Engagement and Learning in a Computer Role Play Game: Neverwinter Nights in Antarctica

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Abstract

This thesis analysed how people learn when playing a computer role play game (RPG) using activity theory's concepts of contradictions and activity systems. Contradictions, defined as blocks or obstacles in an activity system, can be used to point out discrete actions within the activity system of a RPG that can be observed and analyzed. Four actions and two conditions, with and without contradictions, were identified, which were then evaluated against Csikszentmihalyi's (1975) theory of flow. Significant differences were found between actions with and without contradiction on flow. The findings demonstrated that activity theory can be used as a valid framework for game design and that actions and contradictions can be manipulated to affect player engagement and learning. Exploratory and observational results, as well as potential for educational applications for future research, are also discussed.

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Introduction

The engaging nature of games is fuelling the study of games as learning tools (e.g., Malone, 1980; Jones, 1999; Choi & Kim, 2004; Oliver & Pelletier, 2004; 2005). Studies have suggested that learning occurs through playing games (e.g., Malone, 1980; Kaptelinin & Cole, 1997; Dempsey et al., 2002; Kirremuir, 2003; Oliver & Pelletier, 2004). For example, games can teach hand eye coordination through fast action or "twitch" games (Jones, 1998). Also, strategic skills can be developed by playing role-play games that are complex and non-linear (Dempsey et al., 2002). Games can also teach team, social, communication and resource sharing skills through the playing of multi-player and team-oriented games and simulations (Kaptelinin & Cole, 1997). Playing games can also stimulate curiosity and encourage experimentation in a safe "virtual" environment; helping players develop familiarity with technologies, and supporting them to learn how best to use and manipulate software (Kirremuir, 2003).

The above examples all demonstrate that games can be used to teach certain skills, however research was needed to explain what is it about games that makes them engaging and how is this linked to learning. In order to begin to address this question, the current research extrapolated and expanded on Jon Pearce's (2005) study "The Ebb and Flow of Online Learning" (Pearce, Ainley & Howard, 2005) to study engagement in a computer role play game. Pearce et al. measured students' engagement in an on-line learning task using the theory of 'flow' (Csikszentmihalyi, 1975). Flow describes a state of complete absorption or engagement in an activity. The most important condition required to create a state of flow is balancing the right level of skill with the right amount

of challenge (Csikszentmihalyi, 1975). The theory of flow explains that people not only like to be challenged, but that they actively seek it out.

Pearce measured flow at the completion of seven different web-based activities, which involved solving progressively more difficult physics questions using two measures. The first measure was administered after the completion of each problem and consisted of two questions. One assessed the perceived challenge of the problem ("How challenging did you find this last activity?") and the other assessed perceived skill ("Were your skills appropriate for understanding this last activity?"). Pearce then used a formula, .25*(skill-challenge), to find a measure of flow. Values closer to zero indicated that the person was experiencing flow. At the completion of all seven physics problems, Pearce administered an "overall state measure of flow" (Trevino & Webster, 1992) to assess engagement, enjoyment and perceived control, which are considered to describe a mental state of a person in flow.

However, when studying engagement while playing a computer role play game, the difficulty lies in the fact that there are no clear or definitive points in the game where fluctuations in flow can be measured. To address this problem, Martin Oliver's and Caroline Pelletier's (2004) study, "Activity theory and learning from digital games: implications for game design" was used to map specific events in a role play game that would be considered more or less challenging. Oliver and Pelletier designed a framework using Engeström's (1987) model of the human activity system based on cultural historical activity theory. Cultural historical activity theory stems from Lev Vygotsky and his disciple Alexei Leont'ev, who believed that every activity is mediated by a tool or a 'mediating artefact', which acts on an object to achieve a subject's goal

(cited in Vygotsky, 1978). Engeström (1987) added that an integral part of every activity is the community. Both the community and the subject are motivated towards the same object. However, the subject and the community might not always act in unison to achieve a common goal. Conflicts with rules between the subject and the community, or between the subject and the tools to achieve an object lead to what activity theory calls a contradiction. Solving contradictions, which are defined as blocks in an activity system (i.e., where a subject is blocked from achieving their object), demonstrates learning (Engeström, 1987). In other words, one cannot progress towards their object until they learn to overcome or solve a particular contradiction.

Using Engeström's framework, Oliver and Pelletier analysed activity theory's concept of contradictions, which enabled them to observe a young girl learning how to play a computer game without disturbing the natural flow of game play. They devised a data analysis tool, which enabled them to track the progress of a young girl playing a *Harry Potter* computer game. As the girl played the game, Oliver and Pelletier noted every instance where the girl was blocked from achieving her goal. As the girl overcame the obstacles she learned to generalise her actions to similar scenarios. Hence, successful resolution of the obstacle was seen as evidence of learning.

Learning to overcome contradictions can be considered as challenging. A challenge can be defined as a "difficult or demanding task" (Oxford American Dictionary, 1980, p. 102). Studies have shown that challenge is an essential component for engagement in games (e.g., Malone, 1981; Jones, 1998; Csikszentmihalyi, 2000). In both Pearce's study and Oliver and Pelletier's study, learning is simply the successful completion of a task. Since the process of learning a new task is challenging, as

demonstrated in Pearce's study, I was interested in measuring what kind of an effect challenge would have on engagement.

Hence, the goal of this study was to use Oliver and Pelletier's activity theory framework to map a series of events where contradictions are likely to occur in the activity system of a computer role play game (RPG). In the activity system of an RPG, the subject was represented by the avatar or the character and the object was the avatar's goal, such as completing the quest. A contradiction was defined as anything that prevented the subject from achieving their goal, such as an avatar encountering a monster that needed to be overcome. For the purpose of this study, the player was not part of an activity system of the game. Instead the player interacted with the game through their avatar. Oliver and Pelletier's data analysis tool was used in the preliminary study to distinguish between unique events or actions in the RPG. These actions were then modified to either contain a contradiction or no contradiction condition. Finally, the four actions and the two conditions were evaluated by leveraging questionnaires from Pearce's study to measure flow during those events. In particular, the research question was: does imbedding contradictions within actions in an RPG affect the player's ability to enter flow?

Research Platform

As part of a project between the Human Oriented Technology Laboratory (HOT Lab) and The Geomatics and Cartographic Research Centre (GCRC) at Carleton University, our group's goal was to modify a popular computer role play game (RPG) Neverwinter Nights (NWN) in such a way as to stay true to the engaging nature of role play games, while introducing educational content about Antarctica (Dormann et al.,

2005; Woods et al., 2005). Computer RPGs are particularly interesting for studying and implementing educational content because the nature of the game revolves mainly around the player's character (avatar) interacting with other characters in a social context. This enables educational content to be embedded in the dialogue between the characters such that the characters can serve to educate each other on a variety of issues. For instance other characters were used to tell the player's avatar what materials they needed to collect in order to launch a weather balloon or about the importance measuring ozone levels in the atmosphere. In addition, the Aurora development kit provided within the NWN gaming platform enabled us to design and develop our own game quest. While NWN was not intentionally designed for educational purposes, however, we have created a modern day quest whose setting and content reflect living conditions and scientific processes in Antarctica.

Computer Role Play Games

A role play game (RPG) is a game genre where one or more players adopt a role and act it out in a virtual reality (Gee, 2003). Usually in an RPG game, the player through their character (avatar) will set out on an adventure or quest. While RPGs can include a multi-player environment, the scope of this thesis was limited to a single-player environment. In a single-player environment, one player is represented by one avatar. This enabled me to control interactions between the player's avatar and other non-player characters (NPCs), which are characters generated by the game developer. Every player experienced the same characters and conversations, allowing for a comparison of flow between subjects. In a multi player environment this would not be possible because

NPCs are replaced by other players' avatars such that their interactions are dynamic and always changing.

There is a strong cooperative aspect of role play games. The players can compete against or collaborate with other non-player characters, depending on their roles and goals in the quest. Other NPCs often serve to provide information and insight into solving problems and progressing through the quest. The experience of competing against or collaborating with other non-player characters influenced the player's engagement in the game. Since a main component of computer role play games involves interaction with other characters, the focus of this research project was, to a large extent, to evaluate how the player's avatar's interactions with other NPCs affected the player's engagement level. For example, some NPCs offered useful information for the player's avatar to continue and collect items needed for the quests, whereas some characters were rude or nonsensical. There were also monsters, which attacked and tried to kill the player's avatar. In each one of these circumstances, the player's engagement level was evaluated through the theory of flow. The following chapters explain the character/NPC scenarios against which flow was measured.

Neverwinter Nights in Antarctica

Neverwinter Nights is a role play game set in a medieval town called Neverwinter (Bioware, 2003). By using the Aurora development kit to modify Neverwinter Nights, the setting was changed to reflect an Antarctic scientific research station Halley, which was modeled after a real base. The game contains frozen landscapes, and is populated with characters such as students, scientists, support personnel and appropriate monsters. As the player's avatar progressed through the quest, they encountered "frost bite"

monsters, collected various items and explored the environment. True to the nature of RPGs, some characters were more helpful than others. By trying to model our quest as closely as possible to the original, our goal was to have the player become engaged in game play while learning about Antarctica (e.g., geographic layout of Halley station, wildlife, living conditions, global warming, scientific processes, etc.) instead of a fictional fantasy world.

The distinguishing features of role play games from other games stem from the fact that progression in the game requires collaboration with other characters. The goal of the game is not so much to win as it is to accomplish tasks related to the overall story quest. The quests are also non-linear, such that the avatar can explore the environment in any number of different ways. The social and non-linear nature of RPGs makes it difficult to measure progress clearly and is the reason why activity theory was chosen as a framework to study contradictions in the game. Mapping contradictions was used as a way to define actions in the game that are perceived as more or less challenging. These actions could be viewed as situations where a contradiction may happen, such as an NPC not giving the player's avatar useful information to proceed or the avatar being attacked by a monster. The actions were expected to have an effect on the player's engagement level, measured by flow. These actions will be described in more detail as components that make up activity systems in activity theory. The following chapter introduces some characteristics of engagement that will lead to the theory of flow and the idea of challenge as the essential ingredient for sustained engagement.

Games and Engagement

Games have to be fun and engaging or players will not take the time to play them. Because of this ability of games to be highly engaging, researchers and educators have tried to combine entertainment with education in hopes of making education more engaging and fun. This led to a creation of a type of product category called "edutainment" (Maushak, Chen, & Lai, 2001; Quinn, 1994). These endeavours often result in games that are modified in such a way that the student/player encounters a problem that they have to solve (e.g., mathematics equation, or answering a set of multiple choice questions) before they can continue with the game, such as in the development of Descartes' Cove (Wallace, 2005). The problem with this approach is that the educational component often has nothing to do with game play and rewarding problem solving with the continuation of game play can have unintended consequences.

The danger in trying to bridge games and education is outlined by Ryan & Deci (2002) work on motivation. In their self-determination theory (SDT) (1985; 2002) Deci and Ryan postulated that people have inherent growth tendencies and innate psychological needs that are the basis for their self-motivation and personality development. In other words, people are naturally driven to grow and advance. Ryan and Deci (1985) have identified three needs that appear to be essential for facilitating optimal functioning, potential for growth, constructive social development and personal well being. These needs are: competence (i.e., the ability to interact effectively with one's environment), relatedness (i.e., connections to and attachments with other people) and autonomy (i.e., having a sense of control or choice over one's actions) (Ryan & Deci, 2002). Ryan and Deci postulated that people are naturally driven or intrinsically

motivated to do things that provide them with a sense of competence, relatedness and autonomy. If an activity is intrinsically motivating, such as playing games, positive social-contextual events (e.g., feedback, communications, rewards) and optimal challenges can be used to maintain intrinsic interest in that activity. Optimal challenges can be viewed as situations where a person is pushed to the limits of their ability, but not beyond (Csikszentmihalyi, 2000). Ryan and Deci's research (2002) has repeatedly shown that the effect of extrinsic rewards can undermine intrinsic motivation. This occurs when external rewards are associated with an external locus of control, which is then interpreted as a loss of autonomy. This creates an important distinction between rewards that are part of that activity as opposed to rewards that are contingent for engaging in an activity. For example, if a player is rewarded with points as they progress through the game they will continue to be intrinsically motivated to play the game. However, if a player is rewarded for engaging in a game activity that they normally would not engage in, their motivation will come from an external source and may be perceived as a loss of autonomy or control with regard to engaging in a game. Deci and Ryan (2002) have shown that when an external reward is associated with an internally motivated activity its value tends to diminish and the game ceases to be engaging and fun.

Similar to Deci and Ryan, Jones (1999) stipulated that interest towards computer games, which he refers to as computer-based learning environments more broadly, needs to be intrinsically motivated and maintained. In his article "What Can We Learn From Computer Games: Strategies For Learner Involvement", Jones noted that a user must first accept a problem in order to maintain interest in solving it. The medium in which the

problem is presented is not as important as creating an interest in the problem. "Problems that are accepted by a user can promote engagement, and consequently the user maintains interest in the problem (Jones, 1999, p. 327)". Jones defined engagement as: "...nexus of intrinsic knowledge and or interest and external stimuli that promote the initial interest in, and continued use of a computer-based learning environment [including games]" (Jones, 1998, p. 205). Jones (1998) explained that people maintain interest in a problem if they are given a task that can be completed through incrementally increasing levels (i.e., challenge) that culminates in the completion of a game, which can be interpreted as the goal. However, Jones did not explain why a person would become interested in a game to begin with. A possible answer was offered by Malone (1981) who stated that in order to maintain engagement, games must be challenging, however in order to initiate engagement, games need to arouse curiosity and must have an element of fantasy (Malone, 1981). Malone (1981) claimed that "people are driven by a will to mastery (challenge) to seek optimally informative environments (curiosity) which they assimilate, in part, using schemas from other contexts (fantasy)" (p. 356). Jones (1998) also explained that having a sense of control over actions taken and learning how to control the system is an important part of most games.

Jones's and Malone's explanations of what arouses and maintains interest in games was largely corroborated by Ruben and Lederman (1982) who stated that elements of successful games are: goals, objectives, a clear start and finish, challenges and obstacles, ways to win and most importantly rules. Arguably ways to win and rules can be interpreted as a need to have control over the goal and outcome of the game.

Dempsey (2002) also reiterated that players are likely to sustain interest in games that are challenging and goal oriented.

Jones also noted that if the player is not intrinsically motivated to play the game, the environment may need to offer greater extrinsic motivational features to keep the learner interested. This is when other factors such as collaborative experiences and immersive environments, such as realistic graphics, become important (Jones, 1999). Choi and Kim (2004) further explained that for games to be engaging, they must provide the player with "optimal experiences" (p. 15). These experiences are facilitated by realistic graphics, sound and detail in the game, which are used to draw or immerse the player in the game (e.g., Jones, 1998; Jelfs & Whitelock, 2001). These immersive environments enable the player to feel a sense of deeper involvement.

Engagement in Role Play Games

Looking back at the characteristics of role play games, it is possible to extrapolate certain characteristics that are considered engaging as well as characteristics that are unique to role play games. Similar to other games, role play games are governed by *rules*, e.g., character's disposition (e.g., elf or wizard) and their alignment (e.g., good or evil) dictate how they will act. They are *challenging*, e.g., the stronger the character becomes, the more they can accomplish (e.g., kill stronger opponents, collect more treasure, etc.). They also have a *goal*. While the goal is not necessarily to win, the goal is to advance, become stronger, richer, more powerful, etc.

While having rules, goals and challenges are all essential for a player to continue playing a game, Choi and Kim's research particularly addresses the reasons behind the tremendous popularity of role play games. Choi and Kim (2004) found that the main

factors involved in obtaining optimal engagement experiences are: effective personal interactions with the system and pleasant social interactions with other people that are playing the game. More than any other genre of computer game, RPGs have a very strong social component.

Another characteristic prevalent in role play games is that people not only like to play them, but they will frequently report spending days or even weeks being entirely absorbed in a game (Gee, 2004). Jones (1999) also noted that game players can spend hours or even days completely absorbed in a game; however, he did not provide an explanation of why this is the case. Additionally interviews with other role play game players corroborate that they frequently spend entire weekends playing on-line computer games. Is a need for challenge, curiosity, control and purpose enough to sustain engagement or is something more needed?

Measuring Engagement in Games: The Theory of Flow

While Ryan, Deci, Jones, Malone, Choi, Kim and others all touch upon certain aspects of games that are considered essential for engagement, none have offered a theory that incorporates all these elements and proposes a unified explanation. The only theory that takes Jones's, Malone's and others definitions of engagement one step further in explaining exactly why we maintain a sustained engagement in games, is Mihalyi Csikszentmihalyi's (1975) theory of flow.

Flow has been studied in a wide range of areas spanning the disciplines of human computer interaction (HCI), psychology, information systems and education. For example: Web use and navigation (Chen & Nilan, 1998; Chen, Wigand, & Nilan, 1999; Pace, 2000); Web marketing (Hoffman & Novak, 1996; Novak, Hoffman, & Yung,

2000); in everyday life (Csikszentmihalyi, 1975, 2000); in group work (Ghani, Supnick, & Rooney, 1991); technology use in information systems (Agarwal & Karahanna, 2000; Artz, 1996); HCI (Webster, Trevino, & Ryan, 1993); and in instructional design (Chan & Ahern, 1999; Konradt & Sulz, 2001; Konradt, Filip, & Hoffmann, 2003).

Csikszentmihalyi defines the flow state as "the holistic sensation that people feel when they act with total involvement" (Csikszentmihalyi, 2000, p. 36). While Csikszentmihalyi uses the term involvement in his definition of flow, it encapsulates many of the elements considered essential for engagement.

> "[P]oised between boredom and worry; the autotelic experience is one of complete involvement of the actor with his activity. The activity presents constant challenges. There is no time to get bored or to worry about what may or may not happen. A person in such a situation can make full use of whatever skills are required and receives clear feedback to his actions; hence, he belongs to a rational cause and effect system in which what he does has realistic and predictable consequences (Csikszentmihalyi, 2000, p. 36)."

Csikszentmihalyi's theory of flow captures Jones's definition of engagement focusing on intrinsic motivation by stating that playing games appears to need no goals or rewards external to itself. Primarily, flow embodies game play because play is the classic example of an autotelic (i.e., intrinsically motivating) activity (e.g., Huiziniga [1939] 1950; Piaget, 1951, 1965; Callois, 1958 cited in Csikszentmihalyi 2000). However, in order for the player to remain engaged in the game the structure of games needs to provide motivational elements that will keep the player engaged. These are: social interaction, competition and the possibility of gains or rewards, which can be used to

advance the character through the game or win, similar to Choi and Kim's (2004) conclusion. This is also consistent with Ryan and Deci's explanation that an intrinsically motivating activity remains that way it the activity itself provides reasons for sustained engagement such as feedback and rewards.

The theory of flow introduces another important element of engagement: the idea of immersion or absorption in a game described by the merging of action and awareness. "A person in flow has no dualistic perspective: he is aware of his actions but not of the awareness itself (Csikszentmihalyi, 2000, p. 38)." Merging of action and awareness is made possible by a centering of attention on a limited stimulus field or "narrowing of consciousness" (Maslow, 1971, p. 63-65 cited in Csikszentmihalyi, 2000). In games, rules define the relevant stimuli and exclude everything else as irrelevant. The goal is to attain and maintain a state where time loses meaning and you leave your sense of self. These experiences have been variously described as "loss of ego", "self-forgetfulness", "loss of self-consciousness", and even "transcendence of individuality" and "fusion with the world" (Maslow, 1971, p. 65, 70 cited in Csikszentmihalyi, 2000). The activity involves the person completely with its demands for action. A sense of and duration of time is altered. Many games run on an altered time system, but more importantly many gamers report devoting entire nights or weekends to playing games without consciously deciding to do so (Csikszentmihalyi, 1990). The combination of these elements contribute to the sense of total involvement (i.e., engagement) defined as the flow state.

This state is supported by the clearly defined set of rules in games, which usually do not require any negotiation. The player does not need to use the self to get along in an activity. As long as the participants follow the same set of rules there is no need to

negotiate the roles. This is consistent with another characteristic of flow, which is that an activity usually contains coherent, non-contradictory demands for action and provides clear, unambiguous feedback to a person's actions. In a flow episode, one clearly knows what is good and what is bad, such that goals and means are logically ordered. Games have a significant advantage in that players receive immediate feedback on their actions and decisions, inviting exploration and experimentation.

The above characteristics of flow all describe a *mental state* of a person in flow, however Csikszentmihalyi explains that this mental state can be described using an *operational definition* that looks at a ratio of challenges and skills that a person experiences for a given activity. The most important condition required to create a state of flow is balancing the right level of skill with the right amount of challenge (Csikszentmihalyi, 2000) (Figure 1).

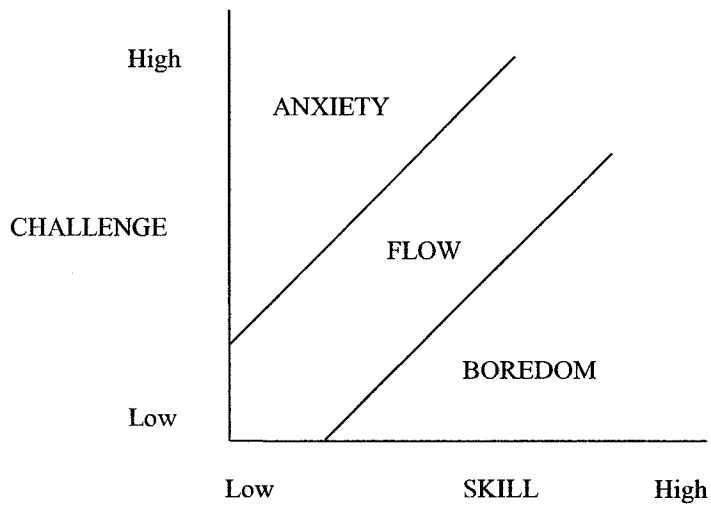


Figure 1. Model of the Flow State (Csikszentmihalyi, 1975).

The theory of flow explains that people not only like to be challenged, but that they actively seek it out. When a person believes that their task challenges are too

demanding for their capabilities, the resulting stress is experienced as anxiety. When the ratio of skills or capabilities is higher, but the challenges are still too demanding for their skills, the experience is worry. The state of flow is felt when the person's skills can cope with the opportunities for action (i.e., demands of the task) are in balance with the actor's skills. The experience is then autotelic. The state of boredom results when skills are greater than the opportunities for using them. This state again fades into anxiety when the ratio becomes too large (Csikszentmihalyi, 2000), see Figure 1.

Csikszentmihalyi concentrated on defining the Flow State; however he also touched upon the idea of flow as a process. He saw optimal activities in the "flow channel" moving outward as skills are gained. According to the flow diagram, as skills are gained challenges must increase. In other words, by visualizing the Flow State as a self perpetuating and an evolving system where challenges are in balance with skills, we can see that as skills are learned, challenges have to increase; otherwise the player will become bored. Similarly, as challenges increase, skills needed to overcome those challenges must be learned, otherwise the player will become anxious. The goal is always to return to the state of flow, which Csikszentmihalyi (1990) relates to pleasure and enjoyment.

Csikszentmihalyi explained that good flow activities offer a wide range of flow channels at various levels of skill. These flow channels can be defined as moments when a person is in flow, such that if someone with a low skill in a particular activity has appropriately low challenges they will still experience flow. Control over one's environment through having a degree of choice of challenge levels is essential. Interestingly, the player does not have a conscious awareness of control but is simply not

worried by the possibility of lack of control. The player may simply think back on the experience and conclude that, for the duration of the flow episode, their skills were adequate for meeting the task demands.

Assessing Flow

The challenge when trying to capture flow lies in figuring out how to measure a state that the player is not expected to have conscious awareness of. Researchers have employed several research methods and measures of flow in the study of leisure and other types of activities (e.g., sports, work, hobbies, composing music and computer usage). Csikszentmihalyi (1975) originally developed the flow model on the basis of extensive interviews. His study participants described their experiences when engaged in their best and most enjoyable leisure (e.g., rock climbers, basketball players, recreational dancers, chess players) and work (e.g., surgeons) activities. He also tracked flow activities through an experience sampling method (ESM) where he paged people at certain moments throughout the day in order to assess at what points they were likely to be in flow and what the activity was. The disadvantage of this method for this study was that Csikszentmihalyi was more concerned about capturing the Flow State at a particular time, rather than tracking the flow process throughout an activity.

Challenge/skill ratio

Since the Flow State is very subjective and fleeting it was important to try to capture it as quickly as possible. Consistent with traditional practice, single item measures were used to represent challenge/skill indicators (Moneta & Csikszentmihalyi, 1996). These typically consist of two questions such as: "How skilful did you feel in what you were doing?" and "How challenged did you feel by what you were doing?"

(e.g., Larson & Csikszentmihalyi, 1983; Larson & Richards, 1994; Moneta & Csikszentmihalyi, 1996).

For the purpose of this study, a brief challenge/skill questionnaire modelled after Pearce, Ainley and Howard's (2005) study "The Ebb and Flow of Online Learning" was used. The reason for referencing Pearce et al. is because they tried to capture flow through a learning activity, similar to how this study planned to capture flow while playing a computer role play game.

Pearce asked students to solve seven, progressively more difficult, physics problems. After solving each problem, the students were presented with a "challenge-skill probe" consisting of two questions: "How challenging did you find this last activity?" and "Were your skills appropriate for understanding this last activity?" (Pearce, 2005, p. 12). These questions were assessed using a 5-point Likert scale, ranging from "challenge too low" to "challenge just right" to "challenge too high" and "my skills too low" to "my skills just right" to "my skills too high", respectively. Pearce then mapped the challenge and skills answers onto a "flow space" (Figure 2).

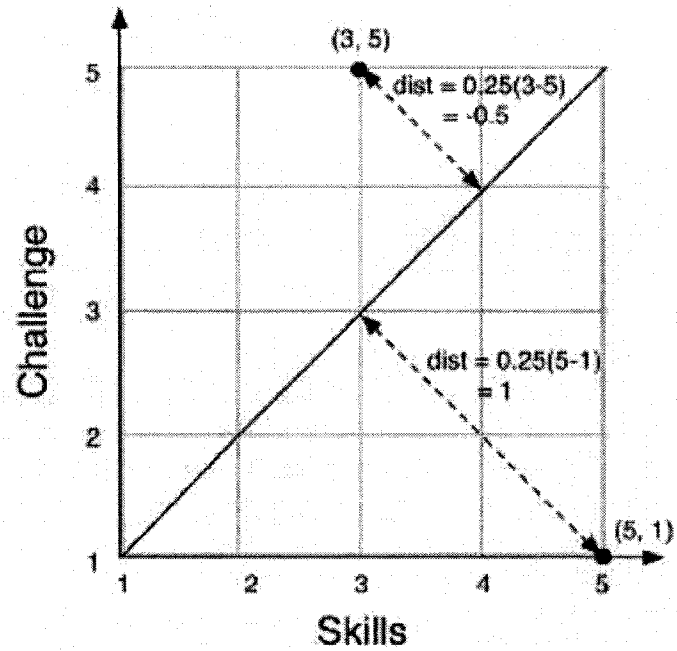


Figure 2. Calculation of flow-from distance.

Based on the figure above, Pearce derived from the geometry of the 5x5 challenge skill space the following equation: *Flow-from-distance* = 0.25 x (skill - challenge), as a measure of how far an individual challenge/skill ratio is from the flow line (Pearce et al., 2005). Pearce's method of measuring "from-flow-distance" was used in this study. The equation was slightly modified to use a 10-point Likert scale such that the geometry of the challenge skill space became 10 x 10 and reversing challenge and skill (i.e., *Flow-from-distance* = 1 x (challenge - skill). A value of 0 represented flow, maximum anxiety was represented by +9 and maximum boredom by -9. In this sense, the flow from distance equation more closely resembled the model of the flow state in Figure 1. Using this method, Pearce was able to track the process of learning and how that related to flow outcomes through the 7 problems. Leveraging Pearce's study, the goal in this study was to track the process of learning and the outcome of flow through the computer role play game.

Pearce's study very closely mirrors the experience of someone learning how to play a game and progress through a quest. For example, a novice, of any activity, would have minimal skills and would need appropriately low challenges in order to help them develop better skills. Csikszentmihalyi (1975) refers to these as 'microflow' experiences. As the skills increase (i.e., as new skills are learned), so must the challenges increase in order to maintain flow. This interplay between increasing skills with increasing challenges goes hand in hand with learning. Hence, the flow model shows the time progression as one continues to learn a new skill or technique and progress up the flow channel. Microflow activities better illustrate the process of flow as moving up the flow channel during a particular activity, whereas overall flow would indicate a particular state of flow captured for an overall activity. For instance, a player may indicate that they were in flow when thinking about the whole game experience; however microflow activities more accurately assess at which points in a game the player may or may not have been in flow.

For our computer RPG, care was taken in defining challenges and skills. Because RPGs have clearly outlined rules, if a player knows the rules and what is expected they found it difficult to understand the concept of skill. For example, once the player learned how to manoeuvre their character the only skill required was to move the avatar through the environment, collect items needed to proceed through the quests, overcome certain obstacles, such as monsters, and talk to other NPCs. Interviews from the preliminary study indicated that players were not consciously thinking about how they were playing the game. They reported that once they learned to control their character, they did not think about what they were doing as they moved through the game. Instead they related

the concept of skill and challenge to what their expectations were concerning the rules of conduct as they progressed through the quest. In the preliminary study players expressed confusion around the concept of skill. From discussions with other game players, it was agreed that the idea of expectation around rules more accurately captured the concept of skill in a computer role play game. For instance, the main actions involved in playing a computer role play game revolve around exploring the environment, interacting with other characters, collecting items, and overcoming monsters. The player's character is led around depending on the instructions from other characters, which help the character accomplish tasks in order to complete quests. In this sense there is not much thinking or strategy involved. Once a player has learned to manoeuvre through the game and has learned what the rules are and how to use the tools, they do not consciously think about how to progress through the game. Skill at playing role play games became more apparent when the players were not certain as to how to proceed or what to do next. Hence, the skill based question became "How certain did you feel about what to do next in this situation?" and the challenge question became: "How challenging did you find this situation?" These questions were evaluated on a 10-point Likert scale, ranging from not at all to very, relating to certainty or challenge, respectively. The 10-point response format was selected to afford response variability for conducting the experimental analysis and to ensure the reliability of the measurement (Churchill et al., 1984).

Dimensions of Flow

Assessing whether or not the players were in flow still did not provide evidence as to what their mental state was while playing a game. There have been many measurements of flow developed to assess different dimensions of flow. For example,

Mannell (1979) and Mannell and Bradley (1986) operationalized the level of flow that was experienced while playing a game as the perception of time going faster (ratings of the duration of a 30 minute period in which the game was played), centering of attention (recall-test of the features of the game setting) and positive and negative moods (mood checklist). Questionnaires have also been used that have participants recall and rate their experiences using items that measured selected features of flow in the activity under study. For example, in a study of computer use, Ghani and Deshpande's (1994) respondents completed items measuring enjoyment, concentration, challenge and control. Webster, Trevino and Ryan (1993) studied the experiences of employees of an accounting firm who attended a course. The employees used a 12-item flow scale to report the amount of control, attention focus, curiosity and intrinsic interest they experienced.

Currently there is no universally accepted measure of flow. For the purpose of this study Trevino and Webster's (1992) experience of flow measure was used that was also used by Pearce et al. (Appendix A). Pearce used factor analysis to identify three common factors in these questions: control, enjoyment and engagement (Pearce et al., 2005). Furthermore, previous work has validated these scales and proposed that these indicators could be used to provide an overall impression of flow during learning (Trevino & Webster, 1992).

The engagement questions specifically addressed the sense of absorption, which is a distinguishing factor for the flow state, (e.g., "I was absorbed intensely by the activity" and "I thought about other things" (negatively scored)). Pearce et al. refer to this as the 'overall-state' measure of flow. The overall-state measure of flow was

administered by Pearce et al. at the end of the learning exercise to assess how the students felt overall as opposed to the challenge-skill measure that was administered at the end of each of the seven problems.

Pearce tried to relate the operational definition of flow with the overall-state measure of flow in his learning task. However because he measured the experience of flow only at the end of his learning activity (i.e., once all seven problems were completed) he was not able to create a direct relationship between challenge/skill perceptions and the overall-state measure of flow. Pearce admitted that "while both forms of measurement point to students experiencing flow, at the individual level, there was no clear link between these two methods representing flow (Pearce et al., 2005, p. 23)." The challenge was that "one would not necessarily expect students to flow consistently through a learning activity", such that their overall impression of the exercise will be different than their impression at certain points in the exercise (Pearce et al., 2005, p. 23). Similar to role play games, some events may be perceived as more challenging than others and if we are to directly relate the operational definition of flow with the dimensions of flow, we must be able to capture it at the same time. Hence, the goal in this study was to administer both the challenge/skill questionnaire and Trevino and Webster's measure of engagement, enjoyment and perceived control at each action in the game. The dimensions of flow were referred to as an *experiential definition* of flow because perceptions of enjoyment, engagement and control could be viewed as a mental state of someone in flow.

The following section describes cultural-historical activity theory and explains exactly how the concept of contradictions to manipulate certain actions in the game was used in order to administer the flow questionnaires.

Cultural-historical Activity Theory

There are three main reasons, which collectively justify why activity theory was used for this study. Firstly, activity theory takes into account the individual in a social context, which is important when studying the interactions between the characters in the computer role play game. Secondly it recognises that people have agency that objects and tools do not (i.e., motivation is a property attributed to people). In the case of a computer role play game, the players act through their avatar to achieve the object. Finally, it provides a framework for mapping distinct events in a game, called actions, through the concept of activity systems, which were used as benchmarks to measure flow.

Theories of cognition such as adaptive control of thought–rational (ACT-R) (Anderson & Lebiere, 1998) have also been used in psychology and computer science to model human computer interaction. However, while ACT-R tries to present an integrated system of the mind and explain the dynamics of how humans interact with a computer, it does not address the social environment within the game. Distributed cognition, developed in 1990 by Edwin Hutchins is a branch of cognitive science that addresses the need to incorporate the environment with the individual. Distributed cognition proposes that human knowledge and cognition are not confined to the individual, but are intricately linked to the environment. Instead, cognition is distributed by placing memories, facts, or knowledge on the objects, individuals, and tools in our environment. Distributed

cognition is similar to activity theory in so far that it takes the social environment into account; however, it does not recognise the motives that drive people to do particular things. Distributed cognition views a system as a set of representations, and models the interchange of information between these representations. These representations can be either in the mental space of the participants or external representations available in the environment (Hutchins, 1995). What divides activity theory from distributed cognition is the "insistence in distributed cognition that people and things are fundamentally the same" (Nardi, 1996, p. 40). "In activity theory, a tool mediates a relationship between a cognizing person and reality, but the tool does not in itself exhibit any cognition (Nardi, 1996, p. 40)." A central tenet in activity theory is that activity systems are motive driven and that subjects have an agency that tools do not. Because I am interested in studying engagement of a player represented through their avatar's interaction in the social environment of the game, activity theory appears to be the most fitting.

Finally, activity theory offers a framework for studying an individual in a social context through activity systems. An activity is a system that comprises of individual and collective actions that have some sort of a common goal (i.e., outcome) (Nardi, 1996). The individual, as the subject; the community, as the people interacting with the individual, all have roles, all act within a certain set of rules and all use tools in order to achieve the object. The object can be looked at as the immediate goal of the activity; however, transforming the object into an outcome motivates the activity (Kuutti, 1996). In other words the object is transformed into an outcome when the full motivation behind the activity is realized. For example, the object of game play might be to win, but the outcome would be realized in the player having fun or feeling enjoyment.

As described earlier, the importance of taking the social context into account when studying role play games stems from the nature of role play games. The primary goal of RPGs is not necessarily to win, but rather to explore the environment and interact with other characters. Since this interaction between the player's avatar and other characters in the quest is at the centre of role play games, the most appropriate psychological theory for studying RPGs is one which takes into account both the individual and the social context.

The following section introduces activity theory and its central tenants, which serve to frame Oliver and Pelletier's activity theory framework based on Engeström's (1987) model of the human activity system. The central role of contradictions is described in greater detail and how they can be used to distinguish between more or less engaging actions.

The First Generation of Activity Theory

Activity theory has evolved through three generations of research (Engeström, 2001). Cultural historical activity theory grew out of cultural historical psychology, which was initiated by Lev Vygotsky in the 1920s and early 1930s (cited in Vygotsky, 1978). The first generation centered on Vygotsky's idea of mediation. The idea of mediation is that every activity is mediated by a tool or a 'mediating artefact', which acts on an object to achieve a subject's goal (cited in Vygotsky, 1978). This idea was illustrated in Vygotsky's triangular model in which the conditioned direct connection between stimulus (S) and response (R) was transcended or made possible by (X), 'a complex, mediated act' (Engeström, 2001, p. 134).

Vygotsky's ideas were further expanded by his colleague and disciple Alexei Leont'ev who introduced the idea of activity as the unit of analysis (cited 1978; 1981). Leont'ev reformulated Vygotsky's triad, which is now commonly expressed as the subject, object and tool (Figure 3).

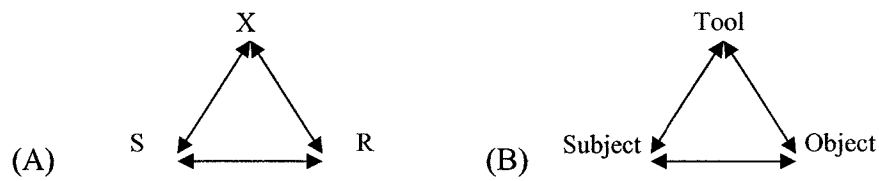


Figure 3. (A) Vygotsky's model of a mediated act and (B) its common reformulation.

For Leont'ev, the main feature of activity is the object, which can direct activity and which is also linked to human need. However motives, form, methods, emotional intensity, time requirements, space requirements, and the physiological mechanism of the activity system are also important. The object can be defined as a project under construction or the raw material that becomes the outcome. The object can arouse engagement, effort, emotion, excitement, frustration, stress, etc., and it gives rise to continuity and coherence to actions (Engeström, 2000). The tool acts as the mediating artefact that transcends or enables the subject (i.e., anyone acting on the tool) to reach the object.

Leont'ev (1978) further refined activity theory by developing three levels at which activity can be analyzed. The most general level is the level of *activity* that describes a group motive such as having fun. Activity is driven by a collective object and motive, but is realized in goal-oriented individual and group actions. Each motive is an object, material or ideal, that satisfies a need. The *action* level focuses on the conscious actions that contribute to an activity such as playing a role play game. Actions make up

an activity. They are relatively short lived and have a temporarily clear cut beginning and end. For example, the player, through their avatar, must complete tasks and win quests in the process of playing the game. In turn, actions are made up of *operations* that are determined by the conditions of an activity. In other words, an activity may have one object, e.g., win the game, but there are a multitude of actions composed of any combination of operations that will lead to that object. Actions consist of operations that contribute to each action and are unconscious or automated (i.e., not part of a person's conscious awareness), such as clicking the mouse in order to direct the avatar to walk in a particular direction. The player must learn to manoeuvre their avatar through the game and must also familiarize themselves with the game rules so that they will know what to expect as they progresses through the game.

The Second Generation of Activity Theory

The second generation of activity theory was expanded to include the cultural and historical context of activities into account in a more explicit way (Kuutti, 1996; Engeström, 2001; Squire, 2002). This expansion, proposed by Engeström (1987), involved adding another layer to the system to represent the community within which the activity takes place (Figure 4). The activity's motive is formed when a collective need meets an object that has the potential to fill that need. "Object-oriented actions are always, explicitly or implicitly, characterized by ambiguity, surprise, interpretation, sense making, and potential for change (Engeström, 2001, p. 134)." Rules act as mediators between the 'subject' and the 'community'. The 'division of labour' represents the function of the individuals within the community, or the allocation of object-oriented tasks to community members. The division of labour act as mediators between the

'community' and the 'object'. In other words, the 'division of labour' can be understood as identifying the 'role' that an individual has in the community, which dictates how they can approach the object.

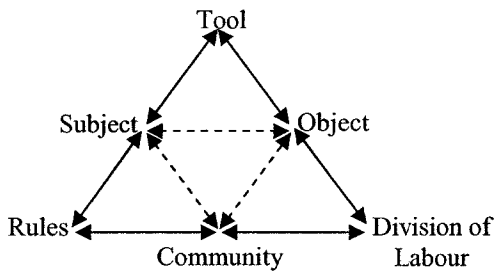


Figure 4. The structure of a human activity system (Engeström, 1987, p. 78).

In a role play game activity, the subject is always the avatar. In this study, the player was not part of the activity system. The player was engaged in an activity system of the game through their avatar, who was acting as the subject. The player controlled the avatar, however the avatar was constrained by their assigned capabilities (e.g., not strong, but has magical abilities, etc.). As the avatar progressed through the game, their skills grew (e.g., stronger, more powerful) and the player's skills also grew as the player learned how to manoeuvre the more powerful avatar. As such, the player and the avatar worked as a team, growing and learning together and developing what James Gee (2003) calls a parent-child relationship. This interdependence between the player and the avatar further supports the appropriateness of using activity theory as a learning framework because it illustrates the dynamic concepts of internalization and externalization:

> "Internalisation is the transformation of external activities into internal ones. Externalisation transforms external activities into internal ones…It is the constant transformation between external and internal that is the very basis of human cognition." (Nardi, 1996, p. 35)

The player starts to care for the avatar since the avatar's evolution is a result of the player's actions and time investment. Similar to a parent, the player begins to take pride in their avatar and the avatar's accomplishments (Gee, 2003). The avatar can be viewed as the extension of the player in such a way that whatever happens to the avatar in the game will be directly related to the player's experience and investment in the avatar.

Since the avatar is the player's intermediary in the game world, the avatar could also be looked at as the tool that the player uses to achieve the object. However, in role play games, that would be a simplistic representation since there is a whole community of other characters that influence the avatar and shape the object of the game, which in turn affect how the player will react. In other words the avatar has agency as the extension of the player. The player's motives are realized through the avatar. Hence, the more appropriate way to view the activity is to link the avatar to the object while attributing the outcome (i.e., what the object is transformed into) to the player (Figure 5).

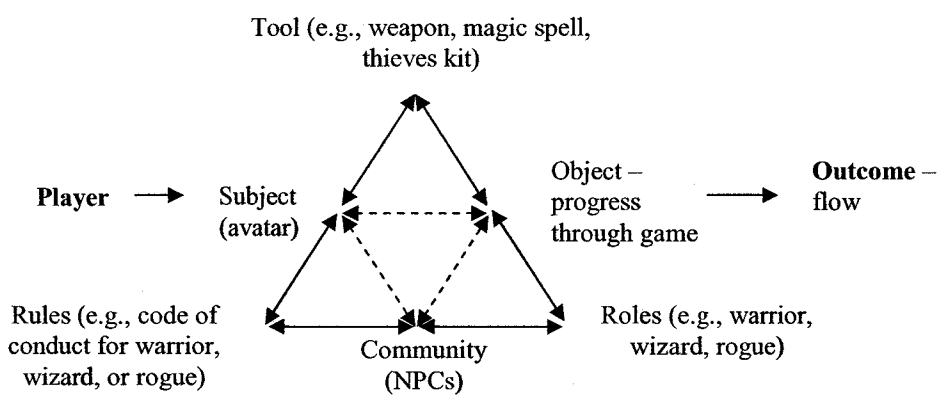


Figure 5. The structure of a game activity system.

The avatar as the subject interacts with the community, abides by the rules and roles set by the game and uses certain tools to achieve the object of progressing through

the game by solving quests. The community consists of non-player characters, each with their own roles, such as warriors, wizards or rogues. The avatar and the NPCs also have the rules that they have to follow that are in accordance to their roles, such as the code of conduct for a warrior, wizard or rogue. Within this activity, the avatar must accomplish actions that lead towards achieving the quest. Some of these actions are straightforward such as following a helpful NPC's instructions, collecting certain items, and exchanging items with other NPCs. Other actions are more complex and involve encountering and overcoming contradictions. These contradictions, or blocks in an activity, were be set up between the subject and the tools or the subject and the rules, such that progress towards an object was blocked. For example, an avatar who did not have the appropriate tools (e.g., weapons, keys, etc.) to proceed had to think of other options, or the rules of that game were broken, such as having a NPC respond in an unexpected way.

The Third Generation of Activity Theory

Engeström noticed that Vygotsky's foundational work on cultural-historical psychology was very much "a discourse of vertical development toward 'higher psychological functions'", which did not take into account cultural diversity (Engeström, 2001, p.135). Historically, Vygotsky's work was more narrowly defined by the Marxist/socialist system in which he existed without taking account the cultural systems of other groups. As activity theory gained international recognition, questions about how to reconcile diversity and dialogue between different traditions or perspectives led Engeström (1987) to develop the third generation of activity theory. The third generation of activity theory needed to develop conceptual tools to understand dialogue, multiple perspectives, and networks of interacting activity systems. These evolving networks of

interacting activity systems can redefine the object of the activity systems and create a new combined object. The new object leads to a culturally new pattern of activity giving rise to what Engeström (1987) refers to as expansive learning. Engeström introduced the concept of 'boundary crossing' to illustrate the formation of a new object as a result at least two activity systems coming together and combining their objects (Figure 6).

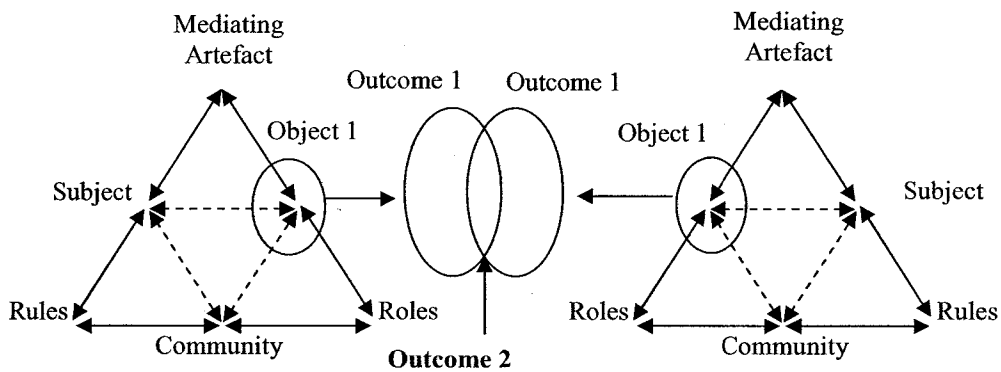


Figure 6. Two interacting activity systems as a minimal model for the third generation of activity theory (Engeström, 2001).

Engeström's model of interacting activity systems can be illustrated by representing the role play game designed for engagement and fun as one activity, and an educational activity, such as educational software, as another activity. This study's focus was on the game activity as opposed to an educational application. Rather than illustrating two activity systems coming together to create a new activity system, see Figure 6, I expanded the game activity to include an educational component.

The focus was on understanding the *actions* that can be used to create opportunities for learning through the successful completion of contradictions set up within those actions. As such, the object of the game, which was designed for educational purposes, was the same as in a standard RPG (e.g., progress through the

game and accomplish the quest), while the outcome for the player was to enjoy playing the game while learning about Antarctica.

The Role of Contradictions in Activity Theory

Engeström's notion of expansive learning describes how systems evolve in response to contradictions that arise in practice. A contradiction is defined as "a misfit within elements, between them, between different activities, or between different developmental phases of a single activity (Kuutti, 1996, p. 34)". 'Contradictions' manifest themselves as breakdowns, disagreements, problems, ruptures or clashes (Kuutti, 1996, p. 34), which suggest that the current system is somehow inadequate or in need of development. For example, a contradiction can be illustrated as a situation where a strategy or tactic that worked in the past for a same or similar situation does not work any more. According to Engeström (1987) solving contradictions, or unblocking an activity, is seen as evidence of learning. In an activity theory sense, learning can be illustrated through Leont'ev's levels of activity. For instance, solving a particular contradiction for the first time is a conscious endeavour (i.e., operational level). This action then becomes operationalized such that the next time a similar action is encountered the subject of learning will automatically know what to do next. In this sense, analysing contradictions in an activity system can be used as a framework to study learning. While there is no inherent epistemic bias between the different constituents of an activity system, only subjects have agency (i.e., directed motive) in a way that tools, rules and roles do not (Nardi, 1996). Hence, it is reasonable to assume that learning should be attributed so subjects.

Activity theory sees contradictions as sources of development; activities are virtually always in the process of working through contradictions (Kuutti, 1996, p. 34). Initial uses of this analytic framework focused on descriptions of children's learning and play; however, as use of activity theory developed, the idea of internal ("secondary") contradictions as a motivation for development grew in importance (Engeström, 2001). Secondary contradictions occur within the constituents of a central activity (Engeström, 1987). The secondary contradiction of actions in games is the structural tension between the tools, rules or roles that would obstruct the avatar from achieving the object.

Roussou (2003) used this analysis of secondary contradictions to provide an account of children's learning from Virtual Reality exhibits designed for use in museums. His work suggested that resolved contradictions between the subject and tool indicate examples of skill development, which was manifested as proficient use of the tool. In addition, resolved contradictions between the subject and rules illustrated examples of learning socially accepted concepts or practices. For example, one of the objects in our RPG quest is to return a crystal to a fairy in order for her to give the avatar the materials needed to launch a balloon. However, a non-player character that has the crystal refuses to give it back to the fairy. The resolution of this contradiction lies in the fairy joining the non-player character and the two of them sharing the crystal. In this sense, the concept of sharing to solve a problem was introduced.

This study primarily focuses on mapping secondary contradictions that occur at the action level of an activity system of a role play game. The contradiction would occur either between the avatar and the tools or the avatar and the rules. The player must learn the rules and how to use the tools. For instance, the avatar must be able to solve the

problem presented by ozone fairy before they can launch the balloon. The avatar must have the right tools to solve the fairy problem and also must be able to use those tools within the rules that are deemed appropriate in that scenario.

Activity Theory Framework for Analysing Contradictions in a Role Play Game

Oliver and Pelletier (2004) noted that what is missing from the literature on learning and digital games in general is a method that looks at the process and outcomes of play and how this relates to the design of the game as well as the social and cultural aspect of play. They noted that understanding the process of learning is particularly important when we are studying games because learning in games is defined not so much as an outcome, but as part of the process of playing (Oliver & Pelletier, 2004).

However, the challenge was how to measure the process of learning in games while staying true to the natural characteristics of the quest since role play game guests have no clearly defined sections that can be assessed as separate activities. For example, I did not wish to introduce artificial breaks such as in the case of Descartes' Cove (Wallace, 2005), which could detract from the quest. In a non-linear quest based role play game scenario there are no clear guidelines that would distinguish between the different actions that a player would go through. To rectify this problem in games Oliver and Pelletier proposed a research methodology to analyze how people learn when playing digital games. They developed a data analysis tool, which enabled them to track the process of learning, which they defined as a successful resolution of contradictions in an activity system (Appendix B).

Using this tool, Oliver and Pelletier observed a teenage girl playing a *Harry Potter and the Philosopher's Stone* video game. Reviewing the individual learning

tactics (e.g. "click on an object") recorded in the table, Oliver and Pelletier proposed a series of learning strategies, equating to learning-oriented *actions* in activity theory. This involved trying to provide reasons that could explain the observed instances of learning. For each, a rule was proposed and then the table reviewed so that it could be refined by testing its explanatory power with each appropriate observational instance. This process was repeated until a set of rules was developed that explained all of the observed behaviour (Table 1).

Table 1

Rules Explaining the Observed Behaviour in a Computer Game "Harry Potter and the Philosopher's Stone"

1. "Spot unusual objects and click on them"
2. "If you can't progress (e.g. a door won't open), systematically explore the area until you find something you missed" (Note: this typically led to uses of rule 1)
3. "If you see a block, levitate it onto something"
4. "If you've run out of things to click on, move on to a new area"
5. "If you haven't explored an area, do so"
6. "If there is a threat, move past it carefully (positioning and timing)".

Rule 1 was related on a one-to-one basis with the category of learning about the properties of objects. Rules 2 and 3 relate to learning game conventions. Rules 4-6 relate to learning about in-game spaces.

Preliminary Study

A preliminary study was conducted to establish clear baselines for the formal study. The study was exploratory by nature and its primary purpose was to lay the groundwork for the formal study. The preliminary study consisted of observations and informal interviews with experienced and non-experienced computer role play game players ($N = 8$). Observations of game play and informal interviews revealed four points of interest that served to frame the study in this thesis. These points were to: 1) establish a set of unique actions that an avatar would experience in a computer role play game quest using Oliver and Pelletier's rules as a guide; 2) to establish a baseline for the minimum level of experience required for engagement at the action level of the game; 3) assess the appropriateness of the flow measures with regard to the player's experience interacting with the activity system of the role play game; 4) assess how the flow measures would be administered.

Oliver and Pelletier's data analysis tool was used to extrapolate actions from the operations in an RPG, similar to Table 1. Oliver and Pelletier's rules were used as a guide in distinguishing the unique actions in an RPG. For an example of how Oliver and Pelletier's data analysis tool was used see Appendix C. These actions related to avatar's interaction with the environment and avatar's interaction with other NPCs. These NPCs were either friendly by nature (i.e., they did not attack the avatar) or hostile (i.e., they attacked the avatar). The friendly NPCs interacted with the avatar through an interactive dialogue. Based on the rules, four actions were extrapolated: 1) exploring the environment (e.g., observing items, collecting items, using items in their inventory as tools to accomplish certain tasks); 2) encountering and overcoming a threat (monsters);

and interacting with non-player characters, which included: 3) being given appropriate responses to proceed and 4) being able to respond appropriately to the NPCs. Observing items, collecting items, using items in their inventory as tools to accomplish certain tasks are considered as a single action because it is passive in a sense that it does not involve interactions with other characters.

These actions are governed by a set of rules in an RPG. The rules lead to certain expectations by the players of what they can expect will happen in a certain situation. For example, the player expects that their avatar will be given hints or be let along in the quest by other helpful non-player characters. The operations associated with these actions are: clicking on items to observe what an item is, moving things in and out of inventory and using certain tools, such as weapons; clicking in front of the avatar to move the avatar in a certain direction; and clicking the appropriate response during a dialogue with a NPC. Contradictions are introduced when the rules in the RPG are broken with regard to these actions. For instance: 1) the avatar is prevented from exploring the environment freely, e.g., by encountering locked doors or trunks; 2) the monster becomes very difficult to defeat; 3) helpful NPCs do not offer useful information; and 4) the avatar is not able to respond to helpful NPCs in a useful way. For the purpose of the formal study, I concentrated on the four actions and two conditions (non-contradiction vs. contradiction), and how these can be used to study engagement by measuring flow.

The second purpose of the preliminary study was to establish a baseline for the minimum level of experience playing RPGs required for engagement at the action level of the game. The goal was to evaluate if players at different experience levels would react differently to the unique actions encountered. The results showed that two of the

eight participants who were complete novices to the RPGs reacted to the game completely differently than players who were familiar with RPGs. One player did not feel engaged at all, i.e., she quickly lost interest in the game when she encountered a contradiction, such as not being able to defeat the monster. Another novice player was so concerned about learning the rules and conventions that she did not become engaged in the overall purpose of the game, i.e. solving the quests. For instance, she continuously stopped playing and asked for clarification as to what to do next. While these are interesting results in and of themselves, they were not suitable for this particular study. Ultimately, it was essential that the participants have the capacity to become engaged in a reasonably consistent manner while playing the game. For the scope of this study, one way to ensure some level of engagement was to choose participants who are familiar with role play games. The reason behind this was also substantiated by Chen and Johnson's (2005 in press) study "Measuring flow in a computer game simulating a foreign language environment". Chen and Johnson discovered that pre-existing knowledge about computer games, in general, and about Neverwinter Nights, in particular, greatly enhanced participants' ability to enter a state of flow in their game module. Participants who had no pre-existing knowledge of role play games experienced interface problems with regard to having to learn how to manoeuvre through the game, which affected their level of enjoyment and engagement in the game. In the preliminary study, the two novice players concentrated on the controls to the extent that they found it difficult to become engaged in the actions related to the quest in the game. Learning how to manoeuvre through the game can be measured at the operational level of Oliver and Pelletier's analysis tool. However, since this study is concerned with contradictions at the action

level of the game, it was essential that the participants' level of engagement was not hampered by having to learn how to manoeuvre through the game. For instance, the contradiction would present itself as a problem with the avatar not having the right response towards the NPC rather than the avatar not being able to use its tools effectively, which would be an operational level contradiction.

Engaging games are designed precisely to offer the proper balance between challenge and skill within the actions of the quest, such that the player's and the avatar's skills will grow in line with incrementally increasing challenges, therefore perpetuating flow. If a game is designed in such a way that the player is not challenged enough, they become disengaged or bored. Conversely, if there are too many events that are too challenging or unusual (i.e., unexpected), the player becomes worried or frustrated (i.e., not be in a state of flow).

For example, the preliminary study indicated that players who consider themselves experts at role play games perceived fewer actions as challenging, whereas more novice players felt more uncertain about what to do next if they encountered an unfamiliar situation. Furthermore, some participants were familiar with other computer role play games, but not necessarily NWN. Since the game genre and the rules and roles are similar across RPGs these participants expectations were in line with those of NWN, however there were differences in their levels of engagement especially if they were unfamiliar with the controls for NWN. Since they were familiar with other computer RPGs, these players familiarized themselves with the controls more quickly than complete novices. It was important that the players could manoeuvre through the game

with relative ease because the goal of this study was to focus on the actions that the player, through their avatar, would encounter and not the operations.

Once the player learned to overcome a challenging action, they knew how to generalize this event to other similar events, which is considered as evidence of learning. Once actions were learned they became operationalized and passed into unconsciousness (Bargh, 1997). For example, if a player, through their avatar encounters a frost bite monster for the first time, they have to think about what tools to use to overcome the monster. If the player, on the other hand, encounters the frost bite monster for the tenth time, they will have learned what actions to take. Because this encounter then passes into unconsciousness (i.e., the actions become operationalized), in order for that action to be engaging, there must be some variation in the scenario. For example, the monster could become harder to overcome by introducing another element, such as making the outside cold conditions drain the avatar's strength. Similarly, if an avatar encounters an NPC that does not offer helpful information to proceed, they would revert back to actions and operations they knew until they could figure out an alternative solution. This event was memorable initially, but once the obstacle was overcome, it passed into unconsciousness and was generalised to other similar scenarios.

The third purpose of the preliminary study was to assess the appropriateness of the flow measures for a role play game scenario. Two issues were discovered. First, the players showed confusion when they were asked questions such as: "How challenging did you find the last action?" ("Encounter with the monster."). The players did not know whether they were supposed to answer from the avatar's perspective or the player's perspective. Because it was decided that the player's experience will be related to the

flow outcome, see Figure 5, it was important to rephrase the question to "Think about how you felt when your character - (e.g., defeated the monster)". The second issue that arose was that players had a difficult time grasping the concept of skill. They did not understand how skill is related to a game playing experience, since once they learned the rules and how to control their avatar, there did not seem to be much skill involved. They believed that certainty about knowing the rules was a closer representation of skill as it related to the player. Hence, the skill question was rephrased to be: "How certain did you feel about what to do next in that situation?", as it related to a particular action.

The final outcome of the preliminary study was to assess how the flow questionnaires would be administered: e.g., throughout the game or at the end. Administering flow questionnaires throughout the game proved difficult since in a non-linear game playing environment, players did not encounter the same actions at the same time. In this sense it was impossible to gauge how other events would affect their experience when they were interrupted. Secondly, experimenter bias was highly likely. It was impossible to stop the game at a particular point in time consistently, such that the experimenter may bias the results trying to judge when someone would feel more or less engaged. Finally, the results did not seem to show much difference between player experiences when they were interrupted with a question about a particular action mid-game or at the end.

Because the questionnaires and the study were adjusted throughout, it is not possible to illustrate definitive results, however the interviews and the feedback was perceived as sufficient enough to establish a methodology for the final study. Based on the results from the preliminary study: the study in this thesis measured engagement, as

defined by the operational definition of flow (challenge/skill) and the experiential definition of flow (control, perceived engagement, measured by a sense of absorption, and enjoyment), through four distinct actions. These actions were separated into two conditions such that one condition had contradictions build in and the other did not.

Hypotheses

As the player, through their avatar, encounters and overcomes these actions in the game, it was hypothesized that:

1a: The operational measure of flow differs between actions with and without contradiction.

1b: The experiential measure of control differs between actions with and without contradiction.

1c: The experiential measure of engagement differs between actions with and without contradiction.

1d: The experiential measure of enjoyment differs between actions with and without contradiction.

Method

Design

For our RPG Neverwinter Nights in Antarctica, we have attempted to modify our quest in such a way as to try to create four distinct actions. These actions were based on Oliver and Pelletier's data analysis tool, and were modified based on the exploratory results of the preliminary study. The actions reflect situations that the player's avatar encounters as they progress through a computer role play game quest. They are based on

the actions defined previously, 1) exploring the environment (e.g., observing items, collecting items, and using items in their inventory as tools to accomplish certain tasks); 2) encountering and overcoming a threat (monsters); and interacting with non-player characters; which includes: 3) being given appropriate responses to proceed and 4) the avatar being able to respond appropriately to the NPCs. Extrapolating from these, four distinct actions were created, which were tested. These are: using tools to accomplish certain tasks such as opening chests/boxes/doors (i.e. 1 above), encountering monsters (i.e. 2 above), receiving useful or appropriate information from other non-player characters (i.e., 3 above), having appropriate responses towards other NPCs (i.e. 4 above).

These four actions were tested against two conditions, with contradictions and without. The no-contradiction condition included actions that obey the rules of the RPG. According to the rules of the RPG, the player, through their avatar, expected to be able to: explore the environment freely (i.e., observe and collect items, open doors, boxes, trunks, etc.), defeat monsters, receive useful information from other characters, and give useful responses to other characters.

The contradiction condition comprised of secondary contradictions, i.e., contradictions between the tools and/or the rules of the RPG, which the player did not expect to encounter from their previous experience playing role play games. The actions then became: not being able to explore the environment freely (i.e., open doors/trunks/boxes with the tools available), encountering monsters that are very difficult to defeat, talking with non-player characters that do not give the avatar useful information

to proceed, and the avatar not having an appropriate response toward the non-player character. Table 2 illustrates the four actions and two conditions.

Table 2

Role Play Game Actions

	condition	
action	no contradictions	contradictions
1	The player's character can explore the environment freely such as walking in and out of certain rooms and having access to items in trunks or boxes	The player's character can not explore the environment freely, such as being prevented from opening doors or having trouble walking through doors and does not have access to items in trunks or boxes.
2	The player's character is able to defeat the monster.	The player's character has difficulty defeating the monster.
3	The player's character is talking to other characters that offer useful information.	The player's character is talking to other characters that do not offer useful information.
4	The player's character has useful responses or questions during a conversation with another character.	The player's character does not have useful responses or questions during a conversation with another character.

The participants were expected to play the game until they have encountered all the actions and conditions described in table 2. They had a maximum of two hours to play the game, however the average time for the participants to encounter all the actions and conditions was expected to be between one and one and a half hours.

The participants and the game were observed and videotaped throughout the game. The experimenter noted the time and place in the game of any interesting behaviours or statements so that they could be related to the videotaped information if required (Appendix D). This form also served as an action checklist for the experimenter to keep track of the actions that were encountered during game play. The video tapes were used to confirm observations where necessary. An ID number was associated with each participant and their respective video tapes such that the player's identity could not be associated with the video tape. The video tapes were only observed by the experimenter and were kept completely confidential. Once the data was analysed the video tapes were to be erased.

A demographics questionnaire was used to assess the difference between the participants' experience level (e.g., novice to expert) in playing computer role play games in general, and Neverwinter Nights, in particular. The demographics questionnaire also requested age and gender (Appendix E).

Each participant was asked to complete an operational (challenge/skill) and an experiential (control, engagement, enjoyment) flow questionnaire for the four actions and two conditions (Appendix F). Each participant was given the same set of questions, however the order of questions was randomized in order to control for primacy and recency effects. These questions correspond to actions and conditions illustrated in Table

2. For instance, there were some situations that the player was likely to encounter earlier than others, such as encountering monsters that they could kill easily or non-player characters that offered useful information. Carry-over effects were difficult to control for because it was impossible to control precisely which actions were encountered when. The questionnaires took approximately 15 minutes to complete.

Analysis

For each of the four hypotheses, the experimental analyses was a 2 (condition) by 4 (action) repeated measures/completely within subjects ANOVA. Level of experience, gender and age were examined for exploratory purposes.

A 10-point Likert scale was used to measure the flow factors. The 10-point response format was selected to afford response variability for conducting the experimental analysis.

Based on Pearce's formula for the flow from distance (challenge/skill) the geometry of the challenge skill space became 10 x 10 and the operational flow measure became: 1 x (challenge – skill) such that + 9 = maximum frustration, 0 = flow, and – 9 = maximum boredom.

The calculation of the aggregate scores for the experiential flow questionnaire also changed slightly such that: Control = (a + (11 – f) + j) / 3; Engagement = (b + (11 – d) + (11 – h) + (11 – k)) / 4; Enjoyment = (c + e + (11 – g) + i)/4.

Participants

Twenty four participants were recruited from the pool of undergraduate psychology students registered in the summer term at Carleton University as well as through personal contacts. The psychology undergraduate students were recruited

through an Announcement for Recruitment posted on the electronic bulletin on the Carleton University Psychology Experiment Sign-Up System (Appendix G). Additionally, Announcement for Recruitment posters posted around the university and submitted to mailing lists. The Announcement for Recruitment stipulated that only participants with some experience playing computer role play games could sign-up. Some experience was defined as being familiar with computer role play games and having at least some experience playing them.

All participants had to be capable of communicating fluently in English both verbally and in writing. There was no defined age group, although most participants were young adults between 18 and 24 years of age. Both male and female participants were admissible. The participants were either be offered two hours of course credit or were paid $10 per game play session.

Apparatus

All sessions were run on Intel Pentium 4 CPU, 3.20 GHz, 1 GB of RAM computers with Windows XP Professional Service Pack 2 (Version 2) Operating System and 19" flat panel screens. There were two speakers, keyboard and a mouse included. The computers were in the HOT Lab, which had the custom Neverwinter Nights computer role play game installed, the Neverwinter Nights in Antarctica module. A video camera recorded the player and a software tracking software "Camtasia" was used to record the player's actions throughout the game.

Each participant was asked to complete a consent form, which stipulated that the game playing session will be videotaped and recorded (Appendix H), a demographics questionnaire (see Appendix E), and a series of flow questionnaires (see Appendix F).

The experimenter noted observations related to the actions, such as time, duration and any interesting events or participant comments on an action checklist (see Appendix D). A more detailed explanation of how the apparatus was used is described in the procedure.

Procedure

Once the participants were selected, they were first asked to sign a consent form (see Appendix H). The participants were then escorted to an experiment room, which was equipped with a computer (keyboard, mouse, monitor and speakers) placed on a desk with a chair and a video camera facing the participant.

Once the participant was seated behind the computer, the experimenter explained the procedure to the participant. The experimenter stressed that it was important for the player to treat the game as if they would any other computer role play game and to try to ignore the discrepancies between the medieval and modern settings and props, such as books, buildings, clothing, etc. If the participants have any questions they should feel free to ask the experimenter. There was no limit placed on the type and amount of questions that the player could ask. The experimenter made it clear that this was a custom-made module based on the Neverwinter Nights game platform that was used for experimental purposes. The participants was not told about the challenges that they were expected to encounter ahead of time. If the experimenter noticed that the participant was having trouble with a contradiction (challenge) (e.g., not being able to proceed or becoming stuck with a particular situation), and not coming to the experimenter for help, the experimenter would intervene after 10 minutes. The experimenter would either help the participant overcome the obstacle, e.g., one way to escape a monster that is difficult to kill was to run into a building, or tell them to move on to another part of the quest, e.g.,

some doors or boxes could never be opened. However, the experimenter did not inform the player that they would intervene if they appear to be blocked by a particular situation ahead of time. The experimenter would also let the player know that they will be asked to answer a series of brief questionnaires once they have completed the quest. For a description of all the instructions given to the participants see Appendix I.

Before the participant began playing the game, they were asked to answer a brief demographics questionnaire (see Appendix E). When the participant completed the demographics questionnaire the experimenter loaded a new game and chose a pre-made character "Aluvian Darkstar" for the participant to use. The participant was then instructed to play the game.

The experimenter sat beside the player and kept track of all the actions the player was expected to encounter using the action checklist (see Appendix D). Once the participants encountered all the actions, they were asked to stop playing the game. Afterwards the participants were debriefed (Appendix J). Finally, the participants were thanked for their time and either paid $10 or given two hours of course credit.

Results

Hypotheses Testing

The study consisted of $N = 24$ participants. The independent variables were the four actions (exploring the environment, encountering threat, NPC responses and avatar responses). The four actions each had two conditions. The no contradiction condition included: the avatar freely exploring the environment; the avatar easily overcoming the threat (i.e., killing the frostbite monster); the avatar receiving meaningful/useful responses from NPCs; and the avatar having meaningful/useful responses for the NPCs.

The contradiction condition included: the avatar not being able to freely explore the environment; the avatar having difficulty overcoming threat (i.e., encountering the frostbite monster that was difficult to kill); the avatar not receiving meaningful/useful NPC responses; and the avatar not having meaningful/useful responses towards the NPCs. This yielded a 2 x 4 repeated measures (completely within-subjects) ANOVA, which provided the results for the analysis of the hypotheses. The dependent variables measured the operational definition of flow (challenge/certainty ratio) and the experiential definition of flow (perceived control, perceived engagement and perceived enjoyment). The results support all four hypotheses showing that imbedding contradictions within actions in an RPG does affect the player's ability to enter flow.

Hypotheses 1a: The operational measure of flow differs between actions with and without contradiction.

The 2 x 4 repeated measures ANOVA indicated a significant main effect of condition on the operational measure of flow, $F(1, 23) = 31.44, p < .001, \eta^2 = .58$. Perceived challenge and perceived certainty were high among the actions in the contradiction condition, with perceived challenge being slightly higher. According to the operational flow formula, 1 x (challenge – certainty), the contradiction condition produced mean values closer to frustration ($M = 1.11$, $SD = 3.61$) and the non-contradiction conditions produced mean values closer to boredom ($M = -1.76$, $SD = 3.32$). However, the means for both conditions were close to zero suggesting that the player is somewhere in the flow spectrum (see Figure 1). Interaction effects were not present between action and condition. Tukey's pair-wise comparison post hoc test

revealed significant factor level mean differences of flow between contradiction and non-contradiction at every action. A significant difference was found at the exploring the environment action between non-contradiction condition (M = -2.46, SD = 3.77) and contradiction condition (M = -0.42, SD = 4.00) means, $q(2, 184) = 8.28, p < .001$. A significant difference was found at the threat action between the non-contradiction condition (M = -0.13, SD = 3.23) and the contradiction condition (M = 2.25, SD = 3.77) means, $q(2, 184) = 6.84, p < .001$. A significant difference was found at the NPC response action between the non-contradiction condition (M = -1.67, SD = 3.03) and the contradiction condition (M = 0.50, SD = 2.95) means, $q(2, 184) = 6.24, p < .001$. The largest difference between the means of flow was at the avatar response action, for the non-contradiction (M = -2.79, SD = 2.70) and the contradiction conditions (M = 1.29, SD = 3.54), $q(2, 184) = 11.76, p < .001$. It appears that the non-contradiction condition of having a meaningful/useful avatar response was perceived as least challenging and most certain about future action. In contrast, the contradiction condition of not having a meaningful/useful avatar response was considered most challenging and least certain about future action. Observational data showed that the player did feel frustrated when they could not use their avatar to elicit a meaningful/useful response from the NPC, much more so than when the NPC did not offer a meaningful/useful response.

In addition, there was a significant main effect of action on the operational measure of flow, $F(3, 69) = 4.464, p < .006, \eta^2 = .163$. Tukey test for post-hoc pair-wise analyses indicated significant effects between encounter with threat and exploring the environment actions, $q(4, 184) = 4.23, p < .05$. The means of the exploring the

environment action fell closer to the boredom boundary (M = -1.02, SD = .67), whereas the encounter with threat fell closer to the frustration boundary (M = 1.06, SD = .67).

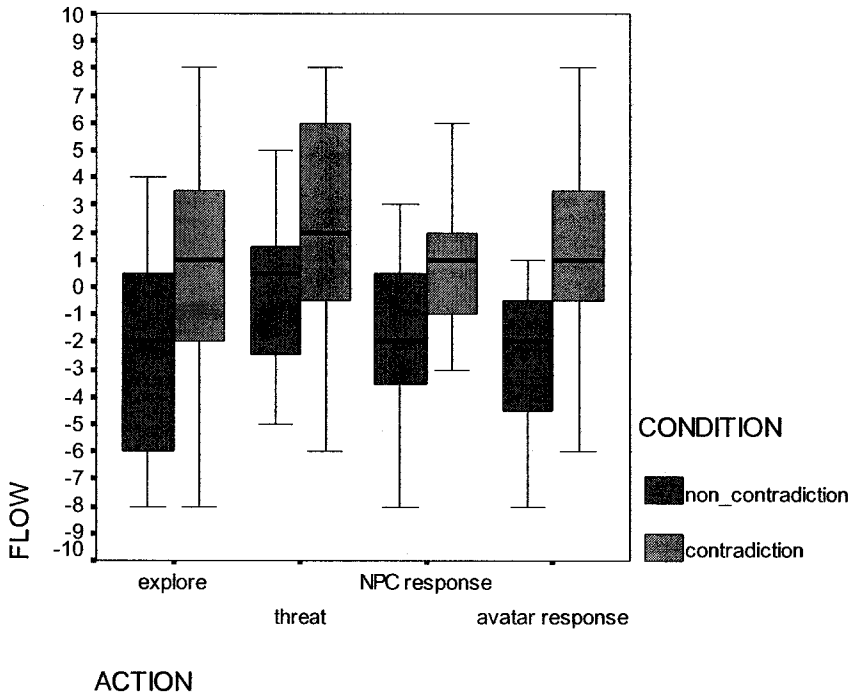


Figure 7. Operational level of flow by action and condition.

Hypotheses 1b: The experiential measure of control differs between actions with and without contradiction.

The 2x 4 repeated measures ANOVA indicated a significant main effect of condition on the experiential measure of control, $F(1, 23) = 38.39, p < .001, \eta^2 = .63$. Participants experienced significantly more control when dealing with actions that had no contradictions (M = 6.76, SD =1.65) than dealing with actions that had contradictions (M = 4.96, SD = 1.93). Interaction effects were not present between action and condition. Tukey's pair-wise comparison post hoc test revealed significant factor level mean differences of the experiential measure of control between contradiction and non-

contradiction at every action. A significant difference was found at the exploring the environment action between non-contradiction condition (M = 6.86, SD = 1.82) and contradiction condition (M = 5.06, SD = 2.14) means, $q(2, 184) = 9.78, p < .001$. A significant difference was found at the threat action between the non-contradiction condition (M = 6.50, SD = 1.67) and the contradiction condition (M = 5.04, SD = 2.13) means, $q(2, 184) = 7.90, p < .001$. A significant difference was found at the NPC response action between the non-contradiction condition (M = 6.57, SD = 1.59) and the contradiction condition (M = 5.06, SD = 1.66) means, $q(2, 184) = 8.20, p < .001$.

The largest difference between the means of the experiential measure of control was at the avatar response action, $q(2, 184) = 13.25, p < .001$. The mean of the experiential measure of control was the highest in the non-contradiction condition of avatar response (M = 7.11, SD = 1.53) and lowest in the contradiction condition of avatar response (M = 4.67, SD = 1.83). A likely explanation would be that not having the right avatar response is perceived by the player as having the least control over the situation. The player likely feels a sense of control over the avatar's response towards a NPC because they can select from a list of response choices. Based on those choices, the player expects to receive a meaningful/useful response from the NPC. The effect of perceived control of the player towards the avatar was explored further in the correlation section. There was no main effect of action, $F(3, 69) = .15, p > .93, \eta^2 = .01$.

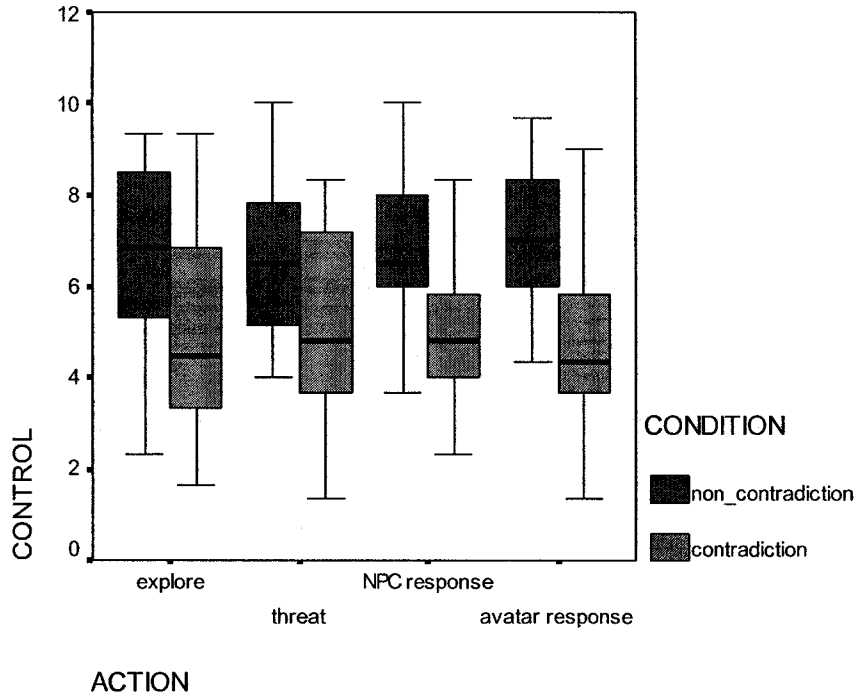


Figure 8. Experiential measure of control by action and condition.

Hypotheses 1c: The experiential measure of engagement differs between actions with and without contradiction.

The 2 x 4 repeated measures ANOVA indicated a significant main effect of condition on the experiential measure of engagement, $F(1, 23) = 15.00, p < .001, \eta^2 = .40$. Participants felt significantly more engaged when dealing with actions with no contradictions ($M = 6.78$, $SD = 1.51$) than when dealing with actions with contradictions ($M = 6.16$, $SD = 1.67$). Interaction effects were not present between action and condition. Tukey's pair-wise comparison post-hoc test revealed significant differences on the experiential measure of engagement between contradiction and non-contradiction factor level means at NPC response, $q(2, 184) = 5.05, p < .001$ and avatar response, $q(2,184) = 6.90, p < .001$, actions,. The NPC response action non-contradiction condition mean was

(M = 6.72, SD = 1.48) and the contradiction condition mean was (M = 5.90, SD = 1.89). The avatar response action non-contradiction condition mean was (M = 6.97, SD = 1.63) and the contradiction condition mean was (M = 5.84, SD = 1.56). Contrary to expectations, the smallest difference in the experiential measure of engagement was found between the means of the threat action. The contradiction condition mean was (M = 6.68, SD = 1.60) and the non-contradiction condition mean was (M = 6.85, SD = 1.60). A likely explanation is that encountering a threat requires immediate action and attention from the player as opposed to other actions, which are more self-paced. Observational data showed that encountering the monster is initially jarring, (i.e., surprising) for both conditions; however the player quickly becomes absorbed into the task of defeating the monster or running away from it. There was no effect of action, $F(3, 69) = 1.32, p > .27$, $\eta^2 = .05$.

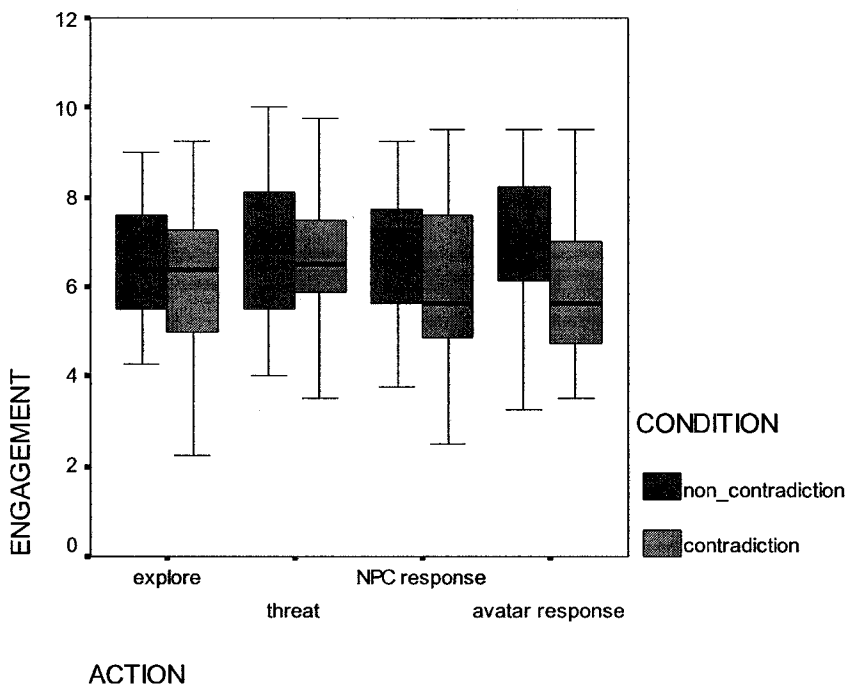


Figure 9. Experiential measure of engagement by action and condition.

Hypotheses 1d: The experiential measure of enjoyment differs between actions with and without contradiction.

The 2 x 4 repeated measures ANOVA indicated significant main effects of condition on the experiential measure of enjoyment, $F(1, 23) = 45.50$, $p < .001$, $\eta^2 = .66$. Participants enjoyed actions with no contradictions ($M = 6.48$, $SD = 1.75$) significantly more than actions with contradictions ($M = 5.05$, $SD = 1.92$). Interaction effects were not present between action and condition. Tukey's pair-wise comparison post hoc test revealed significant factor level mean differences of the experiential measure of enjoyment between contradiction and non-contradiction at every action. A significant difference was found at the exploring the environment action between non-contradiction condition ($M = 6.54$, $SD = 1.76$) and contradiction condition ($M = 5.17$, $SD = 2.08$) means, $q(2, 184) = 7.31$, $p < .001$. A significant difference was found at the threat action between the non-contradiction condition ($M = 6.41$, $SD = 1.79$) and the contradiction condition ($M = 5.57$, $SD = 2.31$) means, $q(2, 184) = 4.43$, $p < .001$. A significant difference was found at the NPC response action between the non-contradiction condition ($M = 6.33$, $SD = 1.63$) and the contradiction condition ($M = 4.84$, $SD = 1.68$) means, $q(2, 184) = 7.91$, $p < .001$.

The largest difference between the means was again at the avatar response action, $q(2, 184) = 10.74$, $p < .001$. The mean of the experiential measure of enjoyment was the highest in the non-contradiction condition of avatar response ($M = 6.65$, $SD = 1.90$) and lowest in the contradiction condition of avatar response ($M = 4.63$, $SD = 1.47$). A possible explanation to the contradiction actions being perceived as less enjoyable is that

actions such as not having a useful response from the NPC and not having a useful avatar response, break the rules of the RPG to the extent that the player loses a sense of certainty as to what to do next. This is confirmed by the observational data. When the player was confronted with a NPC that did not offer useful information or when the player's avatar did not have a useful response, the player would often pause for a while and then resort to familiar actions, such as exploring the environment in further detail or revisiting the NPCs. Interestingly, the mean enjoyment for encountering a monster that was difficult to defeat was slightly higher ($M = 5.57$, $SD = 2.31$) than the means of other three actions in the contradiction condition: exploring the environment ($M = 5.17$, $SD = 2.09$); NPC response ($M = 4.84$, $SD = 1.68$); and avatar response ($M = 4.63$, $SD = 1.47$). This could be related to the difficulty level of the game being perceived as low, such that when the player is presented with an action that is challenging but also familiar (i.e., high certainty), they might feel the greatest enjoyment. There was no main effect of action, $F(3, 69) = .63, p > .60, \eta^2 = .03$.

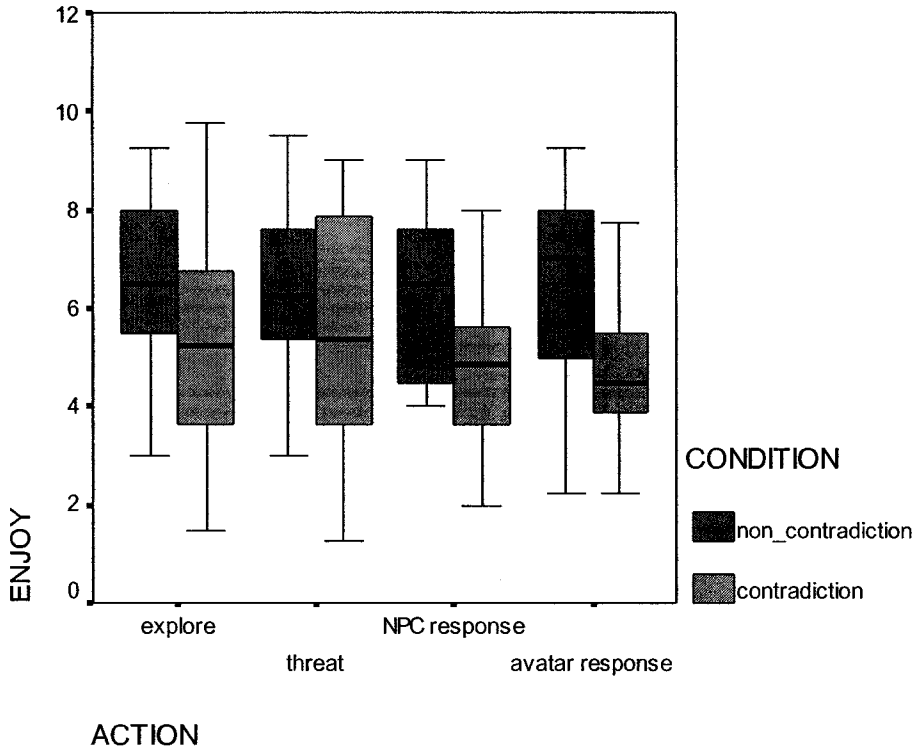


Figure 10. Experiential measure of enjoyment by action and condition.

Correlations

The relationship between the operational definition of flow as defined by the ratio between challenge and certainty and the experiential definition of flow as defined by perceived control, engagement and enjoyment was also explored. The experiment measured the same four dependent variables at the same action and condition and was specifically designed to address a limitation in Pearce et al. (2005) study. Pearce was not able to relate the *overall state measure of flow* (i.e., experiential definition of flow) with the *operational measure of flow* because he did not measure them at the same moments in his learning exercise.

As expected, the three experiential components of flow are highly correlated: control and engagement, $r(192) = .42, p < .001$; control and enjoyment, $r(192) = .46, p <$

.001; and engagement and enjoyment, $r(192) = .53, p < .001$. However, the operational definition of flow is significantly negatively correlated with the experiential measure of control, $r(192) = -.70, p < .001$, experiential measure of engagement, $r(192) = -.23, p < .001$, and experiential measure of enjoyment, $r(192) = -.17, p < .02$. This is contrary to expectations. If the operational measure of flow and the experiential measure of flow are expected to measure the same state, it is expected that when a person is experiencing balanced challenge and certainty (i.e., flow), perceived control, engagement and enjoyment should be the highest. A further correlation of the operational components of flow (i.e., challenge and certainty) with the experiential measures of control, engagement and enjoyment offers clues as to why perceived engagement and enjoyment remain high even when flow is low. Certainty is highly correlated with control $r(192) = .70, p < .001$, engagement $r(192) = .36, p < .001$, and enjoyment $r(192) = .32, p < .001$. However engagement and enjoyment are not at all correlated with challenge. Challenge is negatively correlated with control $r(192) = -.37, p < .001$ and control is so highly correlated with certainty, that they could be perceived as the same thing.

Table 3

Correlations between Operational and Experiential Components of Flow

		FLOW	CNTRL	ENGAGE	ENJOY	CHALNG	CRTNTY
FLOW	Pearson *r*	1	-.699(**)	-.232(**)	-.169(*)	.777(**)	-.730(**)
	Sig. (2-tail)		.000	.001	.019	.000	.000
CNTRL	Pearson *r*	-.699(**)	1	.422(**)	.463(**)	-.367(**)	.700(**)
	Sig. (2-tail)	.000		.000	.000	.000	.000
ENGAGE	Pearson *r*	-.232(**)	.422(**)	1	.532(**)	-.008	.356(**)
	Sig. (2-tail)	.001	.000		.000	.909	.000

ENJOY	Pearson *r*	-.169(*)	.463(**)	.532(**)	1	.050	.320(**)
	Sig. (2-tail)	.019	.000	.000		.488	.000
CHALNG	Pearson *r*	.777(**)	-.367(**)	-.008	.050	1	-.136
	Sig. (2-tail)	.000	.000	.909	.488		.060
CRTNTY	Pearson *r*	-.730(**)	.700(**)	.356(**)	.320(**)	-.136	1
	Sig. (2-tail)	.000	.000	.000	.000	.060	

N = 192; ** Correlation is significant at the 0.01 level (2-tail); * Correlation is significant at the 0.05 level (2-tail).

The fact that perceived control is the only variable related to both challenge and certainty suggests that flow in role play games might be related more to having a sense of control than achieving a balance between challenge and skill. This finding is very interesting and is likely to be related to the fact that in computer role play games, the player is not directly related to the action, but instead interacts with the game through their avatar. Hence it is possible that the player would perceive their avatar as experiencing challenges and requiring certain skills to overcome those challenges rather than the player. The only factor of concern to the player is whether or not they feel a sense of control over their avatar. This finding was touched upon in the exploratory study, where the players would often ask whether the operational and experiential flow questionnaires were geared towards the player's experience or the player's perceived experience of the avatar. Because it was decided that the player would not be part of the game activity system (see Figure 5), player perceptions about the avatar were not explored. However, if the player indeed has different perceptions about their experience than their avatar, then this finding would lend support to Gee's (2003) hypotheses that the player and the avatar have a relationship of mutual dependence rather than the avatar

being a simple extension of the player. This finding also lends support to the "avatar response" action in the contradiction condition being perceived as the least engaging and enjoyable since the player has least control over their avatar in this situation.

Figure 11 illustrates the relationship between the challenge, certainty, perceived control, engagement and enjoyment across the actions. Interestingly, not all actions are perceived in the same way, which could explain why challenge is not correlated with engagement and enjoyment. Exploring the environment, NPC response, and avatar response all show low challenge, but the players' perceived, engagement and enjoyment is also low compared to the encounter with threat action. Encounter with threat action shows higher challenge, but also higher engagement and enjoyment than the other three actions.

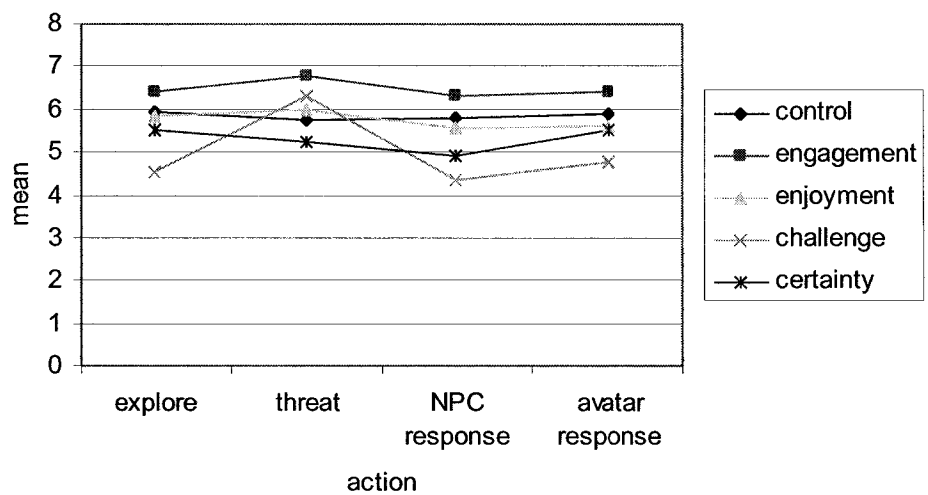


Figure 11. Means of the operational and experiential components of flow across action.

Further examination of figure 11 shows that the player is consistently engaged across the actions, suggesting that the player may be experiencing flow. A closer examination of the flow characteristics (i.e., challenge, certainty, perceived control,

engagement and enjoyment) offer clues as to where in the flow channel the actions would fall. Exploring the environment action indicates low challenge and high certainty. This action also shows high control, but slightly lower enjoyment suggesting that this action would fall closer to the boredom boundary of the flow channel. The encounter with threat action, shows high challenge and low certainty; however enjoyment is higher than perceived control. This suggests that the player might be climbing towards the frustration boundary of the flow channel, but that they are still in flow. Finally, NPC response and avatar response actions both show enjoyment lower than control, suggesting again that the player might be closer to the boredom boundary of the flow path. This finding is very interesting in terms of game design because it shows that having something akin to a threat is necessary in order to move the player through the flow channel and keep them engaged. Exploring the environment, NPC response and avatar response actions all show challenge as lower than certainty. Hence these actions could be interpreted as falling closer to the boredom boundary of the flow path. Conversely, encounter with threat action shows challenge as higher than certainty, which could be interpreted as falling near the top of the flow channel. Because all four actions were high in engagement, enjoyment and control, this illustrates that they fall within the flow spectrum. Figure 12 illustrates how this interplay of the flow components could be interpreted for the four actions.

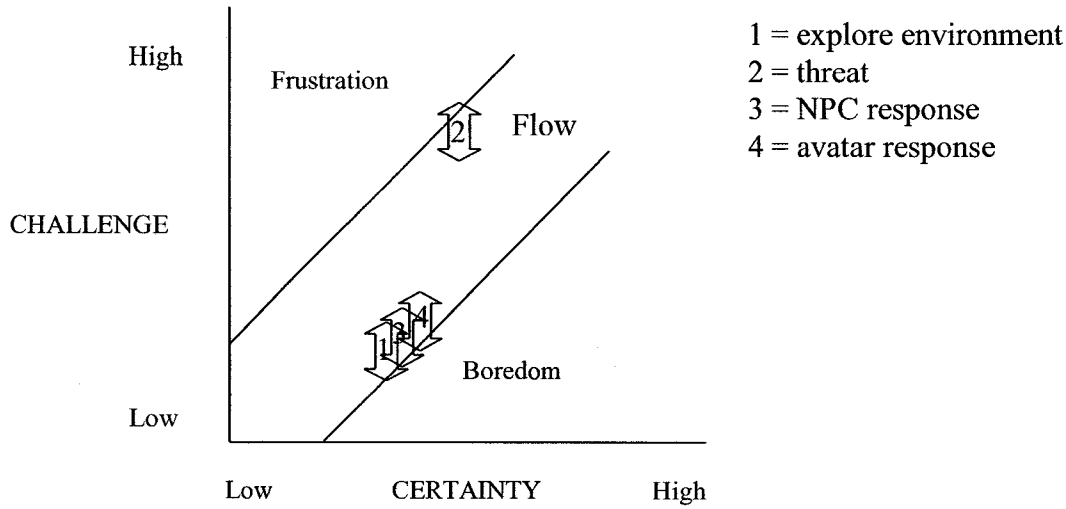


Figure 12. Actions within the flow channel.

Imbedding contradictions within these actions affects the operational definition of flow as well as perceptions of control, engagement and enjoyment. For instance, observational results show that imbedding a contradiction in an "exploring the environment" action, such as having doors that can never be opened or having a cat block a doorway, is overwhelmingly perceived as frustrating. However, introducing a contradiction in the "NPC response" and especially "avatar response" actions tends to pique the players' interest. Hence, contradictions can be used to both frustrate the player and heighten engagement. This will be examined in more detail in the observational results section, where player responses confirm that this is in fact the case.

Overall, however, comparing the operational and experiential measures of flow at the condition level, it is evident that challenge is lowest and certainty highest at the non-contradiction condition, whereas the reverse is true at the contradiction condition. As challenge rises, enjoyment, control and certainty falls.

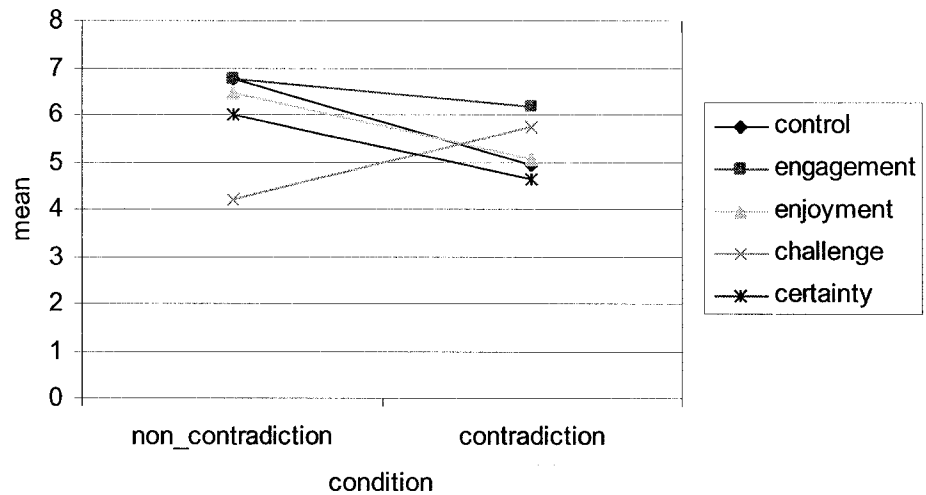


Figure 13. Means of challenge, certainty, control, engagement and enjoyment across condition.

Exploratory Results

Demographics

Exploratory analysis was conducted on gender, age and proficiency level playing computer RPGs in general and Neverwinter Nights in particular in order to evaluate if there are significant between subject effects on the dependent variables. Of the $N = 24$ participants, there were $n = 18$ males and $n = 6$ females. After the data was collected, the age was recoded from the original 7 categories (see Appendix E) to 3 categories in order to better balance the sample and normalize the error variances of the groups. The three new age categories were: less than 19 ($n = 8$), 20 to 24 ($n = 10$), and greater than 25 ($n = 6$).

The question that addresses proficiency with role play games in general and Neverwinter Nights in particular was also recoded in order to better reflect the participant's experience level. The categories of Intermediate (know many shortcuts and

features), Advanced (know most shortcuts and features) and Expert (know practically all shortcuts and features) were sufficiently close in their description of the proficiency level that they could be merged. Additionally, from observational data, some very advanced players would choose intermediate, while others would choose advanced or expert. Hence, the three new proficiency categories became: Novice (still learning to play), Intermediate (know a few shortcuts and features) and Advanced (know many shortcuts and features).

Table 4

Participant Proficiency Level for Computer Role Play Games and Neverwinter Nights

Proficiency	General RPG (*n*)	NWN (*n*)
Novice	2	13
Intermediate	7	7
Advanced	15	4

The four dependent variables: flow, control, engagement and enjoyment

Significant main effects were found between the operational measure of flow and participants' proficiency level playing Neverwinter Nights $F(2, 7) = 17.79, p < .002, \eta^2 = .84$. As expected, novices reported being more challenged and less certain about future situations than the intermediate or advanced players for both proficiency playing RPG's in general and NWN in particular. However, results for general RPG proficiency level are only indicative and are not reliable because the novice category contained only ($n = 2$) participants, which violated homogeneity of error variance. For graphs of between subject effects of proficiency level on flow, see Appendix K.

Significant main effects were found on the experiential measure of control on participant's proficiency playing NWN, $F(2, 7) = 5.24, p < .04, \eta^2 = .60$. In general, novices experienced less control than both the intermediate and advanced players. For graphs of between subject effects of proficiency level on perceived control, see Appendix L.

Significant main effects were found on the experiential measure of engagement only on age, $F(2, 7) = 4.75, p < .050, \eta^2 = .57$. The most significant differences were found between the 20 to 24 year olds, who were the least engaged across action and condition, and over 25 year olds who were the most engaged across action and condition. For a graph of between subject effects of age on perceived engagement, see Appendix M.

There were no significant between factor effects found for the experiential measure of enjoyment. There were also no significant effects found on gender with any of the four dependent variables.

Observational Results: The Four Actions

Exploring the environment

There were many different types of players and many different ways that the players manoeuvred through the environment. However, two broader categories emerged that appear to be linked with player experience playing RPGs. The categories are: those who explore the environment fully (i.e., open all trunks, boxes, bookshelves and speak to every character before going outside or moving to a new area) and those that quickly scan the area and move on. The players that do not explore the environment fully or neglect to talk to all the NPCs seem to be the more novice players. They often resort to backtracking and having to re-explore the environment because the player's avatar will

often miss a crucial piece of information from an NPC or will not find a crucial item. For instance, these player's avatars often quickly get killed by the monster because they neglected to put warm clothes on. This is because the game is designed such that going outside without warm clothes on will drain the avatar's strength and make the avatar easier to kill by the monster. Once the player's avatar gets killed, the player will tend to take more time to explore more diligently in order to make sure they have taken all the precautions to confront the monster again. They tend to double check their inventory, check the character's capabilities, and the other options of the game. As the player explores the environment for the second time their focus seems to narrow in on the screen, i.e., players will often lean closer to the screen.

The hastiness of more novice players could also be related to their lack of understanding the rules of role play games. Younger and more novice players often play the role play game more like an action or a fighting game. They appear more concerned with their avatar collecting items, using items and selling them, rather than completing the quests. For example, one of the younger players spent the most of his time collecting items and going back to the shop keeper to sell or exchange them regardless of how relevant the items were to the quest. Players who are more familiar playing action or adventure games, in particular, focus more on collecting everything they can find and fighting the monster rather than solving the quests. A younger player who was more familiar playing action games focused almost entirely on fighting with and overcoming the monsters. In fact, when all the monsters were killed, she seemed to lose interest in the game. At the end when asked how she found the game experience overall, she said it was "a bit boring". She also admitted that she did not really grasp the point of the game -

she needed to be reminded to talk to other NPCs in order to get instructions as to what to do next.

Players who are more familiar with role play games tend to be more thorough when it comes to exploring the environment and using items in their inventory properly. More advanced players usually obey the rules of the role play game and the character dispositions more so than novice RPG players. They are also more aware of the capabilities of their character. Since the assigned character is a wizard, they are more likely to use magic or run away from the monster than try to kill it using swords or crossbows. These players will also often use their avatar only to take what is needed and leave the rest. As one advanced player remarked: "In the spirit of role playing, I am not inclined to grab and rifle through people's things. [It's] not part of character unless you are a thief." As expected, more advanced players will use the game options such as the shortcut keys, quest log and map more frequently.

The cat blocking the doorway was found the most frequent type of obstacle to exploring the environment freely. The players learned to manoeuvre their avatar around the cat by either going around it carefully or by walking deeper into a room until the cat followed and unblocked the door. Other obstacles encountered were locked doors or locked trunks. The majority of the players used their avatar to try to open a door or a trunk by unlocking it or bashing it in a few times and gave up when not successful. If the player's avatar found keys they would try again, but if it did not work they would either give up or move on.

Often, after trying for several minutes, the player would ask the experimenter for help if their avatar was blocked by the cat or unable to open a locked door or trunk. The

players seemed to welcome the help and appeared relieved to be able to overcome or surpass an obstacle. Asking for help, rather than being perceived as a weakness, speaks to the participatory nature of RPGs. Many players will collaborate with each other on-line or with their friends or neighbours to help them solve an obstacle in a game. As Henry Jenkins states, "games are interactive; game culture is participatory" (Jenkins, 2006, p.1). Jenkins states that interactive games such as RPGs are often used as media for collaboration (Jenkins, 2006).

Encountering Threats

Once the player learns to overcome the monster that is easier to kill they will apply the same strategy with the other monsters, such as trying to kill it by attacking it, running away from it, or running inside a building. Having their avatar get killed by a monster over and over again appears to be very frustrating, as one player remarks: "Come on! Now, this is driving me nuts", especially as the strategies they have used before do not work (i.e., attacking the monster is not effective right away) and players will often try to avoid the area where the monster is or run away, "Can I run somehow?"

Players are also more likely to focus their attention on the dialogue between their avatar and other NPCs right after their avatar is confronted by a threat (i.e., frostbite monster). The players appear more attentive, evidenced by moving closer to the screen and scrolling the dialogue with their cursor when reading what Dr. Smith and Heman Menaset have to say to their avatar. These two characters offer information about what to do about frostbite and are set to appear immediately after their avatar is either confronted by the frostbite monster or killed. One of the players remarked "It's good there is

knowledge in here too", after reading what Heman had to say about how to combat frostbite.

NPC Response

Having useful responses from NPCs was only memorable when it was directly related to the quest, i.e., when the avatar needed to accomplish something. Most players remembered to bring the helicopter gear to Lt. Aviator, which was one of the quests. However no one recalled a conversation with Heman or Dr. Smith. Even though these characters seemed to elicit short term focus/interest with regard to their connection with the threat, they did not appear to cause longer term recollection.

If the dialogue was long, in terms of duration of conversation or the text of the NPC was long, the players seemed to start reading slowly and then speed up and continue to skim. This was evident with some players that used a cursor to track their reading. Initially the player's cursor movement was slower and more precise tracking the text and then it sped up and moved quickly through the text. The same was evident when the player was reading the content in books. If the content was too long, i.e., more than three or four lines, the player would quickly resort to skimming the text.

Two NPCs in particular were purposefully designed to seem central to the story arc of the quest, but who did not offer useful information to the avatar. This was integral in order to assess how contradictions that break the rules of the RPG are experienced. These characters were Ivana Ozana, a research scientist, who has a surly attitude but is expected to know what is needed to launch a balloon (one of the quests) and Crazy Joe, whose dialogue was designed to alternate between offering relevant and educational information about ozone and nonsensical ramblings. These two characters were

overwhelmingly reported to be the most memorable. When a player initially encounters Ivana, she reacts with a stern "What do you want!?" Upon hearing that, the player often reacts with initial surprise (i.e., stirring back in their seat) followed by a brief snicker "Ivana is funny". The player is led to believe that Ivana knows much about what is happening around the research station because the choice of avatar responses given are: "Who is Simon?" (a researcher reported to be missing), "What's with the cat?" (a cat seems to follow the avatar from building to building, but an explanation is never offered), "What materials do I need to launch the balloon?", etc. However, Ivana does not offer any useful information to any of these questions, leaving the player's avatar to explore and talk to someone else. Similar to Ivana, Crazy Joe seems to know much about the hole in the ozone layer, but does not offer the avatar any guidance to how to proceed with the quest. When Crazy Joe finally offers to trade one item (a crystal needed to solve another quest) for another energy source, he does not accept the energy source offered. This is a clear break from conventional RPG rules, and often leaves the player momentarily stunned (i.e., they pause and are unsure as to how to proceed). Players would often click on these characters three to five times in a row to test if this was likely to produce a different reaction and lead to useful information. When this strategy did not work, players paused for a moment and one participant stated that they felt "confused and lost". At this point, most players started to back track and talk to other characters again. Interestingly, the players did not seem worried, they seemed confident that they would find a solution sooner or later. This sense of confidence supports Csikszentmihalyi's (2000) claim that a person in flow is not worried about what may or may not happen, but is simply focused on the task at hand.

Avatar Response

NPC response and avatar response are closely tied actions, because the interaction between the NPC and the avatar is designed to be like a dialogue. In actions where both the NPC and the avatar have a meaningful exchange of information the player tends to quickly skim the NPC dialogue and chose an appropriate response that will further the quest. However not being able to elicit a useful response from the NPC, another action where a contradiction was intentionally embedded, was considered the most frustrating. The main difference between the NPC response actions and avatar response actions is that the player has control over the avatar response choices whereas they do not have control over the NPC response. Players reported that encountering Crazy Joe was the most frustrating because he did not provide information relevant to furthering the quest. The avatar response action was uniquely tested when the avatar brings the crystal to Crazy Joe and he refuses to accept it. The avatar's choice of responses are: "But this is all I have. I need that Crystal.", to which Crazy Joe replies "Sorry kid, you are having to come up with something better than that." The avatar could then either choose to say "Thanks for nothing, I have to go" or "You're Crazy Joe", neither one of which is useful. At this point, most players will click on Crazy Joe, three to five extra times, to see if his or the avatar's responses change. When it does not, most players seem a bit bewildered. This type of contradiction was very interesting in terms of game design possibilities because it serves to heighten the engagement in the player. For example, one player remarked that "the plot twist with Crazy Joe was interesting". The player noted that he felt a "fine line between heightened engagement and frustration". Again, this is when players tend to pause for a moment before exploring other options such as further

exploring the environment and talking to other NPCs. Continuing with the quest can be viewed as evidence that the players are still engaged, because they seem certain that further exploration will lead to a solution. In fact, the solution is offered only when the player's avatar returns to the Antarctic Fairy with no crystal. Here, the avatar's responses to the fairy seem defeatist because there is no crystal; however the fairy perks up when she hears that Crazy Joe has it. The solution becomes that she can move in with Crazy Joe and share the crystal. The fact that this exchange is so unexpected, i.e., the avatar does not have a useful response towards the fairy and yet she responds in a positive way, is quite possibly why this event is so memorable. This type of contradiction lends itself to future study because it seems to elicit heightened engagement and greatest recall.

Exploratory Results: Recall Questions

At the end of game play I was interested in exploring if there was a difference between action and condition (i.e., with and without contradictions) on a player's recollection of that action. After the players completed all the flow questionnaires they were asked three open ended questions: How did you find the game overall? Did you learn anything? and What did you find the most memorable? In general, most players found the game interesting. One advanced player stated that his overall experience of the game was very enjoyable. He enjoyed solving puzzles, which was described by the player as "going from person to person, following leads, judging characters – seeing who is the odd one, seeing who will help you and more". The player described this as "consistent with regular RPG conventions". Some players found the quest boring, especially the ones who are used to fast action or adventure games.

While testing specific learning outcomes was not in the scope of this thesis I was interested to explore how the players would respond to the learning questions and more specifically how the players would define the learning questions for themselves. In particular, I did not specify that the recall questions needed to be related to the educational content embedded within the game quest. When the players were asked "Did you learn anything?" most players did not respond in any way related to the scientific process related to the quest, such as mentioning materials needed to launch a weather balloon or anything related to frostbite, chlorofluorocarbons (CFCs), ozone layer and global warming. A few players mentioned noticing "an educational component", but were not able to explain it in any detail. One player said that they did not learn anything because they already knew about CFCs and global warming. When asked if that distracted from game play they said that it did because "It's like seeing a movie that they've seen before". One of the players noted that they liked how we incorporated stuff for children as well as adults into the game. "You never know who will play the game."

However, most players did not know what was meant by "learn anything" so the question was rephrased: "What was the most memorable?" This question demonstrated more clearly that there was a learning outcome or a recall measure to the game. The majority of the players recalled getting killed by the monsters "I kept on dying" or "Not being able to defeat the friggin' ghost thing [frostbite monster]". Other memorable characters were the cat, "couldn't do anything with the cat?", Crazy Joe, the Antarctic Fairy, and Ivana Ozana: "Was there something specific to her? I found that curious too". The fairy is memorable because she seems "utterly out of place" and is a very unusual character. She also holds the key to solving the crystal quest with Crazy Joe, which was

perceived to be very interesting, as one player responded with a resounding "a-ha!" In addition, Crazy Joe and Ivana have memorable or jarring personalities. Crazy Joe is nonsensical and Ivana is rude.

Crazy Joe is cited by almost everyone as the most memorable. Not only is he "crazy" and nonsensical, but he does not accept the alternate energy source, even though he asks for it. This situation was intentionally designed to be contrary to RPG conventions. At this point players were usually confused for a moment (i.e., they paused), and then they started backtracking. For example, one of the players returned to talk to Dr. Alterego and started to read books that had material on Hydrogen Energy and Wind Energy. This type of scenario may be conducive to embedding educational content as the player is highly focused and driven to solve that problem. Players really appreciated being given hints when they were stuck with a situation such as when Crazy Joe does not accept the solar panel or when the cat was blocking the door. This again speaks to the collaborative experience of role play games and warrants future study.

Observation of the players showed that they are likely to focus their attention when they are confronted by an unusual situation. This was evidenced by players moving their body closer to the screen and tracking the dialogue with their cursor as they read. The situations that elicited these reactions most clearly were: the fairy appearing in a burst of light, Ivana opening up her dialogue with a stern "What do you want!?", and Crazy Joe speaking nonsensically. Players are also likely to focus their attention on the dialogue right after they are confronted by a threat (i.e., frostbite monster). They appear more attentive to reading what Dr. Smith and Heman Menaset have to say.

The observational results served not only to add richness and explanations as to the thought processes and behaviours of the players as they encountered the two contradictions, but they also serve to add a depth and richness to the actions as well. The results clearly showed that not all actions and not all contradictions have the same effect on player engagement. Simply introducing contradictions as obstacles, such as locked doors, seems to serve to frustrate the players. However, introducing contradictions in ways that affect game rules seems to serve to heighten engagement, to a point. For example, players will stay engaged in so far that they believe a solution is possible. Hence, these results offer a glimpse into how contradictions can be used in game design to manipulate player engagement levels.

Discussion

Using Activity Theory for Game Design

This thesis demonstrated that activity theory can be used as a method to study the process and outcomes of play by analyzing contradictions within the activity system of a computer role play game. The results from the hypotheses clearly demonstrated that it is possible to use activity theory not only to distinguish between distinct actions in a computer RPG, but also to manipulate those actions by embedding contradictions. By observing the players' actions after they encountered contradictions in the game, it was possible to observe learning, as defined by successfully overcoming a challenging event (Engeström, 1987). Observations showed that once the players learned to overcome a challenging event, they tried the same strategy when encountering a similar event. For example, once a player's avatar killed a monster that was easy to overcome they tried the same strategy with a monster that was difficult to overcome. If that approach did not

work, they would either keep trying or try a new approach, such as running away or running inside a building. These types of contradictions also introduced a social element, because if they were difficult enough, the players would usually ask the experimenter for help. The experimenter would either help them solve the obstacle or tell them that it could not be solved, which served to satisfy the player. For instance, if some locked doors could never be opened. This is an interesting finding for future research in game design as well as potential uses in education, in terms of using contradictions not only to heighten engagement but also stimulate communication and team based problem solving.

Finally, this study showed that imbedding contradictions within actions produces significant enough results that this method can be used to distinguish between and manipulate actions for future game design.

Measuring Outcomes Using the Theory of Flow

The study in this thesis also demonstrated that it is possible to use actions to map points of interest against which to measure other outcomes, such as engagement through the operational and experiential measures of flow. The results from the hypotheses showed that the operational and experiential measures of flow differed between actions with contradictions and actions without. Further analyses also illustrated that the actions themselves are quantitatively different with regard to how they are experienced (see Figure 11), such that encountering a threat elicits a different experience than exploring the environment or interacting with NPCs. The most likely explanation for the difference in experience is that encountering a threat requires swift and decisive action, whereas interacting with NPCs is more self paced. The player has time to think and react to the

NPC. This is most likely why the player has the most frustration – there is time to respond, but the correct response is not available.

Looking at both actions and conditions, the results are interesting in terms of game design opportunities because they could be used to help game designers understand how a player would experience a particular situation. For example, comparing between actions where a player's avatar is given useful information to proceed and where a player's avatar is not given useful information to proceed. These actions can then be systematically manipulated to achieve the desired player experience. For instance, if a player's avatar encounters an action where they do not have useful information to proceed, as in the case of Ivana or Crazy Joe; further research could evaluate these actions uniquely and assess where in the flow channel they would fall. In addition, these types of actions can be manipulated to measure the level of engagement, e.g., boring, just right, frustrated. At which point would the player need assistance (such as hints from the experimenter or the NPC) before they become too frustrated and give up? This type of information is precisely what drives continued engagement in games, as seasoned players will often talk about and remember a particularly challenging or unusual situation.

Regarding the outcome measure of flow, it was possible to show the correlation between the operational definition of flow (challenge/certainty) and the experiential definition of flow (perceived control, engagement, enjoyment), which was one of the shortcomings of Pearce's (2005) study. The results were slightly unexpected as challenge was not at all related to engagement and enjoyment, but was highly negatively related to control. Certainty about knowing what to do next was highly related to control, engagement and enjoyment, but not at all to challenge. This result is interesting because

it suggests that feeling a sense of control appears to be the determining factor in a player experiencing flow in a computer role play game. The most likely explanation stems from Gee's (2003) description of an avatar player relationship. In role play games, the player becomes highly invested in their character to the extent that it becomes disturbing to the player when they cannot control their avatar in an expected way. For instance, one player cared so much for his avatar's animal companion (i.e., an animal that is summoned by the avatar) that he had to "unsummon" (i.e., withdraw) him for fear that he would get hurt as he continuously tried to bash in a door. "I loved my bat. I unsummoned him because I didn't want him to get hurt. I was afraid something could happen to him, because I couldn't stand if something happened to him. I'd be very very sad."

An explanation as to why challenge was not related to enjoyment and engagement is demonstrated through the different perceptions of the actions. Some actions were perceived as challenging but enjoyable (e.g., encountering threat) and other actions were perceived as challenging but less enjoyable (e.g., encountering a locked door or the cat blocking the door).

Future Direction: Educational Opportunities for Computer Role Play Games

Through activity theory's definition of learning as a successful overcoming of contradictions it was possible to observe how someone would learn to play a game. However that was not enough to offer insight into what, if anything, would be the outcome of learning from playing a computer role play game, especially one that was designed with an educational purpose in mind. As mentioned previously, the quest was designed to deliberately introduce educational components into the game such as making the setting reflect the living conditions in Antarctica through a snowy landscape and wind

noises outside. The avatar's strength was also set to drain, eventually killing the avatar, if they did not equip themselves with the proper warm gear. The threat of cold weather conditions was also represented by a "frost bite" monster. By linking the avatar's life force with the cold weather conditions outside and by making the avatar easier to kill by the frost bite monster we were able to seamlessly combine role play game conventions with real life conditions found in Antarctica. In addition, the quests were related to environmental issues and scientific processes that would be undertaken in Antarctica. These were: collecting materials needed to launch a weather balloon that measures levels of ozone in the atmosphere, learning about alternate energy sources such as solar power and wind power, and dealing with the perils of living in such a harsh climate. Hence, the goal was to introduce educational content seamlessly into a computer role play game, without compromising any role play game conventions.

Leveraging activity theory's actions and contradictions, it was also possible to study learning outcomes through observational data. The observational results served to add richness to the hypotheses and offer explanations as to what was the thought process of the players as they encountered the four actions and the two conditions. Consistent with activity theory's definition of learning it was clear that when players overcame a contradiction once they used the same strategy when they encountered a similar situation again. However the most exciting or memorable points in the game occurred when a previously learned strategy did not work in a similar situation, i.e., when a contradiction was encountered. These were the actions where the player's attention would be focused at that moment, and that were also recalled as the most memorable at the end, such as encountering a monster that was difficult to defeat and interacting with unusual/unhelpful

NPCs. These types of actions warrant future study especially with regard more precisely measuring learning outcomes.

Study Limitations

One of the limitations in our quest was that the Neverwinter Nights game in Antarctica is a custom-made prototype based on the original NWN game that was used as a game research platform. As a result the environment and the characters were a mix between modern and medieval/fantasy. The modern items were mostly borrowed from web sites where NWN aficionados would develop "hak pacs" (custom-made items that could be incorporated into the game) that were free for others to use. Since custom development of every item would require extensive resources, we used what we could find through hak pacs and took creative liberties with other items. For example, the buildings represented the real buildings of Halley research station; however they looked more like buildings that would be found in a fantasy game. Some items were also meant to represent modern items such as helicopter gear or sunscreen, but they looked more like a metal skeleton of an arm or a magic potion, respectively. Hence, even if the items did not look like what was expected, players were instructed that they were playing a prototype and to read the description of the items to confirm what they needed to collect. Because the game settings were such that we could not remove all the fantasy items, the player experienced a mix between the two. For example, they would encounter books about solar and wind energy on the same bookshelf as a fantasy book on magic. This presented some confusion for the players as they initially did not know what was needed for the quest and what was residual from the original game. For instance, players were

unclear as to where to find an alternate energy source or the fairy's crystal, and usually required a little hint as to where to go and who to talk to.

More advanced players also tried to make sense of the quest and the characters. Their curiosity was aroused as to the items and characters that seemed out of place, such as the cat. Not being able to discover anything interesting about the cat was reported as disappointing. Similarly, more advanced players were curious about the characters and the story lines and how they are related to the quest. This is consistent with Freeman's (2003) analysis that people like some mystery and intrigue; however they also feel a sense of accomplishment when they can solve the mystery or complete the quest. Since there was not enough time or resources to complete developing all the quests future research could focus on developing stronger story arcs and more meaningful relationships with characters.

Conclusion

This thesis began to address the broad question of what is it about computer role play games that makes them so engaging and how can this be used for educational purposes. The study consisted of developing a custom-made computer role play game prototype, which allowed us to control for and manipulate certain actions and certain conditions using activity theory as a framework for game design. It was then possible to use these actions and conditions to test outcomes of engagement using the theory of flow. The results are encouraging in a sense that engagement, as measured by flow, was shown to be a quantifiable, measurable and relatively stable attribute that can be linked to discrete actions and conditions. Further research is certainly warranted in order to help validate activity theory as a framework for game design especially with regard to

examining actions and how they could be used to manipulate engagement. As the observational results revealed, this framework can also be further leveraged for exploring the relationship between engagement and learning outcomes. If the findings from this study are any indication, it just might be possible to make education engaging and enjoyable.

References

Agarwal, R., & Karahanna, E. (2000). *MIS Quarterly, 24*(4), 665-694.

Anderson, J. R., & Lebiere, C. (1998). *The atomic components of thought*. Mahwah, NJ: Lawrence Erlbaum Associates.

Bargh, J. (1997). The automaticity of everyday life. In E. R.S. Wyer (Ed.), *Advances in social cognition.*

Bioware. (2003). *Neverwinter Nights*. Atari Publishing.

Chen, H., & Nilan, M. (1998). An exploration of web users' internal experiences: Application of the experience sampling method to the web environment. Orlando, Florida.

Chen, H., Wigand, R. T., & Nilan, M. (1999). Optimal experiences of web activities. *Computers in Human Behavior, 15*(5), 585-608.

Chen, M., & Johnson, S. (2004). *Measuring flow in a computer game simulating a foreignlanguage environment.* Retrieved 05/10, 2005 from http://www.markdangerchen.net/gaming.htm

Choi, D., & Kim, J. (2004). Why people continue to play online games: In search of critical design factors. *Cyberpsychology & Behaviour, 7*(1), 11-24.

Churchill, A., Peter, P. (1984). Research Design Effects on the Reliability of Rating Scales: A Meta Analysis. *Journal of Marketing Research,* 21(4), 360-375.

Csikszentmihalyi, M. (2000). *Beyond boredom and anxiety: Experiencing flow in work and play*. San Francisco: Jossey-Bass.

Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life* (1st ed.). New York: Basic Books.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety.* San Francisco: Jossey-Bass.

Deci, E. L., & Ryan, R. M. (Eds.). (2002). *Handbook of self-determination research* (1st ed.). Rochester, NY: The University of Rochester Press.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York, NY: Plenum Publishing Co.

Dempsey, J. V., Haynes, L. L., Lucassen, B. A., & Casey, M. S. (2002). *Forty simple computer games and what they could mean to educators. Simulation & Gaming, 33*(2), 157-168.

Dormann, C., Fiset, J. P., Caquard, S., Woods, B., Hadziomerovic, A., & Whitworth, E. (2005). Computer games as homework: How to delight and instruct. *Home Oriented Informatics and Telematics Conference,* University of York, United Kingdom, *April 13-15.*

Ehrlich, E., Flexner, S. B., Carruth, G., & Hawkins, J. M. (1980). *Oxford American Dictionary*. New York, NY: Avon Books.

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*(1), 133-156.

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research* Helsinki, Orienta-Konsultit.

Engeström, Y., & Escalante, V. (1996). Mundane tool or object of affection? the rise and fall of the postal buddy. In B. Nardi (Ed.), *Context and consciousness: Activity theory and human computer interaction* (pp. 325-374). Cambridge, Massachusetts: MIT Press.

Freeman, D. (2003). *Creating emotion in games: The craft and art of emotioneering*. New York: New Riders.

Gee, J. P. (2004). *Learning about learning from a video game: Rise of nations.* Unpublished manuscript.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave/Macmillan.

Ghani, J. A., Supnick, R., & Rooney, P. (1991). The experience of flow in computer-mediated and in face-to-face groups. New York, NY.

Ghani, J., & Deshpande, S. (1994). Task characteristics and the experience of optimal flow in human-computer interaction. *The Journal of Psychology, 128*(4), 381-391.

Hasu, M., & Engeström, Y. (2000). Measurement in action: An activity theoretical perspective on producer-user interaction. *International Journal Human-Computer Studies, 53*, 61-89.

Jelfs, A., & Whitelock, D. (2001). Presence and the role of activity theory in understanding: How students learn in virtual learning environments. In M. Beynon, C. L. Nehaniv & K. Dautenhahn (Eds.), (pp. 123-129). Berlin, Heidelberg: Springer-Verlag.

Jenkins, H. (2006). *Game On! The Future of Literacy Education in a Participatory Media Culture,* Threshold, Winter 2006, reprinted on New Media Literacies Web site. http://www.projectnml.org/node/306/

Jones, M. G. (1999). *What can we learn from computer games: Strategies for learner involvement* No. IR 019 785). Houston, TX.

Kaptelinin, V., & Cole, M. (2005). *Individual and collective activities in educational computer game playing.* Retrieved 02/24, 2005 from http://129.171.53.1/blantonw/5dClhse/publications/tech/Kaptelinin-Cole.html

Kaptelinin, V., & Cole, M. (1997). *Individual and collective activities in educational computer game playing. Proceedings of Computer Support for Collaborative Learning (CSCL'97).*

Kirriemuir, J. (2003). *The relevance of video games and gaming consoles to the higher and further* (Techwatch report No. TSW 02-01) JISC.

Kutti, K. (1996). Activity theory as a potential framework for human computer interaction research. *Context and consciousness: Activity theory and human-computer interaction* (pp. 17). Cambridge, Massachusetts: The MIT Press.

Larson, R., & Csikszentmihalyi, M. (1983). *New Directions for Methodology of Social and Behavioral Science,* (15), 41-56.

Larson, R., & Richards, M. H. (1994). *Divergent realities: The emotional lives of mothers, fathers, and adolescents.* New York, NY: Basic Books.

Leontiev, A. N. (1981). *Problems of the development of mind.* Moscow: Progress.

Leontiev, A. N. (1978). *Activity, consciousness and personality.* New York: Prentice Hall.

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science,* (4), 333-369.

Malone, T. W. (1980). What makes things fun to learn? heuristics for designing instructional computer games. 162-169.

Mannell, R. C. (1979). A conceptual and experimental basis for research in the psychology of leisure. *Loisir & Societe, 2*(1), 179-196.

Mannell, R., & Bradley, W. (1986). Does greater freedom always lead to greater leisure? testing a person X environment model of freedom and leisure. *Journal of Leisure Research, 18*, 215-230.

Maushak, N. J., Chen, H. H., & Lai, H. S. (2001). Utilizing edutainment to actively engage K-12 learners and promote students' learning: An emergent phenomenon. Atlanta, GA., *1-2*

Moneta, G. B., & Csikszentmihalyi, M. (1996). The effect of perceived challenges and skills on the quality of subjective experience. *Journal of Personality, 64*(2), 275-310.

Nardi, B. A. (Ed.). (1996). *Context and consciousness: Activity theory and human-computer interaction*. Cambridge: The MIT Press.

Oliver, M., & Pelletier, C. (2005). The things we learned on liberty island: Designing games to help people become competent game players. Burnaby, B.C.

Oliver, M., & Pelletier, C. (2004). Activity theory and learning from digital games: Implications for game design. Paper presented at the conference, Digital Generations: Children, young people and new media. London.

Pace, S. (2000). Understanding the flow experience of web users. Paper presented at the OzCHI 2000 Doctoral Consortium, Sydney.

Pearce, J. M., Ainley, M., & Howard, S. (2005). The ebb and flow of online learning. *Computers in Human Behavior, 21*, 745-771.

Quinn, C. N. (1994). Designing educational computer games. In K. Beattie, C. McNaught & S. Wills (Eds.), *Interactive multimedia in university education: Designing for change in teaching and learning.* (pp. 45-57). Amsterdam: Elsevier.

Roussou, M. (2003). *Interactivity and learning: Examining young learners' activity within interactive virtual environments.* Unpublished PhD report, University College London.

Ruben, B. D., & Lederman, L. C. (1982). Instructional simulation gaming: Validity, reliability, and utility. *Simulation & Games, 13*(2), 233-244.

Squire, K. (2002). Cultural framing of computer/video games. *GameStudies, 2*(1), August 10, 2005.

Trevino, L. K., & Webster, J. (1992). Flow in computer-mediated communication. *Communication Research, 19*(5), 539-573.

Vygotsky, L. S. (1978). *Mind in society.* Cambridge, MA: MIT Press.

Wallace, P. (2005). *Blending instructional design principles with computer game design: The development of descartes' cove.* Montreal, Canada. 402-407.

Webster, J., Trevino, L. K., & Ryan, L. (1993). The dimensionality and correlates of flow in human–computer interactions. *Computers in Human Behavior, 9*(4), 411-426.

Woods, B., Whitworth, E., Hadziomerovic, A., Fiset, J. P., Dormann, C., & Caquard, S. et al. (2005). Repurposing a computer role playing game for engaging learning. Montreal.

Appendix A

Overall State Measure of Flow (Pearce et al., 2005)

Questions (grouped by factor). Response key was from *"Not at all"* to *"A lot"*

Control:

(a) I felt in control of what I was doing

(f) I was frustrated by what I was doing *(negatively scored)*

(j) I knew the right thing to do

Engagement:

(b) I was absorbed intensely by the activity

(d) I thought about other things *(negatively scored)*

(h) I was aware of distractions *(negatively scored)*

(k) It required a lot of effort for me to concentrate on the activities *(negatively scored)*

Enjoyment:

(c) I found the activities enjoyable

(e) I found the activities interesting

(g) the activities bored me *(negatively scored)*

(i) the activities excited my curiosity

Calculating aggregate scores:

Control = (a + (6 – f) + j) / 3

Engagement = (b + (6 – d) + (6 – h) + (6 – k)) / 4

Enjoyment = (c + e + (6 – g) + i)/4

Appendix B

A Data Analysis Tool Based on an Activity Theoretic Perspective of Learning from Games

Activity	Action	Operation	Contradiction between…		Rationale	Evidence of learning (resolution)

Appendix C

Oliver & Pelletier's Data Analysis Tool Modified to study Neverwinter Nights in Antarctica

Example:

Situation	Action	Operation	Contradiction between…		Rationale	Evidence of learning (resolution)
Does not comply with expectation	Trying to open things that do not open	Click on chest, cargo box, storage container…	S	T	Chest does not open	Try using items in inventory (e.g., keys, sword)
			S	T	Chest does not open	Continue to explore environment
			S	T	Chest does not open	Try using items in inventory (e.g., keys, sword)
Complies with expectation	threat	Attack with a weapon	S	T	Fight monster	Monster not killed, or…
		Continue to attack with a weapon	S	R (the longer the avatar is outside the weaker they become, in turn, the monster becomes stronger)	Fight monster	Monster not killed and your life force becomes weaker

		Continue to attack with a weapon	S	R (the longer the avatar is outside the weaker they become, in turn, the monster becomes stronger)	Fight monster	You are too weak from exposure and you are killed by monster, or…
		Continue to attack with a weapon	S	R (the longer the avatar is outside the weaker they become, in turn, the monster becomes stronger)	Fight monster	You are too weak from exposure and you run away from the monster to seek shelter inside and replenish your life force, or …
		Attack with a weapon	S	T	Fight monster	Monster killed

Appendix D

Observation of the Player Engaged in the Game: Action Checklist

Action	**Y/N**	**Notes**	**Time**
1. Exploring the environment freely (e.g., observing items, using items in inventory, collecting items)			
2. Encounter with threat (e.g., frostbite monster)			
3. Receiving helpful responses from NPCs			
4. Receiving useful responses from avatar toward other NPCs			
5. Not exploring the environment freely (e.g., observing items, using items			

in inventory, collecting items)

6. Encounter with threat (e.g. frostbite monster) that is difficult to overcome

7. Receiving non-helpful responses from NPCs

8. Receiving non-useful/Non-sensical responses from avatar toward other NPCs

Other

Appendix E

Demographics

1. What is your gender?

    a. male

    b. female

    c. prefer not to answer

2. What is your age in years?

    a. less than 14

    b. 15 to 19

    c. 20 to 24

    d. 25 to 29

    e. 30 to 34

    f. 35 to 39

    g. greater than 40

    h. prefer not to answer

3. Which of the following best describes your proficiency with **computer role play games** in general?

    a. Novice: still learning to play

    b. Occasional Player: know a few shortcuts & features

    c. Intermediate Player: know many shortcuts & features

    d. Advanced Player: know most shortcuts & features

e. Expert Player: know practically all shortcuts & features

4. Which of the following best describes your proficiency with **Neverwinter Nights**?

a. Novice: still learning to play

b. Occasional Player: know a few shortcuts & features

c. Intermediate Player: know many shortcuts & features

d. Advanced Player: know most shortcuts & features

e. Expert Player: know practically all shortcuts & features

Appendix F

Operational Flow Questionnaire (challenge/skill) and State Measure (control, engagement, enjoyment)

Action (see bottom of page for a list of actions): E.g., Think about how you felt when your character defeated the monster.

Please circle the appropriate number:

How challenging did you find that situation?									
not at all									very
1	2	3	4	5	6	7	8	9	10
How certain did you feel about what to do next in that situation?									
not at all									very
1	2	3	4	5	6	7	8	9	10
I felt in control of what I was doing									
not at all									very
1	2	3	4	5	6	7	8	9	10
I was absorbed intensely by the action									
not at all									very
1	2	3	4	5	6	7	8	9	10
I found the action enjoyable									
not at all									very
1	2	3	4	5	6	7	8	9	10
I thought about other things									
not at all									very
1	2	3	4	5	6	7	8	9	10
I found the action interesting									
not at all									very
1	2	3	4	5	6	7	8	9	10
I was frustrated by what I was doing									
not at all									very
1	2	3	4	5	6	7	8	9	10
The action bored me									

not at all									very
1	2	3	4	5	6	7	8	9	10
I was aware of distractions									
not at all									very
1	2	3	4	5	6	7	8	9	10
The action excited my curiosity									
not at all									very
1	2	3	4	5	6	7	8	9	10
I knew the right thing to do									
not at all									very
1	2	3	4	5	6	7	8	9	10
It required a lot of effort for me to concentrate on the action									
not at all									very
1	2	3	4	5	6	7	8	9	10

This scale will be repeated for every one of the following actions:

Actions without contradictions (expected flow)

- Think about how you felt when your character could explore the environment freely, such as walking in and out of certain rooms and could access items in trunks or boxes.
- Think about how you felt when your character defeated the monster.
- Think about how you felt when your character was talking to other characters that offered useful information to your character.
- Think about how you felt when your character had useful responses or questions during a conversation with another character.

Actions with contradictions (flow not expected)

- Think about how you felt when your character could not explore the environment freely, such as not being able to walk in and out of certain

rooms and could not access items in trunks or boxes.

- Think about how you felt when your character could not defeat the monster.
- Think about how you felt when your character was talking to other characters that did not offer useful information to your character.
- Think about how you felt when your character did not have useful responses or questions during a conversation with another character.

Appendix G

Announcement for Recruitment

(To be posted on the electronic recruitment bulletin with permission)

Earn Credits or Cash While Playing a Computer Role Play Game (Neverwinter Nights)!

Hi, my name is Aida Hadziomerovic and I am from the Human Oriented Technology (HOT) Lab at Carleton University. I will be conducting research to explore player experiences while playing a modified version of Neverwinter Nights set in modern day Antarctica.

You must be familiar with computer role play games and have at least some experience playing them.

The experiment will take between one and two hours to complete depending on you and how long it takes you to progress through the quest. You can either choose to receive two hours of course credit or $10 in cash. You will be asked to play the game and complete short questionnaires about your experiences and perceptions after you finish playing. The game is installed on the computers in the Human Oriented Technology Lab on the 2nd floor of the Social Science Research Building (SSRB) on the West side of the Loeb building (towards the canal).

For any additional information you can come in to the HOT Lab, call me at 520-2600 ext. 6628, or e-mail me at ahadziom@connect.carleton.ca

Thanks again for your participation!

Aida Hadziomerovic

Appendix H

Informed Consent Form to Study Engagement and Recall in a Custom Computer Role Play Game Module, Neverwinter Nights in Antarctica

Introduction

The purpose of an informed consent is to ensure that you understand the purpose and your involvement in the study. The informed consent must provide enough information so that you can determine whether or not you wish to participate in this study.

Study

Engagement and learning in a computer role play game, Neverwinter Nights in Antarctica

Research Personnel

The following personnel are involved in this research project and may be contacted at any time. Aida Hadziomerovic, ahadziom@connect.carleton.ca (Principal Investigator), 520-2600 ext. 6628, Dr. Robert Biddle (Faculty Sponsor), 520-2600 ext. 6317, robert_biddle@carleton.ca. If any ethical concerns about this study should arise please contact Dr. Janet Mantler (Chair, Carleton University Ethics Committee for Psychological Research), 520-2600 ext. 4173, janet_mantler@carleton.ca. Should you have any other concerns about this study, please contact Dr. Mary Gick (Chair, Dept of Psychology, 520-2600, ext. 2664).

Purpose

The purpose of this study is to evaluate engagement and learning through playing a modified computer role play game (RPG) based on the popular RPG Neverwinter Nights.

Task Requirements

You will be asked to fill out a general demographics questionnaire. You will then be asked to play a computer role play game. At the end of the game, you will be asked to answer a series of brief questionnaires related to your experiences playing the game.

The game playing session will be videotaped. There will be two cameras, one will be videotaping you as you play and another one will be video taping your game. The video tapes will be completely anonymous, such that your identity will not be associated with the video tape. The videotapes will be labelled using an ID number that is associated with each participant. The video tapes will only be observed by the experimenter and will be kept completely confidential. Once the data has been analyzed the video tapes will be destroyed.

Duration and Locale

The duration of this study will be between one and two hours, depending on how long it takes you to complete the quest. You will be offered two hours of course credit or a payment of $10 for your participation in this experiment.

Potential Risk or Discomfort

There are no potential risks or discomforts in this study and you will not be evaluated for any right or wrong answers. You can take rest breaks throughout the study if you need to.

Confidentiality

All the participant's data will be coded and will remain anonymous. The participant will be videotaped however the data collected will be coded such that the participant's name will not be associated with the data. The data is to be used only by the researchers involved in this project. Once the data has been analyzed, the video tape recordings will be destroyed.

Right to Withdraw

You have the right to withdraw from the study at any time without penalty.

I have read the above description of the study and understand the conditions of my participation. I agree to participate in this research project.

Participant Name: _____

Participant Signature: _____

Researcher Name: Aida Hadziomerovic

Researcher Signature: _____

Appendix I

Instructions for the Participant

Instructions read by the experimenter:

"You can sit down here (motion to the chair in front of the computer where the game is installed). I will be sitting right there and taking notes (motion to a chair beside and slightly behind the participant). There are two cameras in the room, one camera will be taping the game and another camera will be taping you.

Please fill out this demographics questionnaire before we continue. (Hand out the demographics questionnaire and collect it after they have filled it out.)

You will be asked to play a custom-made game module based on the Neverwinter Nights game platform that is used for experimental purposes. It is important for you to treat the game as if you would any other computer role play game and to try to ignore the discrepancies between the medieval and modern settings.

If you have any questions or comments about the game or anything you experience while playing the game feel free to tell me. If you have a cell phone or pager, please turn it off. You can take breaks if you need to. For consistency, I have chosen the character, Aluvian Darkstar, for you to play with.

When you are finished I will ask you to answer a few brief questionnaires.

You can now start to play the game."

Appendix J

Debriefing

Thank you for participating in this experiment. You were a participant in an experiment conducted by Aida Hadziomerovic (M.A. candidate) and Dr. Robert Biddle. The experiment was created to learn how certain conditions in the game quest affect engagement. The quest was designed to recreate as true as possible a genuine game playing experience and there were no right or wrong answers. We hope that by learning more about the nature of role play games we can understand how to create engagement in educational software applications.

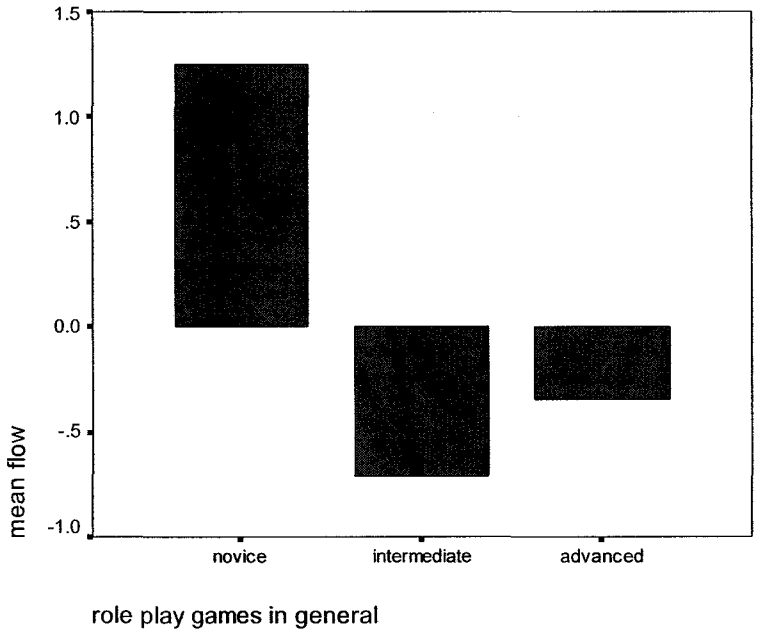
Your feedback will be considered during the development of the next version of the prototype. Thank you for participating in the study. Your time and effort are greatly appreciated!

Please feel free to contact us at any time if you wish to discuss any aspects of the research. Aida Hadziomerovic, ahadziom@connect.carleton.ca (Principal Investigator), 520-2600 x. 6628, or Dr. Robert Biddle (Faculty Sponsor), 520-2600 x. 6317, robert_biddle@carleton.ca. If any ethical concerns about this study should arise, please contact Dr. Janet Mantler (Chair, Carleton University Ethics Committee for Psychological Research), 520-2600 ext. 4173, janet_mantler@carleton.ca. Should you have any other concerns about this study, please contact Dr. Mary Gick (Chair, Dept of Psychology, 520-2600, ext. 2664).

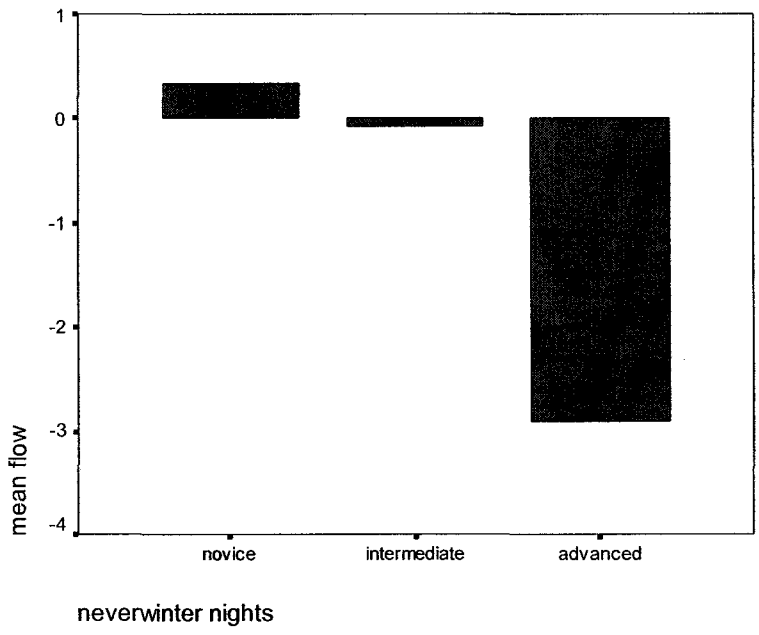
Appendix K

Between Subjects Effects: Proficiency Level by Flow

Role Play Game General Proficiency by Flow



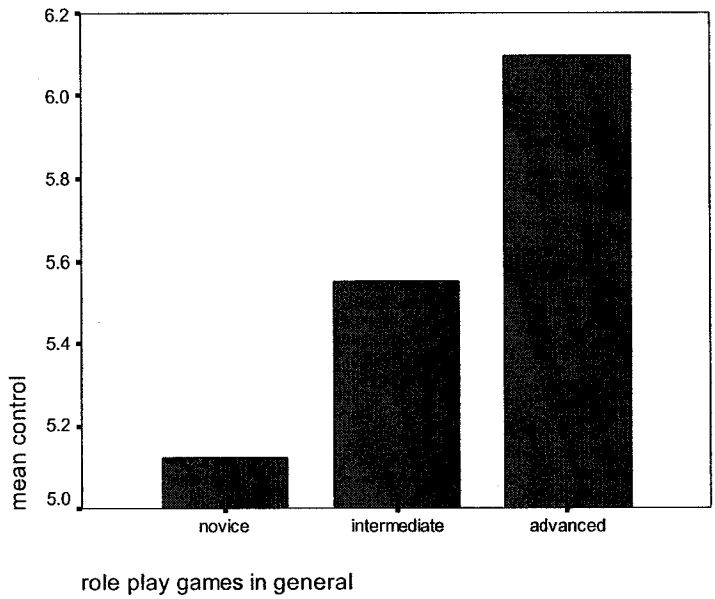
Role Play Game Neverwinter Nights Proficiency by Flow



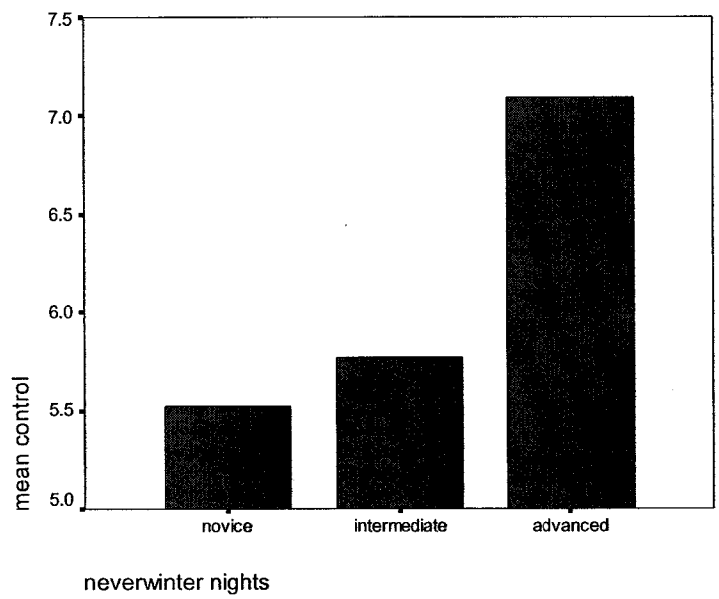
Appendix L

Between Subjects Effects: Proficiency Level by Control

Role Play Game General Proficiency by Control



Role Play Game Neverwinter Nights Proficiency by Control



Appendix M

Between Subjects Effects: Age by Engagement