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

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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.
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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

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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,

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