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ABSTRACT

Flow as an optimal state of experience has been studied in various situations, including online environments. It has been found related to more exploratory behavior, revisit and purchase intention, and positive attitude toward websites. Website complexity is one of the important interface design variables that influence a number of user outcomes. In this study, we investigate the effect of website complexity on flow during web surfing and shopping. Results show that website complexity affects flow through the mediating effects of the three preconditions of flow. This finding has both theoretical and practical implications.

Keywords

Flow, website complexity, e-commerce, website design

INTRODUCTION

A number of research in IS has studied flow in various situations, including interacting with computers and online environments (Agarwal and Karahanna, 2000; Huang, 2003; Koufaris, 2002; Novak et al., 2000; Skadberg and Kimmel, 2004). Flow, as an optimal state of experience, has been found to be related to exploratory behavior, revisit and purchase intentions, and attitude toward websites. Thus it is of interest to study factors that induce flow in online environments. Website complexity is one of the important interface design variables that influence a number of user outcomes. It has been proposed and examined as antecedent of flow w(Huang, 2003). However, most studies focusing on flow during interaction with information technologies has used incomplete models of flow. These studies have rarely included all three theoretical preconditions of flow, perceived balance of challenge and skill, having a clear goal, and having fast, unambiguous feedback. The purpose of this study is to investigate the effect of website complexity on flow during web surfing and online shopping. Moreover, we study its effect in relation to the mediating effects of the preconditions. We believe this approach will provide both theoretical and practical insights of flow in online environments.

FLOW THEORY

When trying to understand enjoyment, Csikszentmihalyi developed the concept of flow. Flow "is the crucial component of enjoyment" (Csikszentmihalyi, 1975, p.11). Flow represents a "peculiar dynamic state—the holistic sensation that people feel when they act with total involvement" (p. 36) and an "ordered, negentropic state of consciousness" (Csikszentmihalyi, 1988), p. 34. In this state, actions transit seamlessly into another, displaying an inner logic of their own. The term "negentropic" refers to being in harmony and a lack of chaos. The actor experiences a smooth transition and total control of his/her actions without distraction. The term "flow" was coined by the informants themselves who participated in those studies when they refer to this "autotelic experience."

In order for flow to occur, the task should have *a clear goal* and *a quick, unambiguous feedback mechanism*. Having a clear goal is to know what to achieve in an activity; with a fast and clear feedback mechanism, a player is able to know the progress in achieving the goal. That is why people often experience flow when playing games (e.g., chess and basketball). These games have goals as to beat the opponent or to score. Also there are rules one can use to tell how he or she is doing. The model of flow also states that the *perceived balance of challenge and skill* leads to *flow*. If challenges exceed skills, people feel overwhelmed and anxious; on the other hand, if the activity is too easy, people get bored. Empirical data suggested both challenges and skills had to pass a certain threshold for flow to occur; otherwise the person showed apathy towards the activity, even when challenges and skills were in balance (Csikszentmihalyi and Csikszentmihalyi, 1988).

The dimensions of the flow experience include *focused concentration*, *"merging of activity and awareness"*, *a sense of control*, transformed sense of time (also called *temporal displacement* or distortion), and loss of self-consciousness ("a *transcendence of self*") (Csikszentmihalyi, 1988). As a result, "consciousness is in harmony and the self – invisible during the flow episode – emerges strengthened" and experience is "*autotelic*, or intrinsically rewarding" (Csikszentmihalyi, 1988). The term "autotelic" (from Greek auto=self and telos = goal, purpose) means with one's own purposes. In other words, the activity "required formal and extensive energy output on the part of the actor, yet provided few if any conventional rewards" (Csikszentmihalyi, 1975), p. 10.

In Information Systems research, flow has been integrated into studies of computer mediated communications (Trevino and Webster, 1992) and human-computer interaction (Ghani and Deshpande, 1994; Webster et al., 1993). Later, flow theory has been applied to the studying of a variety of Internet activities (Chen et al., 1999; Hoffman and Novak, 1996; Koufaris, 2002). In over a dozen empirical studies, flow, as an optimal experience, has been found to be related to desirable ecommerce outcomes, such as positive perceptions of and attitudes toward websites (Agarwal and Karahanna, 2000; Huang, 2003), exploratory behavior with increased learning (Skadberg and Kimmel, 2004), and future intentions to revisit and purchase (Koufaris, 2002; Wan and Nan, 2001).

However, these studies employed incomplete flow models in that (1) not all dimensions of flow are included, and (2) not all preconditions of flow have been included, resulting in different operationalizations of flow and inconsistent flow models (Finneran and Zhang, 2005). There is a discrepancy between these models and the classic flow model , which incorporates all preconditions and dimensions. Although studies of partial flow models have yielded informative results, we deem a study using the classic flow model is necessary to fill the gap. Therefore, investigating what factors facilitate flow experience in Internet shopping and other activities using the classic flow model is of both theoretical importance and practical relevance. The current study focuses on a fundamental website characteristic, complexity, as a determinant of flow in online shopping.

WEBSITE COMPLEXITY

Several studies have investigated the effects of website features on flow-related constructs, such as interactivity, download speed, attractiveness, and design features and quality (Novak et al., 2000; Skadberg and Kimmel, 2004; Wan and Nan, 2001). Complexity is one of them (Huang, 2003). Complexity is a general feature of visually based media such as websites and, as such, is a fundamental design parameter. Our assumption is that complexity influences flow through its influence on the mediating constructs balance of challenge and skill, goal clarity, and feedback.

Complexity has been defined in term of the information load that users perceive (Huang, 2003). Another subjective conceptualization of website complexity is as the degree of difficulty that the users feel when they try to understand, process, and interact with the form and content of the website in the performance of online tasks (Nadkarni and Gupta, 2003). This definition advances a broad and holistic conceptualization of perceived site complexity that captures not only the structural complexity, but also objective and subjective views. A measure of perceived complexity has been developed and it was posited that perceived complexity was influenced by objective aspects of site design and reflects the cognitive aspects of individuals (Nadkarni and Gupta, 2003). However, the relationship between perceived and objective complexity is complex. Measurement of complexity using objective indices is usually done on the basis of a systematic sample of representative pages and procedure for going through the website in order to ensure consistency of classification across sites. However, this is at odds with the more spontaneous and idiosyncratic behavior that users typically employ during browsing. As a result the level of complexity perceived by users may differ considerably from objective scores on complexity. Moreover, different users may apprehend the same site as having different levels of complexity depending on their specific browsing trajectory through the site. A study reported in Guo (2004) found only weak associations among objective and subjective measures of complexity for a sample of websites when the users who provided subjective ratings were allowed to explore the sites spontaneously. Our conjecture is that experienced complexity affects the flow experience. Hence, perceived complexity, which taps the user's experience of the site, is the appropriate construct for the present model.

The structure of the website is not the only factor influencing perceptions of complexity. The nature of the product also contributes to perceived complexity, specifically via the complexity of the product per se and the shoppers' prior knowledge concerning the product. Both product characteristics and subject's prior knowledge are peripheral to this study, which is concerned with website design impacts on flow. Also they are reflected in perceived complexity, challenge, and skill to some extent.
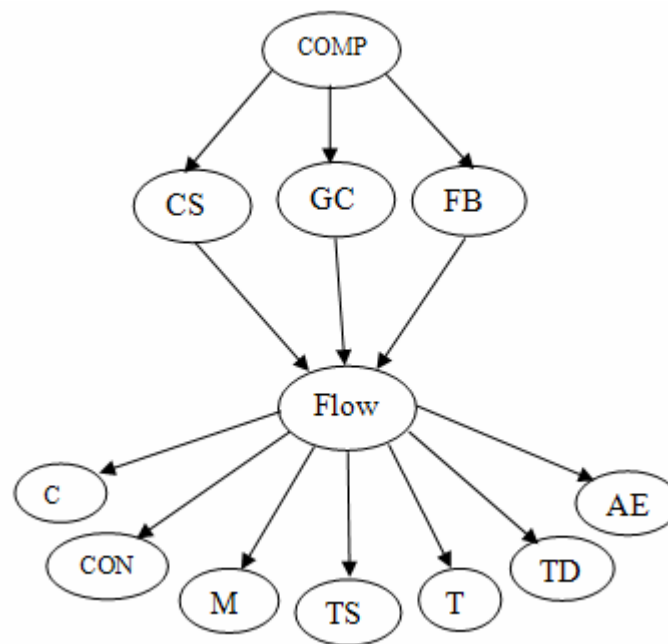
THE RESEARCH MODELS

The purpose of the study is to investigate the effect of website complexity on flow. As mentioned above, several website features have been studied in relation to flow. However, none of this research utilized classic flow theory when examining

exogenous effects on flow. The classic model would posit that the impact of IS features on flow would be mediated by the three preconditions or precursors of flow (balance of challenge and skill, goal clarity, and feedback).

In this study flow was conceptualized as a global, second-order factor with seven first-order factors. Among the first-order factors, six corresponded to the original dimensions of the classic flow model: concentration (C), sense of control (CON), mergence (of activity and awareness) (M), temporal displacement (TD), transcendence of self (TS), and autotelic experience (AE). This conceptualization of flow as a reflective construct is supported by previous studies (Guo, 2004; Siekpe, 2005). We added a seventh dimension, telepresence (Steuer, 1992) (T), to capture the uniqueness of computer mediated environment (Hoffman and Novak, 1996). Previous psychometric analysis of the flow instrument indicated that this dimension fit the underlying flow construct well (Guo, 2004).

Another part of the core flow model is the direct preconditions of the flow experience: (1) the balance between the perceived challenge presented by the activity and the skills possessed by the actor (CS), (2) goal clarity (GC), and (3) a quick and unambiguous feedback mechanism (FB). We posit that exogenous factors impact flow in online environments through the mediating effects of perceived balance of challenge and skill, goal clarity, and feedback. In this study, the exogenous factor was website complexity (COMP) (Figure 1).

Figure 1. The Research Model (RM)

In addition to the main research model, we also wanted to look into three alternative models in light of previous research. The first alternative model (AM1) dealt with the possibility of a direct effect of complexity on flow, which has been documented in one previous study (Huang, 2003). In that study the effect of site complexity on flow was explained as it distracted users' attention, thus impeding flow. Thus, AM1 was a step further from RM in that we modeled both direct and indirect effects of complexity on flow.

Although balance of challenge and skill has rarely been included in previous studies of flow in IS, the two separate components, i.e., perceived challenge and perceived skill, have been studied (Koufaris, 2002; Novak et al., 2000; Skadberg and Kimmel, 2004). The potential issues with compound constructs like balance of challenge and skill are obvious. Using separate constructs reduces the difficulty to some extent and provides the opportunity to study them individually and the dynamics between them. On the other hand, this approach moves away from theory and misses the point of the "balancing" effect, which is crucial to flow. In this study, we wanted to compare these two approaches and to explore the relative impacts of perceived challenge and perceived skill on flow. Thus, we substituted perceived skill (PS) and perceived challenge (PC) for balance of challenge and skill (CS) in the RM1 and AM1, resulting in two more alternative models (AM2 and AM3). A confirmatory approach was taken in data analysis regarding these four models.

THE STUDY

A study was conducted to collect data on key flow experience constructs. Subjects were recruited from a major American university in various majors. Upon agreeing to participate in the study, subjects were randomly assigned to one of the eight pre-selected existing commercial websites. The final set of websites used in the study were systematically sampled from a range of websites in order to ensure variation in perceived complexity of the sites and to control for particularities in website implementation and for subject familiarity with websites. The procedure of selection was similar to those in previous studies (Nadkarni and Gupta, 2003). Eventually, eight websites within two product categories (book & magazine and computer) at two different levels of complexity were selected for this study. Although the use of existing commercial sites imposes some limitations in terms of design styles and control over manipulation, it provides the compensating advantage of realism. Real websites have been used in other research (Koufaris, 2002; Skadberg and Kimmel, 2004).

Data were collected when subjects were surfing the site in the role of shoppers. The questionnaire was presented to the subjects by a series of popup screens and the subjects were instructed to answer the questionnaire right away. Three flow preconditions and six dimensions were measured using the Flow State Scale (Jackson and Marsh, 1996). The telepresence (T) dimension was tapped using a previously validated instrument (Kim and Biocca, 1997; Klein, 2003). Items for Perceived Challenge (PC) and Perceived Skill (PS) were created in consideration of the multi-faceted nature of these two dimensions (Ellis et al., 1994). Complexity was measured using items from multiple sources (Geissler et al., 2001; Nadkarni, 2004; Nadkarni and Gupta, 2003) since there are no fully validated measures available yet. All these measures had exhibited good reliability in previous studies. Two additional questions created by the authors were added: "I found this website was complicated" and a reverse version "I felt the website was pretty simple" using 7-point Likert scale. Eventually, an analysis of these items results in a three-factor structure of website complexity as discussed in the following section. The items are available upon request.

DATA ANALYSIS RESULT

A total of 354 subjects participated in the study, including 214 female and 143 male students. No differences in responses due to gender were found. The average age was 21.2 years. All other constructs have acceptable reliability (Table 1).

Factor analysis of the perceived complexity measure with the Maximum Likelihood extraction method and equamax rotation yielded a three-factor structure. Examination of the items revealed clearly interpretable factors, suggesting that these three groups of items form meaningful sub-dimensions of perceived site complexity. The first dimension was composed of the items "I found this website was complicated," "I felt the website was pretty simple," "The website is complex," and "The website is overwhelming," which suggested an overall assessment of the complexity of the website, thus labeled "Overall Complexity." The second dimension included five items—"The website is interactive," "open/cluttered," and "sparse/dense," "distracting/non-distracting," "sparse/dense," which were related to the design of the webpage. This factor was labeled "Presentation." The items on the third dimension concerned the navigational aspects of the sites. For example, "logical/illogical" and "predictable/unpredictable" relate to ease of movement through the site. Therefore, the three sub factors were included in subsequent analysis: Overall Complexity (COMP1), Presentation (COMP2), and Navigation (COMP3), Reliabilities of the items making up each factor were acceptable, from .76 to .86, according to standards discussed in Straub et al. (2004).

Factor (# of items)	# of items	Cronbach's Alpha
Concentration (C)	4	.90
Autotelic experience (AE)	4	.91
Control (CON)	4	.90
Mergence (M) (4)	4	.72
Transcendence of self (TS)	4	.83
Time displacement (TD)	4	.80
Challenge/skill (CS)	3	.67
Goal clarity (GC)	4	.93
Feedback (FB)	4	.88
Perceived challenges (PC)	4	.76
Perceived skills (PS)	5	.83
Overall complexity (COMP1)	4	.80
Presentation complexity (COMP2)	5	.77
Navigation complexity (COMP3)	4	.81

Table 1. Reliability of Constructs

In the next step, the four models (the base research model and three alternative models) were tested using the Structural Equation Modeling software AMOS. The results are shown in Table 2. An examination of the results for the research model and alternative models reveals that, overall, the proposed research model is the best in terms of goodness of fit and theoretical basis (the standard path coefficients are show in Figure 2, dashed path is non-significant.). The implications are discussed in the next section.

Models	Description and Results	Goodness of fit
RM	CS, GC, FB are all mediating factors of COMP to Flow. All paths are significant at p<.01 level; except GC->Flow and F->TD.	χ^2= 3050.781, df=1359, χ^2/df= 2.245 CFI= .860, NFI=.774, NNFI=.853 RMSEA=.059 (.057 -- .062)
AM1	A direct path from COMP to Flow is added in RM All paths are significant at p<.01 level; except COMP->F and F->T are significant at p<.05 level; GC-> Flow and F->TD are not significant.	χ^2= 3045.459, df=1359, χ^2/df= 2.243 CFI= .860, NFI=.775, NNFI=.853 RMSEA=.059 (.057 -- .062)
AM2	Substitute CS with PC and PS in RM. All paths are significant at p<01 level, except F->T at p<.05 level; PC->Flow, GC->Flow, and F->TD are not significant.	χ^2= 3760.400, df=1690, χ^2/df= 2.225 CFI= .850, NFI=.758, NNFI=.843 RMSEA=.059 (.056 -- .061)
AM3	Substitute CS with PC and PS in AM1. All paths are significant at p<01 level; except F->T at p<.05 level; COMP->Flow, PC->Flow, GC->Flow, and F->TD are not significant.	χ^2= 3759.503, df=1689, χ^2/df= 2.226 CFI= .850, NFI=.743, NNFI=.858 RMSEA=.059 (.056 -- .061)

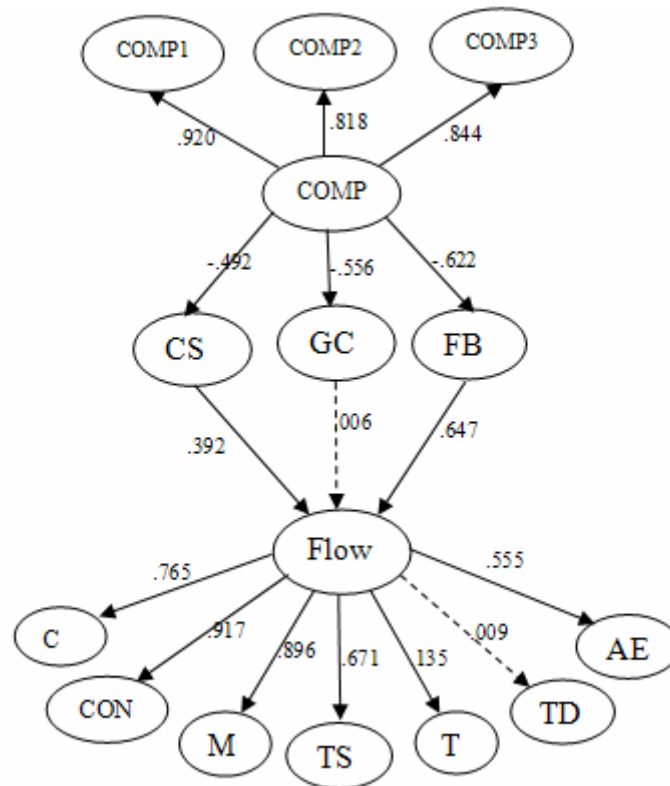**Table 2. Results of Model Analysis**

Figure 2. Results of Test of the Research Model (RM)

DISCUSSION

This study is among the first to include all theoretical dimensions of flow and preconditions in conceptualization and data analysis. Examining the classic flow model in an online shopping context helps to determine the degree to which it applies in the online environment and provides a more coherent theoretical grounding for future research and practice. The proposed second-order structure of flow with seven dimensions (concentration, mergence of action and awareness, a sense of control, transcendence of self, temporal displacement, telepresense, and autotelic experience) was largely supported, except that temporal displacement was not significantly related to flow. However the relative strengths of relationships between individual, distinctive dimensions and their underlying flow construct were not equal. In our study, telepresence had weaker relation with flow compared than other dimensions, whereas control and mergence were the strongest. When in this state, the interaction with websites must have been so smooth that the users seemed to know what exactly to do next and what would happen next. It suggests that flow in online shopping and surfing is featured by sense of control and mergence of activity and awareness. Further investigation with more studies is needed to decide whether including telepresence in conceptualization of flow in online environments.

According to the original flow theory, the three preconditions of flow are the balance of challenge and skill, a clear goal, and a quick and unambiguous feedback mechanism. In our models, both balance of challenge and skill and feedback had positive significant paths to flow as predicted, while goal clarity did not. There were significant correlations among three preconditions. It was possible that goal clarity affected flow in indirect ways. A model with indirect effect showed improved fit (Figure 3, χ^2= 2939.05, df=1358, χ^2/df= 2.164, CFI= .869, NFI=.783, NNFI=.862, RMSEA=.057), compared to our original research model (RM). Clearly, in online activities, whether the users have a clear goal effected their assessment on balance of challenge and skill and also on their perception on their progress. Having unambiguous feedback on their actions seems to play a bigger role in inducing flow. This model also shows that more complicate relationships might exist among preconditions and flow, which should be studied more closely in the future.
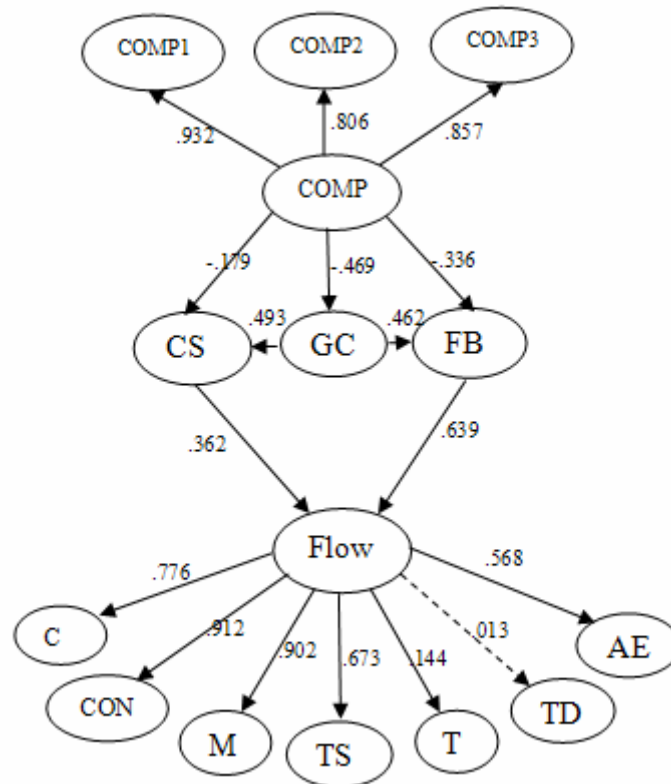
Figure 3. Effect of Goal Clarity (GC)

The effect of complexity on flow was obvious in that it had significant paths with all three flow preconditions; all negative as predicted. The exploration of direct effect of complexity on flow yielded little evidence in the two alternative models (AM1 and AM3); only in AM1, complexity had marginally significant effect (p=.048) on flow in addition to through mediating

effects of balance and feedback. Thus, it can be concluded that the major effect of the exogenous factor, website complexity, is via its effects on the preconditions of flow in online surfing activities. This has several implications. First, when studying flow we should include its preconditions, although not all preconditions may be equally important in a particular situation. Including preconditions allows us to understand the mechanism of exogenous factors more clearly. Secondly, in the future we should select and study exogenous factors more systematically based on their effects on preconditions.

Perceived challenge and perceived skill have been included in a few previous studies of flow in IS field. In the current study, two alternative models with perceived challenge and skill (AM2 and AM3) were proposed and tested. The purpose for this was first to see which approaches was more suitable in term of model fit: balance of challenge and skill or two separate constructs (perceived challenge and perceive skill). We also wanted to assess the effect of perceived challenge and perceived skill on flow individually. In Table 2, RM and AM1 have better fit than their counterparts with perceived challenge and skill and PC had no significant effect on flow in either AM2 or AM3. That means the approach of balance of challenge and skill not only has stronger theoretical foundation but also is supported by stronger empirical evidence in this study. It is perceived balance of challenge and skill that induces flow. On the other hand, what is the relationship among perceived challenge, perceived skill, and the balance? We removed the path between PC to flow and between complexity and PS and added a path from PC to PS. The result was revealing (Figure 4). Goodness of fit of the model were slightly better than those of AM2 and AM3 (χ^2= 3744.107, df=1691, χ^2/df= 2.214, CFI= .851, NFI=.759, NNFI=.844, RMSEA=.059). The path between complexity and perceived challenge was significant at p<0.01 and it was negative as expected. However, in the model, the effect of complexity on perceived skill was mediated by perceived challenge rather than a direct effect. The very path between PC and PS might well indicate the "balancing" act of these two; thus the balance of challenge and skill would be the appropriate one in studying flow.
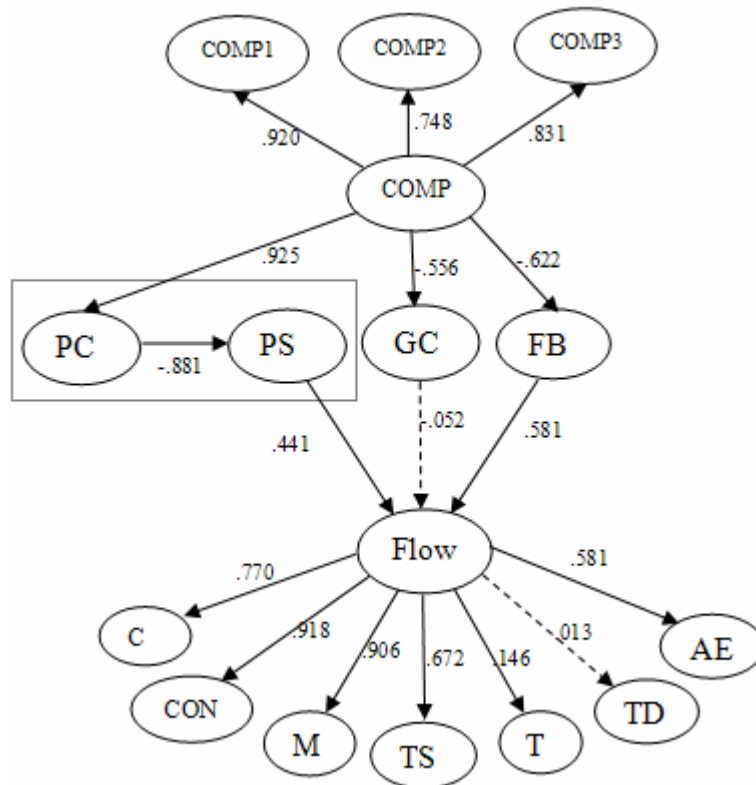

Figure 4. Effect of Perceived Challenge (PC) and Perceived Skill (PS)

The research has practical implications for website designer and managers too. First of all, website complexity has negative effects on all three preconditions of flow. This suggests that to maximize flow complexity needs to be avoided in site design. However, complexity is more of an overall feeling of a user towards a website with two additional important aspects: presentation and navigation. Thus, in order to reduce perceived complexity of a site, a holistic approach should be taken; that

is to improve multiple aspects of the design simultaneously. For example, we can use a simpler, consistent page style with visual aid for easier navigation.

Among three preconditions, feedback has the strongest impact on flow and is closely related to the website design. Hence, providing users clear feedback on how they are doing in pursuing their goals is crucial. Of course reducing complexity will help since it is easier to know what to do next in a simpler site. In addition, there are ways to provide users with clear feedback. For example, if a search does not return any match, a message clearly says so is preferred than just a search result page with an empty list, letting the user to figure out what that means.

CONCLUSION

In this research project we studied the impact of website complexity on flow. In particular, we used the classic flow model and found website complexity had negative relationships with all three preconditions of flow; thus it should be avoid in site design in order for users to experience flow during their visits. Our results supported the classic model of flow with both preconditions and dimensions. This model of flow is more appropriate in studying flow. The finding is of both theoretical importance and practical relevance. In the future, other exogenous factors should be included to study their impacts on flow in a similar fashion as what we did with website complexity.

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