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ABSTRACT

The purpose of this paper is to investigate a flow model (F-model) and its operationalizations ability to measure flow. This flow model differs from the ones presented in existing research through its operationalization and differentiation between experiences with the task and experiences with the artifact. The focus of this research is the intrinsically motivated, flow dependent task of playing computer mediated games. The artifacts used are a game console and a mobile phone. Use of the F-model generated rich data of the test persons' experiences and feelings while playing a computer mediated game. It provided data that indicated differences between the artifact and the task and their influence on the flow experience. Although the F-model worked well the need to give more stringent definitions to some of the concepts in order get a better operationalization is found.

KEYWORDS

Flow, Flow Model, Computer Mediated Games, Computer Mediated Environments, Person-Artifact-Task (PAT) model, Engagement, F-model, Enjoyment, Immersion, Human-Computer Interaction, Mobile Phone, X-box.

INTRODUCTION

In existing flow research within computer mediated environments (CMEs), different models and operationalizations of the flow concept have been used as well as different methods to collect empirical data regarding flow experiences and its antecedents (Agarwal & Karahanna, 2000; Chen, 2000; Ghani & Deshpande, 1994; Huang, 2003; Novak & Hoffman, 1997; Novak, Hoffman, & Yung, 2000; Pace, 2003; Trevino & Webster, 1992; Webster & Ho, 1997). Virtually none of these have had a focus on intrinsically motivated tasks and artifacts upon these tasks are performed. Finneran and Zhang (2005) identify following challenges when studying flow in CME:

- Conceptual challenges due to different and ambiguous models in existing research.
- Challenges concerning the difficulties in operationalizing the concepts influencing flow.
- Methodological challenges concerning difficulties in data collection due to the affective and dynamic nature of flow.

Aderud (2005) proposes a theoretically grounded research design, using a new flow model, the F-model (Figure 1). This model draws on the work by Novak et al. (2000) and Csikszentmihalyi (1990) and is a merge with the view of the PAT model (Finneran & Zhang, 2002, 2003). The F-model differs from the ones presented in existing research through its operationalization and differentiation between experiences with the task and experiences with the artifact. The research design argues in favor of a combination of different qualitative methods for collecting empirical data (Aderud, 2005). The model is designed to be used for measuring flow while engaged in an intrinsically motivated activity. The study object of this research is the intrinsically motivated and flow dependent task of playing computer mediated games (CMG).

The purpose of this paper is to investigate a flow model (The F-model) (Aderud, 2005) and its operationalizations ability to measure flow with differentiation to how the task and the artifact respectively influence the perceived flow experience. The study, a small pilot study, was done with an Xbox game console and a mobile phone. This paper will not deal with differences in the experiences between the artifacts. Though this is an important aspect to the larger body of research which this paper is part of, this pilot study is more of a test of the models generalization and applicability on different artifacts.

Using the model described in this paper could give us clues as to how to design games and artifacts to be more conducive to flow. It could contribute to both the design of games, the design of artifacts upon which games are played and also to the design of artifacts or applications targeted for utilitarian use e.g. education or critical systems used by the e.g. police and rescue forces.

The paper is structured as follows; next section presents the F-model. Section three describes the pilot study design. Section four presents the results. The fifth section discusses these findings and experiences of the study. Finally, section six presents the conclusions of the paper.

THE F-MODEL

The F-model suggested by Aderud (2005) is a development of existing flow models and makes a distinction between task and artifact as Finneran and Zhang (2005). Furthermore, as suggested by Finneran and Zhang (2005), it takes the individuals and their differences into consideration, not only concerning skills, but also their autotelic personalities. The F-model takes the overall view of the flow concept like e.g. Novak et al. (2000) and Csikszentmihalyi (1990) and merges it with the PAT models view of factors influencing the flow experience.

The concepts in the model are categorized in flow antecedents, flow experience and flow consequence. This categorization has been used in earlier research of flow in CMEs (Chen, 2000; Ghani & Deshpande, 1994; Trevino & Webster, 1992) and these categories have been empirically validated by Chen (2000).

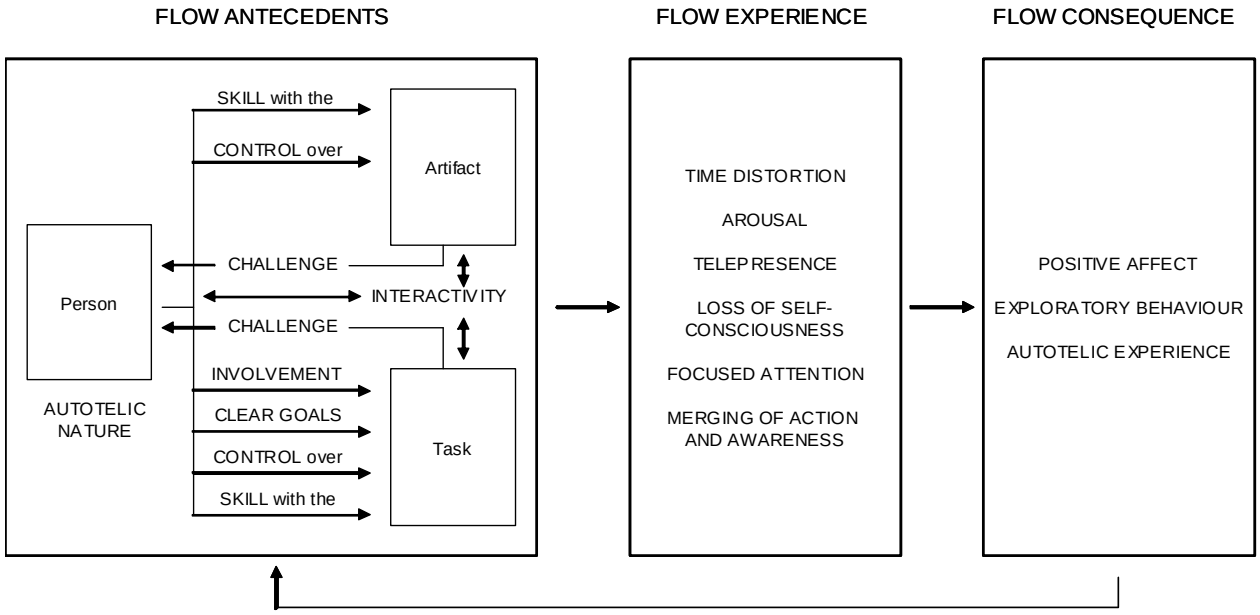

Figure 1. The F-model (Aderud, 2005).

The F-model's (Figure 1) intended use is as a framework for studying intrinsically motivated tasks and the artifacts upon which these tasks are being performed. Figure 1 illustrates how the antecedents influence the person and the experiences s/he has with the artifact and task respectively. The interaction that takes place inside the antecedent's rectangle can lead to flow experiences (middle rectangle) e.g. time distortion. These experiences can then lead to possible flow consequences shown in the rightmost rectangle.

The definition and interaction of the concepts within the **antecedent's rectangle** are shown below. (Since some concepts are used for both artifact and task the letter (A) for artifact and (T) for task will be added to the concept name):

A-Skill: A person's perceived skill using the artifact e.g. earlier experience/use, for how long etc.

A-Control: The person's observable control of the artifact and perceived control while handling the artifact. This concept is influenced by A-Skill and T-Skill.

A-Challenge: The challenge a person perceives as presented by the artifact in using the artifact. This concept is influenced by A-Skill.

T-Challenge: The challenge a person perceives as presented by the task. This concept is influenced by T-Skill.

T-Involvement: The motivation of a person to engage in performing the specific task. Concerning how much time the person is willing to put into the task, the energy the person puts into learning the task, the expectancy of rewards, and the person's willingness to concentrate.

T-Clear Goals: The person's reason/s for performing the task.

T-Control: The person's actual handling of the task and perceived control while performing the task. This concept is influenced by T-Skill and A-Skill.

T-Skill: The person's perceived skill with the task e.g. earlier experience/use, for how long/how many times etc.

Interactivity: The person's perceived experiences of the task's and the artifact's responses to the actions performed by the person.

The definitions of the concepts within the **experience rectangle** are shown below.

Telepresence: The perception that the actual physical environment is real to a lesser extent than the virtual environment one is interacting with.

Time Distortion: The person losing sense of time and experiencing time moving faster or slower than it actually does.

Arousal: The persons perceived level of excitement during the session.

Loss of Self-consciousness: The person not being aware of his/her mimics, movements and what they say during the session.

Focused attention: The person being so focused on the task at hand that he/she is less aware of his/her immediate surroundings.

Merging of action and awareness: The person's perception of that he/she is one with the actions that he/she is performing.

An example of how the concepts in the F-model interact could be as follows: A person trying to cope with both the challenges from the artifact and the task leads to focused attention which could lead to telepresence, time distortion and loss of self-consciousness. Getting involved and motivated in combination with clear goals and challenges could lead to getting the person aroused and influence the focused attention. This could lead to the merging of action and awareness. These experiences could become a flow experience that leads to flow consequences like positive affect.

THE PILOT STUDY

The pilot study is a way to find flaws in the F-model, its operationalization and the way of implementing it before more extensive test is conducted. (Bryman, 2001) The study was conducted on premises at Örebro University, spring 2005 and at a game developing company in Stockholm fall 2005. Four persons participated in the study, two in Örebro and two in Stockholm. The persons in Örebro played games on an X-box console and the Stockholm group played a game on a mobile phone. The test persons (TP) in the pilot study were both male and female ranging between the ages of 25 to 34. They were selected based on a few criteria: their previous experiences in gaming, age (from 15 to 40), their willingness to participating at their own will.

Both tests were conducted in a medium sized office rooms. The rooms were not sterile but would not be called homelike. A digital video camera on a tripod caught the TV screen or the mobile phone screen in an angle that gave a good view on what happened on the screen and the TP in profile.

The TPs were introduced to the task, that the game session was video recorded and that they would be observed at the same time. They were informed that the gaming session would be followed by an interview and a Stimulated recall (SR) session that was to be recorded on audio tape.

The TPs playing on the X-box console was given a couple of different game titles from different genres to choose from. They chose "James Bond – Agent under fire" and "Grand Theft Auto 3", both action games. The TPs playing on a mobile phone played a game already installed on the phone, an adventure game. The observer was positioned behind the TP to be able to observe the TPs handling of the artifact, his movements and the screen at the same time. The session was timed and the observer took notes on the TPs actions and reactions during the session e.g. the TP looking away from the screen to check the buttons on the artifact or sighing etc. These observations generated questions to the SR session were the observer could ask the TP what he was experiencing at the time of the made observation. Each gaming session took about one hour and the following interview and SR session took about an additional hour.

The TPs were interviewed about their experiences during their game session and were also able to see and respond to the video recording of his/her game session hence being able to comment on actions and reactions captured in the recording. A stimulated recall (SR) procedure was used for this to explore the cognitive process of the TP (Lyle, 2003).

The concepts in the F-model (Figure 1) were operationalized into questions asked during the interviews (see Appendix A). The operationalizations stemmed from the definitions of the concepts. The questions were also influenced by existing research (e.g. Agarwal & Karahanna, 2000; Ghani & Deshpande, 1994; Novak et al., 2000; Pace, 2003). The semi-structured interviews allowed the observer/interviewer to reformulate questions for clarification. The problem of the respondents not understanding questions asked to them is evident in earlier research (Agarwal & Karahanna, 2000; Chen, 2000; Novak et al., 2000). The semi-structured interview also gives the possibility to follow the line of thought of the TP with follow-up questions e.g. regarding why they felt the way they described in an answer. The reason for using semi-structured in-depth interviews is that most of the concepts associated with the flow experiences are not directly observable and the power of using in-depth interviews lies in its ability to provide a more direct understanding of the respondents experience through the dynamic and flexible line of questioning (Pace, 2003). The pre-defined questions (Appendix A) were sorted to the concepts in the flow model focusing on the concepts in the antecedents' rectangle and the experience rectangle. The same concepts were the points considered during the observations. (Figure 1)

After the interview and the SR session, TPs were presented with three quotes of people describing their flow experiences and then asked questions regarding the quotes (Chen, 2000). (Appendix B) This part of the study was done to get a picture of the TPs' prior experience of flow not connected to the test situation. It was used as to get a bearing on the TP's autotelic nature (see Figure 1) and ability to experiencing flow. The reason for asking this at the end of the test was that we did not want the TPs to think about flow and flow experiences during the gaming session, due to the fact that this might have influenced the TPs and their focus on playing the game.

The video- and audio recordings from the interviews and SR sessions were transcribed for the analysis. The answers were sorted under the question that was answered. The transcriptions were then further analyzed whereas answers that contained thoughts or experiences about other concepts than what the question regarded were sorted under these concepts respectively. The notes from the observer and the transcriptions from the SR session were compared and sorted to the concepts in the F-model (Figure 1).

RESULTS

The results from the interviews are presented with an account of the TP's answers and quotes to illustrate what the answers could look like. The accounts are sorted to the group of questions the TPs answered. The results from the SR session and observations are presented with quotations from the TPs and indications of observed data. These are grouped to the appropriate concept from the flow model. The presentation takes no regard to what artifact or game the TPs used since it is how well the model and its operationalization works that we want to study.

Interviews

Control

All TPs stated that they felt an over all control of what they were doing while playing the game. Two thought that the artifact was a problem. Others had no problem with the artifact but all had, at times, problems in understanding how to interact with parts of the game.

> "*It felt like I could have performed better if I had had control. It was the console that was the problem but in combination with the game it made me feel like I couldn't control everything.*"

Challenge

The TPs felt challenged by both the game and the console but to different extent and that it gave them some kind of test of their skills. On the question regarding frustration (C4, Appendix A) their answers differed. Two TPs expressed that they had felt frustrated and annoyed at times whereas the other two said that they did not reach that level.

> *"The first missions felt a bit easy…but I know they get harder…I always have problem with time limit missions…then I feel the pressure…The gamepad felt quite natural but...for some actions it depends on the settings of the controls …but it felt natural and no problem to use.*"

Skill

When judging their skills with the artifacts and the task (the specific game) the TPs rated their skill with the type of game very high and that they had much experience playing whereas on skill with the artifacts it ranged from low skill to very high skill.

> "*On a scale from 1 to 5 I would give myself a 4.*"

Focused attention

One TP stated that he was totally absorbed by the game and three did not think about anything else during the gaming session. The same TP (that was totally absorbed) said that he was not aware of any distractions. The other three perceived themselves not that absorbed and were aware of their surroundings and of the observer to some extent.

> *"You I was aware of but it was more like I accomplished something in the game and …whoa…and I looked up and there were you sitting there but it didn't distract me, not a whole lot, no.*"

Interactivity

In describing their feelings about interacting with the game all TPs perceived it as very natural and two TPs thought that the responses by the game to their actions were mostly according to their intentions. The other two felt that there were sections of the game that did not work as the expected. Interacting with the artifacts and its responses to the TPs actions three persons perceived as being easy and intuitive. One person felt that it was a little more problematic.

> *"It felt good. It was logical. It was easier than with the gamepad. Games are usually built similar…so if you played one of these types of game…you learn pretty fast.*"

Time Distortion

All the TPs experienced time distortion to various degrees and could not give the right time for how long they had played the game.

> "*It feels like 20 min.*"

Telepresence

The TPs awareness of their surroundings differed. Two TPs were scarcely aware of the surroundings at times during the gaming session and one felt as to be very much in the game world. The other three TPs did not really feel as being in the game world and was more aware of their surroundings.

> "*No…One time I saw a flutter on the screen and I reacted for about a tenth of a second and then I was back in the game...before I almost got shot! If it was something outside the game…that was it*"

Arousal

The level of arousal also differed between the TPs. Two of them felt just a little aroused and exited, one felt no such thing at all but one felt very exited and aroused.

> "*Oh yes! First I was a bit disappointed that it was so easy…but then in the "submarine level"…that was great it's so much action that you can't concentrate on anything else! If someone would walk into this room I would throw them out!*"

SR sessions

These results were obtained through the SR sessions where the TPs commented on what they saw while watching their own gaming session on video. The observer sometimes asked the TPs to comment on things that had been observed if it was not brought up by the TPs.

Loss of self-consciousness

All of the TPs experienced that they lost some of their self-consciousness during the gaming session. Which their reactions during the SR-session showed:

> "*I look like an idiot!…like I'm weak minded!…it's terrible…you don't think about that at all!*"

Focused attention

Three of the TPs were observed to be very focused at specific moments during the gaming session. During the gaming session the attention was observed to be wavelike which were noticed by the TPs. One was observed and also confirmed that he had not been much focused.

> *"Here, I was laughing, I still thought it was fun…but…it was a quick laugh and then back…because you have to be concentrated again*"

Telepresence

Three of the TPs states that when they look at the recording they seem to some extent be "in the game" and not really aware of their immediate surroundings. One TP reacts on the recording and states that he might have been unconsciously aware of the observer but it was nothing that he thought about.

> "*…I believe that your presence made me act a little bit different…I would have cursed a lot more if you weren't there…I did not think about it but since I know how I react when playing at home and not being filmed…then I would have been cursing more.*"

Control

All TPs observe them self's not being in complete control trying out how the controls for the artifacts work. Which was observed (e.g. – TP is trying the controls, saying "now I know how to drive"). They all reacted on sequences when they had trouble to understand things in the game.

> *"This is part that I didn't understand what I was supposed to do. It flashed and then my guy went down…I tried to control that but I didn't get it. I was completely lost. No control what so ever*."

Challenge

The TPs state that the artifacts challenged them initially in that they had to figure out how to control it. All TPs also saw themselves in the recording being frustrated, not understanding things in the game or with the artifacts. (e.g. – TP getting frustrated – "How the hell do I aim when shooting!??")

> "*I went into the settings menu a couple of times…it was some thing with the gamepad…I didn't really had control on how to do specific actions…it had different setting than I'm used to*".

Quotes

The TPs responses to the questions asked after they had been showed the quotes are illustrated with quotes from their answers under each question. The TPs all had experienced what was described in the quotes to varying extent and their answers reflected upon how they had acted and experienced during the gaming session

1. Have you ever encountered the situation indicated by any one of above paragraphs playing a game?

> "*Yes…during this session…and many times before while playing games…especially action games or games that demands a lot of concentration. It is not really like in one of the quotes…if the phone rings I would answer but…I can ignore eating*."

2. When playing computer mediated games, have you ever experienced the feeling of `time going too fast'?

> "*Yes, definitely! All the time! Even on a mobile phone. When I play on a PC it's almost scary. It feels like no time has passed and you look at the time and finds out that it's been hours.*"

3. Have you ever experienced the feeling of enjoyment while playing computer mediated games?

> "*Yes, absolutely! When you beat a difficult passage or the character in the game is successful.*"

4. Have you ever experienced the feeling of "positive challenge" while playing computer mediated games?

> "*Yes…I have felt it…have no example…but that is actually why I play…getting challenge and beating the game which results in positive feelings.*"

5. Have you ever experienced the feeling of `being in control while playing a game?

> *"Yes, to a pretty large extent…but it's that fraction on "non-control" that is challenging…it is that that you want to master."*

DISCUSSION

The results we got indicate that the operationalization of the concepts in the model worked fairly well in eliciting the answers intended. From the **antecedents rectangle** in the model (Figure 1) the items concerning *control* and *challenge* gave us answers regarding the TPs perceived control over, and the perceived challenges presented by the artifact and game (task) respectively. In the results sections we can see that the TPs experienced some difficulties handling the artifact at times as well as, to some extent, having trouble handling the game. It also show the TPs sometimes experienced frustration because of the game but at the same time having no problem with the artifact. It is evident that using the F-model and the operationalization of the concepts makes the distinction between artifact and task visible, a differentiation that could be hard to distinguish if only asking about an over all feeling of control or challenge while playing. The operationalization of the *skill* concept also shed light on the potential differences between the artifact and task. With the *interaction* concept we could also see differences between artifact and task but there is a need to better define and operationalize this concept. This because the answers were similar to those given in regards to the *challenge* concept. Item 3 and 4 (see Appendix A Interactivity) worked well but the other items need to be revised. There are two things missing in the operationalizations of the concepts in the **antecedents' rectangle**. The concepts *clear goals* and *involvement* has been defined but is not operationalized into questions or items for the interviews. The answers concerning these concepts was supposed to be found in other statements made by the TPs during the interview or SR session but this is a imprecise flaw that needs to be remedied.

The operationalization of the concepts in the **experience rectangle** in the model (Figure 1) also worked satisfactorily. We found no problem in using the operationalization of the consisting concepts. The result show for example that all TPs experienced *time distortion* and that their *telepresence* varied, which we wanted to see if the F-model and its operationalization would capture. There are unfortunately an un-operationalized concept here as well namely *merging of action and awareness*. Questions and observation points for this is needed to cover the model and its intentions.

The combination of qualitative data collection methods proved quite fruitful. During the observations we noticed the way that the TPs used the artifact and acted and reacted while playing the game. The more objective observations of the TPs having trouble with handling the artifact or understanding what to do in the game, exclamations of joy or frustration and over all success or failure in game missions was verified and explained during the SR sessions. Giving the TP a chance to comment and elaborate on their own subjective feelings on why they acted or felt like they did at the observed moment. The results show us the appropriateness of using interviews and stimulated recall sessions to get a deeper understanding of the things influencing the flow experience and capturing the dynamic process of flow and playing CMG's.

When using this combination of qualitative methods it also helped clarify the TPs answers and shed light on things going unnoticed otherwise. Using the concept of *losing self-consciousness* as an example, the SR session provided results of TPs seeing themselves on video and commenting their looks and their degree of focus on the game, results hard to come over using e.g. surveys or ESM. These methods also made it possible to observe and get explanations from the TPs of "waves of focus/absorption" and their reason (See (Csikszentmihalyi & Le Fevre, 1989) and their discussion on quality of experience).

Previous research shows interesting results when presenting quotes, describing flow, to TPs to see if they have had those types of experiences (Finneran & Zhang, 2005).The results from this part of our study shows that they all could relate to that type of experience. From the answers we can see that e.g. one TP seems to experience this more easily than another TP. This and other answers from the results should indicate that that TP has a more autotelic nature. This helps us find how the individual differences influences the flow experience and what hinders and contribute reaching that experience.

The results also show that, although it was a special situation and some of the TPs were aware of the surroundings while playing, the TPs were not bothered or even aware of the observer while playing. This would mean that the situation nevertheless seemed to get the TPs in the right state of mind. Finneran and Zhang (2005) raise some concerns about experiments and their external validity. Since the experimental environment might take away the true context of the artifact and task, experiments might be weak, this because flow experiences are context-specific. What further weakens experiments is that according to Finneran and Zhang (2005), the person's state of mind is probably different in their job situation or other real-world scenario than in the experiment environment. We would argue in favor of the experiment in research on intrinsically motivated tasks since e.g. a gaming session is different from other scenarios. In this study TPs were motivated to play games and were enthusiastic to take part in the study. This is vouching for a stronger degree of intrinsic motivation and the right state of mind among the TPs.

CONCLUSIONS

The purpose of this paper was to investigate the F-model (Aderud, 2005) and its operationalizations ability to measure flow. The operationalization of the concepts in the F-model generated rich data of the test person's experiences while playing a CMG. It also provided data that indicated differences in influencing the flow experience between artifact and task. Together with the combination of qualitative data collection methods the F-model proved to be quite useful.

The results from this pilot study are too limited to making any generalizations but it gives indications on what could be found doing a larger study. It also shows pros and cons of, the F-model, its operationalization and the research design.

Although working quite well there is a need to more finely tune the F-model and its operationalization and in further empirical studies establish relations and dependencies between the incorporated concepts. Concepts like *control* and *interactivity* needs to get a more stringent definition. The operationalization overlapped and there were trouble distinguishing some of the items between the two concepts. Although handled by the observer through rephrasing the questions during the study it is important for the usability of the model and its operationalization that this is done. It is also important to further develop interview- and observation guides to be able to elicit the most from the studies. Finally there is a need to conduct larger scale empirical studies to be able to get more general data.

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APPENDIX A

Question asked during the interviews and SR session:

Control

1. Did you feel in control when interacting with the game?
2. Did you feel in control when interacting with the console?
3. Did the console allow you to control the game interaction?
4. Did you feel in control of what you where doing?

Challenge

1. Did the game challenge you in any way?
2. Did the console challenge you in any way?
3. Did playing the game provide a good test of your skills?
4. Where you, at any time during the gaming session, frustrated by what you where doing? What was it that frustrated you?

Skill

1. Are you skilled at using this type of artifact?
2. Are you skilled at playing this type of game?

Focused Attention

1. Did you think about other things when playing the game?
2. Where you aware of distractions when playing the game?
3. Where you totally absorbed in what you where doing when playing the game?

Interactivity

1. Describe your feelings about interacting with the game.
2. Describe your feelings about interacting with the console.
3. Where the consoles response to your actions was fast and according to your intention?
4. Where the game's response to your actions was fast and according to your intention?
5. Did you know the right thing to do?

Time distortion

1. For how long do you perceive this gaming session has been going on?

Telepresence

1. While playing the game, were you at anytime not aware of your immediate surroundings?
2. Did you ever feel that you were in the world created by the game?

Arousal

1. Did you at anytime get excited during the gaming session?

APPENDIX B

Quotes presented to the test persons after the SR session. The quotes were taken from Chen et al. (1999):

"My mind isn't wandering. I am not thinking of something else. I am totally involved in what I am doing. My body feels good. I don't seem to hear any-thing. The world seems to be cut of from me. I am less aware of myself and my problems."

"My concentration is like breathing. I never think of it. I am really quite oblivious to my surroundings after I really get going. I think that the phone could ring, and the doorbell could ring, or the house burn down or something like that."

"When I start, I really do shut out the whole world. Once I stop, I can let it back in again. I am so involved in what I am doing. I don't see myself as separate from what I am doing."

Questions asked regarding the quotes:

1. Have you ever encountered the situation indicated by any one of above paragraphs playing a computer mediated game?
2. When playing computer mediated games, have you ever experienced the feeling of `time going too fast'?
3. Have you ever experienced the feeling of enjoyment while playing computer mediated games?
4. Have you ever experienced the feeling of "positive challenge" while playing computer mediated games?
5. Have you ever experienced the feeling of `being in control' while playing a computer mediated game?