Information & Management xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Information & Management

journal homepage: www.elsevier.com/locate/im

A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design

Constantinos K. Coursaris [a,b,c,*], Wietske van Osch [d]

[a] Department of Media and Information, 404 Wilson Road, 414 College of Communication Arts and Sciences, Michigan State University, East Lansing, MI 48824, USA
[b] Department of Advertising and Public Relations, 404 Wilson Road, 414 College of Communication Arts and Sciences, Michigan State University, East Lansing, MI 48824, USA
[c] Usability/Accessibility Research and Consulting, Kellogg Center, 219 S. Harrison Road, Room 94, East Lansing, MI 48824, USA
[d] Department of Media and Information, 404 Wilson Road, 436 College of Communication Arts and Sciences, Michigan State University, East Lansing, MI 48824, USA

ARTICLE INFO

Article history:
Received 10 November 2012
Received in revised form 5 November 2014
Accepted 5 October 2015
Available online xxx

Keywords:
Cognitive-Affective Model of Perceived User Satisfaction
Website aesthetics
Playfulness
Usability
Human–computer interaction
Colour temperature

ABSTRACT

Affective dimensions of human–computer interaction design have the potential to elicit emotions and behaviours. However, there is little research into which affective treatments are systematically tested, let alone assessed in light of additional cognitive dimensions. In this study, we formulate and empirically test a Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS) that displays high explanatory power ($R^2 = .69$). CAMPUS offers a comprehensive framework for assessing both direct effects of perceptions of cognitive and affective dimensions on satisfaction and the complex interplay between these two in terms of system design and use. Implications for theory and practice are discussed.

1. Introduction

Recent studies have revealed that the visual design of an information system (IS) has the potential to elicit strong emotional appeal and, consequently, to affect user behaviours and user satisfaction [1–4]. One important dimension of visual design is colour, which has been reported to be the most significant factor in people's assessment of aesthetics and ease-of-use of websites [5]. Colour information, such as hue, brightness, saturation, and temperature, is instantaneously perceived by users and therefore has a significant, immediate impact on our perceptions, emotional reactions, attitudes, and behavioural intentions towards IS [5–10].

In the marketing domain, preliminary research has investigated the effect of colour on attitudes and expectations towards brands, yet surprisingly little is known about the actual influence of colour in advertising [11,12]. Furthermore, even less is known about the effect of colour in virtual settings, in particular the impact of colour in website design [8,9,12,13]. As previously mentioned, although research into the effects of colour is sparse, several studies have revealed the role of website aesthetics in reaching and retaining customers [14–17], as well as the relationship between colour and emotional responses, such as anxiety and pleasure [3,5]. However, research on the effect of affective dimensions of website design in general and colour in particular remains inconclusive, warranting further research [12,16,20–26].

In the IS domain, it has been suggested that affective dimensions of design, including colour, images, and shapes, affect a user's overall perception of an IS, including its utility and usability [15,23,27–31]. Therefore, whereas research on the acceptance of novel technologies has primarily centered on cognitive dimensions, awareness of the

* Corresponding author at: Department of Media and Information, 404 Wilson Road, 414 College of Communication Arts and Sciences, Michigan State University, East Lansing, MI 48824, USA. Tel.: +1 517 353 3122; fax: +1 517 355 1292.
E-mail address: coursari@msu.edu (C.K. Coursaris).

http://dx.doi.org/10.1016/j.im.2015.10.003
0378-7206/

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

importance of affective dimensions of design in relation to perceptions of utility is growing, suggesting the need to adopt a cognitive-affective model for analyzing and subsequently designing IS [32–34].

Consequently, in the current investigation, we aim to adopt a cognitive-affective lens for explaining the effect of perceived dimensions of usability and aesthetics on a user's satisfaction with a website or system design in general. With respect to the cognitive or utilitarian dimension, this study centers on the perceived efficiency and effectiveness of a system. Furthermore, with respect to the affective dimension, this study integrates two separate realms, perceived aesthetics and perceived playfulness [35–38].

Through combining cognitive and affective dimensions, we seek to provide a more comprehensive explanation of user satisfaction and shed light on the relative importance of each of these two dimensions. These insights are not only important for researchers interested in the relative significance and interdependence of cognitive and affective explanations of user satisfaction but also for designers confronted with the challenge of developing systems and websites that are both cognitively and affectively satisfying.

2. A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS)

Cognitive models for explaining satisfaction with or acceptance of novel technologies have been highly influential in the IS domain [39,40]; however, recent research has shown that these models alone cannot fully explain empirical findings about the perception and use of novel technologies [33,41–43]. In this paper, affective accounts, i.e., theories, of user satisfaction are advanced, not so much as an alternative approach to cognitive models, but rather as an augmentation of these cognitive explanations. Thus, rather than building on either cognitive or affective explanations of user satisfaction, the model offered in this paper aims to capture both aspects to build a more accurate representation of satisfaction. Herein, a Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS) is formulated through a description of cognition, affect, and satisfaction.

2.1. Cognition: effectiveness and efficiency

Cognitive theories generally emphasize how user satisfaction and technology use are driven by the relatively objective and instrumental value that people derive from interacting with a technology, such as increasing task performance and efficiency [44]. According to these theories, user satisfaction with and subsequent adoption of novel technologies results from the perceived benefits from adoption and use above and beyond associated costs [45,46]. Furthermore, the dominant design objective for cognitive (or utilitarian) systems is the *productive* use of the technology [44].

To understand the cognitive aspect of user satisfaction, we analyze two dimensions frequently associated with satisfaction in the realm of usability studies, effectiveness and efficiency [47–52]. Effectiveness, here, refers to the accuracy and completeness with which users achieve these specified goals [49,51]. It thus provides a measure of the perceived quality of the task performance or outcome (e.g., low error rate) associated with a particular technology. Efficiency, focuses on the resources that are utilized in accomplishing a goal in an effective—i.e., accurate and complete—manner [49,51]. It thus provides a measure of the perceived expended time and effort of the task performance or outcome associated with a particular technology.

The relationship between cognition—efficiency and effectiveness—and satisfaction has been studied extensively, particularly in the context of usability studies [48,52] and studies drawing on Expectancy-Disconfirmation theory [47,53]. These studies have shown that there is a strong relationship between efficiency (i.e., ease of use) and effectiveness (i.e., usefulness) [54] and that overall perceptions of performance or cognition directly affect users' satisfaction with a technology [47,55,56].

More specifically, with respect to effectiveness, users are more likely to be satisfied with a website or system because of the functions it performs for them and how effective it is in influencing individual task performance. Consequently, explorations of the underlying reasons for a positive relationship between effectiveness (i.e., usefulness) and satisfaction have emphasized the importance of performance enhancement as an antecedent to rewards that are extrinsic to the task context, such as promotions or monetary gains [57]. Thus, the effectiveness of an information system in supporting cognitive or instrumental behaviours will affect a user's satisfaction with the system because of subconscious anticipations of rewards [58,59].

Furthermore, whether users are satisfied with a website or system is further affected by how easy or hard—i.e., efficient—it is to make the website or system perform those functions. Davis [60] and Davis et al. [58] have emphasized self-efficacy perceptions as an explanation of the effect of ease of use on behaviour. Furthermore, it appears that the easier a system is to interact with, i.e., the less time and effort needed to use it, the more time and effort one can allocate to other instrumental activities. Consequently, these other activities may in turn increase task performance; hence, the anticipation of rewards in these other domains is enhanced because of the efficiency of a website or system [59].

As such, there appears to be a strong relationship between efficiency and effectiveness [60,61], that is, perceived efficiency plays a pivotal role in user acceptance of technologies by assisting and supporting perceived effectiveness—i.e., a technology's effect on the user's job performance—in enhancing utilitarian value. In other words, efficiency appears to be secondary to effectiveness because user satisfaction is first and foremost influenced by the perceived increase in job performance—i.e., effectiveness—and only secondarily by the perceived decrease in time and effort spent to complete a task. Effectiveness should thus be considered a mediator in the relationship between efficiency and satisfaction (c.f., [56]). Rather than affecting the direction or strength of the relationship, effectiveness accounts for the *why* of the relationship. Thus, the effect of efficiency perceptions of decreased time and effort spend on satisfaction is mediated by the perceived increase in job performance, i.e., effectiveness.

Thus, based on these existing studies, we can assume that, in addition to a direct effect of effectiveness and efficiency on satisfaction, the effect of efficiency on satisfaction is further mediated by effectiveness. The following hypotheses regarding the relation between cognitive-utilitarian aspects of system use and user satisfaction are therefore proposed.

H1. Higher levels of efficiency will positively affect effectiveness.

H2. Higher levels of efficiency will positively affect satisfaction.

H3. Higher levels of effectiveness will positively affect satisfaction.

2.2. Affect: aesthetics and playfulness

Affective theories generally emphasize how satisfaction and use are driven by the subjective and self-fulfilling value that people derive from interacting with a technology, such as fun and enjoyment [62]. According to these theories, user satisfaction with and subsequent adoption of novel technologies result from the user's pleasurable experience and sensations [63]. Furthermore,

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

the dominant design objective for affective systems is the *prolonged* use of the technology [44].

To understand the affective aspect of user satisfaction, we analyze two dimensions of affect, aesthetics and playfulness. Aesthetics refers to a particular theory or conception of beauty or art: a particular taste for or approach to what is pleasing to the senses, especially sight [65]. Playfulness is a predisposition to be playful and represents the interactive component of affective design [37].

In what follows, we will briefly explore the relations between these two affective dimensions and satisfaction based on a more in-depth review of the literature on aesthetics and playfulness. Although both dimensions of affect, aesthetics and playfulness, have been researched separately in the context of systems and websites, the two dimensions have not yet been included in the same study nor combined to explain satisfaction. In what follows, each of these dimensions will be explored in greater depth.

In the literature on aesthetics, we can identify two distinct approaches for understanding and analyzing aesthetics, classical and expressive aesthetics. *Classical aesthetics*, with its foundation in antiquity, emphasize clear, orderly design and are closely associated with the design rules and principles advocated by usability experts [31]. *Expressive aesthetics* reflect creativity and originality of design and are characterized by the ability to break design conventions [31]. These two dimensions are closely related to the concepts of visual clarity and visual richness, respectively [66]. Visual clarity, similarly to classical aesthetics, consists of attributes such as clarity, cleanliness, symmetry, and contrast. On the other hand, visual richness—like expressive aesthetics—addresses originality, sophistication, and creativity in terms of graphics, layout, and typography. This dichotomy between classical and expressive aesthetics has also been argued to exist in both subjective and objective approaches [67]. Furthermore, several studies have indicated a connection between classical and expressive aesthetics [31], showing that perceptions of the former may affect perceptions of the latter [17,68].

The relationship between classical aesthetics—orderliness and clarity—and expressive aesthetics—originality and creativity—can be explained through processing fluency theory [69,70], which accounts for the mechanisms that operate between simplicity and aesthetic perceptions. Processing fluency theory postulates that aesthetic pleasure is a function of a user's processing dynamics. The more fluently a user can perceive and process a system's or website's stimuli, the more positive his or her aesthetic evaluation will be. Fluency is affected by the ease with which a visual stimulus can be processed. Symmetry and cleanliness in design decrease the cognitive effort required to process a visual stimulus [71]. Classical aesthetics refers to aspects of design such as symmetry, orderliness, and clarity. Thus, an increase in classical aesthetics should increase the ease (i.e., fluency) with which a visual stimulus is processed. Because fluency has been shown to positively affect perceptions of aesthetic design, we hypothesize the following:

H4. Higher levels of classical aesthetics—i.e., clarity and orderliness of perceived system design—will positively affect expressive aesthetics, i.e., creativity and originality of perceived system design

Furthermore, some studies have indicated a positive effect of classical aesthetics—given the focus on orderliness—on perceptions of efficiency and satisfaction [1,14,23,24,27,29,44]. In hypothesizing the positive relationship between aesthetics and perceived usability and satisfaction, three different processes have been identified that may produce such a link [23]: stereotyping, halo effect, and mood-elevating effect.

First, the positive link between aesthetics and usability may be the result of a process of stereotyping, in which successful design on one explicit design objective, e.g., aesthetics, becomes associated with the successful design of other, implicit design objectives, e.g., cognition [72,73].

Second, the positive link between aesthetics and usability may be caused by a halo effect, in which the positive perceptions of an aesthetic design element result in a general perception of superiority in relation to other or all design features [74]. Third, an affective response to the aesthetics of a website or information system may have a mood-elevating effect and therefore positively affect overall evaluations of the website or system [75]. Thus, the pleasure one experiences while interacting with aesthetic components of a website or system elicits a more positive overall mood, which will in turn result in more positive evaluations of other dimensions—such as the cognitive dimension—of the website or system. Although not explicitly discussed by [75], one may anticipate that negative perceptions of or experiences with the aesthetics of a website or system may have a "mood-depressing" effect and therefore negatively affect the overall evaluations of the website or system.

More recently, alternative explanations regarding the relation between aesthetics and usability that focus on cognitive load, increased motivation, focused attention, and felt involvement have emerged. First, [76]—building on cognitive load theory—has suggested that, in the context of understanding learning experiences, high consideration for aesthetic design decreases cognitive load and therefore increases user satisfaction and performance. In particular, because classical aesthetics is concerned with orderliness and clarity, its positive effect on cognitive load appears intuitive and hence may positively affect perceptions of efficiency and satisfaction. Second, [77] has hypothesized that aesthetically pleasing websites and systems may put the user at ease or "in flow" [78], thereby increasing the user's motivation to engage with a website or system as well as his or her perception of feeling in control. As a result, actual increased performance rather than a mere elevation of cognitive perception may emerge. Hence, by maximizing the amount of cognitive resources available to focus on a task, flow helps to explain the link between a user's positive aesthetic perceptions of a technology and the user's task performance. Alternatively, negative perceptions of aesthetics may draw negative attention to the technology, which reduces the cognitive resources available to the user and thereby results in inferior user performance [77].

Third, and relatedly, [79] argue that positive perceptions of aesthetics may affect focused attention i.e., the concentration of mental activity on a single stimulus. Focused attention, such as that associated with increased motivation, may result in a state of flow and therefore positively affect usability. Fourth, [79] found felt involvement—i.e., how immersed users were as a result of having fun during an interaction—to be an important mediator between perceptions of aesthetics and usability. Although it is beyond the scope of this study to disentangle which of these underlying mechanisms is at play in generating the relationship between aesthetics and usability, the abovementioned findings provide sufficient theoretical rationale for hypothesizing the following:

H5. Higher levels of a website interface's classical aesthetics will have a more positive effect on the interface's efficiency

H6. Higher levels of a website interface's classical aesthetics will have a more positive effect on the interface's satisfaction

In the literature on playfulness, we can identify two distinct approaches for understanding and analyzing playfulness, namely playfulness as a state or as a trait [38,80]. The *state of playfulness* refers to a subjective characteristic of an experience [81], that is, a short-term affective or cognitive episode that is context-specific

[80]. The *trait of playfulness* represents a motivational characteristic of an individual [82,83], which is constant, hence, not context-specific [80]. In this study, and in line with the dominant view in the IS literature [38], we concern ourselves with playfulness as an experiential state, that is, an aspect of a user's subjective experience that is characterized by perceptions of pleasure and involvement [84,85]. Because playfulness in the context of our study pertains directly to a user's perception of a system during his or her interaction with the system, playful perception is based on the state of the user-website interaction rather than a trait of the individual.

With respect to the interplay between the two affective constructs, aesthetics and playfulness, existing studies [86,87] have established a link between aesthetics, most importantly expressive aesthetics—because of its inherent association with creativity and originality—and playfulness. Theoretical explanations of the relationship between expressive aesthetics and playfulness [38] have been developed from Csikszentmihalyi's flow theory [88], postulating that a playful state in the context of human–computer interactions emerges from the perceived aesthetics of the system. According to flow theory, flow emerges when an activity sufficiently challenges an individual such that it encourages playful behaviour (Csikszentmihalyi, [78,88]). Flow—a multi-dimensional construct encompassing sense of control, focused attention, curiosity, and intrinsic interest [89]—cannot emerge when an activity is perceived as boring or when an activity is perceived as too complex, thereby inducing anxiety. However, when a website or system is perceived as creative and original—emerging from its expressive aesthetics—flow theory posits that a sufficient level of challenge exists to bring about a state of flow. Hence, it is the perception of creativity and originality that may result in a state of flow and in turn in playful behaviours while interacting with a system or website. In light of these findings, we propose the following:

H7. Higher levels of a website's expressive aesthetics will positively affect its playfulness.

Furthermore, regarding the relation between playfulness and user satisfaction, studies have found that there is a positive link between these two constructs [37,38]. Again, explanations of the relation between playfulness as a state and user satisfaction have largely drawn on Csikszentmihalyi's [88] flow theory. Flow theory would help us predict whether the state of playfulness or flow experienced during an interaction with a website or system serves as a positive reinforcer and therefore increases both user satisfaction and the probability of future usage. Within the context of a website in particular, playfulness as a state helps us account for the playful feeling that is experienced at different times during the interaction with a website and results in an intrinsic motivation towards continued usage [37]. Hence, we propose that

H8. Higher levels of website playfulness will positively affect Satisfaction with a website.

2.3. A Cognitive-Affective Model of Perceived User Satisfaction

Integrating the conclusions and hypotheses outlined above, we propose the following Cognitive-Affective Model of Perceived User Satisfaction (Fig. 1).

3. Research methodology

3.1. Experimental design and manipulation

To assess the effects of and interplay between cognition and affect in the context of user satisfaction, as previously mentioned,

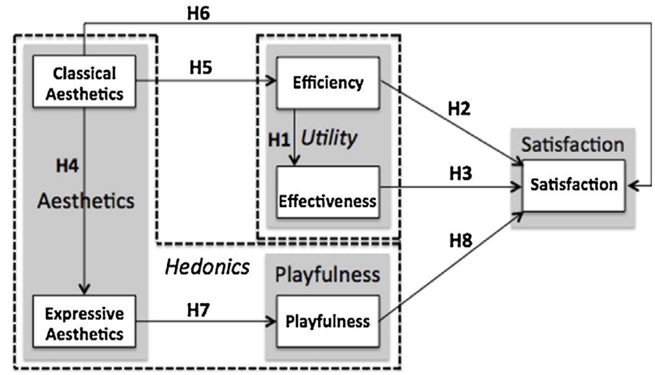


Fig. 1. The Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS).

we focused on and manipulated one element of website design, colour temperature. Colour is a particularly important dimension of design because it is immediately perceived; hence it directly influences the nervous system and stimulates aesthetic responses in the brain [90,91]. Thus, the transduction of colour is instantaneous—i.e., it occurs without cognitive processing or reasoning; the relation between colour and aesthetics is therefore innate. Although responses to colours may not be identical across all individuals, carefully designed colour schemes—particularly the coldness or warmth of a colour—can produce reliable and specific effects on mood [92,93].

The importance of colour in affective and cognitive perceptions has been discussed in the existing literature but only sparsely analyzed through empirical data [5,94–97]. In spite of the infancy of this research domain, a website's colour, combinations of colours, and colour temperature in particular have been found to significantly affect perceived attractiveness [96,98] and cognitive perceptions of utility [5,90]. Therefore, based on findings from this limited body of evidence, it may be argued that design choices regarding colour and colour combinations will affect the perceived aesthetics of a website, which in turn, influence cognitive perceptions of utility and user satisfaction.

To manipulate a website' colour temperature, we conducted a four-group between-subject experiment in which the colour temperature was set to four different levels. Doing so involved categorizing the website's design elements (e.g., logo, navigation bar) into "primary" and "secondary" groupings.[1] Primary elements are those that immediately attract the attention or focus of users or contain primary content. These may include branding (e.g., logos, etc.), top-level navigation, or other primary content containers. Secondary elements are those areas of a site that convey secondary information, including, hyperlinks, secondary or tertiary text, styling, and secondary navigational elements. By assigning different colours to the primary and/or secondary groupings, the site's overall colour temperature could be manipulated.

In manipulating colour temperature, two sets of colours, categorized as either "warm" or "cool," were selected. Warm colours are those that range from yellow to red-violet on the visible light spectrum. Cool colours are those that range from blue-violet to yellow-green on the spectrum. Interaction between colours may cause warm hues to appear cooler or cool hues to appear warmer. For example, red-violet may appear warmer if it is placed next to a cold colour, such as green, or colder if it is placed next to a warm colour, such as orange.

[1] Note that although the terms "primary" and "secondary" are sometimes used to refer to specific color palettes, here they are used to refer only to the design and layout areas of the website where colors were applied.

Fig. 2. Screenshots of the website's designs.

For the purpose of this study, a website for a fictional hotel was created. Four versions of the website design were produced with colour temperature combinations being the only design element that was varied (Fig. 2). The remaining elements and content were the same on all versions of the site, allowing for any differences in user perceptions to be attributed to colour temperature. That is, only the colours used for primary and second elements were manipulated through alteration of text colour, whereas the background colour was kept consistent (i.e., set to standard white) across all versions of the website design.

Four split-complementary[2] colour combinations for the site were used: (1) Warm Primary – Warm Secondary (Red/#FF0000 and Orange/#FF7F02); (2) Warm Primary – Cool Secondary (Red/#FF0000 and Light Blue/#879ADC); (3) Cool Primary – Warm Secondary (Blue/#3C4360 and Orange/#FF7F02); and (4) Cool

[2] Split-complementary colour selections are made by taking a single color on the color wheel, looking directly across to its complement, and using the colors on either side of the complement.

Primary – Cool Secondary (Blue/#3C4360 and Light Blue/#879ADC).

The main motivation for using (i.e., design and develop) a hotel website, as opposed to another product or service, for this study was related to the inherent cognitive-affective nature of the process of booking a hotel. In addition, hotel websites are used by 80% of Internet users [102] and rank among the top travel-related websites per Alexa rankings.[3]

As will be further discussed, participants were randomly assigned to one of four versions of the website and asked to browse through the website in search of specific information to book a room. They were told that their performance was not being measured and that they were being given the opportunity to explore the website's design and find a hotel. Once participants had evaluated the website design that was randomly assigned to them and completed the full questionnaire, they were asked to provide a post-hoc evaluation of the four website designs based on their perceptions of the site's overall aesthetic appeal.

3.2. Participants

A convenience sample of 328 participants was recruited for this web-based voluntary study via email announcements on various databases and electronic mailing lists. After removing missing cases[4] ($N = 37$) and removing outliers ($N = 8$),[5] 273 usable data sets were collected, with a minimum of 66 participants per colour temperature treatment group. Chin [103] recommends a minimum sample size of 10 times the number of the most complex construct when conducting an analysis using PLS. In this study, the largest construct (efficiency) consisted of six items; thus, our sample size exceeded the needed 60 cases.

During the study, each participant was exposed to one treatment level, and the assignment of participants to one of the four treatment groups was fully randomized to control for confounding effects caused by differences in participant characteristics. There was a near-balanced sample split with respect to gender (137 males to 136 females). The average age was 34.5 (and ranged from 18 to 70), and 86% of participants were Caucasian/White, 8% Asian/Pacific Islander, and 6% African American, Hispanic American, Other or Prefer not to disclose. The participants were almost entirely college-educated and had an average experience of 17 years with computers and 10 years with the World Wide Web. ANOVA tests revealed no significant differences among participants in terms of the control variables measured (i.e., gender, age, and education), thereby ensuring the successful randomization of assignment across groups.

3.3. Survey and instrument validation

The questionnaire used in this study consists of scales measuring the constructs from the research model. For all scales, other than the scale for the satisfaction construct, participants were asked to indicate the statement that best matched their opinion on a seven-point Likert scale ranging from "strongly disagree" to "strongly agree." The four items constituting the satisfaction construct were also measured on a seven-point scale; yet, this scale had two defined and extreme ends (e.g., "terrible" defined as 1 and "delighted" defined as 7).

With respect to the affective constructs, aesthetics and *playfulness*, we used existing scales. First, the scales for Classical Aesthetics and Expressive Aesthetics developed in a prior study by Lavie and Tractinsky [31], which had established their reliability and validity, were used in their original form. The survey measured the extent to which people considered their impressions of the website as "clean," "clear," "aesthetic," "pleasant," and "symmetrical" for classical aesthetics and as "original," "sophisticated," "fascinating," "creative," and "uses special effects" for expressive aesthetics.

Second, the scale for playfulness was used in its original form as proposed by Webster and Martocchio [38]; however, two items were removed—creative and original—because of the similarity of these two playfulness items with two of the expressive aesthetics items. Hence, the remaining four items on the playfulness scale measured the extent to which people considered their experience with using the website as "spontaneous," "imaginative," "happiness," and "innovative."

With respect to the cognitive constructs, efficiency and effectiveness, we used the scales proposed by Coursaris et al. [47,56], which provided evidence of reliability and validity. For the efficiency construct, we included four existing items, namely "learning how to use the website was easy," "using the website was easy," "the website was user friendly," and "using the website was fast". Furthermore, we added one item, "the website was easy to navigate," that pertained to the website's navigability, i.e., how quickly users acquire the information they are seeking [104], a usability dimension that was particularly relevant and useful in the context of the specific task the participants had to perform—browsing and navigating the website to book a hotel—as well as for accounting for the efficiency of a website in particular. The effectiveness construct was measured with two items, as in the original scale by Coursaris et al. [47,56], namely "I was able to complete all website tasks successfully" and "given the tasks, the sought after information was accurately obtained".

Finally, we adopted the scale for the dependent variable, Satisfaction, as proposed by Spreng et al. [105] and successfully applied in the context of IS by Coursaris et al. [47,56]. These scales capture respondents' satisfaction levels vis-à-vis their experience with the website on seven-point scales anchored between four semantic differential adjective pairs, "Terrible/Delighted," "Frustrated/Contented," "Unhappy/Gratified," and "Sad/Joyful".

While administering the survey, each construct's items were randomized to prevent systemic response bias.

A further potential hazard with using survey methodology is common method bias, which may occur when independent and dependent variables are provided by the same source. There is an even higher risk when participants respond to items that measure both independent and dependent variables within the same survey instrument [106–109]. To help alleviate some of this risk, participant trait information was collected and controlled for. However, to statistically test for common method bias, the data was rearranged (i.e., paired) such that every participant would provide responses to either the independent or dependent variables only [47,56]. In this manner, no single participant would provide responses to items tapping into both independent and dependent variables. A within-treatment random assignment of binary numbers was used to pair data sets (independent and dependent ones).

The correlation of factor scores was then compared to determine whether a significant difference existed between the two data sets (i.e., full and half sample). The results in Table 1 show (through visual inspection) that there is minimal difference between correlations of factor scores using the total data set and the correlation of factor scores when participant data are

[2] Split-complementary colour selections are made by taking a single color on the color wheel, looking directly across to its complement, and using the colors on either side of the complement.

[3] http://www.alexa.com/topsites/category. Alexa is a subsidiary of Amazon.com that provides commercial web traffic data.

[4] From the 328 respondents, 37 only completed the first part of the survey but did not complete the section for the post hoc test comparing the four designs. Hence, we excluded these cases from the survey.

[5] From the 328 respondents, an additional 8 had responses that were (far) beyond two standard deviations from the mean as identified through SPSS histograms and frequencies. Hence, we excluded these outliers from the analysis.

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

Table 1
Common method bias – Test 1.

	Correlation with satisfaction ($n=273$)[a]	Correlation with satisfaction ($n=136$)[b]	Absolute difference
Classical Aesth.	0.310	0.262	0.048
Playfulness	0.278	0.338	0.060
Efficiency	0.289	0.271	0.018
Effectiveness	0.140	0.115	0.025

[a] Correlation of factor scores between exogenous variables (independent and dependent variables: Needs, Innovat, Popular, Character) with the right-most endogenous variable (Usage) using total data.
[b] Correlation of factor scores using paired data.

paired. Thus, common method bias was not present in this study. This result was further confirmed by our second test for the presence of common method bias, as proposed by Lindell and Whitney [110]. Accordingly, we employed a theoretically unrelated construct, a "marker variable", to observe whether there is any high correlation between it and the study's principal constructs. The marker variable used was "Experience with the World Wide Web," and its correlation with our study's constructs was quite low (Table 2), the highest being at 0.117 with Classical Aesthetics, which is significantly below the suggested 0.300 threshold [111], offering further support for the non-presence of common method bias.

The factor loadings for the items used in this study are summarized in Table 3. An item is significant if its factor loading is greater than 0.7 to ensure construct validity [112]. Adherence to this criterion required the removal of three items: Aesthetic and *Symmetric* from the Classical Aesthetics scale and *Happiness* from the Playfulness. To further validate the remaining items, item-to-total correlations were computed, and all exceeded the suggested threshold of 0.35 [113].

The results of the tests for convergent validity [114], discriminant validity [114,115], construct means, and Cronbach's α can be found in Table 4. All constructs had adequate reliability [116] and displayed internal consistency values well above the threshold of 0.7 [117]. Cronbach's α-values were satisfactory for all constructs (0.734–0.937), and AVE exceeded the 0.5 benchmark for convergent validity [115].

As shown in Table 5, discriminant validity was supported by confirming that the square root of the variance shared between a construct and its items was greater than the correlations between the construct and any other construct in the model [115]. Discriminant validity was further supported by verifying that all items loaded highly on their corresponding factors while loading lower on other factors (Table 6). Although the correlations between some constructs were quite high (e.g., 0.701 between Effectiveness and Efficiency), they were not found to be higher than the threshold of 0.85 proposed by Kline [118], offering further support for the discriminant validity of the two aesthetic constructs. Further evidence for discriminant validity can be found in comparing the loadings and cross-loadings for effectiveness and efficiency, in which the former are in all cases at least 0.2 higher than the latter [111].

Table 3
Construct items and their factor loadings.

Construct	Scale Items	Loading	Item-Total Correlations
Classical	Clean	0.747	0.518
	Clear	0.862	0.543
	Aesthetic	*0.692*	*0.524*
	Pleasant	0.741	0.473
	Symmetric	*0.506*	*0.334*
Expressive	Original	0.837	0.743
	Sophisticated	0.812	0.720
	Fascinating	0.879	0.791
	Creative	0.894	0.808
	Uses special effects	0.757	0.632
Playfulness	Spontaneous	0.784	0.630
	Imaginative	0.924	0.803
	Happiness	*0.599*	*0.479*
	Innovative	0.895	0.683
Efficiency	Easy to Learn	0.912	0.858
	Easy to Use	0.949	0.906
	User Friendly	0.927	0.866
	Fast to Use	0.785	0.702
	Easy to Navigate	0.895	0.833
Effectiveness	All Information Obtained	0.946	0.705
	All Tasks Completed	0.896	0.705
Satisfaction	Terrible (1)/Delighted (7)	0.922	0.850
	Frustrated (1)/Contented (7)	0.914	0.841
	Unhappy (1)/Gratified (7)	0.794	0.669
	Sad (1)/Joyful (7)	0.867	0.754

Italicized items were removed from the final analysis due to factor loadings that were below the 0.7 threshold for adequate construct validity.

4. Results

Using questionnaire data, the proposed model was tested for relationships between (1) perceived efficiency as well as effectiveness and satisfaction; (2) perceived aesthetics as well as playfulness and satisfaction; (3) classical aesthetics and efficiency as well as expressive aesthetics and playfulness; and (4) colour temperature and aesthetics.

This study's structural model (Fig. 1) was tested by Bootstrapping in SmartPLS 2.0. This resampling procedure assesses the significance of PLS parameter estimates [103], with both item and construct statistics being reported in Table 7. Although Bootstrapping is one of several PLS techniques (jackknifing being another popular method) that may be used to evaluate a research models for statistical significance, its results generally converge with other common methods, such as jackknifing [103]. Bootstrapping was performed to test the statistical significance of each path coefficient (derived from sample estimates and equivalent to

Table 2
Common method bias – Test 2.

	Color	Classical Aesthet.	Expressive Aes.	Efficiency	Effectiveness	Playfulness	Satisfaction	WWW Experi.
Color	1.000							
Classical	0.191	1.000						
Expressive	−0.149	0.581	1.000					
Efficiency	0.088	0.623	0.400	1.000				
Effectiveness	0.117	0.543	0.412	0.711	1.000			
Playfulness	−0.103	0.387	0.749	0.315	0.325	1.000		
Satisfaction	0.052	0.694	0.566	0.721	0.701	0.442	1.000	
WWW Exp	−0.078	−0.117	−0.095	−0.080	−0.109	−0.088	−0.080	1.000

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

Table 4
Construct statistics.

Construct	Mean (All Items)	Mean (Used Items)	Cronbach's Alpha (α)	Composite Reliability	Convergent Validity (AVE)	Discriminant Validity (√AVE)
Classical	5.464	5.586	0.748	0.838	0.565	0.752
Expressive	3.248	3.248	0.893	0.921	0.701	0.837
Playfulness	3.399	3.112	0.841	0.903	0.756	0.869
Efficiency	5.396	5.396	0.937	0.953	0.802	0.896
Effect.	5.005	5.005	0.827	0.919	0.849	0.921
Satisfaction	4.669	4.669	0.898	0.929	0.767	0.876

Table 5
Correlation of latent variables.

	Classical	Expressive	Playfulness	Efficiency	Effectiveness	Satisfaction
Classical	**0.701**					
Expressive	0.597	**0.837**				
Playfulness	0.395	0.747	**0.823**			
Efficiency	0.617	0.402	0.316	**0.896**		
Effectiveness	0.533	0.411	0.325	0.701	**0.921**	
Satisfaction	0.693	0.569	0.442	0.721	0.700	**0.876**

Note: Fornell and Larcker (1981) measure of discriminant validity which is the square root of the average variance extracted compared to the construct correlations. Bold values are supposed to be greater than those in corresponding rows and columns.

standardized beta weights; [119]) to evaluate the abovementioned hypotheses. PLS was chosen over covariance-based SEM (CB-SEM) given the former's appropriateness in exploratory research, which extends theories from various domains, involves a large number of constructs and items, and employs a sufficient but not large sample size in testing the proposed research model [120]. Ultimately, PLS will offer a good approximation of CB-SEM results.

All expected relationships in the model were supported (Hypotheses 1 through 10). A summary of the results of the hypothesis testing as well as a more detailed evaluation is provided in Fig. 3 and Table 8, respectively. In the following section, the results from the structural equation modelling analysis are discussed in greater depth. The results regarding the effects of and interplay between the cognitive and affective constructs are reviewed first, followed by a discussion of the analysis of variance (ANOVA) regarding colour temperature.

4.1. The cognitive dimension of perceived user satisfaction

The first sets of results pertain to the cognitive part of the research model, that is, to the effect of efficiency and effectiveness on satisfaction as well as the relation between the two cognitive dimensions, i.e., from efficiency to effectiveness. Results showed that both constructs significantly influenced satisfaction, that is, both paths from efficiency to satisfaction ($\beta = .277$, $p < .001$) and effectiveness to satisfaction ($\beta = .293$, $p < .001$) were significant. These two cognitive dimensions jointly accounted for approximately 15% of the variance in satisfaction (unique $R^2 = .148$; $p < .001$). Hypotheses 2 and 3 were confirmed, showing that higher levels of perceived efficiency and effectiveness result in higher levels of user satisfaction.

Additionally, the results regarding the relationship between the two cognitive constructs showed that Efficiency was indeed a

Table 6
Matrix of loadings and cross-loadings.

Construct	Scale Items	Class	Exp	Play	Effic.	Effect.	Satis.
Classical	Clean	**0.747**	0.307	0.167	0.368	0.309	0.436
	Clear	**0.862**	0.468	0.323	0.647	0.621	0.657
	Pleasant	**0.741**	0.603	0.412	0.395	0.275	0.507
Expressive	Original	0.470	**0.837**	0.606	0.307	0.324	0.463
	Sophisticated	0.574	**0.812**	0.540	0.358	0.287	0.522
	Fascinating	0.572	**0.879**	0.693	0.432	0.426	0.542
	Creative	0.499	**0.894**	0.713	0.335	0.373	0.487
	Uses special effects	0.363	**0.757**	0.557	0.232	0.297	0.351
Playfulness	Spontaneous	0.193	0.483	**0.784**	0.196	0.211	0.243
	Imaginative	0.385	0.678	**0.924**	0.276	0.289	0.398
	Innovative	0.408	0.743	**0.895**	0.328	0.328	0.468
Efficiency	Easy to Learn	0.519	0.299	0.227	**0.912**	0.609	0.631
	Easy to Use	0.580	0.372	0.283	**0.949**	0.721	0.702
	User Friendly	0.636	0.429	0.331	**0.927**	0.686	0.718
	Fast to Use	0.412	0.314	0.264	**0.785**	0.518	0.514
	Easy to Navigate	0.586	0.375	0.302	**0.895**	0.627	0.638
Effectiveness	All Information Obtained	0.567	0.427	0.329	0.743	**0.946**	0.712
	All Tasks Completed	0.392	0.316	0.262	0.513	**0.896**	0.562
Satisfaction	Terrible (1)/Delighted (7)	0.677	0.516	0.410	0.682	0.650	**0.922**
	Frustrated (1)/Contented (7)	0.603	0.510	0.396	0.626	0.599	**0.914**
	Unhappy (1)/Gratified (7)	0.549	0.526	0.429	0.521	0.477	**0.794**
	Sad (1)/Joyful (7)	0.592	0.451	0.324	0.681	0.708	**0.867**

Note: To evaluate the discriminant validity of measures, one compares the loading of an item with its associated factor (i.e. construct) to its cross-loadings. Bold values are the highest, confirming the discriminant validity of each item.

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

Table 7
Items and construct statistics.

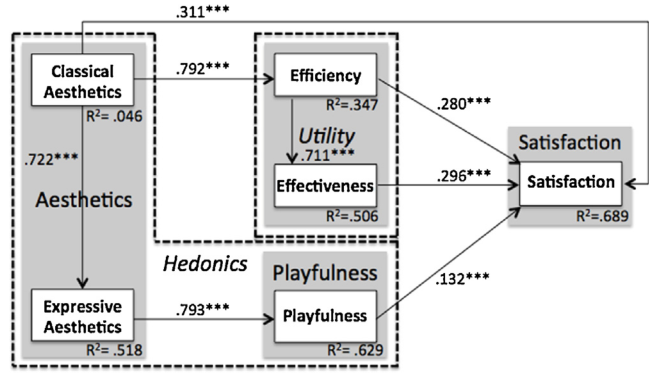
Construct	Indicator	Mean	S. Dev.	Loading	S. Err.
Classical	Clean	5.941	1.009	0.747	0.061
	Clear	5.341	1.382	0.862	0.084
	Pleasant	5.476	1.112	0.741	0.067
Expressive	Original	3.363	1.479	0.837	0.090
	Sophisticated	4.051	1.509	0.812	0.091
	Fascinating	3.026	1.420	0.879	0.086
	Creative	3.385	1.474	0.894	0.089
	Uses special effects	2.418	1.298	0.757	0.079
Playfulness	Spontaneous	3.084	1.335	0.784	0.081
	Imaginative	3.158	1.301	0.924	0.079
	Innovative	3.095	1.447	0.895	0.088
Efficiency	Easy to Learn	5.480	1.378	0.912	0.083
	Easy to Use	5.418	1.435	0.949	0.087
	User Friendly	5.216	1.556	0.927	0.094
	Fast to Use	5.465	1.460	0.785	0.088
	Easy to Navigate	5.403	1.472	0.895	0.089
Effectiveness	All Information Obtained	4.879	1.785	0.946	0.108
	All Tasks Completed	5.132	1.943	0.896	0.118
Satisfaction	Terrible (1)/Delighted (7)	4.747	1.377	0.922	0.083
	Frustrated (1)/Contented (7)	4.674	1.312	0.914	0.079
	Unhappy (1)/Gratified (7)	4.491	0.944	0.794	0.057
	Sad (1)/Joyful (7)	4.762	1.434	0.867	0.087

strong predictor of effectiveness ($\beta = .711$, $p < .001$), accounting for over half of the variance in effectiveness ($R^2 = .506$), thereby confirming Hypothesis 1.

4.2. The affective dimension of perceived user satisfaction

The second set of results pertains to the affective part of the research model, including aesthetics and playfulness. Here, we analyzed the relationship between the two types of aesthetics, classical and expressive; the hypothesized positive effects of aesthetics on playfulness and efficiency; and the positive effects of classical aesthetics and playfulness on user satisfaction. The results show that assessments of classical aesthetics significantly affect user perceptions of expressive aesthetics ($\beta = .649$, $p < .001$), thus supporting Hypothesis 4. Furthermore, assessments of classical aesthetics also positively affect perceived efficiency ($\beta = .617$, $p < .001$), accounting for over one-third of the variance in efficiency ($R^2 = .381$), therefore providing strong support for Hypothesis 5. Additionally, classical aesthetics significantly predicts satisfaction ($\beta = .311$, $p < .001$), accounting for one-third of the variance in satisfaction (unique $R^2 = .336$; $p < .001$), thereby supporting Hypothesis 6.

Regarding the effect of expressive aesthetics on playfulness, we found that the effect was indeed significant ($\beta = .747$, $p < .001$),



* significant at 0.01 level, ** significant at 0.05 level, *** significant at 0.001 level

Fig. 3. The Cognitive-Affective Measurement Model of Satisfaction.

explaining over half of the variance in playfulness ($R^2 = .558$), thus supporting Hypothesis 7. Playfulness, in turn, was found to significantly predict satisfaction ($\beta = .136$, $p < .001$), accounting for a small yet statistically significant R^2 change of 2.3% ($p < .001$), thereby providing strong support for Hypothesis 8.

Therefore, CAMPUS, by combining cognitive and affective dimensions, explains 68.9% of the variance in satisfaction.

4.3. Post hoc tests for colour temperature

To validate the manipulation of colour temperature, we conducted a one-way analysis of variance for the main effect of temperature as well as a series of pairwise comparisons of the four website designs to determine whether they are significantly different with respect to user satisfaction. First, we found a main effect of colour temperature on aesthetics through a one-way ANOVA, $F(3,1088) = 47.295$, $p < .001$. Post hoc tests confirmed that the warmest design—warm primary-warm secondary—resulted in the poorest mean aesthetic rating, followed by the next warmest—warm primary-cool secondary—and so on through to the "cooler" designs. That is, the highest mean aesthetic rating was associated with the coolest design—cool primary-cool secondary—followed by the next coolest—cool primary-warm secondary.

Furthermore, aesthetic ratings of all four different colour temperature versions of the website were significantly different from each other based on a Tukey test (Table 9). Additionally, aesthetic ratings of all versions were found to be significantly different from the mid-point of the scale by a one-sample t-test such that the two warmest versions were on the "least aesthetic" side and the two coolest versions were on the "most aesthetic" (see Table 10). Furthermore, post hoc tests for confidence intervals between all four groups were significant for both classical aesthetics ($F = 5.512$; $p < .001$) and expressive aesthetics ($F = 2.934$; $p < .05$).

Table 8
Validity test results.

Hypothesis	From	To	Path Coeff.	*t*-Value	*p*-Value	Status
1	Efficiency	Effectiveness	0.711	19.965	<.001***	Supported
2	Efficiency	Satisfaction	0.277	6.014	<.001***	Supported
3	Effectiveness	Satisfaction	0.293	5.401	<.001***	Supported
4	Classical	Expressive	0.649	17.790	<.001***	Supported
5	Classical	Efficiency	0.617	14.390	<.001***	Supported
6	Classical	Satisfaction	0.311	8.179	<.001***	Supported
7	Expressive	Playfulness	0.747	28.715	<.001***	Supported
8	Playfulness	Satisfaction	0.136	3.410	<.001***	Supported

* Significant at 0.05 level.
** Significant at 0.01 level.
*** Significant at 0.001 level.

Table 9
Tukey post hoc comparison of mean aesthetic rankings of website designs[a].

Condition 1 Color temperature (primary-secondary)	Condition 2 Color temperature (primary-secondary)	Mean Diff.	Sd. Err.	Sig.	Lower Bound	Upper Bound
Warm–warm	Warm-cool	0.377	0.090	0.001***	0.130	0.630
	Cool-warm	0.537	0.090	0.000***	0.390	0.890
	Cool-cool	1.040	0.090	0.000***	0.790	1.290
Warm–cool	Warm-warm	−0.377	0.090	0.001***	−0.630	−0.130
	Cool-warm	0.260	0.090	0.040**	0.010	0.510
	Cool-cool	0.663	0.090	0.000***	0.410	0.920
Cool–warm	Warm-warm	−0.637	0.090	0.000***	−0.890	−0.390
	Warm-cool	−0.260	0.090	0.040**	−0.510	−0.010
	Cool-cool	0.403	0.090	0.000***	0.150	0.660
Cool–cool	Warm-warm	−1.040	0.090	0.000***	−1.290	−0.790
	Warm-cool	−0.663	0.090	0.000***	−0.920	−0.410
	Cool-warm	−0.403	0.090	0.000***	−0.660	−0.150

*Significant at 0.01 level.
**Significant at 0.05 level.
***Significant at 0.001 level.
[a] The rating scale ranges from 1 (most aesthetic) to 4 (least aesthetic).

Table 10
Website rankings of perceived aesthetics and one-sample comparison of means[a].

Color temperature (primary-secondary)	*N*	Mean	Std. Dev.	Std. Error
Warm-warm	273	3.00	1.155	0.070
Warm-cool	273	2.63	0.935	0.057
Cool-warm	273	2.37	0.991	0.060
Cool-cool	273	1.96	1.111	0.067

[a] Mean reflects average of forced rank between 1 (most aesthetic) and 4 (least aesthetic).

5. Discussion and conclusion

In this paper, we have proposed and subsequently tested the Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS) by augmenting dominant explanations centering on cognitive dimensions of system design and use—more specifically, efficiency and effectiveness—with an account of affective dimensions, including aesthetics and playfulness. The model was formulated drawing on literature from human–computer interaction, marketing, communications, and psychology and encompasses well-established usability, IS, and marketing constructs, including utility, aesthetics, playfulness and user satisfaction.

To verify the proposed model, we used results from a partial least squares (PLS) analysis of a four-group between-subject experiment in which a website's colour temperature was manipulated. Validation of the CAMPUS was provided by finding strong support for all ten hypotheses underlying the model and by high levels of explained variance (between% 28 and 69%, with the exception of classical aesthetics).

Our results showed that both cognitive and affective dimensions are significant predictors of user satisfaction, with classical aesthetics being the strongest predictor of user satisfaction, followed by effectiveness, efficiency and finally playfulness. This finding could be related to the task of the experiment—in which subjects had to browse a hotel website to book a hotel. Hence, the clarity and orderliness—i.e., classical aesthetics—of the website was the most important antecedent to users' satisfaction with the website, implying the more orderly the website, the higher the satisfaction.

Furthermore, our results show that there is an important interplay between the two affective dimensions, namely aesthetics and playfulness, revealing that perceptions of expressive aesthetics, that is, a design's perceived creativity and originality, positively affect assessments of playfulness, i.e., pleasure and involvement in navigating the website. This finding implies that the more creative the design of the website is—as one of the core and distinguishing components of expressive aesthetics—the higher the felt involvement (i.e., playfulness) with the website during the interaction becomes.

Additionally, although previous papers have highlighted the potential relation between classical aesthetics and expressive aesthetics [69,70], this study provides the first empirical evidence of a significant relationship between the two constructs. Although the current study only proves the correlation between the two constructs, rather than a causal relationship, drawing on the theory of processing fluency, it is plausible that orderliness of design—i.e., classical aesthetics—results in, and thus precedes, more positive perceptions of originality and creativity—i.e., expressive aesthetics. Because fluency has been shown to positively affect overall perceptions of aesthetics, an increase in classical aesthetics—which pertains to orderliness and thus fluency—should positively affect other forms of aesthetics, such as expressive aesthetics.

Moreover, our findings show that there is a strong interplay between the affective and cognitive dimensions of website design, revealing that perceptions of classical aesthetics, that is, a design's perceived orderliness and cleanness, positively affect user assessments of efficiency, i.e., ease of use. Thus, the more orderly a website's design is, the lower the perception of time and effort spent by the user during interaction becomes.

Regarding the relation between colour temperature, and aesthetics, we found that warmer colours are associated with perceptions of expressive aesthetics—i.e., creativity and originality—which in turn positively affect perceived playfulness. In contrast, cooler colours are associated with perceptions of classical aesthetics—i.e., orderliness and cleanness—which in turn positively affect perceived efficiency. Interestingly, the findings of the one-way ANOVA regarding the main effect of colour temperature on aesthetics showed that the cooler the design is, the more positive the overall evaluation becomes, revealing that people's intuitive and initial assessment of aesthetics is based on dimensions of classical rather than expressive dimensions of aesthetics.

From a theoretical perspective, this study provides four important contributions. First, both cognitive and affective dimensions of website design are confirmed as significant determinants of user satisfaction. Although these relationships have been validated by others [37,38,47–50,53,56], this study is among the pioneering attempts to validate these relationships in the context of website colour treatment manipulations. This study therefore contributes to a discussion in the IS field in general and the e-commerce domain in particular regarding how one specific element of website design—colour temperature—affects perceived satisfaction in intricate ways.

Second, although previous theoretical contributions have emphasized the importance of combining cognitive and affective dimensions in the analysis of satisfaction, this study extends these conceptual efforts by applying these insights to colour manipulations in a website context with consequent effects on satisfaction. Not only does this study reveal the respective significance of cognitive and affective dimensions for explaining user satisfaction, it also reveals the important interplay between these two dimensions of system design and use. Therefore, our model suggests that although the two dimensions of system design and use may compete at times, the strong relationship between cognitive and affective dimensions makes independent manipulation of aesthetics impossible.

Third, our finding that classical aesthetics is the most significant predictor of user satisfaction—explaining twice as much of the variance in user satisfaction than the two cognitive constructs (i.e., efficiency and effectiveness) combined—appears to confirm the findings of previous studies [77,123,124]. These studies [77,123,124] discussing the strong effect of visual appeal or apparent beauty on satisfaction also demonstrated that people may be more satisfied with a beautiful—i.e., aesthetically pleasing—rather than a more usable technology. These papers have further suggested that judgments regarding products, such as perceptions of satisfaction, are reliably made after only 50 milliseconds and hence are largely based on affective rather than cognitive responses [123]. These results regarding the large effect of perceptions of aesthetics compared to the lower observed effect of cognitive perceptions—i.e., efficiency and effectiveness—on post-use satisfaction [125,126] strongly suggest that we pay more attention to people's perceptions of aesthetics then we have done to date.

Fourth, this study shows that colour temperature is a significant antecedent of aesthetics. Aesthetics, in this respect, was empirically found to be a complex phenomenon comprising two distinct dimensions—classical and expressive—that hold a conflicting relation vis-à-vis colour temperature. Whereas cooler colours result in perceptions of higher classical aesthetics, warmer colours result in perceptions of higher expressive aesthetics.

However, despite these conflicting relations between colour temperature and the two dimensions of aesthetics, both dimensions have an (in)direct positive effect on user satisfaction through enhancing perceptions of utility and playfulness, respectively. Ultimately, however, in the context of a utility-centered task, such as a hotel website reservation inquiry, the orderly presentation of information as measured through classical aesthetics can be established through the use of cooler colours. Alternatively, in the context of hedonic-centered tasks, such as the leisurely browsing of hotel pictures, the arousing and creative presentation of information as measured through expressive aesthetics can be established through the use of warmer colours.

Based on these findings, an important topic for discussion and future research emerges regarding the differentiation between cognitive and affective dimensions of information systems. Our results show that efficiency and effectiveness are nearly equally strong predictors of user satisfaction. Whereas Van der Heijden's [62] study on the importance of ease of use in the context of hedonic systems found ease of use to be a strong predictor than usefulness, in our study, both dimensions are of comparable importance. One could argue that this finding may be related to the fact that the mock hotel website is neither solely cognitive nor merely affective but rather supports both functions. Thus, given that many online websites provide amalgamated support of cognition and affect, the relevant distinction may not be between cognitive versus affective systems but between voluntary versus mandatory systems. For instance, see [40] for a detailed discussion of voluntary versus mandatory system use. Concerns over task performance—in the anticipation of rewards—are likely to be higher in mandatory rather than voluntary system use; hence, concerns over effectiveness or usefulness may be more prominent for users of the former.

From a practical and design perspective, this study provides numerous significant contributions. In particular, designers of websites and information systems are advised to pay attention to the specific colours and colour combinations employed in the design. Colour has the potential to innately communicate meaning and influence perceptions of cognitive and affective system design components, which in turn affects users' satisfaction with the website, prior to the occurrence of cognitive processing and reasoning. Hence, designers must carefully consider colour choice because colour combinations will convey information about the quality of the site or system that may not be intended. Thus, our results indicate that from a utilitarian and usability standpoint, cooler colours are more effective, whereas from an aesthetic and playfulness standpoint, warmer colours are more appropriate. Although this study centered on the relation between colour temperature with perceptions of cognitive and affective dimensions of websites, future research may explore the effect of colour on other perceptions of website or system quality, such as trustworthiness [90].

Furthermore, based on the findings that cognitive dimensions—efficiency and effectiveness—as well as affective dimensions—aesthetics and playfulness—are both significant predictors of user satisfaction, making websites efficient and effective is not sufficient for maximizing user satisfaction. Instead, designers must additionally consider aesthetics and playfulness to create websites that are easy to use and reliable yet simultaneously offer pleasant, engaging and creative experiences.

Additionally, given the conflicting effect of colour with respect to classical and expressive aesthetics, the results of this study can provide a tool for designers to determine which colour combinations trigger positive perceptions of cognitive or affective dimensions, depending on the dominant function of the system. Thus, based on the findings that (i) perceived efficiency plays a pivotal role in explaining user satisfaction with a website or IS and (ii) classical aesthetics and perceived efficiency are strongly related, designers aiming to produce more functional systems, in terms of efficiency, should use cooler colours and colour combinations. However, designers aiming for more creative and playful user experiences should use warmer colours and colour combinations. These recommendations should be considered and implemented in compliance with accessibility guidelines, e.g., regarding contrast, to ensure users' capacity to peruse the website content with relative ease.

Although the effects of colour temperature on classical and expressive dimensions of aesthetics were significant and expected, they were not particularly strong in terms of explained variance, which is a reasonable outcome considering that colour is a single design element in an interface that consists of multiple design elements. Hence, future research should analyze the effects of other design elements, such as white space [53], human images [63,127] (e.g., faces or hands), and layout structure [128], and potentially consider the interaction effects among these elements. Although relevant, looking at multiple design elements simultaneously will be methodologically complex—primarily in determining each element's unique variance and covariance across various elements—and practically challenging in terms of time and resources required.

Based on the foregoing discussion, several relevant directions for future research emerge. First, although this study provided a comprehensive Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS), other dimensions of cognition and affect can be considered, such as attractiveness [44,68]; credibility [29]; enjoyment [36]; visual complexity [129]; accessibility, responsiveness, and readability [130,131]; curiosity [87]; goodness [132]; and emotions [35,86,96,133]. Second, and as previously mentioned, although colour and colour temperature are significant elements of website design, the effects of other dimensions, such as white space, human images, and layout structure, on perceptions of aesthetics should be explored. Third, although satisfaction is an important dependent variable in the context of website use, other outcomes of website use—such as trust or loyalty—and user experience—such as intention to return and intention to recommend—could be explored by adopting, extending, or adapting the CAMPUS offered in this paper.

References

[1] D. Cyr, M. Head, A. Ivanov, Design aesthetics leading to m-loyalty in mobile commerce, Inf. Manag. 43, 2006, pp. 950–963.
[2] D. Cyr, M. Head, H. Larios, B. Pan, Exploring human images in website design: a multi-method approach, MIS Q. 33, 2009, pp. 539–566.

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

[3] D. Cyr, M. Head, H. Larios, Colour appeal in website design within and across cultures: a multi-method evaluation, Int. J. Hum. Comput. Stud. 68, 2010, pp. 1–21.
[4] J.J. Garrett, The Elements of User Experience: User-Centered Design for the Web and Beyond, 2nd ed., New Riders, Indianapolis, IN, 2010.
[5] L. Brady, C. Phillips, Aesthetics and usability: a look at color and balance, Usability News 5, 2003, p. 2003.
[6] P. Valdez, A. Mehrabian, Effects of color on emotions, J. Exp. Psychol. Gen. 123, 1994, pp. 394–409.
[7] R.H. Hall, P. Hanna, The impact of web page text-background colour combinations on readability, retention, aesthetics and behavioural intention, Behav. Inf. Technol. 23, 2004, pp. 183–195.
[8] J.-É. Pelet, P. Papadopoulou, The effect of colors of e-commerce websites on consumer mood, memorization and buying intention, Eur. J. Inf. Syst. 21, 2012, pp. 438–467.
[9] J.E. Pelet, The influence of e-commerce website colors on usability, integrating usability engineering for designing the web experience methodologies and principles, IGI Global, 2010 pp. 264–288.
[10] N. Bonnardel, A. Piolat, L. Le Bigot, The impact of colour on website appeal and users' cognitive processes, Displays 32, 2011, pp. 69–80.
[11] M.J. Latomia, A.J. Happ, The effective use of color for text on the IBM 5153 color display: Random access II, The Human Factors Society 31st Annual Meeting, New York, NY, 1987, pp. 19–22.
[12] M.-C. Lichtlé, The effect of an advertisement's color on emotions evoked by an ad and attitude toward the ad: the moderating role of the optimal stimulation level, Int. J. Advert. 26 (1), 2007, pp. 32–62.
[13] C. Liu, J.T. Marchewka, C. Ku, American and Taiwanese perceptions concerning privacy, trust, and behavioral intentions in electronic commerce, J. Glob. Inf. Manag. 12, 2004, pp. 18–40.
[14] J. Knight, M. Pandir, Decoding websites: from aesthetics to meaning, Understanding and Designing for Aesthetic Experience Workshop HCI, Napier University, Edinburg, UK, 2005, n.d..
[15] N. Tractinsky, Does aesthetics matter in human–computer interaction? Mensch Comput. 2005, pp. 29–30.
[16] N. Tractinsky, Aesthetics in information technology: motivation and research directions, in: D. Galletta, P. Zhang (Eds.), Advances in Management Information Systems, M.E. Sharp, New York, NY, 2006, pp. 330–347.
[17] N. Tractinsky, M. Hassenzahl, Arguing for aesthetics in human–computer interaction, I-Com 4, 2005, pp. 66–68.
[20] S. Diefenbach, M. Hassenzahl, Give me a reason: hedonic product choice and justification, C.H.I.'08 Extended Abstracts on Human Factors in Computing Systems, ACM, Florence, Italy, 2008, pp. 3051–3056.
[21] N. Tractinsky, O. Lowengart, Web-store aesthetics in e-retailing: a conceptual framework and some theoretical implications, Acad. Mark. Sci. Rev. 11, 2007, pp. 1–18.
[22] N. Tractinsky, Aesthetics and apparent usability: empirically assessing cultural and methodological issues, ACM Request Permissions, 1997.
[23] N. Tractinsky, A.S. Katz, D. Ikar, What is beautiful is usable, Interact. Comput. 13, 2000, pp. 127–145.
[24] P. Zhang, N. Li, The importance of affective quality, Commun. ACM 48, 2005, pp. 105–108.
[25] R. Hoffmann, K. Krauss, A critical evaluation of literature on visual aesthetics for the web, in: Proceedings of the 2004 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries, South African Institute for Computer Scientists and Information Technologists, Stellenbosch, Western Cape, South Africa, 2004, pp. 205–209.
[26] B.N. Schenkman, F.U. Jönsson, Aesthetics and preferences of web pages, Behav. Inf. Technol. 19, 2000, pp. 367–377.
[27] A. Gray, Website aesthetics: what has it got to do with usability, Webcredible 2009.
[28] B. Pan, H.A. Hembrooke, G.K. Gay, L.A. Granka, M.K. Feusner, J.K. Newman, The determinants of web page viewing behavior: an eye-tracking study, in: S.N Spencer (Ed.), in: Proceedings of 2004 Symposium on Eye Tracking Research and Application, ACM, San Antonio, Texas, 2004, pp. 147–154.
[29] D. Robins, J. Holmes, Aesthetics and credibility in web site design, Inf. Process. Manag. 44, 2008, pp. 386–399.
[30] S.J. Simon, The impact of culture and gender on web sites, SIGMIS Database 32, 2001, p. 18.
[31] T. Lavie, N. Tractinsky, Assessing dimensions of perceived visual aesthetics of web sites, Int. J. Hum. Comput. Stud. 60, 2004, pp. 269–298.
[32] D. Cyr, M. Head, A. Ivanov, Perceived interactivity leading to e-loyalty: development of a model for cognitive-affective user responses, Int. J. Hum. Comput. Stud. 67, 2009, pp. 850–869.
[33] D. Te'eni, Review: a cognitive-affective model of organizational communication for designing IT, MIS Q. 25, 2001, pp. 251–312.
[34] E. Stolterman, The aesthetics of information systems, Unpublished manuscript, Institute of Information Processing, University of Umea, Sweden, 1995.
[35] M. Hassenzahl, N. Tractinsky, User experience: a research agenda, Behav. Inf. Technol. 25, 2006, pp. 91–97.
[36] M.K.O. Lee, C.M.K. Cheung, Z. Chen, Acceptance of Internet-based learning medium: the role of extrinsic and intrinsic motivation, Inf. Manag. 42, 2005, pp. 1095–1104.
[37] C.S. Lin, S. Wu, R.J. Tsai, Integrating perceived playfulness into expectation-confirmation model for web portal context, Inf. Manag. 42, 2005, pp. 683–693.
[38] J. Webster, J.J. Martocchio, Microcomputer playfulness: development of a measure with workplace implications, MIS Q. 16, 1992, pp. 201–226.
[39] A. Bhattacherjee, An empirical analysis of the antecedents of electronic commerce service continuance, Decis. Support Syst. 32, 2001, pp. 201–214.
[40] V. Venkatesh, M. Morris, P. Ackerman, A longitudinal field investigation of gender differences in individual technology adoption decision-making processes, Organ. Behav. Hum. Decis. Process. 83, 2000, pp. 33–60.
[41] R.E. Kraut, R.E. Rice, C. Cool, R.S. Fish, Varieties of social influence: the role of utility and norms in the success of a new communication medium, Organ. Sci. 9, 1998, pp. 437–453.
[42] W. Van Osch, O. Mendelson, A typology of affordances: Untangling sociomaterial interactions through video analysis, Proceedings of International Conference on Information System 2011, p. 1.
[43] W. Van Osch, M. Avital, O. Mendelson, Biases in usefulness assessment: the realized value of generative support systems, in: Proceedings of European Conference on Information System, 2011, p. 129.
[44] H. van der Heijden, Factors influencing the usage of websites: the case of a generic portal in The Netherlands, Inf. Manag. 40, 2003, pp. 541–549.
[45] E.M. Rogers, Diffusion of Innovations, 5th ed., Free Press, Glencoe, 1995.
[46] L.G. Tornatzky, K.J. Klein, Innovation characteristics and innovation adoption-implementation: a meta-analysis of findings, IEEE Trans. Eng. Manag. 29, 1982, pp. 28–45.
[47] C.K. Coursaris, K. Hassanein, M. Head, N. Bontis, The impact of distraction on the usability and the adoption of mobile devices for wireless data services, in: Proceedings of European Conference on Information System, 2007.
[48] C.K. Coursaris, D.J. Kim, A qualitative review of empirical mobile usability studies, in: Proceedings of the American Conference on Information System, 2006.
[49] E. Frøkjær, M. Hertzum, K. Hornbæk, Measuring usability: are effectiveness, efficiency, and satisfaction really correlated? in: Proceedings of SIGCHI Conference on Human Factors in Computer System, ACM, 2000, pp. 345–352.
[50] C. Watters, J. Duffy, K. Duffy, Using large tables on small display devices, Int. J. Hum. Comput. Stud. 58, 2003, pp. 21–37.
[51] International Organization for Standardization, ISO 9241-11: Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs): Part 11: Guidance on Usability, 1998.
[52] C.K. Coursaris, D.J. Kim, A meta-analytical review of empirical mobile usability studies, J. Usability Stud. 6, 2011, pp. 117–171.
[53] C.K. Coursaris, K. Kripintris, Web aesthetics and usability: an empirical study of the effects of white space, Int. J. E: Bus. Res. 8, 2012, pp. 35–53.
[54] D. McCloskey, Evaluating electronic commerce acceptance with the Technology Acceptance Model, J. Comput. Inf. Syst. 44, 2004, pp. 49–57.
[55] R.L. Oliver, A cognitive model of the antecedents and consequences of satisfaction decisions, J. Mark. Res. 17, 1980, pp. 460–469.
[56] C.K. Coursaris, K. Hassanein, M.M. Head, N. Bontis, The impact of distractions on the usability and intention to use mobile devices for wireless data services, Comput. Hum. Behav. 28, 2012, pp. 1439–1449.
[57] V.H. Vroom, Work and Motivation, Wiley, New York, NY, 1964.
[58] F.D. Davis, R.P. Bagozzi, P.R. Warshaw, User acceptance of computer technology: a comparison of two theoretical models, Manag. Sci. 35, 1989, pp. 982–1003.
[59] A. Bhattacherjee, Understanding information systems continuance: an expectation-confirmation model, MIS Q. 25, 2001, pp. 351–370.
[60] F.D. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology, MIS Q. 13, 1989, pp. 319–340.
[61] E. Karahanna, D.W. Straub, The psychological origins of perceived usefulness and ease-of-use, Inf. Manag. 35, 1999, pp. 237–250.
[62] H. Van der Heijden, User acceptance of hedonic information systems, MIS Q. 28, 2004, pp. 695–704.
[63] M.B. Holbrook, E.C. Hirschman, The experiential aspects of consumption: consumer fantasies, feelings, and fun, J. Consum. Res. 9, 1982, pp. 132–140.
[65] Merriam-Webster, Webster's New Collegiate Dictionary, Merriam-Webster, Springfield, MA, 2011.
[66] J.L. Nasar, Design by Competition: Making Design Competition Work, Cambridge University Press, 1999.
[67] G. Mbipom, S. Harper, Visual aesthetics and accessibility: extent and overlap. Human centred web lab, Sch. Comput. Sci. 2009.
[68] P. van Schaik, J. Ling, The role of context in perceptions of the aesthetics of web pages over time, Int. J. Hum. Comput. Stud. 67, 2009, pp. 79–89.
[69] R. Reber, N. Schwarz, P. Winkielman, Processing fluency and aesthetic pleasure: is beauty in the perceiver's processing experience? Personal. Soc. Psychol. Rev. 8, 2004, pp. 364–382.
[70] J.H. Choi, H.-J. Lee, Facets of simplicity for the smartphone interface: a structural model, J. Hum. Comput. Stud. 70, 2011, pp. 129–142.
[71] C.C. Chen, J.H. Wu, C.C. Wu, Reduction of image complexity explains aesthetic preference for symmetry, Symmetry 3 (3), 2011, pp. 443–456.
[72] K. Dion, E. Berscheid, E. Walster, What is beautiful is good, J. Personal. Soc. Psychol. 24, 1972, pp. 285–290.
[73] A.H. Eagly, R.D. Ashmore, M.G. Makhijani, L.C. Longo, What is beautiful is good, but...: a meta-analytic review of research on the physical attractiveness stereotype, Psychol. Bull. 110, 1991, pp. 109–128.
[74] C. Derbaix, M.T. Pham, M. Lambkin, For the development of measures of emotion in marketing: summary of prerequisites, in: M. Lambkin (Ed.), European Perspectives on Consumer Behaviour, Prentice Hal, Englewood Cliffs, NJ, 1998 pp. 140–155.
[75] R.H. Fazio, D.R. Roskos-Ewoldsen, M.C. Powell, Attitudes, Perception, and Attention. The Heart's Eye, Academic Press, New York, 1994.
[76] C. Miller, Aesthetics and e-assessment: the interplay of emotional design and learner performance, Distance Educ. 32, 2011, pp. 307–337.
[77] G. Lindgaard, Aesthetics, visual appeal, usability and user satisfaction: what do the user's eyes tell the user's brain? Aust. J. Emerg. Technol. Soc. 5, 2007, pp. 1–16.
[78] M. Csikszentmihalyi, Creativity, Harper Perennial, New York, NY, 1997.

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003

[79] H.L. O'Brien, Toms R E.G., The development and evaluation of a survey to measure user engagement, J. Am. Soc. Inf. Sci. 61, 2009, pp. 50–69.
[80] J.-W. Moon, Y.-G. Kim, Extending the TAM for a World-Wide-Web context, Inform. Manag. 38, 2001, pp. 217–230.
[81] M.J. Ellis, Why People Play, Prentice-Hall, Englewood Cliffs, N.J, 1973.
[82] J.N. Lieberman, Playfulness, Academic Press, New York, NY, 1977.
[83] U. Kokil, Investigating players' affective states in an interactive environment, ThinkMind//ACHI 2013, The Sixth International Conference on Advances in Computer–Human Interaction, 2013.
[84] L.E. Sandelands, G.C. Buckner, Art and work: aesthetic experience and the psychology of work feelings, in: L.L. Cummings, B.M. Shaw (Eds.), Research in Organizational Behavior, JAI Press, Greenwich, CT, 1989, pp. 105–131.
[85] W.H. Starbuck, J. Webster, When is play productive? Acc. Manag. Inf. Technol. 1, 1991, pp. 71–90.
[86] J. Chung, F.B. Tan, Antecedents of perceived playfulness: an exploratory study on user acceptance of general information-searching websites, Inf. Manag. 41, 2004, pp. 869–881.
[87] M.-H. Huang, Designing website attributes to induce experiential encounters, Comput. Hum. Behav. 19, 2003, pp. 425–442.
[88] M. Csikszentmihalyi, Beyond Boredom and Anxiety, Jossey-Bass, San Francisco, CA, 1975.
[89] L.K. Trevino, J. Webster, Flow in computer-mediated communication electronic mail and voice mail evaluation and impacts, Commun. Res. 19 (5), 1992, pp. 539–573.
[90] M. Gobé, Emotional Branding: The New Paradigm for Connecting Brands to People, Allworth Press, New York, NY, 2010.
[91] O. Droulers, B. Roullet, Neuromarketing: les neurosciences du consommateur, Dunod, 2005.
[92] S. Brave, C. Nass, Emotion in human–computer interaction, in: J.A. Jacko, A. Sears (Eds.), The Human–Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, Lawrence Erlbaum Associates, Inc., Mahwah, NJ, 2003, pp. 81–96.
[93] H. Zettl, Essentials of applied media aesthetics, in: C. Dorai, S. Venkatesh (Eds.), Media Computing: The Kluwer International Series in Video Computing, Springer US, Boston, MA, 2002, pp. 11–38.
[94] M. Dittmar, Changing colour preferences with ageing: a comparative study on younger and older native Germans aged 19–90 years, Gerontology 47, 2001, pp. 219–226.
[95] J. Kim, J. Lee, D. Choi, Designing emotionally evocative homepages: an empirical study of the quantitative relations between design factors and emotional dimensions, Int. J. Hum. Comput. Stud. 59, 2003, pp. 899–940.
[96] E. Papachristos, N. Tselios, N. Avouris, Inferring relations between color and emotional dimensions of a web site using Bayesian networks, in: M. Costabile, F. Paternò (Eds.), Human–Computer Interaction – Interact 2005, Springer Berlin/ Heidelberg, Berlin, Heidelberg, 2005, pp. 1075–1078.
[97] L. Thorlacius, The role of aesthetics in web design, Nordicom Rev. 28, 2007, pp. 63–76.
[98] J. Kim, J.Y. Moon, Designing towards emotional usability in customer interfaces-trustworthiness of cyber-banking system interfaces, Interact. Comput. 10, 1998, pp. 1–29.
[102] Y.T. Chang, Demographic and motivation variables associated with Internet usage activities on hotel websites, 2011 Available from: http://repositories.tdl.org/ttu-ir/bitstream/handle/2346/14377/31295019507606.pdf?sequence=1 (accessed 20.12.13).
[103] W.W. Chin, The Partial Least Squares Approach for Structural Equation Modeling, Lawrence Erlbaum Associates, 1998.
[104] J. Palmer, Designing for Web site usability, Inf. Syst. Res. 13, 2002, pp. 151–167.
[105] R.A. Spreng, S.B. MacKenzie, R.W. Olshavsky, A reexamination of the determinants of consumer satisfaction, J. Mark. 60, 1996, pp. 15–32.
[106] R.P. Bagozzi, Y. Yi, L.W. Phillips, Assessing construct validity in organizational research, Adm. Sci. Q. 36, 1991, pp. 421–458.
[107] D.T. Campbell, D.W. Fiske, Convergent and discriminant validation by the multitrait-multimethod matrix, Psychol. Bull. 56, 1959, pp. 81–105.
[108] P.M. Podsakoff, W.D. Todor, R.A. Grover, V.L. Huber, Situational moderators of leader reward and punishment behaviors: fact or fiction? Organ. Behav. Hum. Perform. 34, 1984, pp. 21–63.
[109] P.M. Podsakoff, S.B. MacKenzie, J.-Y. Lee, N.P. Podsakoff, Common method biases in behavioral research: a critical review of the literature and recommended remedies, J. Appl. Psychol. 88, 2003, pp. 879–903.
[110] M.K. Lindell, D.J. Whitney, Accounting for common method variance in cross-sectional research designs, J. Appl. Psychol. 86, 2001, pp. 114–121.
[111] J. Gaskin, Common Method Bias, Gaskination's StatWiki, 2012.
[112] J. Hulland, Use of partial least squares (PLS) in strategic management research: a review of four recent studies, Strateg. Manag. J. 20, 1999, pp. 195–204.
[113] R. Saxe, B.A. Weitz, The SOCO Scale: a measure of the customer orientation of salespeople, J. Market. Res. 19, 1982, pp. 343–351.
[114] R. Bagozzi, Evaluating structural equation models with unobservable variables and measurement error: a comment, J. Mark. Res. 18, 1981.
[115] C. Fornell, D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error, J. Mark. Res. 18, 1981, pp. 39–50.
[116] E.G. Carmines, R.A. Zeller, Reliability and Validity Assessment, Sage Publications Inc., Beverly Hills, CA, 1979.
[117] Nunnally, Psychometric Theory, 2nd ed., McGraw-Hill, New York, NY, 1978.
[118] R.B. Kline, Principles and Practice of Structural Equation Modeling, 3rd ed., Guilford Press, New York, NY, 1998.
[119] C.H. Ho, K.H. Chiu, The effect of computer self-efficacy, personal goal and pre-training individual difference on computer task performance, Proceeding of the International Conference on Business and Information, Tokyo, Japan, 2007.
[120] J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, Multivariate Data Analysis, Prentice Hall, Upper Saddle River, NJ, 2010.
[123] G. Lindgaard, G. Fernandes, C. Dudek, J. Brown, Attention web designers: you have 50 milliseconds to make a good first impression! Behav. Inf. Technol. 25, 2006, pp. 115–126.
[124] K. Kashimura, M. Kurosu, The structure of the screen design and the cognitive process, Paper Presented at the 58th Japanese Psychological Association, 1994.
[125] S.R. Hiltz, K. Johnson, User satisfaction with computer-mediated communication systems, Manag. Sci. 36, 1990, pp. 739–764.
[126] M. Kurosu, K. Kashimura, Determinants of the apparent usability, IEEE Int. Conf. Syst. Man Cybern. 1995, pp. 1509–1514.
[127] E.C. Hirschman, M.B. Holbrook, Hedonic consumption: emerging concepts, methods and propositions, J. Mark. 46, 1982, pp. 92–101.
[128] A. Sutcliffe, Assessing the reliability of heuristic evaluation for Web site attractiveness and usability, Hicss-02, IEEE Computer Society, 2002, pp. 1838–1847.
[129] E. Michailidou, S. Harper, S. Bechhofer, Visual complexity and aesthetic perception of web pages, in: Proceedings of 26th Annual ACM International Conference on Design of Communication, 2008, pp. 215–224.
[130] G. Mbipom, Good visual aesthetics equals good web accessibility, SIGACCESS Accessibility and Computing, 2009, pp. 75–83.
[131] M.Y. Ivory, R. Megraw, Evolution of web site design patterns, ACM Trans. Inf. Syst. 23, 2005, pp. 463–497.
[132] P. van Schaik, J. Ling, Modelling user experience with web sites: usability, hedonic value, beauty and goodness, Interact. Comput. 20, 2008, pp. 419–432.
[133] M. Thüring, S. Mahlke, Usability, aesthetics and emotions in human–technology interaction, Int. J. Psychol. 42, 2007, pp. 253–264.

Please cite this article in press as: C.K. Coursaris, W. van Osch, A Cognitive-Affective Model of Perceived User Satisfaction (CAMPUS): The complementary effects and interdependence of usability and aesthetics in IS design, Inf. Manage. (2015), http://dx.doi.org/10.1016/j.im.2015.10.003