AN EXAMINATION OF THE MULTIDIMENSIONALITY OF FLOW CONSTRUCT IN A COMPUTER-MEDIATED ENVIRONMENT

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ABSTRACT

As the Web becomes a part of peoples' everyday lives, there is a growing need to understand user behaviour on the Web. Recently, the flow construct has been proposed as important for understanding the nature of user online experience. Researchers assert that the benefits of flow online include increased learning, exploratory and positive behavior, positive subjective experience, and perceived sense of control over their interaction. Overall, flow could affect outcomes such as navigation patterns and repeat visits on commercial Web sites. Although widely studied over the past years, a review of the literature indicates discrepancies among various flow models and some unclear conceptualization and operationalization of the construct. This paper examined flow according to two specific conceptualizations with respect to its measurement, and tests each conceptualization in an identical nomological network. The results indicate that there is better fit of a reflective flow model compared with a formative flow model to the study data. The results of the study may aid in the understanding of the relationships between the higher order flow construct and its first order dimensions, which may help inform system designers to better assess flow and, thus, be more conducive to flow.

Keywords: Computer-Mediated Environment, Flow, Multidimensionality, Web

1. Introduction

Contemporary information technologies tend to utilize multiple media and richer graphical interfaces to excite and engage the user. This has resulted in an alternative stream of research with the purpose of investigating individual behaviors toward new information technologies based on their experiences with the technology. In this tradition, constructs such as the concept of flow (Csikszentmihalyi, 1975; 1977), which captures an individual's subjective enjoyment of the interaction with the technology, have been empirically confirmed to be significant predictors of several important outcomes related to technology use, for example, attitude toward the information system and the extent of use of the system (Trevino and Webster, 1992).

Careful examination of studies involving the concept of flow, however, reveals that the construct is often treated as a multidimensional construct yet with an unclear definition (Agarwal and Karahanna, 2000). This lack of precise definition has led many researchers to suggest that each researcher should specify how the concept is operationalized in a particular study (Koufaris, 2002). As a result, serious inconsistencies pertaining to the operationalization of flow exist in the literature. Nevertheless, according to Steiger (1988), reliable replication would not be possible without a clear discussion of how a construct is operationalized, more so when it is multidimensional. We also concur with Law and Wong (1999) that the nature of a multidimensional construct differs when different interpretations are attributed to the relations between the overall construct and its dimensions and among the dimensions as well.

Law and Wong defined a multidimensional construct as a construct involving more than one dimension. These dimensions or factors are usually moderately correlated and are imperfect representations of a high order (HO) latent construct of interest. They are grouped under the same HO because each dimension represents some portion of the overall multidimensional latent construct.

This article calls attention to the competing effects of different assumptions about the relationship between the dimensions and the overall latent construct on the conclusions drawn from structural equation analysis involving the flow construct in the online shopping context. An empirical study is conducted to illustrate how these different views of flow construct could lead to different parameter estimates and conclusions of the same research question with the same data-set. The rest of the paper is structured as follows: Section 2, from literature review, presents the concept of flow and its role in computer-mediated environment. In Section 3, we employ the concept of typology to explicate flow as a multidimensional construct. Sections 4 and 5 present the methodology and results, and finally, Section 6 discusses the implications of the results and direction of future research involving the flow construct.

2. The Concept of Flow

The focus of this study is on assessment of flow as it relates to computer-mediated environment, specifically, Web-based e-commerce systems. Literature reveals that the decision process and acts of people involved in buying and using products has been of concern for researchers. One observation is that consumers interact with retail shopping environments for a variety of reasons (Tauber, 1972). These interactions generally consist of either goal directed pre-purchase search activity, or some form of ongoing search activity such as browsing behavior (Bloch, Ridgway , and Sherell, 1986). No matter what the activity is, its success of completion depends, to a great extent, on the user's level of involvement. Csikszentmihalyi (1975; 1977) and Csikszentmihalyi and Csikszentmihalyi (1988) developed a theory of flow: "the state in which people are so involved in an activity that nothing else seems to matter" (Csikszentmihalyi, 1975, p. 4). Athletes equate this to entering the zone, and video gamers liken this to feelings of immersion in the game or being lost in the experience. Csikszentmihalyi operationally defined flow as "the holistic sensation that people feel when they act with total involvement" (p.36). When people are in flow, they "shift into a common mode of experience when they become absorbed in their activity. This mode is characterized by a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out, by loss of self-consciousness, by a responsiveness to clear goals and unambiguous feedback, and by a sense of control over the environment" (Csikszentmihalyi, 1977, p.36). Cskiszentmihalyi characterizes flow as a state of optimal experience that can occur not only in the pursuit of physical activities, but also in interactions with symbolic systems such as mathematics and computer languages. Privette and Bundrick (1987) defined flow as "...an intrinsically enjoyable experience, …is similar to both peak experience and peak performance.…Flow per se does not imply optimal joy or performance but may include either or both" (p. 316). Cskiszentmihalyi and LeFevre (1988) and Massimini and Carli (1988) characterized flow as balanced of challenges and skills above average weekly levels.

2.1 Flow in Computer-Mediated Environments

Building upon the work of Csikszentmihalyi, flow has also been studied in the context of information technologies and computer mediated environment and has been recommended as a possible metric of the online consumer experience (Ghani and Despnade, 1994; Ghani, Supnick, and Rooney, 1991; Hoffman and Novak, 1996; Novak, Hoffman and Yung, 2000; Tervino and Webster 1992; Webster et al., 1993). Ghani, Supnick, and Rooney (1991) noted that the two key characteristics of flow are total concentration in an activity and the enjoyment which one derives from an activity, and the precondition for flow is the balance between the challenges and skills. With particular reference to the World Wide Web, Hoffman and Novak (1996) argue that flow is a central construct in the hypermedia environment because of the nature of commercial activities in the Web. According to Hoffman and Novak, the benefits of flow online include increased learning, exploratory and positive behavior, positive subjective experience, and perceived sense of control over their interaction. Overall, flow could affect outcomes such as navigation patterns and repeat visits on commercial Web sites. Facts indicate that about 45 percent of users surveyed experienced flow online (Novak, Hoffman and Yung, 2000). Sautter, Hyman, and Lukosius (2004) proposed that the range of appropriate approach/avoidance behaviors for the study of e-tail atmospherics includes flow.

2.2 Operationalizing Flow

While a valuable construct, Koufaris (2002) and Agarwal and Karahanna (2000) noted that flow is too broad and ill-defined because of the numerous ways it has been operationalized, tested, and applied. For instance, while Trevino and Webster (1992) operationally defined flow as the linear combination of four characteristics: control, attention, curiosity, and intrinsic interest, Webster, Trevino, and Ryan (1993) were unable to empirically distinguish between the two flow dimensions of intrinsic interest and curiosity. They, therefore, recommended that flow be conceptualized as consisting of three rather than four dimensions, with the third dimension representing a combination of intrinsic interest and curiosity.

Other conceptualizations of the flow experience in human-computer interactions include those by Ghani and Deshpande (1994), Ghani, Supnick, and Rooney (1991), and Hoffman and Novak (1996). Ghani, Supnick and Rooney (1991) in their study of computer-mediated interaction found control and challenge predicted flow. Control and flow also predicted exploratory use, which in turn predicted extent of use. Trevino and Webster (1992) fit an alternative causal model in their study of workers' perceptions of flow during email and voice mail interactions. They used a different operational definition of flow that consisted of four items measuring control, attention focus, curiosity and intrinsic interest. Novak, Hoffman and Yung (2000) conceptualize flow on the Web as a cognitive state experienced during navigation that is determined by (1) high levels of skill and control; (2) high levels of challenge and arousal; and (3) focused attention; and (4) is enhanced by interactivity and telepresence.

Hoffman and Novak (1996) further theorized that flow would result in several outcomes such as a positive subjective experience, increased learning, and perceived behavioral control. As far as the measurement of flow, they did not provide a specific measurement scale but proposed any measurement of the construct should include its antecedent conditions, consequences, and dimensions. Novak, Hoffman, and Yung. (2000), using data gathered from 2,037 Web users, declared that flow can be defined as a set of directed relationships among 12 unidimensional constructs (i.e. importance, skill, challenge, interactive speed, arousal, playfulness, positive affect, exploratory behavior, time distortion, optimum stimulated level, and focused attention) and three Web usage variables (i.e. years of using the Web, time of using the Web, and expected use in the coming year). Significant effects were found for the hypothesized antecedents of skill and control, challenge and arousal, but focused attention was found to exhibit an influence on flow that was mediated by telepresence and time distortion.

Table 1. Relationship of First-Order Latent Variables to Flow Construct

First order latent variable	Conceptualization	
	Factor of flow	Antecedent of flow
Enjoyment: captures an individual's subjective enjoyment of the interaction with the technology[a].	Ghani and Despande (1994); Ghani, Supnick and Rooney (1991); Koufaris (2002); Intrinsic Interest - Trevino and Webster (1992); Webster, Tevino, and Ryan (1993)	
Concentration: the extent to which the individual's attention is completely absorbed by the activity to the extent that nothing else matter[a].	Focused attention - Trevino and Webster (1992); Webster, Tevino, and Ryan (1993) –Koufaris (2002).	Hoffman and Novak (1996); Novak, Hoffman and Yung, (2000)
Control: capturing the individual's perception that s/he exercises control over the interaction with the technology[b].	Trevino and Webster (1992); Webster, Tevino, and Ryan (1993); Koufaris (2002);	Ghani and Despande (1994); Ghani, Supnick and Rooney (1991); Skill/Control - Hoffman and Novak (1996); Hoffman et al (1999) Skill - Trevino and Webster (1992); Ghani, Supnick and Rooney (1991); Hoffman and Novak (1996); Hoffman et al (1999)
Challenge: level of perceived complexity provoked by the activity[b].	Koufaris (2002)	Ghani and Despande (1994); Ghani, Supnick and Rooney (1991); Hoffman and Novak (1996); Hoffman et al (1999)
Curiosity: heightened arousal of sensory, cognitive curiosity, and exploratory behavior[c].	Trevino and Webster (1992); Webster, Tevino, and Ryan (1993);	Exploratory behavior: consequent of flow- Hoffman and Novak (1996)
Telepresence: extent to which one feels present in the hypermedia CME, rather than in one's immediate physical environment[c].		Hoffman and Novak (1996); Hoffman et al. (1999)

a. Csikszentmihalyi (1990)
b. Ghani and Despande (1994)
c. Hoffman and Novak (1996)

In summary, prior work related to the state of flow with information technologies has adopted alternative conceptualizations, often with different terminology of the major dimensions related to flow construct as illustrated in Table 1. The Table presents the main dimensions employed either as "reflective" or "formative" of the flow construct. As formative, these dimensions are represented as antecedents and as reflective they are represented as factors. Collectively, these conceptualizations affirm the key role played by the flow experience in shaping individual behaviors towards the target information technology.

While the authors' theoretical conceptualizations converge with respect to enjoyment or intrinsic interest as a dimension, and telepresence as an antecedent of flow, they diverge with respect to challenge/skill, concentration/focus attention, control, curiosity/exploratory behavior (see Table 1). The concern of this study is centred on those factors that have received diverging views, namely, challenge, concentration, control, and curiosity. This study examines these different theoretical conceptualizations of these factors by, first, investigating the conceptual classification of flow in relation to the variables associated with it, and second, examining the covariance among the variables which will guide in the selection of model with a stronger explanatory power.

3. Typology of Multidimensional Constructs

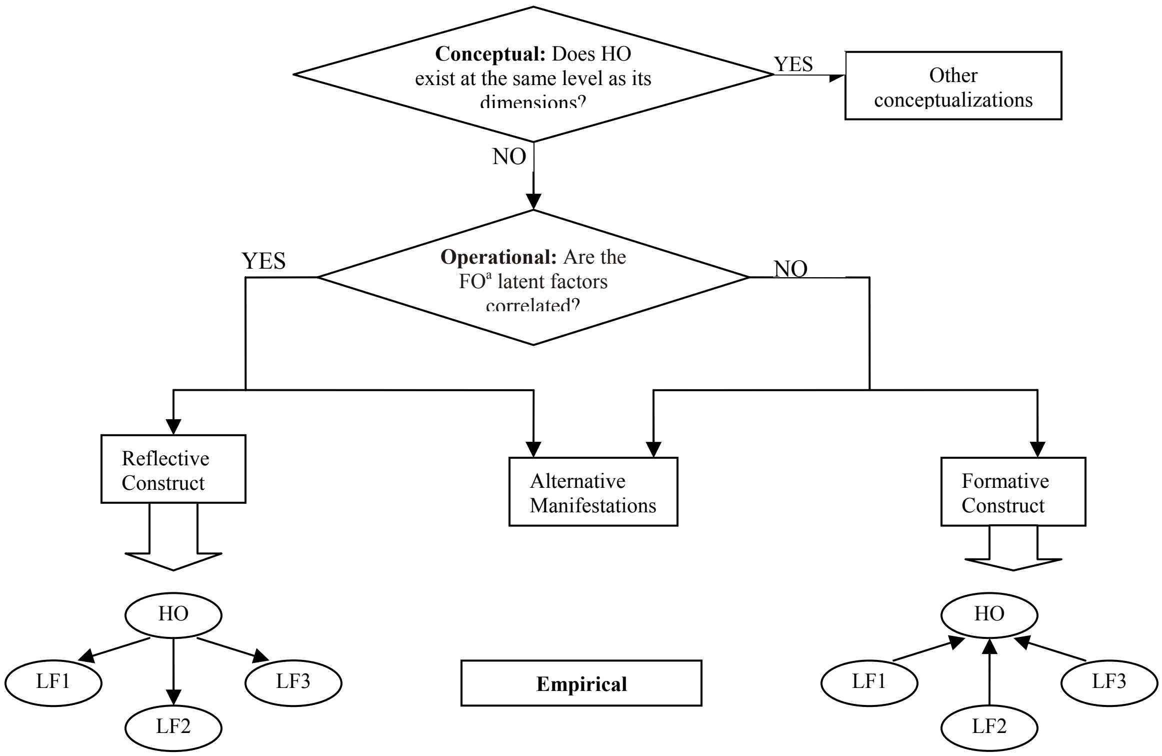
According to Bailey (1994), typologies can be useful as the premier tools for defining and explicating multidimensional concepts. In examining the multidimensionality of flow, we adapted Baileys (1994) three classification rules – conceptual, operational, and empirical levels – for delineating a type of overall construct as illustrated in Figure 1.

3.1.1 Conceptual Level: The first classification rule asks the question, "Does the overall construct exist at the same level as its dimensions?" (First order (FO) dimensions in this typology are latent constructs that are measured by observable indicants). We argue that an overall construct may relate to its dimensions at one of two levels. That is, the overall construct may exist at the same level of its dimensions (i.e., as a profile model) or it may exist at a different level than its dimensions. As none of conceptualization of the flow construct in the literature was considered to be a profile type this study will exclude this type from further discussion.

3.1.2 The Operational Level: The second classification rule delineates the relationships among the dimensions. The classification rule asks is, "Are the dimensions correlated among themselves?" If the dimensions are correlated, we would argue that the correlations among the variables are the effect of an underlying HO construct (Bollen and Lennox, 1991). We term this type of overall construct a "reflective construct." However, the HO construct these dimensions reflect could be the construct of interest (in this case flow) or an alternative construct. However, if the dimensions are not correlated, we argue that the dimensions, again, take on two possible roles in forming two types of HO constructs. One possibility is that the FO constructs is in the formation of an overall HO construct. We term this type of HO construct a formative construct because the dimensions determine (exert a causal influence on) the construct and is formed by some means of aggregation of its underlying dimensions. Formative indicators, first introduced by Blalock (1964), are measures that form or cause the creation or change in the latent variable. As to whether or not a formative construct exists at a higher level from its dimensions, we suggest that the HO formative construct contains a set of attributes that are necessary and sufficient to define the conceptualization of the overall construct, while each respective dimension is necessary, although not sufficient, in defining the construct. Therefore, because no one FO dimension captures the richness and scope of the overall formative construct, we argue that the formative construct exists at a higher level than its dimensions. The other role of the dimensions may be considered as alternative manifestations of other HO constructs. The literature on flow demonstrates that no alternative conceptualizations of the flow construct takes this view, thus, we will also exclude this type from further discussion.

3.1.3 The Empirical Level: This level addresses the following questions: 1) Are the factors separate and independent dimensions? This question is proposed because the possibility exists the facets of the construct are not separate and distinct and are actually measuring the same phenomenon. The resolution to this question rests on the establishment of discriminant validity between the latent FO constructs through the use of a confirmatory factor analysis (CFA). 2) Do the dimensions covary? As Dess, Lumpkin, and McGee (1999) suggest, this question has been assumed away but is a central issue. We also concur that this question is central to the conceptualization and operationalization of the flow construct. This question will also be addressed in a CFA. 3) What is the source of this covariance? The covariance among the factors is a key demarcation between the two conceptualizations of the multidimensional flow construct. Therefore, we developed a structural model of each conceptualization within an identical nomological network. If the factors covary, comparing and contrasting the two models may be instrumental in identifying the source of the covariance among the constructs. 4) Which model exhibits the most explanatory power? This question not only asks which model may have the most explanatory power within its own nomological network, but also entertains the notion that regardless of how one defines the construct, the question arises as to whether it is worth the effort to define and measure it. To be of relevance to scholars and practitioners, we situated flow to determine two outcome measures comprising of behavioral intensions as suggested by Koufaris (2002.)

In sum, with the use of three classification rules, a typology is developed that depicts multiple types of constructs derived from the relationships among the dimensions and how these dimensions relate to an overall HO construct (in this case, flow), only two of which are relevant to this study: a reflective and a formative construct. Figure 2 depicts these models of flow in a similar nomological network. In addition, it is possible to verify each conceptualization through covariance modelling and to test how well the models fit the data. Furthermore, in order to establish the role played by flow in extending our understanding of users' experience with a technology application, it is necessary to situate the construct within a nomological network.



a. FO: First Order latent factor HO: High Order latent construct LF: Latent Factor

Figure 1: Typology of Multidimensional Construct

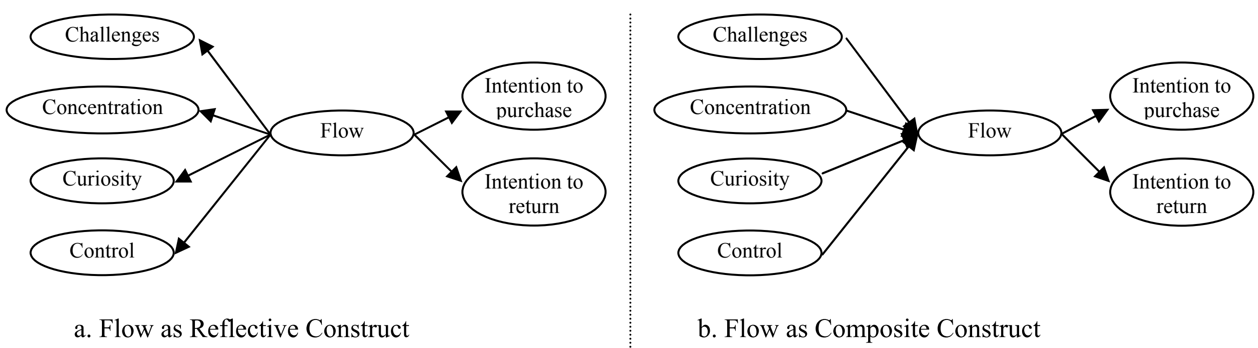


Figure 2: Models of Flow as Reflective and Formative Conceptualizations

In examining flow, we focus on its application to the World Wide Web environment for online shopping. As indicated earlier, Hoffman and Novak (1996) proposed that Web designers should add flow experience to e-commerce Web sites. Koufaris (2002) noted that the intention to purchase from and to return to the online store are potential outcomes of flow experienced in the online shopping context. Similarly, Sautter, Hyman, and Lukosius (2003) proposed that approach/avoidance behaviors, such purchase or revisit, related to e-tail atmospherics includes flow. These two outcomes are included in the network of relationships pertaining to outcomes of flow on the Web.

A major difference between the reflective and formative view of multidimensional constructs is that in the path diagram of a covariance structure analysis, facets would have structural paths pointing to the multidimensional construct under the formative view, whereas the multidimensional construct would have structural paths pointing to its facets under the reflective or factor view (Law and Wong, 1999). This difference is important for covariance structure analyses because the direction of structural paths will have serious effects on parameter estimates. Because the objective of covariance structure analysis is to find a set of parameters that will maximize the fit between the observed covariance structure and the hypothesized structure, all parameters estimated will be misleading when structural direction between facets and the multidimensional construct are reversed.

A second difference between the two views of multidimensional constructs is related to the concept of variance partitioning. The observed variances of facets are composed of three elements: common variances, specific variances, and random variances (Nunnally, 1978). Common variances are the variances shared by all facets of the multidimensional construct. Specific variances are the variances unique to a single facet. Random variances are the portion of observed variances caused by random factors or measurement error (Law and Wong, 1999). Under the reflective view, the multidimensional construct is the factor common to all facets. In other words, only common variances or covariances shared by all facets are considered as the true variance of the construct. Variances specific to one facet, covariances shared by some facets only, and random variances are treated as error variances in the reflective model. In contrast, under the formative view, the multidimensional construct is the composite formed by the facets. Variances specific to one facet or covariances shared by some facets are, therefore, part of the true variance of the construct. As a result, only random variances are considered as error variances (Law and Wong, 1999). The implication of this difference between the two views on covariance structure analyses is that error variances of the facets may be overestimated if the reflective view is assumed when, in fact, the composite view is the reality. An overestimation of the error variances of the facets in a covariance structure analysis is analogous to an overcorrection of the observed correlations among the constructs when they are corrected for unreliability. This overestimation would, therefore, lead to biased estimates of the path coefficients in the structural model.

4. Methodology

4.1 Measures of Constructs

The main dimensions of contention associated with flow, from the literature review are, concentration, control, challenge, and curiosity, and thus are considered in this study. This study adopts measurement scales for concentration, challenge, curiosity, and control based on flow measurement proposed by Ghani and Desphande (1994). These scales comprise of a three-item challenge and control semantic and four-item concentration and curiosity semantic differential measurement scale. These scales were found to have acceptable reliabilities in previous studies (Koufaris, 2002). The other latent constructs, intention to purchase and intention to return, were equally operationalized with established scales. Purchase intent is a widely used measure in studying behavioral intentions. In the context of Web studies, we adopted two-item scales from Yoo and Donthu (2001) to assess intention to purchase and intention to return.

4.2 Sample and Data Collection Procedure

A sample frame of 2500 Web users in the US was generated from national database on Internet users developed by a reputable commercial database vendor. Subjects were invited via email to participate. The data collection was accomplished through an online survey method. Before completing the survey participants were asked to visit a Web site of their choice and simulate a purchase for a laptop computer. The purpose of the shopping task was to acquaint and refresh subjects' memories of the online buying experience; therefore, participants were warned not to actually purchase the product since they would not be reimbursed. The questionnaire site was deployed for six weeks in the summer of 2003. Total usable responses received were 281 giving a response rate of 11.24%. According to MacCallum, Browne and Sugawara (1996), an important issue in research design involves the determination of sample size necessary to achieve adequate power to carry out planned hypothesis tests. They presented minimum levels of sample sizes for selected levels of degrees of freedom (df) to assure power of at least 0.80. In the present context of testing hypotheses about model fit, the sample size of 281 is adequate for df = 35 to achieve a power of .80 for a close fit model.

The sample consisted of 152 male (54%) and 129 (46%) were female. 84% of the subjects were older than 18 years. About half the sample said they have a college degree. More than 60% rated their Internet use skills as good and about the same number reported they have shopped online in the past.

We tested the validity of our instrument using a two-stage analysis procedure. First, by splitting the sample into halves, an exploratory factor analysis using maximum likelihood factor method with oblique rotation rather than the most commonly used orthogonal method was employed for the first half of the sample (n=140). Orthogonal rotations offer the advantage of simplicity at the expense of poorer factor definition. The choice of oblique rotation involved some consideration of possible relationships between features. Factors are usually rotated to make the factor solution more interpretable. Proper rotation will (1) strengthen the relation between variables and factors, (2) concentrate the variance shared by two variables that correlate highly on a single factor, and (3) level the variance.

Second, structural equation modeling (SEM) was employed to test for convergent and discriminant validity (Anderson and Gerbing, 1988) using the second half of the sample (n=141). We also tested the reliability of each scale using Cronbach's coefficient alpha (α) and composite reliability (ρ) which is a measure of internal consistency argued to be superior to coefficient alpha (Fornel and Larcker, 1981). SEM was equally employed for path analysis of the proposed models. As Chin (1998) stated SEM involves generalizations and extensions of earlier first-generation procedures such as simple regression analysis. The SEM approach is integrative in the sense that it includes the ability to predict and allows latent variables to be indirectly inferred from multiple observed measures. In particular we found SEM useful in this study because it provides the researcher with the flexibility to model relationships among multiple predictor and criterion variables and statistically test a priori substantive/theoretical and measurement assumptions against empirical data. Furthermore, SEM can be used as a means of estimating other multivariate models, including regression, principal components (Dolan, 1996), and even MANOVA (Bagozzi and Yi, 1988).

4.3 The structural models

Because different conceptualizations by the various researchers represent two distinct types of overall constructs—formative and reflective—two structural equation models were developed, with each model situated and tested in the same nomological network. The first model, which we term the reflective model, represents the conceptualization of the FO dimensions as independent but covarying, with the source of this covariance being the underlying HO flow construct. The second model, the formative model, represents the conceptualization of the FO constructs as independent but do not covary, but through some combination (composite), determine an overall the HO flow construct.

5. Results and Discussion

Data were analyzed using LISREL 8.5 software (Jöreskog and Sörbom, 2003) and the models tested were linear covariance structure models. The analysis followed a two-step procedure, an approach recommended by Anderson and Gerbing (1988). In the first step, confirmatory factor analysis is used to develop a measurement model that demonstrated an acceptable fit to the data. In step two, the measurement model is modified to represent the theoretical models of interest. The models were then tested as being meaningful, parsimonious, and having a statistically acceptable fit.

First, the data was tested for normality. From the PRELIS, the companion software for LISREL, Mardia's statistic is a test for multivariate normality (Mardia's PK), which is based on functions of skewness and kurtosis, was 1.23. It is suggested that Mardia's PK should be less than 3 to assume the assumption of multivariate normality, thus, this indicated multivariate normality was not violated. Furthermore, a simple inspection of scatterplots indicated the assumptions of normality and linearity were not violated in the data. In addition, the correlation matrix (see Table 4) between the constructs indicated there was no correlation above .90, indicating no multicollineraity (Hair et al, 1998) between the constructs.

Second, non-response bias on the results was also access due to the relatively small percentage (11.2%) of responses received from the sampling frame. Consistent with prior research, non-response bias was assessed by using extrapolation methods. The midpoint of the data collection period was used as the cut-off point for distinguishing between early and late respondents. 71.8% of the responses were from early respondents and the remaining 28.2% was from late respondents. These two groups of respondents were compared based on demographic data and model constructs using non-parametric and MANOVA techniques and no significant differences were found between the early and late respondents.

5.1 The Measurement Model and Instrument Validation

Churchill (1979) contends that in many cases scales developed in one context perform relatively poorly in another context. In light of this, attempts were made during pre-testing to ensure that measures employed were psychometrically sound. As stated earlier, the scales were subjected to exploratory factor analysis to confirm the unidimensionality of the FO construct and ensure item loadings conform to those in the literature. Using a factor loading threshold of 0.45, as recommended by Nunnally and Bernstein (1994) (for a sample size of about 150) we determined which items loaded on a particular factor. Table 2 contains factor loadings for items used to measure the constructs of concentration, challenge, curiosity and control. The FO constructs, challenge, concentration, control, and curiosity were measured by the indicator items CHALL1-CHALL4, CONC1-CONC4, CONT1-CONT3, and CUR1-CUR4, respectively.

Table 2. Factor Analysis Results for Flow Scales

Item	Factor			
	1	**2**	**3**	**4**
CHALL1	**0.570**	0.111	0.222	0.012
CHALL2	**0.483**	-0.083	-0.102	-0.056
CHALL3	**0.764**	0.113	-0.008	-0.061
CONC1	-0.067	-0.097	-0.145	0.366
CONC2	0.141	-0.010	0.175	**0.756**
CONC3	-0.031	0.144	0.144	**0.841**
CONC4	-0.032	0.235	0.153	**0.689**
CONT1	0.183	**0.451**	0.176	0.141
CONT2	0.102	**0.691**	0.099	0.079
CONT3	-0.016	**0.881**	-0.140	-0.089
CUR1	0.190	0.236	0.365	0.281
CUR2	0.163	0.196	**0.677**	0.159
CUR3	0.125	0.061	**0.849**	0.210
CUR4	-0.097	-0.055	**0.238**	-0.162

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin

The resulting scales from the exploratory factor analysis substantially correspond with those in the literature. Only two items (CONC1 and CUR1) did not load in their respective factors. These two items were eliminated in the final instrument partly because these scales used in assessing flow construct have not been rigorously tested and there is not strong enough existing theoretical basis for their retention. As proposed by Churchill (1979) this exclusion is appropriate for better scale validity. Furthermore, we believe that pre-testing provides a statistical basis to shorten long survey instruments without sacrificing their explanatory power. Participants may perceive long survey instruments as burdensome and may contribute to attrition and/or non-response.

Using confirmatory factor analysis (CFA), we further evaluated the validity of the measurement model. It is recommended to consider a variety of Goodness-of-fit indexes that include 1) absolute fit measures which assess the overall model fit with no adjustment for the degree of overfitting, 2) incremental fit measures which compare the proposed model to another model specified by the researcher, and 3) parsimonious fit measures which adjust the measures to provide a comparison between models with differing numbers of estimated coefficients (Bollen and Long, 1993; Hair et al., 1998). Specifically, Kline (1998) recommends at least four tests, such as chi-square; GFI, NFI, or CFI; NNFI; and RMR which we employed in this study. The measurement model was estimated using the maximum likelihood method with asymptotic correlation matrix.

Table 3. Fit Indices of Measurement Model

Indices	χ^2/df	RMSEA	NFI	NNFI	CFI	RMR
	1.82	0.054	0.96	0.97	0.98	0.079
Recommended values	<3[a]	<.05[b] <.06[c] <.08[d]	>.90[e]	>.90[e]	>.90[e]	<.05[e]

[a] [Bollen, 1989], [Hair et al], [Jöreskog and Sörbom, 1993].
[b] [Browne and Cudeck, 1993]
[c] [Hu and Bentler, 1999]
[d] [Byrne, 1998]
[e] [Hair et al], [Jöreskog and Sörbom, 1993].

Table 3 contains results of the fit indices of the measurement model. The chi-square value for the measurement model was statistically significant: $\chi^2 = 236.35$, $p < .001$ (130 df, n = 281). However, one should be cautious about rejecting the model on the basis of this statistic, which is sensitive to small departures from a multivariate normal distribution (Hatcher, 1994) and sample size (Byrne, 1994). Further, the values for the Bentler-Bonnet Normed fit index (NFI) and Non-normed fit index (NNFI) (Bentler and Bonnet, 1980), and the comparative fit index (CFI) (Bentler, 1990) were greater than .90, indicating an acceptable fit. Additional fit indices used to evaluate model fit were the root mean squared residual (RMR) and the root mean-square error of approximation (RMSEA). The RMR index was .079, above the .05 recommended for better fitting models (Jöreskog and Sörbom, 1993). RMSEA is a measure of model discrepancy per degree of freedom, which incorporates a measure of parsimony into the measure of (lack of) fit. The model displayed an RMSEA value below .054, with a 90% confidence interval (CI) of .043 to .065, indicating a close fit of the model relative to the degrees of freedom (Hu and Bentler, 1999 suggest 0.06 cut-off).

With the measurement model displaying an acceptable fit, a number of tests were conducted to assess the construct's reliability and validity. Standardized factor loadings for the indicator variables ranged from .69 to .95 and t-scores obtained for the coefficients (of factor loadings) ranged from 11.57 to 21.85, indicating that all factor loadings were significant ($p < .001$) (Table 4). This finding provides evidence supporting the convergent validity of the indicators (Anderson and Gerbing, 1988). Table 3 presents correlation matrix between the constructs and reliabilities of the scales used for their measurement.

Table 4. Correlation Matrix between Dimensions and Reliabilities of Scales

Construct	1	2	3	4	5	6	α	ρ
1. Curiosity	1.00						0.73	0.77
2. Challenge	0.67	1.00					0.83	0.85
3. Control	0.53	0.69	1.00				0.90	0.91
4. Concentration	0.49	0.54	0.74	1.00			0.81	0.88
5. Int. purchase	0.34	0.46	0.54	0.48	1.00		0.93	0.97
6. Int. return	0.40	0.47	0.59	0.48	0.86	1.00	0.81	0.86

Discriminant validity is a means of assessing latent factors as being separate and distinct constructs; i.e., not measuring the same underlying dimension. We assessed discriminant validity using correlations between the constructs (Table 4). We expected significant correlations because of the theoretical relation between them and the large size of the sample. The intercorrelations between concentration, control, curiosity, and challenge showed moderate values ranging from .49 to .74. Nevertheless, the correlation coefficients should be lower than the reliability coefficients if discriminate validity is to be achieved (Gerbing and Anderson, 1988). The correlations results show that no pair of correlations exceeded 0.90, suggesting that there is no multicollineraity (Hair et al, 1998) but indicating that the constructs have discriminant validity. Thus, the constructs may be interpreted as independent. In sum, our findings generally support the reliability and validity of the constructs and their indicants, in addition to establishing the constructs as independent dimensions.

The reliabilities of the scales show acceptable values. Cronbach's αs are all above the recommended 0.70 cut-off for acceptability (Nunnaly and Bernstein, 1994). Composite reliability (ρ) is a measure of internal consistency comparable to coefficient alpha (Fornel and Larcker, 1981). However, this measure is superior to Cronbach's α in that it does not assume equal item loadings (Howell, 1996). All scales demonstrated acceptable levels of reliability with Cronbach's αs for the constructs ranging from .73 to .90 for the factors of flow and .93 and .81 for intentions to purchase and intention to return respectively.

5.2The Structural Models

From the LISREL structural analysis, the NFI, NNFI and CFI fit indices are all above .90 for both models, indicating an acceptable fit (Table 4). The reflective model operationalizes flow as a multidimensional (concentration, challenge, control, curiosity) HO reflective construct. The standardized loadings between concentration, challenge, curiosity, and control (FO dimensions) and flow construct ranged from .69 to .91 with significant t-tests ($p < .001$). This provides evidence supporting the convergent validity of the HO factor (Anderson and Gerbing, 1988). Additionally, the composite reliability of the HO factor was .84. In sum, these results initially suggest that the HO flow construct factor is a source of the covariance among the latent FO latent constructs thus addressing the question 1 raised at the empirical level of the multidimensional construct. The reflective model also indicated a value .11as RMR, and 0.059, [CI (90%), .051 to .070] as RMSEA, indicating that the theoretical model provided a fit that was not significantly worse than that provided by the measurement model (Howell, 1996).

On the other hand, the formative model of flow proposes that concentration, challenge, control, and curiosity are antecedents of flow. As demonstrated in Table 5, even though the fit indices of the formative model suggest an acceptable fitting model to data, they are a little worse of than the fit of the reflective model. In addition, the path coefficient between flow and control was not statistically significant (0.11, $p>.05$), suggesting that control is not an antecedent but rather a dimension of flow as proposed in the reflective model. Finally, our findings for the path coefficient between the flow construct and intentions to purchase and to return are positive and statistically significant for both reflective and formative conceptualizations of the construct. However, with the formative model, the standardized estimates recorded were .89 ($p < .001$) and 0.92 ($p < .001$) for intention to purchase and to return respectively, and for the reflective the standardized estimates were .92 ($p < .001$), and .95 ($p < .001$) respectively for intention to purchase and to return.

Table 5. Goodness of Fit Indices of Reflective and Formative Models of Flow

Index	Theoretical Model	
	Reflective	**Formative**
χ^2/df	1.97	2.72
RMSEA	0.059	0.078
NFI	0.95	0.93
NNFI	0.96	0.95
CFI	0.97	0.95
RMR	0.11	0.20
R^2		
– Intent to purchase	0.39	0.34
– Intent to return	0.49	0.40

In summary, the findings for the reflective model on the validities, reliabilities, and fit indices, provide overall support for this theoretical model. Furthermore, the results suggest that the source of the covariance among the FO factors may be an HO reflective construct. In addition, as evidenced by the changes in R^2 in the outcome variables (0.05 for intention to purchase and 0.09 for intention to return), the reflective model indicated it had a higher, though only marginal, explanatory power than the formative model.

6. Implications

In this paper we address measuring flow construct in relation to consumers' online shopping experience at Web sites. When consumers shop in a brick-and-mortar store, they have a chance to browse the aisles and inspect products carefully and closely. This user experience is enhanced through the stimulation of the senses with colorful displays, ambient music, inviting scents, physical inspections of products, and interaction with salespeople or other customers. However, online shopping lacks these real experiences but makes up for it in terms of convenience, cost, and time savings. An interactive, well-designed user interface can overcome these limitations to create a more enjoyable shopping episode (Lohse, 1998; Koufaris, 2002) that can lead to the state of flow (Hoffman and Novak, 1996).

It is also important to point out that online consumers do not act as only regular shoppers but also as computer users. This necessitates that good interface, navigational architecture, and other facets of human-computer interaction may be as significant as customer service and low prices (Koufaris, 2002; Lee, and Kim, 2002; Lim, 2002). Online customers are not simply looking for efficiency in shopping but value an engaging Web site (Koufaris, 2002). Related to factors such as interactivity, entertainment value, attractiveness, content, and download time, is the concept of flow which is proposed to be a significant contributor of user evaluation of a Web site (Hoffman and Novak, 1996; Novak, Hoffman, and Yung, 2002; Koufaris, 2002).

However, taken together, studies involving flow assessment demonstrate that some potentially serious consequences of measurement model misspecification exist, and researchers need to think carefully about the direction of causality between constructs and their measures. This study sets out to evaluate the assessment of the flow construct in an online shopping context. Most studies that examined flow adopted a multidimensional view of the flow concept. Therefore, more specifically, this study examines the relationship between important first order constructs and the second-order flow construct. The typological analysis of flow and its dimensions resulted in two models – reflective and formative models of flow. In this regard, we performed several tests on the two models to examine their validity and reliability and most importantly to compare their predictability of the same outcome variables.

Specifying the right measurement model is important, because it provides a practical way for researchers to decide on the causal interrelations among variables employed their research. Our results suggest that challenge, control, curiosity, and concentration (FO latent variables) are better formulated as reflective dimensions of the flow construct (Trevino and Webster, 1992; Webster, Tevino, and Ryan, 1993, Koufaris, 2002) rather antecedent dimensions (Hoffman and Novak, 1996; Novak, Hoffman and Yung, 2000; Ghani and Despande, 1994; Ghani, Supnick and Rooney, 1991). This means that to assess flow: 1) the direction of causality is from the HO construct to the FO latent variables, 2) The FO variables are manifestations of the HO construct, and while changes in the FO variables should not cause changes in the HO construct, changes in the HO construct do cause changes in the FO variables, 3) The FO variables should share a common theme and are expected to covary with each other.

6.1 Limitation and Recommendations for Future Research

While flow has been studied in a broad range of contexts, including sports, work, shopping, games, hobbies, and computer use, we focus on flow during consumer navigation of a commercial Web site. As many researchers of flow suggest the operationalization of the construct may differ depending on the context. This call for comparative research studies that investigates the multidimensionality of the flow construct. The most apparent limitations of our study are its cross-sectional nature and the use of a convenience sample data. Thus, caution must be taken when generalizing our findings. In particular, Web sites are dynamic in their developments, and a longitudinal survey is needed to identify the changing consequences of Web interactivity as perceived by users along side Web technology advancements and consumer continued use of the Web services.

In addition, in our CFA, we found that the factors correlated moderately high; however, just because high correlations exist among the factors, it does not necessarily follow that a causal mechanism is driving the correlations. For example, two explanations for these correlations may be a true halo effect (Nisbett and Wilson, 1977) or simply that there is a degree of systematic error which was not separated out from true score (Pedhazur and Pedhazur-Schmedlkin, 1991). Alternatively, it is possible that these correlations are actually driven by an underlying causal mechanism, such as an HO reflective construct. Therefore, our answer to Question 2 raised at the empirical level is that the factors are correlated but, as to making a definitive and absolute assessment of its source, it is dubious at best.

Furthermore, there are many other factors that can influence the shopping experience. For, example, customers' attitude toward online shopping is reported as the key to the survival and profitability of Internet retailers in the intensely competitive market (Zhou, Chiang, and Zhang, 2004). How is flow linked to attitude? Is flow an antecedent, or consequence of attitude toward online shopping or one is a dimension of the other? Moreover, with the proliferation of broadband technologies, the shopping experience becomes richer and more engaging. Will media richness become a factor to be examined? Will we see consumers demanding for an even more Web features in exchange for flow? Or will we see them lose more control over what they see and do on the Web?

We also recon that, some researchers might argue that a construct must be conceptually and empirically unidimensional to be meaningful. However, such a view is often inconsistent with the way constructs are defined in the field. We would argue that whether a construct is viewed as unidimensional or multidimensional may depend on the level of abstraction used to define the construct. For example, job satisfaction is frequently defined as being composed of several different facets, including satisfaction with one's pay, coworkers, supervisor, opportunities for advancement, and so forth (Jarvis, MacKenzie, and Podsakoff, 2003). Although one can look at each facet as being a separate construct, at a more abstract level, they are all integral parts of a person's job satisfaction. Indeed, we think this kind of abstract multidimensional construct definition is quite common in the social sciences literature.

Finally, while not often discussed in many business studies, nomological validity is beginning to be seen more frequently in assessing construct validity. Cronbach and Meehl (1955) describe nomological validity as a form of construct validity that derives from the existence of a well developed theoretical research stream (or nomological network). We recommend that to achieve nomogical validity for the flow construct, its instrument validation process should be tested against a variety of persons, settings, and in the case of business, products and services, then as Straub, Bordreaux, and Gefen (2002) argue, the case that the construct is valid will be more compelling.

7. Conclusion

A number of recent IS papers have presented higher order (HO) latent factor models with diverging approaches with respect to their operationalization. This study investigates the multidimensional conceptualization of the flow construct that has recently been achieving attention among IS researchers. We centred the investigation of the construct within the online shopping context for one main reason. Facts show that the Internet is becoming the first global public computer network that is accessible to all, easy to use and inexpensive. Several retailers have created World Wide Web (WWW) sites that provide users with information ranging from store locations and sales promotions to employment opportunities and product catalogues. Nevertheless the main problem is that it is not easy to build sites that are entertaining and engaging to the extent that the visitor can interactively complete a shopping transaction without frustration. In an effort to construct Web sites that attract visitors to shop online, the incorporation of flow has been proposed as one concept that can enhance the visitor experience while carrying out the online shopping transactions and thus may lead to a future return to the site. However, the literature on flow indicates a broad range of definitions, thus, leading to inconsistent operationalization of the construct. Though most studies consider flow to be a multidimensional construct, it is observed that different interpretations are attributed to the relations between the overall construct and its dimensions.

The purpose of this study was to empirically investigate outcomes of the differences in conceptualization of the flow construct in a similar nomological network. Following a typological process suggested by Bailey (1994), two conceptualizations of flow – reflective and formative – were examined. Using a survey sample of Internet users, structural equation modelling was used to investigate the model with better data fit and explanatory power. The results suggest that the reflective conceptualization of flow with respect to the dimensions of challenge, concentration, control, and curiosity outperform the formative model in data fit and explanation of behavioral intentions. Nevertheless we should point out that our findings is an instantiation of a more broad construct of flow that can be applied to most major human activities including consumer behavior. Thus, in order for the favorable reflective model as shown in this study to reach an optimal equilibrium point both for the applicable areas of flow it must be tested and fine-tuned over not just one but a series of activities including shopping offline, sports, learning, etc.

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