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Revisiting the Antecedents of Flow Experience in Different On-Line Communication Environments

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REVISITING THE ANTECEDENTS OF FLOW EXPERIENCE IN DIFFERENT ON-LINE COMMUNICATION ENVIRONMENTS

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Abstract

Flow experience is quite frequent when performing a variety of on-line activities and is a good predictor for on-line users' loyalty and revisiting. Most previous research emphasizes the effects of challenge/skill, focused attention, telepresence and web characteristics on flow experiences. However, text-based communication systems without features of telepresence and web characteristics still seem to create opportunities of flow experience. Subject involvement and interpersonal interaction were identified as other important factors when users gradually rely on Internet for information sharing, message exchange and relational communication. To explore the reasons of the prevalence and flow state in text-based communication environments, this study incorporate subject involvement and interpersonal interaction as critical antecedents. Results show that subject involvement, interpersonal interaction and interactivity speed are critical to focused attention, which enhances users' flow experience. As regards effect of telepresence, perceived attractiveness of interface is a significant facilitator for users to get into flow experience in web-based, rather than in text-based communication environments. Interactivity speed is unrelated to flow experience in both web-based and text-based communication environments. The influence of interpersonal involvement is diminished in web-based communication environments. Implications and limitations are discussed.

Keywords: Flow experience, Subject Involvement, Interpersonal Interaction, Telepresence, Text-based Communication Environments.

1 INTRODUCTION

Most of Internet activities offer users enjoyment and playfulness, such as information retrieval/searching, reading/writing e-mail, gaming, chatting in virtual communities. Chen et al. (1999) indicated that almost 40% of on-line users had achieved the state of flow. When users mind flow experience in Internet, they usually feel a subjective sense of time and then integrate themselves with this cyberspace (Chen & Wigand & Nilan, 1999; Csikszentmihalyi, 1977). “Providing flow opportunities for consumers” is also treated as an important strategy for increasing the number of navigator or opportunity of purchase by for on-line marketers (Hoffman & Novak, 1996).

Studies about flow experience usually emphasize the influence of skill/control, challenge/arouse and telepresence (Chen, 2006). Skadberg and Kimmel (2004) suggested that an important consideration of flow experience is to provide tasks or operations with high level of balance between skill and challenge, as well as vivid and attractive interface when practitioners design an on-line system. Studies usually start from issues of interface design, multimedia effects and other web characteristic, e.g., Hsu and Lu (2004). However, the substantial prevalence of text-based communication systems could not be explained from this research stream. Text mode interface and pure keyboard operations without mouse click are the particular features of text-based communication systems. Text-based communication systems are served as valuable information sources and fields of receiving relational support and friendship. In Taiwan, lots of users are absorbed in virtual text-based communities, such as bulletin boards systems. Bulletin boards systems, much like to “Network Newsgroups,” are comprised of several discussion boards with distinct subjects and articles, personal email boxes, chatting rooms, as well as real-time communication space. Almost every department of university and college establish their own bulletin boards systems. Students are stuck on bulletin boards systems and surf overnight. They are absorbed in it and even give up sleep and classes. The everyday transaction of the ptt.cc, which is the most famous BBS, is near to 5 billion person-times and the registered member is close to 6 billion by Nov. 2004 (ptt.cc, 2004). Besides, the number of concurrent on-line users is over 50,000 by March 2005 (ptt.cc, 2005). Users’ needs of social relationship and knowledge can be satisfied in virtual text-based communities. Although web-based interface and operations have been more popular, text-based communication systems are not replaced.

The question of what factors contribute to users’ flow experience in text-based communication systems is interesting and deserves to be investigated. The field interviews highlighted the importance of developing relationships and collecting valuable information in text-based communication environments. Some researchers also keep the same position. For example, Wellman et al. (1996) indicated that users can have social supports, companions and belongs in virtual communities. Choi and Kim (2004) presented that the considerable factors of flow experience can be how to reinforce social relationship and please social interactions. The purpose of this study is to figure out what distinct factors facilitate flow experiences in web-based and text-based communication environment, both of which provide similar functions except for some system characteristics.

2 CONPETUAL BACKGROUND

2.1 Flow Theory

Csikszentmihalyi (1977) first introduced the concept of “flow,” which is “the holistic sensation that people feel when they act with total involvement.” During the state of flow, people are immersed in an activity, fully control their actions, centre their focus of awareness, filter everything unrelated to this activity, as well as lose their self-consciousness and the sense of time transformation. When people are in the state of flow they feel deep enjoyment, happiness and exhilaration (Csikszentmihalyi, 1990). This concept is also applied in the computer mediated environment (Csikszentmihalyi, 1990;

Hoffman and Novak, 1996), such as web surfing, content navigation, on-line chatting, on-line game, etc. The flow phenomenon has been analyzed with different external variables and in various application of Internet environment. Chen et al. (1999) indicate that the majority of web activities which induce flow experience and enjoyment are related to interpersonal communication, searching for information, and interactivity. Huang (2003) investigated the influence of web attributes on flow experience. Some studies were applied in on-line shopping environment, e.g. Skadberg and Kimmel (2004) and in on-line game, e.g. Hsu and Lu (2004) and Choi and Kim (2004). Hoffman and Novak (1996) defined flow as “a seamless sequence of intrinsic enjoyment facilitated by interactivity with computers, which is accompanied by loss of self-consciousness.” There are two primary and two secondary determinants of flow on the Internet in Hoffman and Novak’s (1996) model. The primary antecedents of flow include congruency between skills and challenges and focused attention. Only on-line users perceive the high level of balance between their skills and challenges of the interaction with computers, the state of flow could be achieved (Csikszentmihalyi, 1990). Focused attention is defined as “a centring of attention on a limited stimulus field” (Csikszentmihalyi, 1977). Vividness, interactivity and involvement determine the level of focused attention (Hoffman & Novak, 1996). Interactivity and telepresence, as secondary antecedents, mainly increase intensity of flow state. The relationship between flow and its antecedents is empirically confirmed in some works, e.g. Hoffman and Novak (1996) and Novak et al. (2000).

2.2 Subject Involvement and Challenges/Skills

The original definition of challenges and skills which are measured as users’ perception of computer skills and operating challenges are inappropriate now (Skadberg & Kimmel, 2004). As Internet technology is improved, the challenges and skills required for searching information, web surfing, on-line chatting, and browsing web pages are gradually disappeared, while related to the information presented and users’ knowledge about the information on the web pages is come up over time (Koufairs, 2002). It may be better to consider on-line users’ involvement and understanding of contents about Internet activities, instead of balance of challenges and skills. Involvement, which is formed by the presence of situation and/or intrinsic self-relevance (Hoffman & Novak, 1996), affects attention and comprehension effort (Celsi & Olson, 1988). Involvement is defined as individual’s perceived relevance of extrinsic events/objects based on inherent needs, values, and interests (Zaichkowsky, 1985). Once users think events/objects are important and meaningful, they tend to pay more attention on them. The positive correlation is testified in Internet environment, e.g. Novak et al. (2003). For example, on-line users tend to immerse in searching specific information on the web pages when they are interested in this subject and eager to looking for more information to understand the content. Hence, the involvement of subject on Internet activities turns into an important factor of focused attention and flow.

2.3 Interpersonal Interaction

Internet is a many-to-many communications environment incorporating both people and computers (Hoffman & Novak, 1997). Burgoon et al. (1999-2000) indicated that it is insufficient to only pay attention on the characteristics of media for exploring the interactive process, so they stressed on the feeling of participants and conceptualized interpersonal interaction based on the principle of interactive communication. Some studies also highlight the importance of interaction among users. Chen et al. (1999) argued that on-line activities inducing the state of flow contain intense interactivity with the Internet environment and communications among users. Wellman et al. (1996) proposed that users can get social support through communication in virtual communities. People will feel the state of immersion or flow via daily online communication during involved in a virtual community (Koh & Kim, 2003). User-to-user communication is related to social interaction with other on-line users and provides users with social needs and social support in virtual environments, such as belongings or self-esteem (Choi & Kim, 2004). Burgoon et al. (1999-2000) proposed that qualitative experience is a

mean of analyzing interpersonal interaction. Qualitative experience refers to individuals' feelings about the process of interpersonal interaction and the extent of companion's engagement. Once users feel good, they will exchange more information and are more devoted to the interaction (Burgoon et al., 1999-2000). Interaction involvement is the major component of qualitative experience and concerns the experience of participants' engagement. It enhances attractiveness of decision making and accurate understanding of messages exchanged during communication. When people deeply involved in interpersonal interaction, they will be in the presence of the interactive situation, in turn, get into the state of immersion. Hence, we center on the properties of "interaction involvement" of interpersonal interaction here. On-line activities, such as bulletin boards, newsgroup, forums and chat rooms, provide an interactive and real-time medium for interpersonal communication. Users' social needs will be satisfied during the process of interpersonal communication.

3 RESEARCH MODEL AND HYPOTHESES

The substantial prevalence and flow experience of text-based communication systems drives us to look into underneath antecedents of flow state, except for the main research stream about web characteristics. This research model, derived from the Hoffman and Novak' (1996) model of flow, emphasizes the importance of interpersonal interaction and subject involvement, as well as the different influence of antecedents in web-based versus text-based communication environments, as presented in Figure 1.

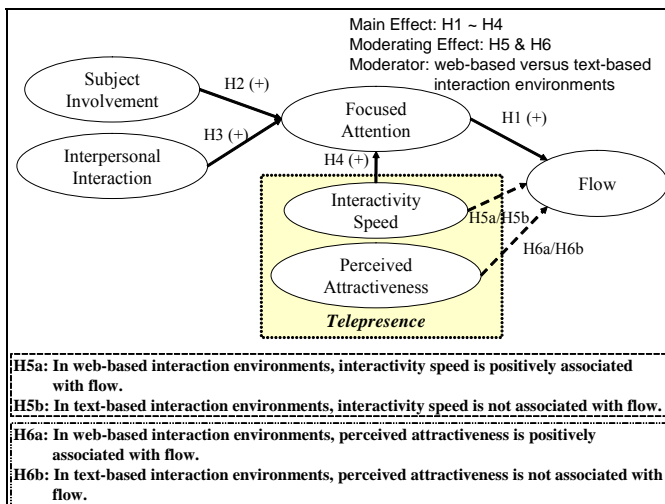


Figure 1. Research Framework

3.1 Focused Attention

Focused attention is one of the major antecedents of flow experience in computer mediated environments (Hoffman & Novak, 1996). When users invest all of attentional resources in on-line activities, they tend to ignore everything in the surrounding physical environment except for the task on hands (Novak & Hoffman & Yung, 2000). They lose self-consciousness, perceive an altered sense of time and then achieve the state of flow. The relationship of focused attention and flow is examined in empirical studies, e.g. Chen et al. (1999), Hoffman et al. (1997) and Novak et al. (2000). Hence, we propose:

H1: Focused attention is positively associated with flow.

Involvement is defined as an intrinsic self-relevance of the object based on inherent needs, values, and interests (Zaichkowsky, 1985). Involvement in presented content facilitates centring users' attention

and comprehensive efforts (Celsi & Olson, 1988). Skadberg and Kimmel (2004) supposed that the way of defining challenges and skills is unsuitable in Internet, since the required skills and challenge is relatively easy to be learned or controlled by experienced users, especially in web environments. By contrast, users' attention on the displayed content and users' knowledge about the information of web pages arouse their motivation of being willingly stuck on on-line activities (Skadberg & Kimmel, 2004). In Hoffman and Novak's (1996) proposed model, involvement is a major factor of focused attention. If users think a specific topic in on-line activities is highly relevant and important, they tend to respond to the content without distraction. Empirical studies also show the positive relationship of product involvement and concentration (Koufairs, 2002). Hence, we propose:

H2: Subject Involvement is positively associated with focused attention.

User-to-user and user-to-system interactivity should be considered simultaneously in virtual environment (Chen & Wigand & Nilan, 1999). On-line users interact with on-line companions by entering in relational communication and then get social support and belongings from their affiliated virtual communities. Once users are cognitively, affectively and behaviourally engaged in intensive interactions, they will experience a sense of presence (Shoham, 2004) and then concentrate their attention on these activities (Hsu & Lu, 2004). A series of specific interaction and responses make users concentrate on the going exchange and disregard unrelated conversation or messages (Shoham, 2004) and satisfy their social needs (Choi & Kim, 2004). Hence, we propose:

H3: Interpersonal Interaction is positively associated with focused attention.

Interactivity usually describes a process of information exchange between systems and users (Huang, 2003). Users usually expect the speed of displayed message and changing pages will be good enough in on-line communication system. Hoffman and Novak (1996) proposed that interactivity speed is an important determinant of focused attention. The results of Novak et al.'s (2000) research revealed that slow interactivity speed reduces the time and frequency of web usage in several kinds of web activities, such as on-line chatting, news forums and on-line shopping. Users are usually distracted and lose their patience because of long waiting time. Fast interactivity assists users in concentrating on the current activity because of a seamless sequence of action. Hence, we propose:

H4: Interactivity speed is positively associated with focused attention.

3.2 Telepresence in different on-line communication environments

Telepresence means that a person experiences present in both of a physical and virtual environment, yet the virtual environment is more real than the actual physical world when they are surfing in Internet (Steuer, 1992). Telepresence is influenced by interactivity and vividness/attractiveness (Hoffman & Novak, 1996). If interactivity speed is fast and smooth, users will feel that the process of interacting with on-line systems seems to be happened in a physical environment. Vividness is related to the website/interface attribute, such as novelty (Huang, 2003), attractiveness of web pages (van der Heijden, 2003) and friendliness of interface (Burgoon et al., 1999-2000). If the appearance of on-line systems is richness, users will be attracted and starring into the interface. Users' telepresence experience of Internet assists them in getting into the state of flow (Hoffman & Novak, 1997).

The influence of telepresence on flow in web-based communication environments is different from in text-based communication environments. Telepresence primarily centres on the level of system performance and interface design (Skadberg & Kimmel, 2004). High telepresence is represented by fascinating interface layout and speedy interactive process with systems. Nevertheless, characteristics of text-based systems are not satisfied with the criteria of high telepresence. Lots of contents, interesting subjects, and social relationships of chat rooms in text-based environments are just the major causes attracting immersed users.

The first condition of web design for inducing users' flow experience is interactivity speed of interaction with computer, such as download time, responsiveness and feedback (Chen, 2006). The

positive relationship of interactivity speed and flow experience is been testified in empirical studies, e.g. Skadberg and Kimmel (2004). However, the importance of interactivity speed for inducing flow experience is not happened to text-based communication systems. The download speed of text-based communication systems is always quick, since only text is transmitted. The only bottleneck of process of interactivity is determined by the speed of users' operation by keyboard and command-mode instruction. Interactivity speed is not the mainly factors of flow experience in text-based communication systems. Hence, we propose:

H5: In different on-line communication environments, the influence of interactivity speed on flow varies.

H5a: In web-based communication environments, interactivity speed is positively associated with flow.

H5b: In text-based communication environments, interactivity speed is not associated with flow.

When users are surfing in Internet, richness and colourful interfaces often capture their eyes, induce their curiosity and then make the process of interactivity more fluent and playful (Hoffman & Novak, 1996). This enjoyable navigation leads users to feel present in a virtual environment and further experience the state of flow (Skadberg & Kimmel, 2004). However, the influence of attractiveness on flow is inexistent in text-based communication environments. A text-based communication system is incapable of providing multimedia operation settings and attractive interface. Hence, we propose:

H6: In different on-line communication environments, the influence of perceived attractiveness on flow varies.

H6a: In web-based communication environments, perceived attractiveness is positively associated with flow.

H6b: In text-based communication environments, perceived attractiveness is not associated with flow.

4 RESEARCH DESIGN AND METHODOLOGY

4.1 Operationalization and Instrument Design

The instruments for all constructs were adapted from literature and were revised to fit our research context. The definitions of all constructs are shown in Table 1. All items were anchored on seven-point Likert-type scales, from strong disagreement to strong agreement. The scales of subject involvement, interactivity speed, perceived attractiveness, interpersonal interaction and flow were adopted from the works of Zaichkowsky (1994), Novak et al. (2000), van der Heijden (2003), Burgoon and Hale (1987) and Koh and Kim (2003) respectively. For maintaining the consistent type of scales, the scale of focused attention was adopted from Agarwal and Karahanna's (2000), instead of Novak et al. (2000). A short interview with several colleagues and experts and a pre-test were carried out to ensure face validity and content validity for the compliant questionnaires.

Construct	Definition
Subject Involvement	The degree to which users perceive relevance to the topical subject on the discussion boards based on their inherent needs, values and interests (Zaichkowsky, 1985).
Interpersonal Interaction	The degree to which users express attentiveness, interest, and accessibility toward the interaction with other on-line users (Burgoon & Hale, 1987).
Perceived Attractiveness	The degree to which users think that the communication system is aesthetically pleasing to the eye (van der Heijden, 2003).
Interactivity Speed	The degree to which users perceive the speed of interaction with the communication system, including the time of pages download and display (Novak & Hoffman & Yung, 2000).

Focused Attention	The degree to which all of the attentional resources of users are focused on the particular task of using communication systems (Novak & Hoffman & Yung, 2000).
Flow	The degree to which users feel holistic sensation and totally involved in the particular task of using communication systems (Csikszentmihalyi, 1977, p.36).

Table 1. Operationalization for Constructs

WWW forums and BBS were chosen for this research, since they are the most popular web-based and text-based communication environments in Taiwan. Two versions of questionnaires were designed for them. All of the measurement items were adjusted according to the assigned context. We arranged two special items at the top of questionnaire. The first question was for avoiding on-line users without experience of using WWW forums and BBS. The second question was for distributing on-line users to the distinct version of questionnaire based on their using experiences. If respondents had accessed to both of WWW forum and BBS, they had to fill out both versions of questionnaires.

4.2 Data Collection

A web-based questionnaire was administered for collecting data from on-line users, since it could inspect occurrence of missing values when respondents were filling up the questionnaire. We posted messages to solicit participation on several BBS of national universities and popular virtual communities of WWW forums in Taiwan for two weeks. The message comprised objectives of this study, URL address, and incentive of a drawing for small prizes, which could attract more on-line users to attend this survey. During this period, out of 449 questionnaires were filled in. After filtering unusable returns, 390 completed questionnaires are usable for data analysis. Two hundred and ninety five covered both WWW Forum and BBS, 63 were only for BBS, and 32 were only for WWW Forum, as shown in Table 2. Most respondents were experienced on-line users with more than three years. The demographic was similar to the results of survey for the composition of population of on-line users by Yam.Com, a popular portal site in Taiwan (Yam.Com, 2004), as shown in Table 3.

	Filled-in Questionnaires	Usable Questionnaires	Response Rate
Both Two Context	346	295	85.3%
Only WWW Forum	39	32	82.1%
Only BBS	64	63	98.4%
Total	449	390	86.9%

Table 2. Effective Sample Size and Response Rate

Gender	Male		Female
	40.3%		59.7%
Age	<= 20	21~30	>30
	19.7%	76.2%	4.1%
Internet Experience	<= 3 years		7.4%

Table 3. Sample Demographics

5 DATA ANALYSIS AND RESULTS

5.1 Measurement Model

The measurement model is assessed by confirmatory factor analysis using LISREL 8.50. Only two items are dropped because of low factor loading as compared to the acceptable level of 0.5. One is in the construct of “subject involvement” and the other is in “interactivity speed.” The factor loadings of

all remaining indicators are all significant ($p \leq 0.01$). The reliability and convergent validity are acceptable as compared the threshold suggested by Bagozzi (1980): 0.7 and 0.5 respectively, as shown in Table 4. The discriminant validity is acceptable based on the rule that the correlations between any two distinct construct are lower than the square root of the average variance extracted of these constructs (Fornell & Larcker, 1981), as shown in Table 5.

Construct	Mean	S.D	Composite Reliability	Average Variance Extracted
Subject Involvement (one item deleted)	5.078	0.873	0.909	0.558
Interpersonal Interaction	3.817	1.381	0.991	0.909
Perceived Attractiveness	4.831	0.970	0.848	0.658
Interactivity Speed (one item deleted)	4.936	1.167	0.935	0.915
Focused Attention	4.160	1.150	0.962	0.770
Flow	4.214	1.132	0.933	0.779

Table 4. Reliability and Convergent Validity

N=685	Focused Attention	Interpersonal Interaction	Perceived Attractiveness	Interactivity Speed	Focused Attention	Flow
Subject Involvement	0.752					
Interpersonal Interaction	0.272	0.953				
Perceived Attractiveness	0.335	0.258	0.811			
Interactivity Speed	0.245	0.242	0.378	0.957		
Focused Attention	0.295	0.263	0.496	0.366	0.877	
Flow	0.203	0.166	0.420	0.279	0.665	0.883

Table 5. Discriminant Validity (Diagonal represents square root of AVE of each construct)

5.2 Hypotheses Testing

The structure model is analysed using LISREL 8.50. Two steps are performed for testing hypotheses. First, the main effect is examined (H1~H4). Then, the moderating effect (H5a/H5b and H6a/H6b) is examined by multi-group structural equation modelling analysis.

The fit statistics of main effect are acceptable compared to the desired level suggested by Bentler (1980), as presented in Table 6. It reveals that this model fit well with the observed data. The summary results of main effect are presented in Figure 2. The main effect, including H1~H4, are all significant ($p \leq 0.05$) and the directions are consistent with our predictions. The explained variance of focused attention and flow are 28% and 60%. The results reveal that subjective involvement, interpersonal interaction, and interactivity speed are important antecedents of focused attention. When users focus their attention on using on-line forum, they could easily get into flow experience.

	χ^2	Degree of Freedom	$\chi^2 / d.f.$	Standardized RMR	RMSEA	NFI	CFI	GFI
Model	1524.46	446	3.42	0.057	0.059	0.92	0.94	0.88
Desired levels	Not significant	--	< 5.0	.05 ~ .08	.05 ~ .08	> .90	> .90	> .80

Table 6: Model Fit Indices for Structural Model – Main Effect

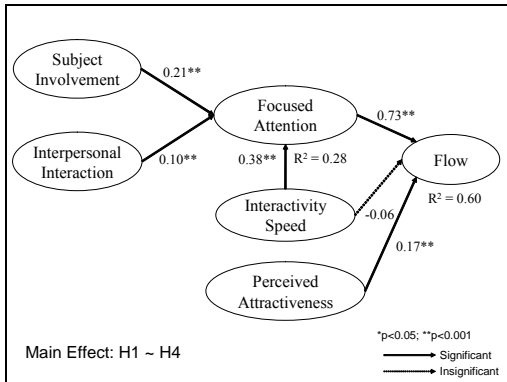


Figure 2. Structural Model – Main Effect.

As for testing moderating effect of different on-line communication environments (H5a/H5b and H6a/H6b), we applied multi-group SEM analysis technique. The model fit statistics of web-based communication environments are presented in Table 7. All fit indices, presented for the suitability of this model and observed data, are acceptable. The summary results are shown in the shadow square of Figure 3 (H5a & H6a). The results indicate that the association between interactivity speed and flow is insignificant and perceived attractiveness is positively associated with flow. In web-based communication environments, focused attention and perceived attractiveness are important factors of flow experience. The insignificant relationship of interpersonal interaction and focused attention is contradictory to our expectation in the main effect model.

	χ^2	d.f.	$\chi^2 / \text{d.f.}$	Standardized RMR	RMSEA	NFI	CFI	GFI
Model	988.756	446	2.22	0.059	0.061	0.90	0.94	0.84
Desired levels	Not significant	--	< 5.0	.05 ~ .08	.05 ~ .08	> .90	> .90	> .80

Table 7: Model Fit Indices for Structural Model – Web-Based Communication Environment

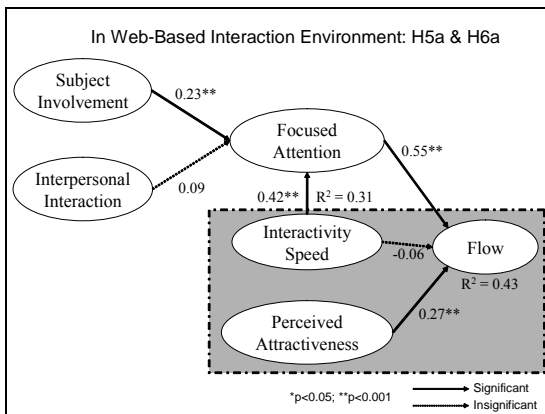


Figure 3. Structural Model – Web-Based Communication Environment

In text-based communication environments, all fit indices of this structural model are acceptable, as shown in Table 8. The summary results, including path coefficients and explained variances, reveal that both H5b and H6b are supported, as shown in the shadow square of Figure 4. In text-based communication environments, both interactivity speed and perceived attractiveness could not lead to strong flow experience. An important finding is that the explained variance of flow (75%) reveals that focused attention is the most important contributor to flow experience. Interpersonal interaction is still a significant antecedent of focused attention. Interactivity speed is significantly associated with focused attention. It shows that the indirect effect of interactivity speed and flow is existence.

	χ^2	d.f.	$\chi^2 / \text{d.f.}$	Standardized RMR	RMSEA	NFI	CFI	GFI
Model	1100.870	446	2.36	0.065	0.062	0.90	0.92	0.84
Desired levels	Not significant	--	< 5.0	.05 ~ .08	.05 ~ .08	> .90	> .90	> .80

Table 8: Model Fit Indices for Structural Model – Text -Based Communication Environment

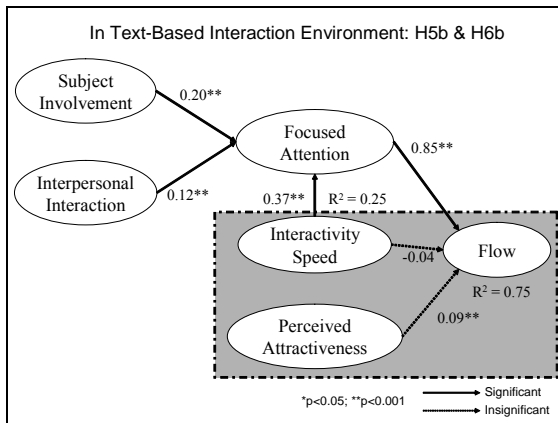


Figure 4. Structural Model –Text -Based Communication Environment.

6 DISCUSSION AND IMPLICATION

6.1 Conclusions and Future Research

Previous studies of flow experience usually pay research attention on users' required skills, given challenge in activities and users' concentration, e.g. Hsu and Lu (2004) and Novak, et al. (2000). Little research notices the growing users' desire of social relationship and the critical role of subject involvement in on-line communication environment. Even if some studies mentioned the influence of involvement on flow experience, the concept of involvement is usually treated as a subsidiary role accompanied skills and challenges, e.g. Novak and Hoffman (2003). However, this study finds evidence to this substantial phenomenon: interpersonal interaction and involvement are the major reasons for focused attention and focused attention is the principle cause of flow experience because of over 50% of variance explained, as shown in Figure 2. The more users' involvement of subjects in on-line systems and users' pleasant relational communication, the more users' concentration on this system, in turn the more feeling of time distortion and distraction.

An important finding of this study related to web attributes are drawn from the difference influence in web-based and text-based communication environments. A research stream of flow experience emphasized importance of web design for arousing users' flow experience, so as to increase users' intention to revisit a web site and on-line shopping, e.g. Huang (2003) and Skadberg and Kimmel (2004). Nevertheless, the prevalence of text-based communication environments can not be explained by this relationship. Our result indicates that focused attention is more important for inducing users' flow experience, while the effect of web attributes does not always exists in on-line environments. The influence of perceived attractiveness on flow experience is less than the influence of focused attention in web-based communication environments and is insignificant in text-based communication environments. In both web-based and text-based communication environments, interactivity speed is unrelated to flow experience and indirectly influence flow experience mediated by focused attention. The results are inconsistent with previous studies, e.g. Huang (2003), Novak et al. (2000) and Sakdberg and Kimmel (2004). Their studies reveal that the direct effect of interactivity on flow

experience is significant, but the effect on focused attention is insignificant. The possible explanation may be due to advancement of Internet infrastructure and technology. The process of interactivity with systems is generally not so slow that users' feel boredom and distract their attention. However, it should be further examined.

An interesting finding of this study, which is out of proposed hypotheses, could be extended for further investigation in the future. Interpersonal interaction is not associated with focused attention in web-based communication environments, yet it is a significant antecedent of focused attention in text-based contexts. The possible reason may be that there is so many stuff in web-based communication environments that users are easy to be distracted from interpersonal communication. Hence, the needs of social relationship may be diminished. Yet, the simple interface of text-based systems let users more concentrate on the activities of navigating boards/newsgroups and communicating with member.

6.2 Managerial Implication

Our findings lead to three suggestions for Internet content providers who want to promote users' intention of revisiting and retention in their sites. First, Internet content providers should endeavour to emphasize the valuable, interesting, meaningful and relevant subjects, so as to evoke users' involvement. By increasing the level of involvement on specific contents, users will feel a sense of time distortion, a loss of self-consciousness, and then perform strong loyalty to this on-line system. Second, Internet content provider should adapt priority of functions and characteristics for on-line systems with different purpose. On the one hand, if its objective is to run forums for providing users a field of sharing information, providers should try their best to design interface with colourful layout, multimedia presentation and vivid look. On the other hand, if communication and consciousness of virtual communities is main objectives of on-line communication systems, providers should consider embedding the feeling of connectedness and social belongs in system design. Finally, on-line system managers should be aware of the importance of focused attention for creating users' flow experience. Subject involvement and interactivity speed is the ways to enhance focused attention. Enriching information and encouraging discussion are the effective methods to make difference to the level of users' concentration. For on-line communication systems and virtual communities, intensive interpersonal interaction among on-line users will cause more devotion to using these systems. Hence Internet content providers should try to create an atmosphere of a cohesive group in which everyone could get support and belongings to attract more users join in and closer communication.

6.3 Limitations

Due to limitations of this study, results should be treated with caution. First, flow is measured by recalling their previous flow experience in on-line communication environments. Although this approach is consistent with those in other literature (Koh & Kim, 2003), the answers possibly miss subtle dimension of consciousness during the process of reconstruction. Second, data were collected through a self-administered web questionnaire in this study. The doubts of self-selection maybe lead to a bias. Although our research design tried to eliminate duplicate response through an examination of identical e-mail addresses, the possible threat of a single respondent filling the questionnaire with different e-mail address was still unavoidable.

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