CHAPTER VIII

RESULTS AND FINDINGS

This chapter interprets the results from the final flow model presented in Figure 7.12. Although this diagram provides a graphical representation that illustrates associative relationships among various factors in the model, an interpretation of the parameters will improve the utility of this model. Kaplan (2000) criticizes the current literature on structural equation modeling for the lack of interpretation of the estimated parameters. He states that if the goal of the research is to go beyond an explanation of phenomena and toward utilizing the model to address specific questions, then interpretation of the results is crucial.

One of the primary purposes for the second part of this research was to test relationships of latent variables in the proposed flow model. Each path in the model represents a causal relationship between two factors. Each estimated path coefficient represents the magnitude of this causal effect. The total magnitude of the causal relationships takes into account both the direct and indirect effects of latent variables on one another.

Defining and constructing the measurement for flow in a hypermedia environment was also a special focus of this research. Findings from the validity test of the measurement for latent variable flow will benefit future research on measuring and analyzing flow experience in the hypermedia environment of the Web.

The final flow model demonstrates the hypotheses that were supported by this research, as well as the new relationships that were found during the model-fitting process. The following sections will discuss the implications of the final structural model. The numerical values about the magnitudes of impacts come from the path coefficients in the model as presented in Figure 7.12. Interpretations of these absolute values are: values less than 0.1 indicate "small" effects, around 0.30, "medium" effects, and greater than 0.5, "large" effects (Kline 1994). The summary section will include a table that summarizes the findings, and several graphics that illustrate the major contributors to flow experience, increased learning about a place, and changes of attitude and behavior.
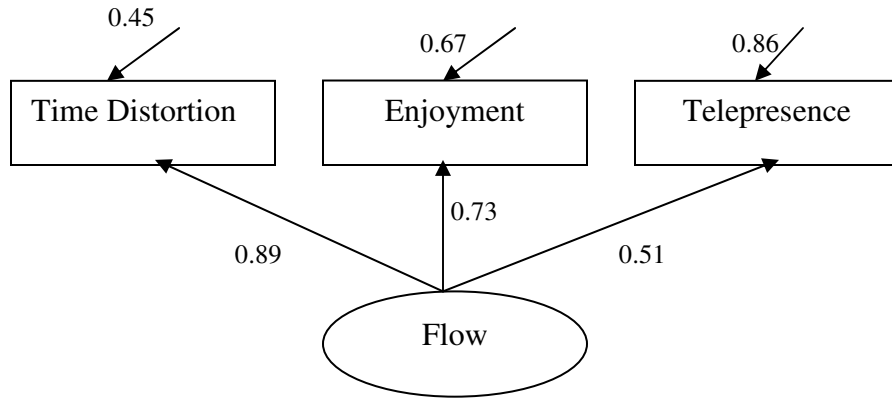
Flow and Its Measurements

One of the major challenges in the research of flow experience is how to measure it. This research proposed time distortion and enjoyment as two indicators of flow. The model fitting process also identified telepresence as being another indicator of flow experience in the context of the hypermedia environment of the Web.

Telepresence refers specifically to the feeling of being present in an environment other than the one the person is actually in during the interaction between that person and the computer. It has not been included in characterizing flow experience prior to this research. Figure 8.1 shows the result of the confirmative analysis with telepresence as the third measurement variable for flow.

One requirement for a variable to be the indicator of a latent variable is that the magnitude of the path coefficient from the latent variable to that measurement variable should be at least moderate. As shown in Figure 8.1, the standardized estimation of the

Figure 8.1 Measurements of flow construct

Time Distortion   Enjoyment   Telepresence

0.45   0.67   0.86

0.73

0.89   0.51

Flow

path coefficients for all three measurement variables are relatively high, ranging from 0.51 to 0.89. This indicates that the causal relationships between flow and its three indicators are of an acceptable magnitude. Another condition that must be met is that the measurement's composite reliability be not less than 0.6. As calculated before, the measurement's composite reliability of flow is 0.69, satisfying the requirement for composite reliability. Thus, there is adequate evidence for these three variables – time distortion, enjoyment and telepresence, to be the measurement variables of flow in the context of human-computer interaction on the Web. This result is an important finding of this research, especially regarding telepresence.

Factors That Directly and Indirectly Contribute to the Flow Experience

Experience and Its Impact

Contrary to expectation, this research did not find that visitors' experience with virtual tour Web sites affects their attitudes towards the attractiveness of a Web site. Experience did not show any statistically significant effect on people's feeling of the Web site's ease of use either. However, these results are inconclusive because there were indications of problems with the measurement of this factor.

Speed

Contrary to the original hypothesis, speed was not associated with the level of interactivity. Instead, it demonstrated a strong positive impact on the Web site's

attractiveness. The magnitude of the impact was 0.9343. This relationship was not specified in the initial flow model.

This research also found that speed was highly correlated with challenge. The magnitude of this correlation was 0.7479. Challenge was defined as the content of the Web site. Therefore, this result suggests that a Web site's response speed affects people's evaluation of its content.

Although these results do not conform to Steuer's (1992) model of interactivity, they are in agreement with the result found by Dellaret and Kahn (1999). Their research shows that Web waiting time affects people's evaluation of the Web site's design or content. Their findings support the results of this research that speed affects people's evaluation of the attractiveness and the content of a Web site.

The indirect impact of speed on flow was mediated through attractiveness. The total impact of speed on flow was the product of 0.9343 (speed $\rightarrow$ attractiveness) and 0.9707 (attractiveness $\rightarrow$ flow), which yields a positive impact of 0.9069.

Attractiveness

There were strong evidences that people's evaluation of the Web site as being interesting and attractive had a strong direct impact on flow experience. The magnitude of this impact was 0.8092. The indirect positive impact of this factor on flow experience was mediated through ease of use and interactivity. The magnitude of this indirect impact was the product of 0.8687 (attractiveness $\rightarrow$ ease of use), 0.8960 (ease of use $\rightarrow$ interactivity, and 0.2075 (interactivity $\rightarrow$ flow), which yields 0.1615. The total effect of attractiveness on flow was 0.9707.

The attractiveness of the Web site also demonstrated a moderate direct impact on changes of attitude and behavior -- to investigate more or to take responsible actions. The magnitude of this direct effect was 0.3153. The result revealed that an attractive Web site could lead to positive and responsible actions, including (1) finding out more about the place, (2) coming back to the Web site, or (3) visiting the place.

Attractiveness also had a strong direct impact on people's impression of the Web site's ease of use. The magnitude was 0.8687. It seemed that if a visitor was impressed with the Web site, he/she also tended to be less critical about the ease of use of the Web site. This relationship was not anticipated by the original flow model.

Ease of Use

Ease of use refers to the ease with which visitors can locate the relevant information for which they are searching. As predicted, ease of use played an important role in people's interaction with the Web site. Higher levels of perceived ease of use led to higher levels of interactivity. The direct impact of ease of use on interactivity was of the magnitude 0.8960.

Ease of use does not directly affect flow experience. The indirect impact of ease of use on flow was through interactivity. The magnitude was the product of 0.8960 (ease of use → interactivity) and 0.2075 (interactivity → flow) yielding an effect of 0.1859.

Interactivity

Interactivity demonstrated a moderate causal relationship with flow experience. It had a direct impact on flow experience. The direct effect is also its total effect. The magnitude was 0.2075.

Challenge -- Content of the Web Site

The original hypothesis predicted that challenge could be one of the factors that contributed to flow experience. It was thought that challenge would come from the content of the Web site, that is, whether the Web site provided something new to visitors. However, the result did not show a statistically significant impact for this factor on the flow experience.

On the other hand, this factor had a significant impact on people's learning about a place. The result shows that if a Web site provides something new that challenges visitors' knowledge about a place, it would then have a positive effect on people's learning about a place. The magnitude of this effect was 0.4128. As will be discussed later on, learning about a place had a positive influence on taking positive and responsible actions. Therefore, the content of the Web site, reviewing something new yielded a total positive effect of 0.2443 on people's willingness to know more about the place or to visit that place. This effect level is the product of 0.4218 (challenge $\rightarrow$ learning about a place) and 0.5793 (learning about a place $\rightarrow$ changes of attitude and behavior). This relationship was not specified in the original flow model.

Skill -- Visitors' Domain Knowledge

This research defined domain knowledge as people's knowledge of the place presented in the Web site – the Texas coastal region and birding. Contrary to what was expected, domain knowledge, or skill, did not indicate a statistically significant effect on the occurrence of flow experience. Instead, the final flow model suggests that visitor's knowledge demonstrated a small influence on changes of attitude and behavior. People with more knowledge of the area or having birding skills were slightly more likely to inquire into getting more information about the place, come back to the Web site for birding information, or visit the place. The magnitude of this positive influence was 0.1942.

Summary of the Direct, Indirect and Total Effect of
Factors on Flow Experience

Four factors were directly and indirectly associated with flow experience. Factors that directly contribute to flow are interactivity and attractiveness. Factors that indirectly contribute to flow include speed and ease of use.

Interactivity demonstrated a relatively moderate level of impact on flow experience. The magnitude the total effect was 0.2075. Attractiveness, on the other hand, showed a strong influence on people's experience of flow. The direct impact was of the magnitude 0.8092. The indirect effect of attractiveness on flow was 0.1615, yielding total effect of 0.9707.

Speed and ease of use affect flow experience through attractiveness and interactivity. The magnitudes of this indirect, transmitted effect were 0.9065 and 0.1589 respectively.

Consequences of Flow Experience

The third research question concerns the consequence of flow as it relates to the effectiveness of a place-based interpretive Web site. Effectiveness is the central concern for any Web development or any online interpretive project. The purpose of an environmental interpretive presentation is to inform people about natural resources, foster awareness, and stimulate responsible actions. As expected, the path coefficients of the final flow model report that flow experience contributes to increased learning as well as changes of attitude and behavior.

Learning about a Place

As expected, flow experience had a positive impact on people's learning about a place. People experiencing flow while browsing the Web site were more likely to respond positively about their increased knowledge about the place presented. The magnitude of this effect was 0.4708.

Another factor that contributes to learning about a place is the content of the Web site. The magnitude of this direct influence was 0.4128. This result suggests that if visitors were challenged by the content of the Web site, they appeared to feel they had gained more knowledge about the place. This relationship was not specified in the original flow model.

The indirect effects of speed and attractiveness on learning about a place were mediated through flow experience. The influence of speed was 0.4268. The influence of attractiveness was 0.4570.

Changes of Attitude and Behavior

The results of this research show that all other factors in the flow model had a direct or indirect effect on people's changes of attitude and behavior. To test how an interpretive Web site could achieve the goals of environmental interpretation, this research defined the following actions, after visiting the Web site, as measurements of this factor:

(1)   inquiring for more information after visiting the Web site

(2)   coming back to the Web site later for information

(3)   visiting the place

The results of this research indicate that the increased learning about the place by visiting the Web site is the most significant contributor of these actions. This direct positive impact was 0.5793 in magnitude.

Two other factors also showed direct influence on these positive actions. They are attractiveness of the Web site and visitors' knowledge base. The results showed that if people were attracted to the Web site, they were more likely to take these actions. The magnitude of this direct effect was 0.3153. The indirect effect of attractiveness on positive actions was through increased learning about a place. The indirect effect was 0.2647. Thus, the total effect of attractiveness of the Web site on changes of attitude and behavior was 0.5800.

As discussed earlier, domain knowledge, which refers to knowledge about birding and the geographical area presented in this research, had a small positive impact on these actions. The influence was 0.1942 in magnitude.

The indirect impact of flow on changes of attitude and behavior was mediated through increased learning about a place. The magnitude of this influence is the product of the standardized path coefficients of 0.4708 (flow → increased learning about a place) and 0.5793 (learning about a place → changes of attitudes and behavior), yielding a level of 0.2162.

Summary

The results of this study indicate that the interrelationships among factors in a Web site's development are closely related to the quality of people's experience and the effectiveness of the Web site to relay an interpretive message. This result supports the general hypothesis that factors in Web site development affect the performance through their direct and indirect influence on people's experience while browsing the Web site. These factors can be grouped into four domains: design, performance, visitors' individual differences and the content of the Web site.

Table 8.1 summarizes the direct, indirect and total effect among factors in the final flow model. Figure 8.2 – 8.4 illustrate the major contributors to flow experience, learning about a place and changes of attitude and behavior.

The results presented in Table 8.1 and Figure 8.2 – 8.4 indicate that attractiveness appear to be a key to designing effective interpretive Web sites. Attractiveness is the most important factors that that leads to flow experience; and flow is the most important factor contributing to learning about a place. Attractiveness and learning about a place, which is driven by attractiveness, are the most important factors that affect changes of

TABLE 8.1

Summary of direct, indirect and total effects among factors in the final flow model

	Speed	Attractiveness	Ease of Use	Interactivity	Challenge / Web Site Content	Skill / Domain Knowledge	Flow	Learning about a Place	Changes of Attitude / Behavior
Speed									
direct									
indirect									
total									
Attractiveness									
direct	0.9343								
indirect									
total	**0.9343**								
Ease of Use									
direct		0.8687							
indirect	0.8042								
total	**0.8042**	**0.8687**							
Interactivity									
direct			0.8960						
indirect	0.7272	0.7784							
total	**0.7272**	**0.7784**	**0.8960**						

Table 8.1 -- *continued*

	Speed	Attractiveness	Ease of Use	Interactivity	Challenge / Web Site Content	Skill / Domain Knowledge	Flow	Learning about a Place	Changes of Attitude / Behavior
Challenge / Web Site Content									
direct									
indirect									
Total									
Visitors' Skill / Domain Knowledge									
direct									
indirect									
Total									
Flow									
direct		0.8092		0.2075					
indirect	0.9065	0.1615	0.1859						
total	**0.9065**	**0.9707**	**0.1859**	**0.2075**					
Learning about a Place									
direct					0.4128		0.4708		
indirect	0.4267	0.4570	0.0875	0.0977					
total	**0.4267**	**0.4570**	**0.0875**	**0.0977**	**0.4128**		**0.4708**		

Table 8.1 -- *continued*

	Speed	Attractiveness	Ease of Use	Interactivity	Challenge / Web Site Content	Skill / Domain Knowledge	Flow	Learning about a Place	Changes of Attitude / Behavior
Changes of Attitude / Behavior									
direct		0.3153				0.1942		0.5793	
indirect	0.2472	0.2647	0.0507	0.0566	0.2391		0.2727		
total	**0.2472**	**0.5800**	**0.0507**	**0.0566**	**0.2391**	**0.1942**	**0.2727**	**0.5793**	

Figure 8.2. Factors that affect flow experience
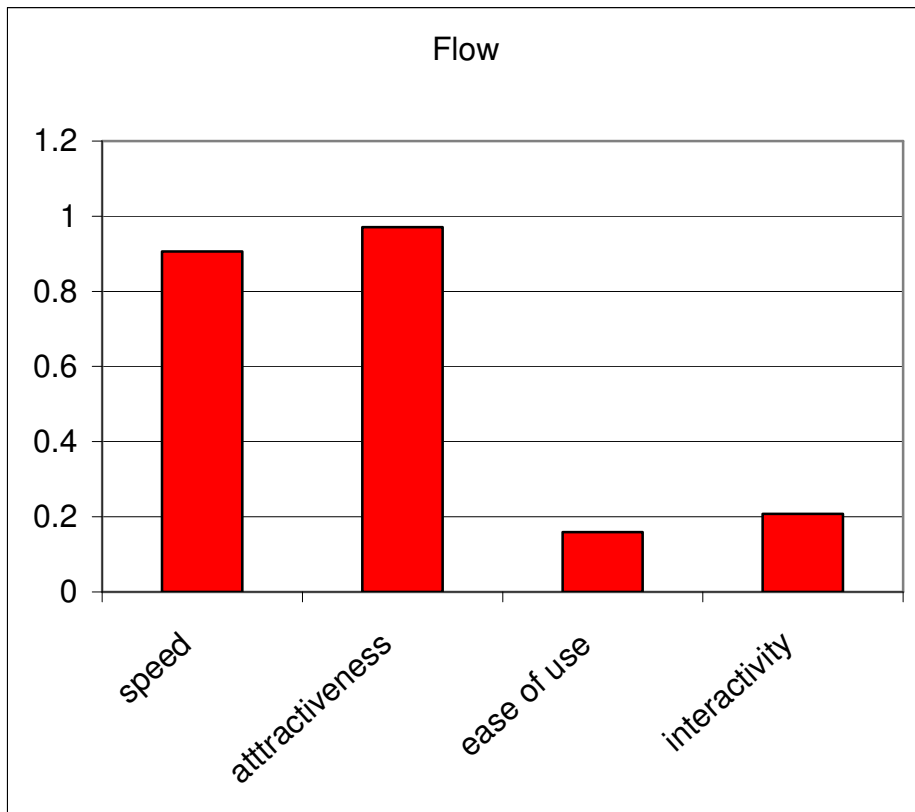
Figure 8.3. Factors that affect learning about a place

Increased learning about a place

0.48	
0.47	
0.46	
0.45	
0.44	
0.43	
0.42	
0.41	
0.4	
0.39	
0.38	

speed   attractiveness   flow   content of the web
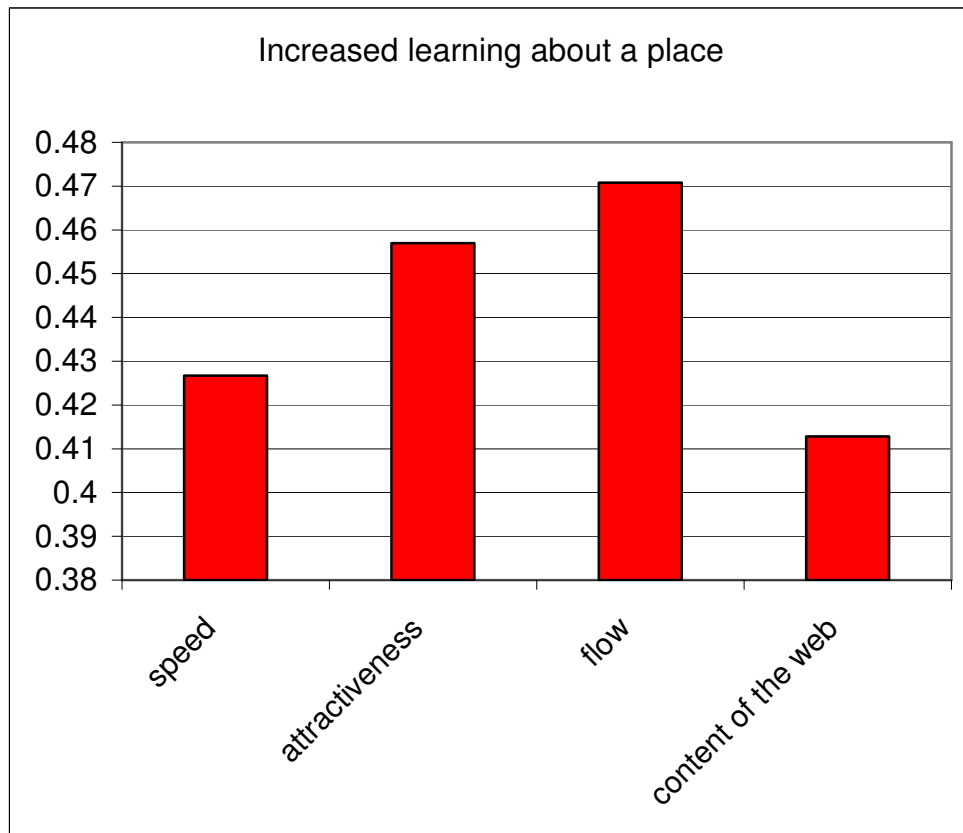
Figure 8.4. Factors that affect changes of attitude and behavior
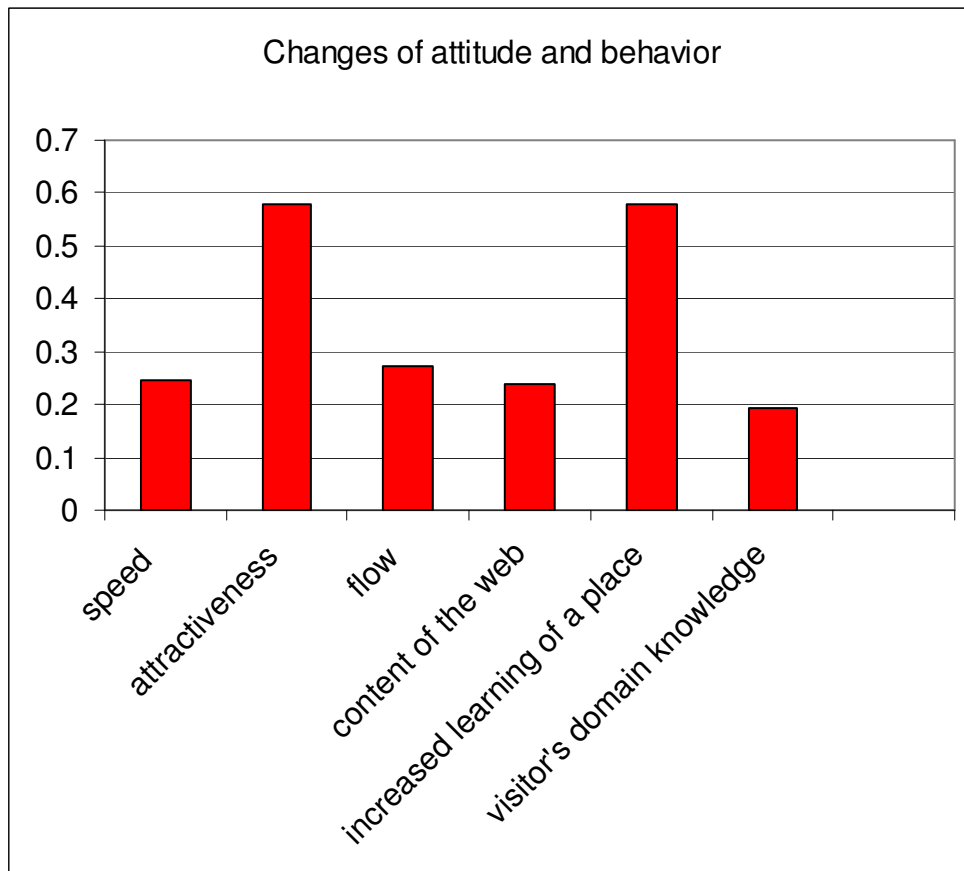

Changes of attitude and behavior

attitude and behavior. Speed was one of the factors that affect people's evaluation on a

Web site's attractiveness.