship for this most downstream criterion. Enjoyment is a positive state of mind that promotes a positive evaluation of the stimulus that initially triggered this emotion (Batra and Ray 1986; Bauer, Maeder, and Fischer 2003; Lutz 1985).

H1a. The influence of complexity intensity on perceived speed is negative.

H1b–f. The intensity of Web site complexity has an inverted U-shaped influence (negative quadratic coefficients) on (b) ease of navigation, (c) perceived control, (d) focused attention, (e) enjoyment, and (f) attitude toward the Web site.

Based on Hoffmann, Schwarz, and Mueller’s (2011) findings, we propose that the optimal level of complexity may be contingent on the evaluation criterion. By integrating the latter approach with the outlined curvilinear relationships of complexity, we assume that the outcome variable interacts with overall complexity in such a way that the optimal range of Web site complexity rises from upstream to downstream criteria. As we have outlined, users may require a low level of complexity for most positive evaluations of perceived speed. Ease of navigation and perceived control also require rather low levels of complexity. Put more formally, for the upstream criteria, the negative complexity effect (i.e., confusion) is pronounced, whereas the magnitude of the positive effect (i.e., interestingness) is dampened. Unlike the aforementioned rather cognitive evaluation criteria, the downstream criteria (enjoyment, attitude toward the Web site) pertain to affective reactions in particular, as they depend on the interestingness of the Web site to a greater extent. Accordingly, we expect that the impact of the negative effect of complexity is deteriorating, whereas the influence of the positive effect is increasing.

H2. The inverse U-shape of the curvilinear complexity effects varies with the criteria of Web site effectiveness. Responses to lower levels of complexity will be more positive for upstream criteria, whereas responses to higher levels of complexity will be more positive for downstream criteria.

Design

In the experimental study, we used real Web sites to increase the ecological validity. We followed a rigorous process to select the different levels of overall objective Web site complexity. First, we gathered potential Web sites from one industry. We focused on detergent brands because we found a wide variety of Web site complexity in this area. Next, in a group discussion, five online experts with extensive knowledge of Web design evaluated the degree of overall complexity according to quantitative criteria (e.g., depth of navigation, number of pictures, animation). The experts coded the eight Web sites according to the number of pictures and animation (both criteria: 1 ‘no’, 2 ‘few’, 3 ‘many’) and in terms of depth of navigation and the overall assessment of complexity (both criteria: 1 ‘low’ to 5 ‘high’). Based on these criteria (see Appendix 1), we chose four corporate Web sites as stimuli for the experiment to obtain a wide range of Web site complexities. Participants were randomly assigned to one of these four Web sites. By applying the activity/survey method (Novak, Hoffman, and Yung 2000), subjects were asked to browse the page for several minutes. After surfing the Web site, they answered a short questionnaire. As a cover story, we told the participants that this study aimed to assess user perceptions of a company Web site. On average, they took ten minutes to complete the questionnaire. Having concluded this procedure, we debriefed the subjects, and they were thanked for their participation.

Sample

The subjects for the experiment were recruited using a pool of respondents who have taken part in prior studies of the authors. Of the 221 individuals approached, we drew a sample
of 87 users (response rate: 39%). Altogether, 62% of subjects were men, and the sample had a mean age of 28.5 years ranging from 21 to 56 years. They were all highly involved with the Internet. In all, 97% of respondents used the Internet daily (the remaining 3% surf the Web at least once a week).

Measures

We adopted measurement scales of the evaluation criteria that had been applied successfully in previous studies. The reliability and validity of the scales as well as the specification of the suggested sequence of evaluation criteria were tested and confirmed in a pretest.1 The wording and sources of all indicators are displayed in Table 2. We asked the respondents to evaluate these statements on a seven-point rating scale.

To control for their potential confounding influence, we additionally measured involvement (two items, Cronbach’s alpha \( \alpha = .74 \)), brand image (four items, \( \alpha = .82 \)) and experience with the Internet (one item). We introduced these variables as controls in further analysis (see also Table 2). As a subjective measure of Web site complexity, we added a four-item Likert scale (\( \alpha = .75 \)) of perceived Web site complexity adapted from Nadkarni and Gupta (2007).

As presented in Table 3, all scales showed high levels of internal consistency (average variance extracted: AVE > .70; factor loadings: FL > .70; Cronbach’s alpha: \( \alpha > .70 \)). Applying CFA, Fornell and Larcker’s (1981) criterion provided evidence of discriminant validity: the AVE for each factor exceeded its shared variance with every other factor (AVE > \( r^2_{\text{max}} \)).

As an ex-ante means of avoiding response biases such as acquiescence and common method variance, we used a counterbalanced question order. We also assured the subjects of anonymity and highlighted that there were no wrong (or right) answers (Podsakoff et al. 2003). To offer additional evidence, we conducted the ex-post test, as suggested by Lindell and Whitney (2001). We included a conceptually unrelated marker variable in the questionnaire. The lack of significant correlations between this variable and the evaluation criteria (\( |r_{\text{max}}| = .135, p > .21 \)) indicated that common method variance did not harm this study’s findings. The following analyses applied the factor scores of the variables.

Manipulation Check

Although the stimulus Web sites were carefully selected, we ran further manipulation checks to ensure the suitability of the

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1 A pretest with 209 participants checked the scales using covariance-based SEM (AMOS 21). Confirmatory factor analysis (CFA) supported the reliability (all scales: \( \alpha \geq .70 \); composite reliability \( \geq .60 \)) and discriminant validity according to Fornell and Larcker (1981). The pretest also empirically tested the suggested sequence of Web site performance criteria via SEM (\( \chi^2 = 299.73, \text{df} = 125, p = .000; \chi^2/\text{df} = 2.40; TLI = .926; CFI = .940; RMSEA = .082 \)). Given that a misconfiguration of their logical order would seriously distort this study’s results, we contrasted the suggested sequence of evaluation criteria with two alternative models. The test confirmed that our specification of the interrelationships was superior. Due to space limitations, the full report of the pretest is not included in the manuscript. It can be obtained from the authors upon request.

Table 2

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Wording</th>
<th>FL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived speed 1, 2, 3</td>
<td>During my visit to the Web site,...</td>
<td>–</td>
</tr>
<tr>
<td>Ease of navigation 1, 2, 3</td>
<td>... I found the interaction with the Web site slow and tedious.</td>
<td>.90</td>
</tr>
<tr>
<td>Perceived control 1, 2, 3</td>
<td>... I was able to choose the content in which I was interested.</td>
<td>.88</td>
</tr>
<tr>
<td>Focused attention 1, 2, 3</td>
<td>... I was able to decide which pages I wanted to look at.</td>
<td>.88</td>
</tr>
<tr>
<td>Enjoyment 1, 4</td>
<td>... I enjoyed the experience.</td>
<td>.93</td>
</tr>
<tr>
<td>Attitude toward the Web site 5, 6</td>
<td>The Web site is...</td>
<td>.91</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>M</th>
<th>SD</th>
<th>( \alpha )</th>
<th>AVE</th>
<th>F/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived speed</td>
<td>5.11</td>
<td>1.40</td>
<td>–</td>
<td>–</td>
<td>Yes</td>
</tr>
<tr>
<td>Ease of navigation</td>
<td>5.04</td>
<td>1.30</td>
<td>.89</td>
<td>.83</td>
<td>Yes</td>
</tr>
<tr>
<td>Perceived control</td>
<td>5.00</td>
<td>1.04</td>
<td>.71</td>
<td>.78</td>
<td>Yes</td>
</tr>
<tr>
<td>Focused attention</td>
<td>3.43</td>
<td>1.14</td>
<td>.92</td>
<td>.72</td>
<td>Yes</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>3.02</td>
<td>1.26</td>
<td>.95</td>
<td>.91</td>
<td>Yes</td>
</tr>
<tr>
<td>Attitude toward the Web site</td>
<td>4.04</td>
<td>1.31</td>
<td>.89</td>
<td>.82</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes. Scales adapted from 1 Bauer, Maeder, and Fischer (2003); 2 Hoffmann, Schwarz, and Mueller (2011); 3 Novak, Hoffmann, and Yung (2000); 4 Ghani and Deshpande (1994); 5 Bruner and Kumar (2000); 6 Chen, Clifford, and Wells (2002). Note: ‘...’ item is reversely coded; factor loadings (FL) from factor analysis.

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Most importantly, we assessed whether users perceive Web site complexity as intended. The ANOVA indicated that the subjective measure of Web site complexity differed significantly \((F(3, 83) = 10.301, p \leq .001, \eta^2 = .27)\). Planned comparisons between individual groups demonstrated that the four Web sites differ, although with one exception. The difference in perceived complexity between the two medium-level Web sites did not reach significance. For that reason, we excluded one experimental group from the subsequent analysis. Still, the three distinct complexity conditions (62 subjects, \(M_{\text{moderate}} = .82; M_{\text{low}} = .18; M_{\text{high}} = .65\) enabled us to test for quadratic effects. To ensure the stability of the results, we merged the moderate group with the excluded Web site and reran all tests. We found no meaningful differences in the results.

**Results**

**Objective Complexity**

First, we applied a multivariate analysis of variance (MANOVA) to examine the impact of the experimentally manipulated Web site complexity on the set of evaluation criteria. All preconditions for the MANOVA were fulfilled. The analysis confirmed that Web site complexity significantly affects the evaluation criteria (Wilks’s \(\lambda = .542\); Roy’s largest root = .637, \(F(6, 55) = 5.838, p \leq .001\)). Web site complexity explains 38.9% of the evaluation criteria’s variance. According to Cohen’s (1988) conventions, the magnitude of this influence is exceptionally strong.

While there is no effect on perceived speed \((F(2, 59) = .658, p > .05)\), the univariate tests demonstrated complexity effects for all other evaluation criteria. Complexity has a significant influence on ease of navigation \((F(2, 59) = 3.244, p \leq .05, \eta^2 = .10)\), perceived control \((F(2, 59) = 9.129, p \leq .001, \eta^2 = .24)\) and focused attention \((F(2, 59) = 10.114, p \leq .001, \eta^2 = .26)\). A polynomial trend analysis indicated that the means increase in a linear way for perceived control \((p \leq .01)\) and focused attention \((p \leq .001)\). There is also a quadratic term (i.e., group means are represented by a curve) for ease of navigation \((p \leq .05)\), perceived control \((p \leq .01)\) and focused attention \((p \leq .05)\). We also found significant effects on enjoyment \((F(2, 59) = 7.221, p \leq .01, \eta^2 = .20)\) and attitude toward the Web site \((F(2, 59) = 12.588, p \leq .001, \eta^2 = .30)\). The trend analysis and inspection of the mean scores showed that Web site complexity has a linear influence on these dependent variables (both \(p \leq .001\)), with a maximum in the high complexity condition. Concerning attitude toward the Web site, there is also a marginally significant curvilinear pattern in group means \((p = .07)\). The mean scores for each level of Web site complexity are reported in Fig. 2.

**Subjective Complexity**

Based on the social constructivism paradigm, the literature has shown that subjective perceptions have greater explanatory power of actual behavior than objective criteria (Lastovicka and Joachimsthaler 1988; Thorson and Rodgers 2006). Accordingly, we analyzed whether there is a quadratic trend in the perception of Web site complexity. To make use of all available data, we used the full sample of 87 respondents. Again, the regression analyses of the subjects’ perceived complexity scores provided evidence for a quadratic trend regarding all evaluation criteria (except for perceived speed, Table 4). Overall, we found strong curvilinear relationships for the objective measures (i.e., experimental manipulation) and subjective measures (i.e., perceived complexity), supporting hypotheses H1b–f. Perceived speed deteriorates steadily as the level of complexity rises. Thus, H1a is supported for objective and subjective measures.

**Shifting range of the optimum**

We lastly examined how the optimal range of Web site complexity depends on the primary objective of the Web site. For this purpose, we conducted mixed-design ANOVAs with the three experimental groups to explore whether user assessments differ along the sequence of evaluation criteria. Because Mauchly’s test of sphericity was significant \((W = .432, \chi^2 = 47.932, p < .001)\), we applied the rather conservative Greenhouse–Geisser correction factor. We found that users do not significantly differ in their

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**Fig. 2. Shifting of the Optimal Level of Web Site Complexity (Study 1).**

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The analysis of the between-subjects factor showed a significant main effect of Web site complexity ($F(2, 59) = 9.523, p \leq .001, \eta^2 = .24$). Notably, the analysis yielded a significant linear interaction between Web site complexity and the sequence of evaluation criteria (Greenhouse–Geisser corrected $F(7.71, 227.38) = 4.479, p \leq .001$). The magnitude of this interaction effect ($\eta^2 = .13$) is considerably strong (see also Fig. 2).

We also examined the shift in pattern for the subjective measures of Web site complexity. We ran a mixed-design ANOVA with the set of evaluation criteria as a within-subjects factor (main effect using a Greenhouse–Geisser correction: $F(3.85, 227.38) = .498, p > .05$) as well as the linear ($F(1, 84) = 10.112, p \leq .01, \eta^2 = .11$) and quadratic terms of perceived complexity ($F(1, 84) = 11.816, p \leq .001, \eta^2 = .12$) as covariates. Similar to the experimental conditions, the analyses confirm strong interactive effects. Both the linear (Greenhouse–Geisser corrected $F(3.95, 331.92) = 15.868, p \leq .001, \eta^2 = .16$) and the quadratic components of the complexity effect (Greenhouse–Geisser corrected $F(3.95, 331.92) = 3.746, p \leq .01, \eta^2 = .04$) vary with the evaluation criteria. Fig. 3 illustrates this shift. H2 is supported for both objective and subjective Web site complexity.

Having demonstrated that there is a shift in the curvilinear influence, we examined which links in the proposed sequence of evaluation criteria are affected. To this end, we conducted a series of fifteen mixed-design ANOVAs. These follow-up analyses spotlighted all possible pairs of the evaluation criteria.

In terms of the three Web sites, we find that in more than half the analyses (eight pairs) the complexity effects differ in their shape between individual measures of Web site effectiveness (for the results, refer to Appendix 2). In particular, the shape of the complexity effects on the upstream criteria (i.e., perceived speed, ease of navigation) differs from that of the more downstream criteria. These observations substantiate our central assumption that the form of the curvilinear complexity effects varies with the dependent variable under study.

### Table 4

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Linear term $\beta$</th>
<th>$t$</th>
<th>$p$</th>
<th>Quadratic term $\beta$</th>
<th>$t$</th>
<th>$p$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived speed</td>
<td>-.294</td>
<td>-2.774</td>
<td>**</td>
<td>.065</td>
<td>.613</td>
<td>n.s.</td>
<td>.08</td>
</tr>
<tr>
<td>Ease of navigation</td>
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<td>-1.618</td>
<td>n.s.</td>
<td>-.354</td>
<td>-3.443</td>
<td>***</td>
<td>.14</td>
</tr>
<tr>
<td>Perceived control</td>
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<td>2.727</td>
<td>**</td>
<td>-.188</td>
<td>-1.793</td>
<td>+</td>
<td>.10</td>
</tr>
<tr>
<td>Focused attention</td>
<td>.413</td>
<td>4.264</td>
<td>***</td>
<td>-.325</td>
<td>-3.354</td>
<td>***</td>
<td>.23</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>.400</td>
<td>4.022</td>
<td>***</td>
<td>-.260</td>
<td>-2.617</td>
<td>**</td>
<td>.19</td>
</tr>
<tr>
<td>Attitude tw. Web site</td>
<td>.543</td>
<td>6.050</td>
<td>***</td>
<td>-.326</td>
<td>2.185</td>
<td>*</td>
<td>.34</td>
</tr>
</tbody>
</table>

Note. + $p \leq .10$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, n.s. not significant.
conducted a mixed-design ANOVA with the subjective perceptions of complexity. We used pairs of evaluation criteria as the within-subjects factor and the perceived Web site complexity (both linear and squared terms) as a covariate (see Appendix 3). In ten of the fifteen comparisons, the shape of the complexity effects significantly differed regarding the linear and/or quadratic term. Also in terms of the subjective measures, we find that the shape of complexity effects is particularly distinct for the upstream criteria, whereas the effects are very similar across the more downstream criteria.

To ensure the stability of the results, we applied a multivariate analysis of covariance (MANCOVA) including five control variables: age, sex, brand image, involvement and Internet experience. All results remained stable. We also controlled for treatment effects in the analyses of the subjective measures (including the experimental conditions as dummy variables). We did not find meaningful differences.

Discussion

Study 1 confirms the theoretically derived assumption of curvilinear Web site complexity effects for the evaluation criteria (except perceived speed). The analysis consistently shows this pattern for objective (except enjoyment) as well as subjective Web site complexity. The findings also confirm our fundamental assumption that the optimum shifts along a sequence of criteria, ranging from a rather low optimum for ease of navigation to a rather high optimum for enjoyment and attitude toward the Web site. This shift is remarkably strong and it is particularly prominent among the upstream criteria. From a management perspective, Study 1 has shown that some degree of complexity is favorable depending on the evaluation criteria. Study 2 now elaborates on this finding by delineating the mechanisms underlying this shift. In this way, the study examines a second crucial boundary condition to Web site complexity by showing which type of complexity marketers should adjust.

Study 2: Dimensions of Web Site Complexity

Objective

Study 1 provides ample evidence for our basic premise that different levels of overall complexity are needed to address the various evaluation criteria. Thus far, we have conceptualized Web site complexity at an abstract level as a one-dimensional concept. We now look at distinct dimensions of complexity, which may jointly constitute the shifting effects observed in Study 1. Prior work (e.g., Pieters, Wedel, and Batra 2010) suggests treating structural complexity and visual complexity as distinct dimensions of complexity. Structural complexity is primarily related to functional aspects, whereas visual complexity is primarily related to aesthetic and hedonic aspects. Users may want Web sites related to functional aspects (e.g., search engines) to be sparse and simple in terms of structural complexity, irrespective of the actual level of visual complexity. In contrast, Web sites related to pleasure (e.g., the corporate Web site of a beer brand) may be more visually complex irrespective of structural complexity. Thus, both aspects can vary independently in practice, and Web designers can easily control them. As discussed next, both dimensions of complexity elicit effects pointing in different directions, and they are expected to operate along different parts of the evaluation criteria sequence.

We test our assumption that structural complexity underlies the negative effect of Web site complexity and that visual complexity is the source of the positive effect. We suggest that these types of complexity are of different relevance for different evaluation criteria. Hence, we seek a more elaborate explanation for the shifting range to provide marketers and Web site designers with the necessary knowledge regarding what changes to make to improve Web site performance. Beyond the scope of Study 1, we consider subsequent company-related outcomes (attitude toward the company). In addition to the conceptual extension of Study 1, we make several methodological improvements to ensure the stability of the findings. We use Web sites built from scratch to increase the internal validity of the findings. To provide evidence of the external validity of the findings, we change the product category. Lastly, in addition to the self-reported scales, we employ reaction time measurements as an objective evaluation criterion.

Hypotheses

Hypothesis H1 of Study 1 is based on the assumption that Web site complexity evokes two ambivalent effects resulting in the curvilinear pattern. We claim that the negative (i.e., confusion) and the positive (i.e., interestingness) effects of Web site complexity stem from different sources. This assumption rests on research on perceived visual aesthetics (e.g., Lavie and Tractinsky 2004; Pieters, Wedel, and Batra 2010), which, at the most general level, distinguishes two main dimensions pertaining to usability (e.g., visual clarity, patterns, shapes) and aesthetic aspects (e.g., visual richness, creativity). Building on this bi-dimensional conceptualization, we expect that the negative effect of Web site complexity is primarily caused by structural complexity, whereas the positive effect is caused by visual complexity. We argue that both properties underlie these negative and positive effects, causing a shift in the optimal level of Web site complexity (as suggested by H2, Study 1). Thus, both dimensions of complexity are more or less important depending on the evaluation criteria considered.

The negative effect is expected to be rooted in Web site structure in particular. As discussed in the conceptual background section, Web site structure relates to a clear, symmetrical and orderly design. Given that this dimension is closely tied to usability and facilitates the understanding of the Web site (e.g., Lavie and Tractinsky 2004), we expect that the unfavorable consequences of structural complexity are pronounced in terms of upstream criteria such as navigation. Because these criteria are primarily associated with functional benefits, visual complexity may be less important. In contrast, the positive Web site complexity effect is expected to stem from visual complexity. The aesthetic qualities of Web site design are related to arousal, beauty and appeal (e.g., Schenkmam and Jönsson 2000). For this
reason, downstream criteria (e.g., enjoyment) may be driven by visual complexity because they are related to pleasure associated with Web site use. Given that aspects such as joy and pleasure are relevant, structural complexity may be less important with respect to downstream criteria.

H3. The influence of Web site complexity on the different evaluation criteria depends on the dimension of complexity. While structural complexity primarily influences the upstream criteria, visual complexity primarily influences the downstream criteria.

H3a. Regarding the upstream criteria, lower levels of structural complexity are evaluated better than higher levels.

H3b. Regarding the downstream criteria, higher levels of visual complexity are evaluated better than lower levels.

Design

We conducted a 2 × 2 experiment. Participants were asked to surf a Web site of a fictional service provider (rent-a-boat.com) that was manipulated regarding structural complexity (low/high) and visual complexity (low/high). The Web sites were built from scratch and were identical except for the aspects used to manipulate the experimental factors. All Web sites contained the same information. Hence, content complexity was kept constant. The Web sites used shades of blue, white and gray. Low levels of structural complexity employed an intuitive horizontal navigation, whereas high levels of structural complexity had in-text navigation. Low levels of visual complexity were achieved by applying fewer graphics and animations than in the Web sites with a high degree of visual complexity. For example, the file sizes of the start page differed between low (134 kB) and high visual complexity (286 kB).

Participants were assigned randomly to one of the four treatment conditions. In a first step, the subjects were asked to browse the Web site and to perform four search tasks. Reaction times to these search tasks were measured using E-Prime 2.0. Lastly, the participants were asked to complete a questionnaire and they were thanked and debriefed afterwards. To control for the influences of the setting, we conducted the experiment in a separate laboratory room of a university library.

Sample

We recruited a sample of 120 young consumers in the lobby of a university library. We considered only young participants to ensure a homogeneous sample and, thus, to increase the internal validity of the findings (Calder, Phillips, and Tybout 1981). Approximately half the respondents were men (54%). On average, the subjects were 23.3 years old (SD = 3.0). All of the participants were experienced Internet users.

Measures

In Study 2, we employed an objective measure of an evaluation criterion. The respondents had to perform different tasks, and we measured their reaction times. This approach is based on the rationale that consumers need more time to complete tasks that present increasing Web site complexity. We posed the following four tasks: “What is the length of the motorboat ‘Ducky’?”, “Where is the home base of the company rent-a-boat.com?”, “What is the address of the boat rental?” and “What is the regular price being charged for the special offer ‘cast away’?”. The order of these four search tasks was randomized to avoid order effects. Reaction times did not differ across the four tasks (p > .05), indicating that the four tasks are similarly difficult. We asked respondents to answer quickly and precisely. Having read the instructions of each search task, they were asked to click in the middle of a fixation screen to ensure the same starting point for all subjects. All tasks were serial search tasks in which the subjects had to visit several consecutive pages of the Web site. To solve the task, the participants had to click on the required information and they were given feedback. Then, the next search task was presented.

Having completed the four search tasks, the respondents were asked to fill in a questionnaire, which contained the same measurement scales as in Study 1: ease of navigation (M = 4.94, SD = 1.45, α = .86), perceived control (M = 5.18, SD = 1.15, α = .73), focused attention (M = 3.42, SD = 1.10, α = .88), enjoyment (M = 3.40, SD = 1.28, α = .90) and attitude toward the Web site (M = 3.57, SD = 1.28, α = .84). Because we did not find significant differences for perceived speed in Study 1, we did not include this variable. In addition, respondents indicated their attitude toward the brand on a three-item seven-point semantic differential scale (”not high quality/high quality”, “unfavorable/favorable”, “worse than other brands/better than other brands”, M = 4.10, SD = .99, α = .77). Again, the internal consistency of all scales was high (AVE ≥ .60, α ≥ .70), and there was discriminant validity according to the criterion of Fornell and Larcker (1981). In addition to several a priori measures to avoid common method bias (e.g., short pauses between the measurement of the dependent variables, experimental design, interaction effects), we tested post-hoc whether the dependent variables were correlated with a conceptually unrelated marker variable (“Compared with my friends and relatives, I have great online experience”). We found no significant correlations (rmax = .09, p ≥ .35), suggesting that common method variance did not distort our findings (Lindell and Whitney 2001).

Manipulation Check

Although we drew a homogeneous sample and randomly assigned participants to the four experimental groups, we first tested whether there were unwanted differences between the groups. We found no differences in involvement with boat rentals, previous experience with boat rentals, online experience, age or sex (all p > .05). Next, we tested the manipulation of the four treatment conditions. We included a three-item seven-point scale to measure perceived structural complexity (“The Web site structure is intuitive”, “The menu navigation is structured with a logical flow”, “The individual pages of the Web site are clearly structured”, M = 4.90, SD = 1.50, with ‘1’
“I completely disagree” and ‘7’ “I completely agree”). We also measured perceived visual complexity with a three-item seven-point scale (“The Web site contains: pictures”, “animation”, “colors”, $M = 3.45$, $SD = .65$) with the anchors ‘too few’ and ‘too many’. The ANOVA for the perceived structural complexity confirmed that there is a significant main effect of the structural complexity condition ($F(1, 108) = 105.897, \eta_p^2 = .001$, $\eta^2 = .50$) and no main effect of the visual complexity condition, as well as no interaction effect (both $p > .05$). In contrast, the analysis for perceived visual complexity confirmed the manipulation (main effect visual complexity: $F(1, 108) = 34.196$, $\eta_p^2 = .001$, $\eta^2 = .24$, structural complexity and interaction: $p > .05$). We also checked whether the Web site content was affected by both dimensions of complexity using a single-item seven-point Likert scale (“The Web site offers comprehensive information”, $M = 4.63$, $SD = 1.31$). We did not find significant main and interaction effects, which confirms that Web site content is similar across the experimental conditions.

We lastly assessed the perceived overall complexity of the four Web sites (three items, $M = 3.03$, $SD = 1.11$, $\alpha = .68$). The ANOVA showed that both factors independently contribute to perceived overall complexity (structural complexity: $F(1, 108) = 10.234$, $p \leq .001$, $\eta^2 = .09$, visual complexity: $F(1, 108) = 4.755$, $p \leq .05$, $\eta^2 = .04$, interaction: $p > .05$).

Results

Influence on Reaction Times

The ANOVA demonstrated that only structural complexity affects subjects’ total reaction times ($F(1, 108) = 29.720$, $p < .001$). Responses to the four questions were much quicker on the Web sites with low ($M_{sc \text{ low}} = 54.06$ s) than high structural complexity ($M_{sc \text{ high}} = 75.63$ s). This effect is markedly strong ($\eta^2 = .22$). In contrast, visual complexity does not affect reaction times ($p > .05$), and there is no interaction effect ($p > .05$).

Web Site Effects

Having examined the specific effects of structural and visual complexity with regard to the initial evaluation criterion of navigation (as indicated by reaction times), we then analyzed their effects along the sequence of Web site effects. We reran the mixed-design ANOVA with the seven evaluation criteria as within-subjects factors and the two dimensions of complexity as between-subjects factors. As in Study 1, these analyses provided evidence of a shifting range of optimal complexity along the sequence of evaluation criteria. There are interactions of the criteria with both structural complexity (Greenhouse–Geisser corrected $F(4.51, 486.95) = 7.821$, $p < .001$) and visual complexity (Greenhouse–Geisser corrected $F(4.51, 486.95) = 6.811$, $p < .001$). The within-subjects contrasts provided evidence of strong linear interaction effects (structural complexity: $F(1, 108) = 14.282$, $\eta^2 = .12$, visual complexity: $F(1, 108) = 16.769$, $\eta^2 = .13$). A series of follow-up ANOVAs lent support to H3. The upstream criteria are primarily driven by structural complexity, whereas the downstream criteria of evaluation (i.e., enjoyment, attitude toward the Web site, attitude toward the brand) are primarily driven by visual complexity (Table 5). Because there are no interaction effects (all $p > .05$), the overall complexity effects are additive in nature. Higher structural complexity results in lower scores of the respective criterion (if the main effect is significant). By contrast, higher levels of visual complexity result in greater evaluation scores (if the main effect is significant). For example, in terms of attitude toward the Web site, a simple structure and a high level of visual complexity are optimal (post-hoc LSD tests: all differences $p < .001$).

Shifting Optimum

We lastly analyzed the shifting range of overall complexity to confirm the major finding of Study 1. For objective complexity, the mixed-design ANOVA indicated a strong interaction between the four experimental conditions and the evaluation criteria (Greenhouse–Geisser corrected $F(13.53, 486.95) = 5.070$, $p \leq .001$; $\eta^2 = .12$). For upstream criteria (reaction times, ease of navigation, perceived control), the Web sites with lower levels of structural complexity yielded the greatest effectiveness (Fig. 4). For downstream criteria, in contrast, Web sites with high visual complexity yielded the greatest effects and those with low visual complexity decreased (low structural complexity) or remained at the lowest level (high structural complexity). Obviously, the Web site with high structural complexity and low visual complexity yielded the most unfavorable user experiences and the lowest communication effects.

Perceived Overall Complexity

Given that both dimensions of Web site complexity contribute to perceived overall complexity, we expect a similar shift as in Study 1. Based on the estimated regression functions (with perceived complexity as the predictor and the evaluation criteria as dependent variables), we assessed the optimum for each criterion. As expected, the optimal level of perceived complexity rises from upstream to downstream evaluation criteria (reaction times: $-1.51$, ease of navigation: $-2.97$, perceived control: $-0.65$, focused attention: $39$, enjoyment: $46$). Similar to Study 1, the optimum slightly decreased in terms of the business-relevant evaluation criteria (attitude toward the Web site: $10$, attitude toward the company: $21$). This finding supported Study 2’s fundamental premise that the additive effects of both complexity dimensions explain the patterns observed in Study 1.

Discussion

This paper aimed to disentangle the effects of Web site complexity for a comprehensive sequence of evaluation criteria that are frequently applied in marketing practice. By integrating prior approaches and theories, we developed an overarching theoretical framework to help resolve the two major contradictions identified in our literature review. The results of the Web site complexity effects are inconsistent when looking at individual criteria and when comparing different criteria. Two experimental studies tested this framework and yielded several noteworthy findings. In our first study, we provide support for the inverted U-shaped pattern of Web site complexity effects (for both objective and subjective measures of complexity). This finding, therefore, confirms the assumptions derived from Berlyne’s...
complexity theory and online flow theory (Hoffman and Novak 2009). By demonstrating that Web sites are most effective at intermediate levels of complexity, we contribute to the discussion of whether Web site complexity helps or hurts Web site performance. There are two exceptions for the most downstream criteria. Note that although the experiment revealed only a positive linear relationship for enjoyment and a marginally significant quadratic effect for attitude toward the Web site, we expect that these effects are truly curvilinear when looking beyond the examined range of complexity (as indicated by the results of the regression analysis for perceived overall complexity). If we had employed more extreme levels of complexity, the user evaluations presumably would have decreased as well.

Most importantly, Study 1 reveals an interaction effect that helps resolve the second inconsistency in the literature (i.e., the shape of Web site complexity effects differs when comparing various measures of Web site effectiveness). For objective and subjective measures, we find conclusive evidence that the optimal level of curvilinear complexity effects shifts from the upstream to the downstream criteria of this sequence. Overall, the study confirms that users find it is easier to navigate simpler Web sites than highly complex Web sites. Because low degrees of complexity do not offer sufficient stimulation, increasing complexity fosters surfing enjoyment and better attitudes toward the Web site. Thus, we have revealed two major contingencies that determine when a certain Web site is ideal, namely, the degree of Web site complexity and the type of evaluation criteria that are most important to the company (utilitarian or hedonic criteria).

While Study 1 demonstrated that some degree of complexity is indeed favorable, the second empirical study elaborated

Table 5
Follow-up ANOVA (Study 2).

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Structural complexity (sc)</th>
<th></th>
<th></th>
<th></th>
<th>Visual complexity (vc)</th>
<th></th>
<th></th>
<th></th>
<th>Interaction sc × vc</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>p</td>
<td>$\eta^2$</td>
<td>$M_{low}$</td>
<td>$M_{high}$</td>
<td>F</td>
<td>p</td>
<td>$\eta^2$</td>
<td>$M_{low}$</td>
<td>$M_{high}$</td>
<td>F</td>
</tr>
<tr>
<td>Reaction times</td>
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<td>.45</td>
<td>-.48</td>
<td>.15</td>
<td>n.s.</td>
<td>.00</td>
<td>.02</td>
<td>-.05</td>
<td>.23</td>
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<tr>
<td>Ease of navigation</td>
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<td>.39</td>
<td>.60</td>
<td>-.64</td>
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<td>n.s.</td>
<td>.01</td>
<td>.07</td>
<td>-.11</td>
<td>.41</td>
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<td>Perceived control</td>
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<td>***</td>
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<td>.33</td>
<td>-.36</td>
<td>.00</td>
<td>n.s.</td>
<td>.00</td>
<td>-.02</td>
<td>-.01</td>
<td>.32</td>
</tr>
<tr>
<td>Focused attention</td>
<td>5.51</td>
<td>**</td>
<td>.05</td>
<td>.21</td>
<td>-.23</td>
<td>.77</td>
<td>n.s.</td>
<td>.01</td>
<td>-.09</td>
<td>.07</td>
<td>.06</td>
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<tr>
<td>Enjoyment</td>
<td>5.4</td>
<td>n.s.</td>
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<td>.06</td>
<td>-.07</td>
<td>15.48</td>
<td>***</td>
<td>.13</td>
<td>-.35</td>
<td>.35</td>
<td>.01</td>
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<td>Attitude tw. Web site</td>
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<td>.14</td>
<td>.33</td>
<td>-.36</td>
<td>15.99</td>
<td>***</td>
<td>.13</td>
<td>-.35</td>
<td>.32</td>
<td>.50</td>
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<td>Attitude tw. brand</td>
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<td>.12</td>
<td>-.13</td>
<td>6.71</td>
<td>*</td>
<td>.06</td>
<td>-.24</td>
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</table>

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, n.s. not significant, $M_{low/high}$ mean of factor scores for the high/low condition of structural/visual complexity.

(1960, 1974) complexity theory and online flow theory (Hoffman and Novak 2009). By demonstrating that Web sites are most effective at intermediate levels of complexity, we contribute to the discussion of whether Web site complexity helps or hurts Web site performance. There are two exceptions for the most downstream criteria. Note that although the experiment revealed only a positive linear relationship for enjoyment and a marginally significant quadratic effect for attitude toward the Web site, we expect that these effects are truly curvilinear when looking beyond the examined range of complexity (as indicated by the results of the regression analysis for perceived overall complexity). If we had employed more extreme levels of complexity, the user evaluations presumably would have decreased as well.

Most importantly, Study 1 reveals an interaction effect that helps resolve the second inconsistency in the literature (i.e., the shape of Web site complexity effects differs when comparing various measures of Web site effectiveness). For objective and subjective measures, we find conclusive evidence that the optimal level of curvilinear complexity effects shifts from the upstream to the downstream criteria of this sequence. Overall, the study confirms that users find it is easier to navigate simpler Web sites than highly complex Web sites. Because low degrees of complexity do not offer sufficient stimulation, increasing complexity fosters surfing enjoyment and better attitudes toward the Web site. Thus, we have revealed two major contingencies that determine when a certain Web site is ideal, namely, the degree of Web site complexity and the type of evaluation criteria that are most important to the company (utilitarian or hedonic criteria).

While Study 1 demonstrated that some degree of complexity is indeed favorable, the second empirical study elaborated

Figure 4. Diverging Effects of the Type of Web Site Complexity on Different Criteria (Study 2).
on these findings by showing which sources of complexity are favorable. We examined whether different dimensions of complexity are responsible for the shifting range of optimal Web site complexity. Note that while a number of studies (e.g., Butkiewicz, Madhyastha, and Sekar 2011; Guo and Hall 2009) have examined how to conceptualize and measure a multidimensional construct such as Web site complexity, research is sparse on how the different facets of Web site complexity affect user experiences and communication effectiveness. By filling this gap, Study 2 demonstrated that structural and visual complexity evoke different influences. The observation that structural complexity primarily affects upstream criteria can be explained by the fact that aspects of navigation (e.g., reaction times, ease of navigation) or attention (e.g., perceived control, focused attention) are mostly driven by cognitive processes. Consequently, confusion and being lost in cyberspace (which users are more likely to experience when surfing pages with a highly complex structure) have a greater detrimental effect on these variables than on the downstream criteria. The latter, by contrast, are mostly driven by affective processes (e.g., enjoyment), which is why visual complexity plays a much greater role for these criteria. Because visual complexity increases interestingness and stimulation, this fosters enjoyment and attitude toward the Web site. Remarkably, while most criteria depend either on structural or on visual complexity, attitude toward the Web site is affected by both. Thus, a careful configuration of structural and visual complexity is needed to elicit optimal attitudes toward the Web site: although users prefer a low degree of structural complexity, they value a high degree of visual complexity. This also clarifies our observation that for this criterion the optimal level of complexity is lower than for enjoyment (which is guided by visual complexity only).

In conclusion, there is broad evidence that the preferred level of Web site complexity depends upon the criterion one considers. The most relevant criteria determine which source of complexity (structural or visual) needs to be optimized.

**Limitations and Future Research**

This paper provides a fruitful starting point for further research. Our study was conducted in the fields of detergents (a low-involving, functional product) and boat rental (a more involving product with hedonic elements). We call for more real-life investigations in other fields to test the external validity of our findings. Further investigations are also needed from a methodological perspective. In the first study, we used real Web sites. Such sites are professionally crafted and designed according to the users’ needs. As argued above, highly complex (and simple) Web sites may not embody the highest (and lowest) possible level of complexity (see also Tuch et al. 2009). It is conceivable that our stimulus material includes only a range of moderately complex Web sites. This does not harm our interpretation of the interaction effect. By contrast, it is a rather conservative test. Nonetheless, future examinations should widen the range of complexity.

Several endogenous and exogenous factors may moderate complexity effects: setting (e.g., mobile vs. online Web sites, work vs. private use, time pressure), company (e.g., intangible vs. tangible goods, perceived risks, complexity of the products and services), user (e.g., Web site and task familiarity, involvement, motivation, cognitive abilities) and task (goal-directed vs. experiential surfing). For example, because mobile Internet usage is on the rise (Meeker 2009), scholars should analyze whether the ideal levels of complexity differ for surfing on mobile phones or tablets. For smaller screens, the optimal level of complexity may be generally lower because less navigational elements can be presented. Studies should also incorporate relevant user variables. For instance, the curvilinear shape of Web site complexity effects may depend on the user’s motivation and the goals of his/her visit to the Web site. The optimal level of complexity should be lower for goal-directed searchers than for experiential browsers (e.g., Nadkami and Gupta 2007; Novak, Hoffman, and Duhachek 2003). Additionally, the cognitive characteristics of the user, such as information processing, perceived task complexity, Web familiarity (Chen et al. 2011) and site familiarity (Guo and Hall 2009), may serve as moderators.

It has been shown in other contexts that novices and experts react differently to complexity, meaning that the negative influence of complexity decreases with repeated exposure (via learning) and that processing fluency increases (Berlyne 1974; Janiszewski and Meyvis 2001; Reber, Schwarz, and Winkielman 2004). In our studies, the participants were engaged in rather utilitarian goal-oriented online activities. Thus, further research should replicate our findings for hedonic experiential online activities. Although flow is more likely to occur for goal-oriented tasks, Novak, Hoffman, and Duhachek (2003) provide evidence that it can also arise for experiential activities. Lastly, it might be interesting to analyze the moderating effects of personality traits (e.g., sensation seeking and need for cognition; Srivastava, Shukla, and Sharma 2010).

Study 2 differentiated between structural and visual complexity. Further studies should consider other dimensions of complexity, such as interactive (Gupta, Nadkarni, and Gould 2005) or outcome (Gupta and Gould 2009) complexity. Lastly, when analyzing the suggested moderators, scholars may take into account the specific consumer behavior stages. It is plausible that visitors in the initial stage of decision making (e.g., information search) will place much greater emphasis on more intense and more complex information, whereas those in the final stage (e.g., order placement) may favor fluent information. The reverse is also possible. In the initial stage, users are unfamiliar with the Web site, which is why they are more likely to be overwhelmed by complex Web sites. Hence, the shift in the optimal level of complexity may be more or less pronounced depending on the specific consumer behavior stage.

Additionally, we examined Web site complexity in a single-exposure situation. The shift in the optimal degree of complexity may decline with subsequent exposure as the user learns to adapt to higher degrees of complexity. Thus, future studies should consider examining visitors in different stages of decision making by using longitudinal designs with mere-exposure situations.
Practical Implications

Our results provide new insights into the effectiveness of a Web site. Most importantly, the study pinpoints that providers and Web site designers must bear in mind that there is no ideal range of Web site complexity. Regardless of content, the optimal level of complexity depends on the evaluation criterion the Web site is most particularly aiming at. From a general perspective, a two-dimensional hedonic/utilitarian approach may help structure the site is most particularly aiming at. From a general perspective, a two-dimensional hedonic/utilitarian approach may help structure the Web site complexity, they also must pay close attention to which downstream criteria are more important. Given that hedonic aspects such as joy and pleasure are deemed to be especially relevant, the optimal level of Web site complexity is primarily driven by more details and rich variations in the features of a given Web site (e.g., multimedia, streaming audio). In summary, marketers not only must be careful about how much they increase Web site complexity, they also must pay close attention to which type of complexity is increased to achieve ideal user experiences and to improve Web site performance and communication effectiveness.

Appendix 1. Evaluation of the Potential Web Sites for the Main Experiment (Study 1)

<table>
<thead>
<tr>
<th>Web site</th>
<th>Pictures*</th>
<th>Animation*</th>
<th>Navigation*</th>
<th>Impression*</th>
<th>Overall score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web site 1</td>
<td>2.7</td>
<td>2.3</td>
<td>4.0</td>
<td>4.3</td>
<td>83%</td>
</tr>
<tr>
<td>Web site 2</td>
<td>3.0</td>
<td>1.7</td>
<td>3.3</td>
<td>4.0</td>
<td>79%</td>
</tr>
<tr>
<td>Web site 3</td>
<td>3.0</td>
<td>1.7</td>
<td>2.0</td>
<td>3.3</td>
<td>66%</td>
</tr>
<tr>
<td>Web site 4</td>
<td>2.7</td>
<td>2.3</td>
<td>1.7</td>
<td>2.7</td>
<td>63%</td>
</tr>
<tr>
<td>Web site 5*</td>
<td>3.0</td>
<td>2.0</td>
<td>2.3</td>
<td>1.7</td>
<td>62%</td>
</tr>
<tr>
<td>Web site 6</td>
<td>2.7</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>59%</td>
</tr>
<tr>
<td>Web site 7</td>
<td>2.3</td>
<td>1.0</td>
<td>2.3</td>
<td>3.3</td>
<td>56%</td>
</tr>
</tbody>
</table>

Notes. Bold... selected Web sites. * Web site 5 is not included in the analysis of the objective measures of Web site complexity, 1 three-point scale, 2 five-point scale, overall score (sum of normed scores of the four criteria).

Appendix 2. Mixed-design ANOVA with the Three Experimental Conditions (EC) as Between-subjects Factor and a Pair of Web Site Effectiveness Criteria (WE) as the Within-subjects Factor (Study 1)

<table>
<thead>
<tr>
<th>F-value of the WE × EC interaction</th>
<th>Perceived speed</th>
<th>Ease of navigation</th>
<th>Perceived control</th>
<th>Focused attention</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of navigation</td>
<td>3.13*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived control</td>
<td>7.89***</td>
<td>1.97**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focused attention</td>
<td>8.86***</td>
<td>2.25**</td>
<td>22**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment</td>
<td>7.13**</td>
<td>3.34*</td>
<td>1.76**</td>
<td>2.42+</td>
<td></td>
</tr>
<tr>
<td>Attitude tw.</td>
<td>10.33***</td>
<td>3.98*</td>
<td>1.18**</td>
<td>0.65**</td>
<td>1.81**n.s</td>
</tr>
</tbody>
</table>

Web site

Notes. n.s. not significant, * p ≤ .1, ** p ≤ .05, *** p ≤ .01, **** p ≤ .001, EC three experimental conditions (between-subjects factor: low, moderate, high complexity), WE criterion of Web site effectiveness (within-subjects factor: e.g., perceived speed vs. ease of navigation).

Appendix 3. Mixed-design ANOVA with Pairs of Web Site Effectiveness Criteria as the Within-subjects Factor (WE) and the Perceived Web Site Complexity (PWC) as the Covariate (Study 1)

<table>
<thead>
<tr>
<th>F-value of the WE × PWC interaction</th>
<th>Perceived speed</th>
<th>Ease of navigation</th>
<th>Perceived control</th>
<th>Focused attention</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of navigation</td>
<td>1.32**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived control</td>
<td>15.38***</td>
<td>7.74**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focused attention</td>
<td>27.83***</td>
<td>10.53**</td>
<td>1.08n.s.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment</td>
<td>24.77***</td>
<td>8.34**</td>
<td>.40n.s.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude toward the Web site</td>
<td>43.30***</td>
<td>19.45**</td>
<td>4.39*</td>
<td>1.82n.s.</td>
<td>2.48n.s.</td>
</tr>
</tbody>
</table>

Web site

Notes. n.s. not significant, * p ≤ .1, ** p ≤ .05, *** p ≤ .01, **** p ≤ .001, WE criterion of Web site effectiveness (within-subjects factor: e.g., perceived speed vs. ease of navigation), PWC perceived Web site complexity (between-subjects factor: linear and quadratic term), L... linear term, q... quadratic term.

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