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Behavioral Correlates of Flow in Internet Browsing

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ABSTRACT

This study explores the relationship between flow experience and browsing behavior of online shoppers. Behavioral patterns were identified and extracted from screen recording. Analysis both positive and negative correlates of flow experience shows support of perception-based flow measures.

Keywords: flow experience, behavioral correlates, Internet browsing

INTRODUCTION

According to flow theory (Csikszentmihalyi 1975), people in flow concentrate on the task at hand and are deeply involved in task related activity. They also feel a mergence of their conscious awareness and the activity in which they are engaged and perceive time differently than normal, with time generally seeming to fly by while the person is engaged in the activity. They also experience a "loss" of self and forget their everyday concerns temporarily. The experience is intrinsically rewarding. In order for flow to occur, people have to have a clear goal of they want to accomplish, and the skill to meet the challenge of the activity. The activity provides fast and clear feedback to the participants. People experience flow while engaged in a variety of activities, including interacting with computers and the Internet (Agarwal and Karahanna 2000, Trevino and Webster 1992, Chen 2007).

As a construct related to the experience of web use, flow should be reflected in the actions users take: the behavior of subjects in flow should differ from that of subjects not in flow. For example, people who are in flow should display smooth navigation patterns, stay on web pages longer as they concentrate on their content, and browse in a systematic fashion. It is expected that people in flow would not run into trouble or have problems navigating web pages. Problems or interruptions, such as pop-ups, should "jolt" them out of flow if they are in that state or, alternatively, prevent them from achieving flow.

The objective of this study is to explore the relationship between flow experience and browsing behavior of online shoppers. Secondly, this study validates the perception-based flow measures against constructs from wholly different domain, behavior. In the study we recorded subjects browsing the Internet while engaged in an Internet shopping task. From this sample of recordings we selected sets of subjects with very high and very low levels of flow based on perception measures. We identified behavioral correlates of high and low flow states and coded the behaviors for the two sets of subjects. Finally we tested for differences between the two sets to determine if the behaviors of subjects with high and low levels of flow differed as expected.

PROCEDURES

There were no previously developed methods for analyzing the mouse movement data for our purposes, so we developed the coding system and coding procedures in a retroductive fashion. Initial ideas concerning the types of browsing behavior that would be expected from people in flow and not in flow were generated based on flow theory. A pilot study of 126 college students was conducted as a chance to closely observe behaviors indicative to flow and to refine and extend the initial set of behavioral patterns. In the pilot study flow was measured using seven items adapted from the questions in (Csikszentmihalyi and Csikszentmihalyi 1988). Subjects with the ten highest and ten lowest flow scores were selected to test and refine the initial ideas and uncover additional ideas regarding coding procedures and rules.

79 subjects, students taking information systems courses, participated in the final study. Subjects were asked to fill out a pretest questionnaire regarding their Internet usage habits and demographic data. Then they were directed to an e-commerce website. They were asked to surf the site for a while and behave like a "real shopper." A Visual Basic form was scheduled to popped up on their screen after 5 to 7 minutes. The forms included items measuring flow. Items were adapted from Flow State Scale (Jackson and Marshall). Subjects were then asked to go back to their shopping task until they achieved their goal. Subjects' mouse movements as they navigated the website were captured in individual video files with the screen-capture software Camtasia® of Techsmith, Inc.. Twenty subjects, ten with the highest flow scores and ten with the lowest flow scores were selected for data analysis.

Transcription of Browsing Behavior

The first step in data analysis was to transcribe the video files into textual and graphical data, which could then be coded and classified. One researcher made an initial transcript and developed an initial set of instructions on how to transcribe the video. A second researcher then viewed the videos and original transcripts, adding any missing information based on the transcribing instructions and making suggestions for additions to the instructions. Researcher One then viewed the videos and refined the transcripts a second time, discussing with Researcher Two about possible additions and reconciling the changes. This continued in an iterative fashion until a final set of transcribing and coding rules resulted.

We transcribed the session starting when subjects accessed the web site until the time when the survey popped up. Transcripts were naturally segmented into pages based on the page that the subject was on at a given point in time. Each segment, which is the basic unit of analysis for coding, consisted of a group of browsing behaviors on one web page (Figure 1 shows a transcribed segment). We use the term "browsing behavior" in a broad sense to also include the following actions: mouse movements, clicking, typing, and responses to events such as the appearance of messages or pop-ups.

The transcript for each segment had two parts. The first part is the title line, in which we recorded the type and content information of the page. To make the transcripts as consistent as possible across different websites, we classified web pages into several broad categories, such as home page, department page, product page and so forth. The second and major part of the transcript for each segment consists of the activity entries describing mouse movements and events. Each entry is an action or an event that cannot be broken down further. For each entry, there is an associated time stamp and this allowed us to calculate how long it took to accomplish each action. For example, it took the subject in Figure 1 two seconds (from 3:06 to 3:08) to move the mouse to scrollbar and she/he spent 13 seconds (from 3:08 to 3:21) scrolling the page up and down. Other information relevant to visitors' actions was recorded as well, for example, the appearance of a pop-up advertisement or an Internet Security warning message, or a broken link (i.e., Error 404). More subtle things could affect subjects as well. For an instance, one mistake that an e-commerce website sometimes makes is having extra items in the shopping cart which were put in by a previous user. These types of events were recorded in the transcripts as well.

Coding the Transcripts

The next step was to code the transcripts. The development of initial categories of behavior related to flow states was in part deductive, i.e., based on our expectations of the differences that would occur in web behavior given flow theory, and in part inductive, in that some categories were suggested by analysis of the set of 10 transcripts from the pilot study (five highest and five lowest flow scores). Categories were defined based on behaviors that were expected to indicate that subjects were in flow, those indicating that subjects were out of flow, and certain events that could prevent subjects from being in flow. Once an initial set of behavioral categories had been developed, another 10 subjects were drawn from the sample and used to confirm and refine the behavioral categories. Selection of subjects was similar to the original set in that the five with the next highest flow scores and the five with the next lowest flow scores were sampled. The categories resulting from this process are shown in Table 1. The detailed transcription and coding procedure will be provided upon request.

Table 1. Behavioral Categories of Flow

Correlates	Symptoms	Level
Positives		
Clear goal		
P1-1	Browsing products in one category	Whole session
P1-2	Use of search engine	One activity entry
Concentration		
P2	Systematic mouse movements	One segment
Mergence of activity and awareness		
P3-1	Going through product hierarchy from top to bottom consecutively (3 or more pages)	A group of segments
P3-2	Going through pages at same level consecutively (3 or more pages)	A group of segments
Negatives		
Navigation problems		
N1-1	Attempting alternative ways of reaching the product	A group of segments
N1-2	Going back and forth	A group of segments
N1-3	Nonsystematic mouse movements	One segment
Interruptions		
N2-1	Advertisements	One activity entry
N2-2	Task-related messages	One activity entry
Errors		
N3-1	Technical errors on the web page	One segment
N3-2	Logical flaws on the web page	One segment
N3-3	Mistakes made by visitors	One segment

There are two general types of behavioral categories: positive correlates and negative correlates. The positive correlates represent behaviors that reflect flow preconditions and dimensions. Not all the preconditions and dimensions of flow are equally open to observation based on mouse movements and actions. For example, the Balance of Perceived Challenge and Skill is normally difficult to see directly, except that the visitor may run into trouble when trying to find a particular product, which would be a negative sign of imbalance. It would also be difficult to find observable behaviors corresponding to dimensions like Transcendence of Self and Transformation of Time. Based on an analysis of the preconditions and dimensions of flow, three aspects with the potential for corresponding observable behaviors are Goal Clarity (P1), Concentration (P2), and Mergence of Activity and Awareness (P3). There are also negative behavioral correlates of Flow, events that make it more difficult for a person to get into or to stay in flow. These include navigation problems (N1), interruptions (N2), and various kinds of errors (N3). These behavioral correlates operate at different levels. Some correlates can be identified by looking at a single segment, while others require us to observe a group of segments, and one indicator of goal clarity requires us to observe the entire session. To make the process of coding as systematic as possible two forms created.

Codes for each segment were recorded on a coding card. This card codifies information needed to make classifications based on a single segment. To track activities across segments, a record of the subject's browsing behavior over the entire session, a "trace tree," was created to depict the path that the subject took through the web pages. Properties of the trace tree enabled classification of behavioral correlates that were spread over multiple segments. The transcripts generally provided sufficient information for coding, but the video files were also consulted in cases in which classifications were not obvious. Detailed coding rules are available on request.

To reduce bias, all cases were disguised so that the subject's flow score was not known by either coder. All recordings were transcribed "blind" as well. Only two categories in the coding system required subjective judgments by coders, the codes of systematic and. non-systematic mouse movement (P2 and N1-3). These categories were related such that a judgment regarding one for a segment determined the value of the other. Thus it was necessary to calculate inter-coder reliability for these categories. A second coder was trained by coding three cases together with the first author. Then after both coders coded another three cases independently, disagreements were discussed and resolved. Finally, four more cases were coded by two coders independently. The results of this last iteration, in which a total of 46 segments that were coded, were used to compute inter-coder reliability. Inter-coder reliability computed with Cohen's Kappa was .792 ($t = 5.789$, $df=44$. $p < .01$). Since Kappa is a conservative statistic for inter-rater reliability (Neuendorf 2002), this represents satisfactory coder reliability. Having achieved acceptable levels of reliability, the first coder coded the rest of the cases.

RESULTS

The data based on 20 cases from final study are summarized in Tables 2.

Table 2. Behavioral Correlates Summary

Sub-no	FSS Score	Flow Level	# of Segments	Time Spent	Site Assigned	# of Positives	# of Negatives
104	58	Low	12	4:46	cdworld.com	3	8
175	88	Low	18	4:59	cdworld.com	4	0
109	69	Low	3	2:04	outpost.com	3	1
124	75	Low	20	5:21	macys.com	5	2
139	83	Low	17	4:47	buy.com	5	2
135	91	Low	23	5:04	Macys.com	9	2
123	92	Low	9	2:46	Cdworld.com	2	7
125	95	Low	15	5:09	Buy.com	6	1
158	95	Low	30	5:04	Outpost.com	5	2
141	98	Low	8	4:55	Buy.com	4	1
Average						*4.6*	*2.6*
177	152	High	29	4:46	Dillards.com	14	0

162	156	High	7	4:45	Cdworld.com	3	6
144	161	High	26	4:12	Macys.com	8	0
131	159	High	20	4:58	Dillards.com	11	3
122	161	High	7	2:46	Cduniverse.com	4	2
147	148	High	24	4:58	Dillards.com	5	2
173	145	High	15	3:23	Dillards.com	3	1
168	143	High	13	4:56	Macys.com	7	0
167	143	High	13	2:44	Macys.com	7	1
148	142	High	13	3:58	Outpost.com	7	0
Average						*6.9*	*1.5*

As noted previously, we expected that subjects with high flow scores should display more positive correlates than subjects with low flow scores, while subjects in flow would display fewer negative correlates than those with low flow scores. This pattern holds in that the mean number of positive correlates of the high flow score group is higher than that of low flow score group. On the other hand, the mean negative correlates of the high flow score group is lower than that of the low flow score group. Independent sample t-tests indicated that high and low flow groups differed significantly for the positive behavioral correlates ($t = -1.81$, $df = 18$, $p = .044$, one-tailed, equal variances assumed), but not for the negative behavioral correlates ($t = 1.06$, $df = 18$, $p = .151$, one-tailed, equal variances assumed).

It is also instructive to look into specific patterns of differences in positive and negative correlates, though no formal statistical tests can be conducted. One noteworthy pattern is that most subjects exhibited both positive and negative correlates. Second, among the negative correlates, navigation problems (N1) and the errors (N3) occurred more frequently than interruptions (N2), task-related messages (N2-2) in particular. This observation is consistent with our original expectation that this type of message would not affect visitors too much because we are so used to it. Also, among positive correlates, going through product lists (P3-2) and spending time reading (P2) seem to be the best indicators of flow.

DISCUSSION

This is the first using behavioral data to study flow experience in a computer-mediated environment. The study assessed the validity of perception-based flow measure, FSS, by relating it to behavioral correlates of flow. By relating the scales to constructs measured in a different domain, behavior, this study contributes additional evidence regarding convergent validity across different methods. Subjects who differed on their FSS flow scores showed differences in positive behavioral correlates of flow, as predicted. First, the subjects' behavior in the test for the FSS was relatively consistent. Second, positive behavioral correlates provide more definitive evidence for the validity of any flow measure, because they can be logically linked to the presence of flow—what a flow scale is designed to measure—while negative behavioral correlates merely suggest that the subject is in *some* other state. FSS as a measure of flow in the Internet browsing have support from behavioral indicators.

Since flow experience are related to positive attitude towards the website and desired behavioral intentions of future return and purchase (Koufaris 2002, Skadberg and Kimmel 2004), how to facilitate flow and help visitors stay in flow are of practical importance to website designer. Based on the result, website designer should prevent negatives especially navigation problems and errors as much as possible. These are the main obstacles for visitors to get into flow or interrupters of flow experiences. First of all, an error free and reliable system is a must. Secondly, in order to design a site that is easy to navigate designers need to understand their visitors' need and navigational patterns. A user group study can be used to gather the information. An assessment of the site using a similar approach as this study can be used to discover problematic designs.

The main limitation of the study is their relatively small sample sizes. The labor intensive transcription and coding process put limits on the number of cases that can be studied with reasonable resource levels. Moreover, the sample sizes of the two studies would have to be much larger to permit larger groups of high and low Flow subjects to be drawn. In the current study we sampled the ten highest and lowest Flow scores from samples of 79. Taking many more subjects from these groups would yield flow scores that would not necessarily be clearly high or low for the population. To provide more extremely high and low Flow scores, a larger sample would be required. Another limitation of the study results from the variations introduced by different web sites, tasks, and subjects. Although our main interest is in the behavioral indicators of flow experience regardless of individual differences and particular designs of web sites, idiosyncrasy may also introduce "noise" and make is harder to discern the true nature of flow behaviors.

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