EMBRY-RIDDLE
Aeronautical University™
SCHOLARLY COMMONS

Dissertations and Theses

Summer 2013

Investigation of Videogame Flow: Effects of Expertise and Challenge

Jolie G. Gascon
Embry-Riddle Aeronautical University - Daytona Beach

Follow this and additional works at: https://commons.erau.edu/edt

Part of the Cognitive Psychology Commons

Investigation of Videogame Flow: Effects of Expertise and Challenge

by

Jolie G. Gascon

B.S., Embry-Riddle Aeronautical University, 2011

A Thesis Submitted to the
Department of Human Factors & Systems
in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Human Factors & Systems

Embry-Riddle Aeronautical University
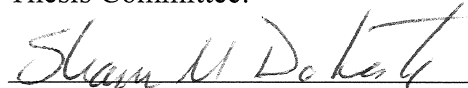Daytona Beach, Florida
Summer, 2013

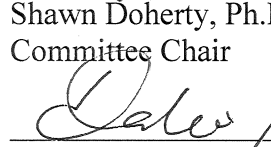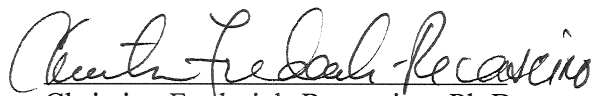# INVESTIGATION OF VIDEOGAME FLOW: EFFECTS OF EXPERTISE AND CHALLENGE
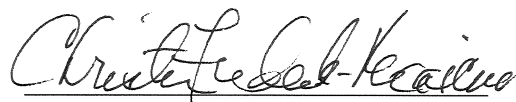
By

Jolie G. Gascon

This thesis was prepared under the direction of the candidate's Thesis Committee Chair, Dr. Shawn Doherty, Associate Professor, Daytona Campus, and Thesis Committee Members Dr. Dahai Liu, Associate Professor, Daytona Campus, and Dr. Christina Frederick-Recascino, Professor, Daytona Campus, and has been approved by the Thesis Committee. It was submitted to the Department of Human Factors & Systems in the College of Arts and Sciences in partial fulfillment of the requirements for the degree of Master of Science in Human Factors & Systems.

Thesis Committee:

_____
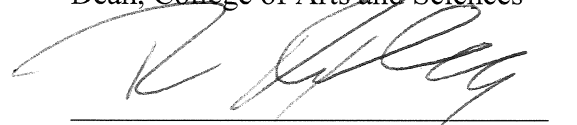Shawn Doherty, Ph.D.
Committee Chair

_____
Dahai Liu, Ph.D.
Committee Member

_____
Christina Frederick-Recascino, Ph.D.
Committee Member

_____
Christina Frederick-Recascino, Ph.D.
MS HFS Program Coordinator

_____
Scott Shappell, Ph.D.
Department Chair

_____
William Grams, Ph.D
Dean, College of Arts and Sciences

_____
Robert Oxley, Ph.D.
Associate Vice President of Academics

Date: 8-8-2013

Acknowledgements

I would like to thank my thesis committee chair, Dr. Doherty, for allowing me the opportunity to pursue this research and thereby introducing me to a field that was new to me. I now understand so much more about game play, immersion, and flow! I am also very appreciative of the patience, support, and guidance that I received. Thank you!

To Dr. Liu, my second committee member, thank you for making sure that I knew you would be available if I had any questions and for the vote of confidence in me!

I would also like to thank Dr. Steinhauer, my original third committee member, for believing in me with so much gusto from the very start! Although you could not be there at the end for my defense, I do appreciate your support and spot-on feedback.

For replacing Dr. Steinhauer at such short notice, I definitely thank Dr. Frederick-Recascino for stepping in so willingly, and for all the defense feedback!

There is simply no way I could have done this without the help of my assistant, William Dziura, who devoted so much time to a project for which no tangible incentive was received. You responded to my call, and like a true friend, you were there to help with managing participants, resolving numerous technical issues, and brainstorming ideas with me. For all of these sacrifices, I do thank you

I would also like to thank my Mom, Susan Gascon, and my friends and family who gave of their time proofreading… on the various drafts.

And finally, last but never least; I thank God for blessing me in so many ways, and with such a great committee and support structure. From family to friends to faculty, I sincerely thank you all from the bottom of my heart!

Abstract

The number of participants in this expertise and videogame flow test totaled 80 from multiple target locations. Participants engaged in various levels of the videogame *SuperMario Bros*. Twenty experts and twenty novices experienced the easier level of World 1-2 while the other twenty experts and novices were exposed to the more difficult level World 6-1. After gameplay, participants completed a modified survey measuring flow. This survey, along with overall percentage game score, was analyzed. A significant interaction was found between game level (challenge level) and skill levels in perceived immersion, with significant main effects for expertise in perceived skill, for game level (challenge level) in perceived challenge, and for game level (challenge level) in overall percentage score. No significant correlation was found between perceived skill and overall percentage score, between perceived challenge and overall percentage score, or between perceived immersion and overall percentage score. These findings are relevant for understanding videogame flow in videogames of varying degrees of challenge and in players of different expertise levels. Discussion on these findings highlights the purpose of this paper.

Table of Contents

List of Tables

List of Figures

Introduction

The videogame industry is a viable industry ever-increasing in profitability. In 2004, the United States (U.S.) videogame industry not only generated 144,000 jobs, but was worth $10.3 billion (Bloomberg Businessweek, 2006), a number that grew to $18.8 billion by 2007 (Seeking Alpha, 2008). Globally, in 2011 the total worth was a substantial $65 billion (Baker, 2011), with a projected increase of $68.4 billion in 2012 (Caron, 2008) and $91 billion by 2015 (V824/7, 2009). This economic profit is both realistic and anticipated due to the fact that the number of videogame players has also been on the rise. In 2010, 67% of U. S. households played video games (Entertainment Software Rating Board, n.d.; Entertainment Software Association, n.d) approximately 13 hours weekly (Makuch, 2010). In 2011, the number of U.S. households playing videogames rose to 72% (Gamers Daily News, 2012), while the average hours played weekly also jumped to 18 (Fox News, 2012). These numbers not only indicate the prevalence and economic power of videogame players, but may be the result of the benefits that video games offer. Such benefits include relaxation and the resulting feeling of happiness that nonviolent games educe (Coxworth, 2011), and a productive way of spending time developing social skills and honing emotions and creativity (McGonigal, 2011; Provenzo Jr., 2000; Bogost, 2007). Regardless of skill level, people increasingly play videogames. Even those who do not typically like videogames will still play for the social interaction (Sweetser & Wyeth, 2005). Although the reasons for playing videogames may vary somewhat from person to person, one important motivation is the experience of flow (Paras, 2005).

Flow

Flow is an emotional state, derived from heightened feelings generated by an activity, during which the individual experiences a sense of pleasure and achievement or accomplishment.

A major characteristic necessary for inducing flow is the appropriate combination of skill and challenge (Jin, 2012).

Csikszentmihalyi (1997b) terms flow as the place of perfect harmony between expectations and accomplishments, "flow experiences." "Flow", also known as being "in the zone" by athletes, is the state of being mentally focused and immersed in the activity, so that performance is an effortless joy where outside interference and distractions are forgotten. Flow occurs when a person's talents and skills are sufficiently challenged to not only prevent boredom or helplessness, but rather propels perseverance and continuance (Hunicke, 2005; Clanton, 1998).

The importance of skill-challenge balance and its ensuing emotional state is shown in the flow theory model visual of Figure 1. Here can be seen that overly-challenging activities result in feelings of frustration, followed by worry, and finally anxiety whereas under-challenging activities result in relaxation leading to boredom. Where both skill sets and challenges are modest, apathy occurs. The importance of flow applies to more than just personal enjoyment in life; it addresses a broad scope of real-life issues (Csikszentmihalyi, 1991), from health and sports to marketing and learning, to name a few.
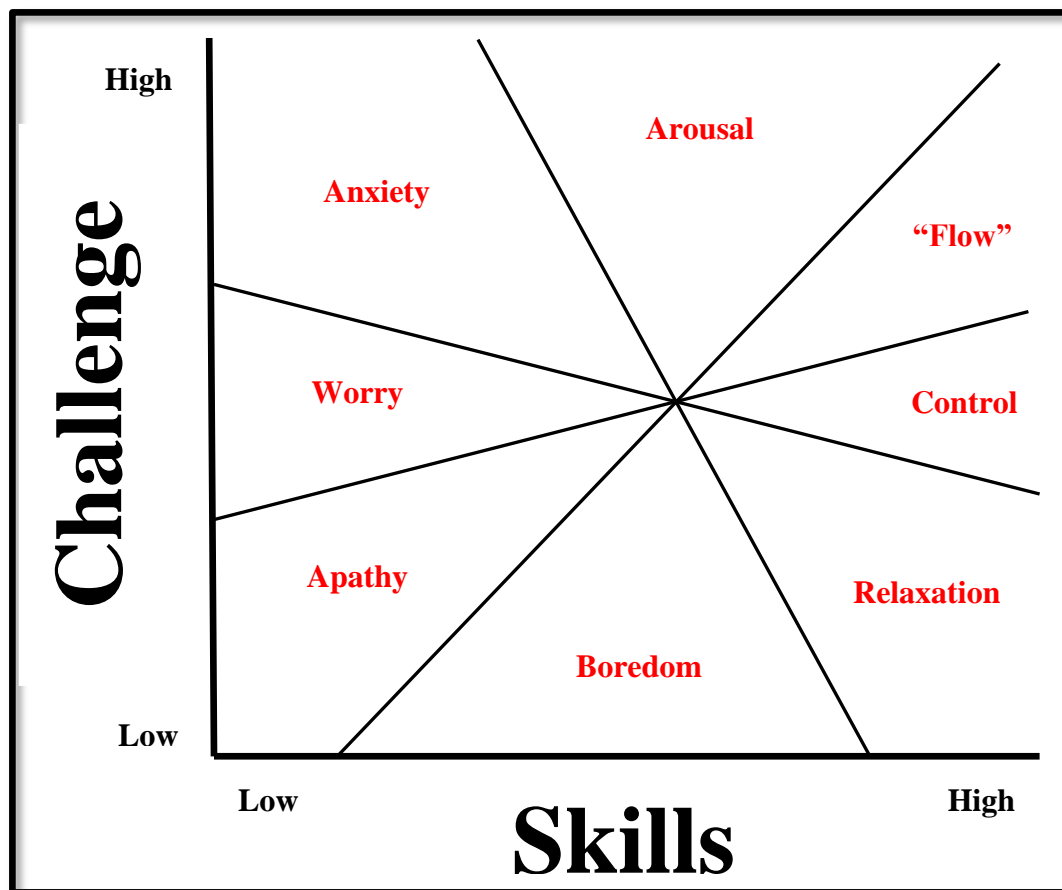
Figure 1. Challenge level and the correlating skill level with resulting emotion. Adapted from Abilla (2011).

Flow importance.

Evidence of the flow state can be found in a wide variety of domains: physical health (Kennedy & Vecitis, 2004), mental health (Slade, 2012), clinical practice (Duckworth, Steen, & Seligman, 2005), and occupational therapy for the disabled (Law, 1991), sports (Jackson, Ford, Kimiecik, & Marsh, 1998). Non-health-related domains also benefit from experiencing flow states which include the non-industrial clothing and textile industry (Blood, 2006), interface hedonic (enjoyment-driven) experiences (Stelmaszewska, Fields, & Blandford, 2004), teaching (Ho & Kuo, 2009), commercial design experience (Wright, Mccarthy & Meekison, 2004), and user-centered home design (Monk, 2000).

Flow in the videogame industry.

One major outlet for experiencing flow can be found within the videogame entertainment industry, granted that the challenge-level needs of a novice are not necessarily the same as those of an expert, as shown in Figure 2. These needs are important to note, since differences in abilities determine how well changes in difficulties are received (Malone & Lepper, 1987). Although meeting the appropriate skill/ challenge balance for the novice and expert is important in order for flow to be attained (Pavlas, 2010), not many studies have researched flow in videogame-play, especially with a focus on skill level and challenge.
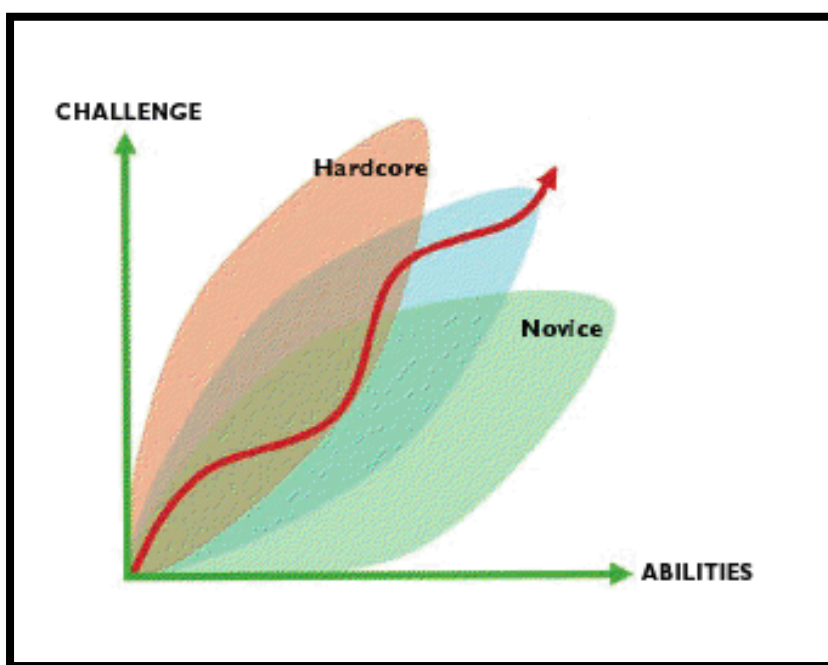
Figure 2. Players at different levels have different flow zones. Adapted from Chen (2007).

Theories of flow.

Flow states.

In 1999, Moneta and Csikszentmihalyi sought to investigate a flow theory prediction based on subjective concentration feelings which depend upon perceived challenges and

perceived skill levels (Moneta & Csikszentmihalyi, 1999). This flow theory prediction breaks down into two models, the Flow Theory Internal Model and the Flow Theory External Model.

The Flow Theory Internal Model assumes that the quality of daily subjective experience is based on the skills people believe they have and the perceived challenge level of the activity. In the case of a Japanese private university, 102 students were tested for flow experiences using the Experience Sampling Method (ESM), a method consisting of pre-programmed wrist-watches that signal eight times daily for wearers to complete an Experience Sampling Form (ESF) which elicits information pertaining to wearers' daily activities and accompanying psychological states (Asakawa, 2004). Results indicated situations of high skill and high challenge created the best state of mind and overall happiness of the students. These results agree with what the Flow Theory Internal Model postulates.

Flow Theory's External Model suggests that flow processes may be of more importance than the contexts of action in determining experiential states. This means that flow states (situations in which challenges and skill levels are equally met) are more important than the action itself (working or lounging) in determining how a person feels during a particular experience (experiential state). This is typical of flow, since a person working may experience flow just as much as a person relaxing. An example of this is Fave & Massimini's (2003) study involving 140 professionals; 80 teachers in primary or secondary schools, and 60 physicians, half of which specialized in surgery, anaesthesiology, or gynecology. All participants answered two questionnaires. The first questionnaire, a flow questionnaire, concerned information on both optimal (flow) experiences and the quality of the experience of daily activities. The second questionnaire, a life theme questionnaire, dealt with both positive and negative life influences, current challenges and future goals. All professionals reported flow experiences (Fave &

Massimini, 2003), the most for teachers being reading (20.4%), hobbies (14.7%), and work/teaching (13.9%). For physicians, work took first place (25.2%), followed by hobbies (15.8%) and sports (15.1%). These results indicate that in both work and leisure activities, flow can be experienced.

Both models are supported by Csikszentmihalyi (1997b)'s discussion on the occurrence of flow when challenge levels match skill sets in both work and leisure situations. For the purposes of this study, however, flow in the leisure activity of videogame playing with both experts and novices will be investigated, since understanding how players of both levels of expertise experience flow states can lead to improved videogame designs that entice more players of both skill levels. This in turn can create increased sales and profits for the videogame industry.

Flow theory robustness.

The Flow Theory has been tested multiple times, across many domains, producing the same results; performance is peak when the challenge and skill levels match. Such domains range from the likes of Csikszentmihalyi's study (1996) spanning five years and boasting of 91 participants (14 Nobel prize winners and 77 heavy contributors in their fields) from the fields of sciences, arts, business, government, or overall human well-being; to experiencing flow states during aesthetic experiences (experiences inciting feelings of awe and exhilaration when experiencing something beautiful) (Csikszentmihalyi & Robinson, 1990); to factors initiating, preventing, and interrupting flow states in elite athletes (Jackson, 1995) of various sports (Jackson, 1996); to understanding the role of flow in writing (Perry, 1999).

Eight ingredients for experiencing flow.

According to Chen (2007), Csikszentmihalyi's eight ingredients for experiencing flow, although not necessarily collectively needed for flow to occur, are usually incorporated into most videogames.

For experiencing flow, the first ingredient needed is a challenging activity requiring skill. The activity needs to be manageable enough that a person's skills are adequate to overcome the challenge of the activity (Csikszentmihalyi, 1997b). Secondly, there needs to be a merging of action and awareness. This occurs when involvement is total, so much so that action and awareness are no longer separate, such as actors who become "one with their character" (flow skills). Third is the presence of clear goals for providing direction and structure to the task (Csikszentmihalyi, 1997b), while fourth is direct and immediate feedback that is relevant to the activity and to the individual involved in the activity. Fifth, one should feel a sense of control over the activity and its outcome, and experience the presence of task-at-hand concentration (intent, deep focus on an activity). Sixth, when task-at-hand concentration occurs, distractions cannot interrupt or intrude upon the person's focus. This is usually followed by the seventh, a loss of self-consciousness resulting in the individual feeling stronger; since feelings of fear, anxiety, inadequacy, and rumination disappear. Lastly eighth, an altered sense of time is experienced - when time seems to "fly" (hours feel like minutes), or when time seems to drag on (seconds feel like minutes). Of these eight, the last three ingredients which are bolded in Table 1 combine to form a typical and necessary characteristic of flow, immersion.

Table 1

Eight Ingredients for Experiencing Flow

	Flow Ingredients	Descriptions
1	Challenging Activity/Appropriate Skill	Surmountable Activity
2	Action/Awareness Merge	Total Involvement
3	Clear Goals	Direction/ Task Structure
4	Feedback	Individual/Game Relevant
5	Sense of Control	Activity/Outcome Control
6	**Task-at-Hand Concentration**	**Uninterruptable Focus**
7	**Loss of Self-Consciousness**	**No Negative Feelings of Self**
8	**Altered Sense of Time**	**Timelessness**

Immersion.

The correlation between immersion in video games and player enjoyment has been studied. Knutsun (2006, p.24) defined, "immersion" as the feeling of being lost "inside a fictional world", a definition that is supported by McMahan (2003), Nacke and Lindley (2008), Sheridan (2000), Sweetser and Wyeth (2005) and Jennett et al. (2008), and that matches well with Csikszentmihalyi's loss of self-consciousness. Knutson observed evidence of immersion, especially engagement, strongly related with game satisfaction in *Half-Life: Deathmatch*, a first person shooter (FPS) game. The deeper players are immersed in their game, the more real the gaming environment becomes to them (Bracken & Skalski, 2006) and the more enjoyable the experience (Qin, Rau & Salvendy, 2009).

Immersion is not limited to only multi-player games. This means, since the immersion experience occurs when players feel they are truly in the game world, and less like playing a game, that immersion can take place in a variety of videogame models, from playing a super-fast blue hedgehog in *Sonic the Hedgehog*, to a pink voracious blob in *Kirby's Adventure*, to a block in *Tetris (*Adebajo, 2012*),* to a real-time strategy game (*Age of Mythology*) (George, 2002). In addition to more than one type of game needed for achieving immersion and therefore, flow, there is also a need for different levels of challenge, since experts and novices require different appropriate challenge levels.

Immersion and game challenge.

 Game challenge on player immersion has also been studied. Relating to flow, if the level of game challenge matches the player's skill level, immersion is more likely to occur; whereas a game with too little challenge will lead to boredom and a game with too much challenge will frustrate the player. Several studies have explored this relationship.

Qin, Rau, and Salvendy (2010) investigated changing the challenge of a level within a game with a focus on direction change (increasing then decreasing, decreasing then increasing, or continuous challenge) and rate change (slow, medium, fast). Direction changes are the changes within a game pertaining to character, game environment, level, puzzle, and obstacle attributes. For their study, focus was placed on number of character's lives, and number of various foes. Rate change is the range of challenge change between two game points. This is set by either assigning one level of challenge at the beginning and end of the game level with change occurring in-between, or by setting a degree of challenge for an entire level. Their study utilized the second method of rate change setting. The 48 male participants were divided and put into the Slow, Medium, or Fast change rate group, all of which experienced the direction changes at both

Easy and Hard levels. Results showed that game challenge increased then decreased and medium change rate was best for inducing immersion overall, but for slow change rate, decreasing then increasing challenge was best suited.

Sweetser and Wyeth (2005) identified immersion as a criterion to measure flow in the model, *GameFlow*. According to their research, immersive games provide players a mental form of escape from the world and its hectic stresses through the games' audio (such as soundtracks and sound effects) and storyline. Such details entice the player to linger and become more and more involved in the game, the storyline, and its characters. In the testing of *GameFlow* and its criteria (concentration, challenge, skills, control, clear goals, feedback, social interaction, and immersion), two similar games were looked at; Blizzard's *Warcraft 3* and Sony's *Lords of EverQuest.* Results showed that in *Warcraft 3*, achieving immersion was easy due to its variety of tasks on which to focus and other details such as graphics, sound, and animation. In Lords of EverQuest, players were not really able to achieve immersion due to its slow pace. Other hindrances included minimum focus needed to play the game and insufficient challenge, too much time lapse (such as waiting for units to build) with nothing to do and insufficient character, background and storyline development to grip the player. Ultimately, Sweeter and Wyeth concluded that immersion is achieved through focused attention (such as is necessary for executing tasks, monitoring, etc.), feeling connected to characters and storyline, feeling gripped by the game's pace, and no inactive waiting periods; as pointed out by Sweetser and Wyeth (2005).

While Qin, Rau and Salvendy (2010) looked at the direction changes and change rates that effect achieving immersion, and Sweetser and Wyeth (2005) looked at immersion as a criterion measurement for the flow measuring model, *GameFlow,* Kiili (2005) looked at

developing a web-based learning environment that facilitated flow in students, the goal of which is to integrate educational theories with videogame design. Kiili noted that the most successful videogames incorporate flow-inducing elements, which is equally important as in educational games. However, when combining videogames and educational games, the educational theories and elements of gameplay (the game's linked challenges and the actions taken by players to meet those challenges) within a game need to be maintained. One of the major issues Kiili looked at was cognitive overload (players'/students' working memory being taxed with too much multimedia learning material). In order to relieve this overload, haptic feedback not only was investigated and incorporated in the learning materials, but was found to facilitate immersion.

All of this indicates that immersion, while necessary for flow, is best facilitated when appropriate challenge levels are set to accommodate the skill differences between expert and novice players. Games that facilitate these challenge levels encourage players to spend more time on them, or in other words, such games encourage player motivation.

Encouraging player motivation.

Appropriate challenge accompanied by performance feedback and long- and short-term goals are the tenets of flow that foster player motivation.

Fabricatore, Nussbaum, and Rosas (2002) asked the question, "What do players want in videogames?" In other words, what determines game quality? To answer this, the researchers studied single-player games and each player's experiences. Their research identified certain insights into player expectations: a consistent gaming environment, an understanding of the game's boundaries, reasonable solutions, clear goals (long-term goals), feedback at points (short-term goals), possibility of failure (i.e. challenge), varied goals, surmountable tough-spots, reduced inactive instances, and immersion. Furthermore, Fabricatore et al. (2002) propose that

the player's character should interact throughout the entire game (beginning to end, versus just at the beginning and end of the game) with the storyline elements, a theory that is also supported by Sweetser and Wyeth (2005). Such an interface design recommendation improves the circumstance for immersion to occur.

Appropriate challenge levels.

However, discrepancy exists between appropriate challenge levels for expert game players and for novice game players.

Bailey and Katchabaw (2005) already knew players' needs vary according to skill level, and that developing a game that can satisfy all these needs is difficult. Usually, to mediate this discrepancy among skill levels, designers incorporate within games either options for degree of "challenge" that players can select at the start of the game, or one assigned "challenge" level. However, in addition to other drawbacks to each of these solutions, determining what is "challenging" can be a subjective assignment. To counter this, Bailey and Katachbaw sought to develop auto-dynamic challenges; which means that the game itself adapts to the skill level of the player. Their study was successful, but still required editing as before the game could adapt to the players' skill level, the players first had to experience a number of too-easy or too-challenging levels of the calibration games that resulted in player dissatisfaction. Results also showed that the abrupt changes disrupted immersion.

Charles et al. (2005) also endeavored to bring to the forefront approaches for player-centered game design using adaptive game technologies, with a focus on understanding and modeling players, and adaptive game technology. Their argument was that using these approaches for player-centered game design improvement would result in the ability to provide more appropriate challenge levels, a smoother learning curve, thus enhancing the overall gaming

experience. As Charles et al. (2005) noted, every player has a different pace, gameplay style, and range of capabilities and as such, feedback and an interactive game improve the likelihood for players to enter immersion.

In a similar argument, Hunicke (2005) made the case for dynamic challenge adjustment in games, noting that in order for novices to be successful, tasks tend to have to be repeated. This tendency may stem from the way in which experts and novices think. To do this, Hunicke had participants play the game *Case Closed* for roughly 15 minutes on computers. Performance data and evaluation form data were collected. Results indicated that even minor dynamic game adjustments improved performance and immersion although with the latter, care must be taken that the adjustments do not interfere with player immersion.

Experience Sampling Method (ESM).

Once *Flow Theory* was tested and proven robust, Csikszentmihalyi and Hunter (2003) used the *Experience Sampling Method* (ESM) to test for some of the momentary conditions of intra-individual happiness reports, as well as investigated how demographic variables and patterns of behavior relate to happiness levels. To execute the ESM, participants rate their experiential states on a questionnaire that captures their emotional states whenever an electronic pager randomly beeps during waking hours of the day. Results suggested that the activity and cohorts (researcher accomplices) affected base-line happiness. As expected, freely chosen activities resulted in elevated happiness levels and perseverance in continuing the activity, versus obligatory activities. As is the trend with an activity undertaken by will and not by coercion, participants are likely to experience flow during the activity of videogaming, especially since this recreational outlet offers various challenge levels to complement diverse skill levels.

First published report of ESM data.

Twenty-five teenagers, from age thirteen to eighteen, participated in a study
(Csikszentmihalyi, Larson & Prescott, 1977) interested in what adolescents do with their time
during the week, why, and how they feel about their activities. To gain this insight, the
researchers had the participants equipped with pager devices that were set to emit 5 - 7 beeps at
random between the waking hours of 8a.m. to 11p.m. for one week, thus signaling the
participants to fill out a self-report questionnaire at each beep. The self-report questionnaire
consists of open-ended questions such as, "Where were you?" with responses coded as either
Primary or *Secondary Activities,* followed by the question "Why were you doing this?" Answer
choices were "I had to do it," "I wanted to do it," or "I had nothing else to do." These answers
were categorized as *Activity Rational.* Another set of questions measured participants'
interaction-with-environment quality on a 10-point scale (low – high) with questions such as,
"Were you in control of your actions?" The last set of questions measured mood and physical
states of the participants by asking them to rate on a 7-point scale of extreme opposite states (for
example, "hostile" versus "friendly", with "do not feel either" in the middle) that which best
corresponded with their state at the time of the beep. Results indicated that conversation with
peers was the most commonly indulged in activity (1/3 of total time for the week), which was
also the most voluntary and highly positive in mood. Television watching was second after peer
conversations, but was usually selected when participants had nothing else to do and was
followed by feeling worse than they did when doing any other activity. Work was rare (13% of
total time for studying, 5% for other work), least voluntary, and associated with negative moods.

Recent uses of ESM.

Medical students in overseas rotation.

Due to an increase in medical students' interest in international experiences, academic health centers now include global medicine in their curriculum. The benefits of such an addition include increased skill, self-confidence, appreciation for cross-cultural communication, and likelihood to work internationally. However, most medical student programs have been evaluated using only feedback reports after the fact. These reports tend to reflect positively on the overseas experience, but important information (dangerous living situations, illness concerns, etc.) may be lacking, and thus the whole picture is not given. This positive feedback may be due to remembering mostly the good times (recall bias) or due to a fear that the overseas program may be discontinued if negative feedback is given. Therefore, to remedy this, Ahmad et al. (2012) strived to assess medical students' feelings concerning their overseas experiences, using the ESM. To do this, the seven students enrolled in the University of Chicago Department of Medicine's *Geographical Medical Scholars Program* (GMSP), a local lecture with a one month overseas inclusion, wore Digital Casio watches that beeped randomly eight times daily, five days a week during Weeks 1 and 3 of their one-month overseas experience. Results showed that the ESM was a useful, appropriate tool for finding out the needs and thoughts of the medical students. According to their responses, more structured activities are needed for the global health rotations to maintain engagement when the thrill of being in a foreign place wears off, as well as training on countering certain fears such as contracting illnesses.

Secure mobile online transactions.

Safe and secure financial transactions and security for any other sensitive information exchange is always paramount, and is no less crucial when engaging in such activities via smart

phones. Currently, user authentication for a smart phone is the same as for a desktop computer: four-digit personal identification number (PIN), text-based passwords, or external hardware devices (Angulo et al., 2012). The main problems associated with these techniques is that most users end up choosing weak or short passwords due to the agitation of dealing with a cumbersome touch-screen keyboard, and memory recall limitations. Angulo et al. (2012) conducted a study to offer a different approach, TEE (Trusted Execution Environment). TEE interacts with the phone display and touch-screen, creating a *Trusted User Interface* (TUI), which enables trusted applications only to acquire user consent, in a manner that bars non-users from intercepting the information. To test the usability and efficiency of TEE, 21 participants were administered two scenarios (one low-risk, one high-risk [depending on payment or information quantity]) typical of users executing purchases online. For the seven low-risk transactions, participants received a transaction receipt after agreeing to send the information or payment. The six high-risk transactions require a signature for the transaction, done by drawing the participant's secret unlock pattern that the participant created at the beginning of the study. In situ user experience was captured via a modified ESM, which participants completed when signaled to do so after executing a scenario step. The signal, an SMS (short message service), was given thrice daily (morning, afternoon, and evening) over the course of one week. The ESM measured, among other things, participants' emotional states, the situation in which participants were performing the transactions, participants' understanding and satisfaction with the unlock patterns and with the transaction itself, and participants' feeling of security. Results from the ESM indicated that for the participants, unlock pattern usability was a separate entity from the participants' sense of security with the system overall; participants understood that using the

unlock pattern for authenticating was different from using the unlock pattern for electronic signing; and that unlock patterns were preferable over PINs and strong passwords.

ESM under different names.

Experience Sampling Method has been used under different names, with slight variances to its methods. Names include *time sampling, beeper study*, and *ecological momentary assessment*, with alerts that are randomly delivered throughout the day, are scheduled, are event-based (triggered when certain events occur), are delivered only during a specific daily time period, are limited to a certain number per day, are limited to a certain number of alerts overall for the entire study's duration, are audible, or are tactile (Consolvo & Walker, 2003).

ESMs with different equipment.

Previously, ESMs utilized electronic pagers or watches for beeping, but now ESMs can be executed using handheld electronic devices, or "palmtops". In this way, the beeping alert is not only initiated by the electronic device, but responses can be entered and stored in the device, then later collected and transferred to a master computer (Barrett & Barrett, 2001).

As can be seen, the Experience Sampling Method has been around for a fairly long time (Csikszentmihalyi, Larson & Prescott, 1977), its usefulness to address various studies has been maintained in current times (Ahmad et al., 2012; Angulo et al., 2012), be it under the original name of Experience Sampling Method, or otherwise, such as the beeping method; or using different equipment such as watches that beep or handheld electronic devices (Barrett & Barrett, 2001), or modified.

Skill and Challenge Differences in Experts and Novices

In Hong and Liu's study (2002) of computer game experts and novices' thinking strategies, Stubbart and Ramaprasad's description of "expert" is used: superior analysis,

judgment ability, conceptual knowledge; resilient and faster problem-solving methods; quicker

error realizing; use pattern recognition; chunk knowledge; and infer questions forward from facts

(whereas novices work backwards from outcomes). That novices are generally backward

problem solvers is supported in Ericsson and Smith's (1991) book concerning expertise, noting

also that experts tend to adapt to the situation and use as the situation requires either backward or

forward problem solving.

Clanton (1998) advises that, from the videogame designer's perspective, just as game

genres exist to facilitate the spectrum of player type (perceptual, cognitive), so too must games

facilitate the variety of player skill level (expert, novice) by offering a variety of challenges. He

notes that learnability (the degree to which an interface can be learnt, usually based on learning

time) needs to be accessible for both skill levels, and that players should progress at their own

pace. In addition to this, motivation causes may be different between the two experience levels.

For experts, a challenging level in itself may be appealing and motivating for 'conquering', or

for feeling "a sense of control over", whereas for novices, a too-challenging level may result in

diminished motivation (Ghani & Deshpande, 1994; Sweetser & Wyeth, 2005). Therefore, game

challenge in game design is very important.

Examples of flow theory and novice/expert skill and challenge levels in various

domains.

E-commerce has experienced rapid growth from $167.3 billion in 2010 to $194.3 billion

in 2011 (a 16.1% jump), which in itself increased from 4.3% of total retail spending in 2010 to

4.6% in 2011(Enright, 2012). Excluding products not usually bought online (gas, for example),

e-commerce's total retail sales of 7.6% in 2010 increased to 8.6% in 2011. When including e-

commerce sales, total retail sales increased to 7.9%, a $4.2 trillion value (Enright, 2012). These

numbers demonstrate the increasing viability and profitability of the online medium, underlining the importance of understanding online customer behavior. In order to do so Novak, Hoffman, and Yung (2000) posted an internet survey in conjunction with Georgia Institute of Technology's ninth version of the *WWW User Survey*. Results showed that greater Web-usage skills and sense of control, greater challenge and arousal, greater telepresence (immersion) and loss of time, and greater speed corresponded with greater flow while using the Web. While greater focused attention did not in itself correspond with greater flow, telepresence and loss of time, it was observed to contribute to the two variables telepresence and loss of time. Greater importance corresponded with greater focused attention, and the longer a participant used the Web, greater skill and sense of control resulted. These end results are not limited to e-commerce, but are also found in other online applications.

In the world of hypermedia computer-mediated environments (CMEs), or as defined by Hoffman and Novak (1996); "[a] distributed computer network used to access and provide hypermedia content;" interfaces and flow are also important. Such environments provide multimedia content with hypertext links to the network, which in turn provides businesses with a format for advertisement and customer interaction that is highly accessible to the customer (Hoffman & Novak, 1996). However, the customer's skill in maneuvering in the challenges of the CME (online shopping, for example) bring the experience of flow to the forefront. Flow during CME interaction involves, according to Hoffman and Novak (1996); smooth response sequences generated by the machine interactivity, enjoyment, loss of self-consciousness, and self-reinforcement. This evidence shows that user skill level and the degree of challenge put forth by an interface affect the presence of flow. This is also depicted in another commonly-used online application, the World Wide Web.

While the World Wide Web (Web) may be used in a manner that facilitates negative experiences (for example, addiction behavior (Young, 1996)), most of its usage is for what it was designed – entertainment, research, and communication. To gain an understanding of total engrossment (flow) in Web activities, Chen, Wigand and Nilan (1999) had 304 participants answer an open-ended questionnaire on their flow experiences, pleasure, perceived challenges and time loss, and sense of control while engaged in Web activities. Results indicated that most challenges related to situational conditions in participants' own agendas (such as researching) and not to hardware or software, while most flow experiences tended to occur with communication/interaction and research activities. According to these results, Web activities that induce flow, from the most to the least frequent, are researching, reading/interacting in newsgroups, checking email, creating webpages, playing games, and chatting. These are also the Web activities that elicited pleasure, which were dissected to define why they elicited pleasure: information found, interesting/humorous reading, expanding knowledge, the act in itself of using the Web, tracking interesting information, socializing, receiving feedback, the act in itself of posting, playing games, and feeling accomplished. These results provide evidence that insufficient skill can hinder the occurrence of flow, whereas in activities where a participant feels more adequately matched skill-wise, more incidence of flow can be produced. This has been seen and noted in the field of marketing.

Shopping is an activity that is engaged in heavily and generates much profit. This activity has been researched for flow since shoppers in flow are likely to be recurrent and happier shoppers (Wang & Hsiao, 2012). In this study, 240 participants each completed a retrospective survey measuring their flow experiences while retail shopping over a wide range of products (cars, books, food, etc.). Results showed that while flow antecedents (challenge, skill) for online

shopping (navigational challenge, web skill) are not the same for offline/ in-store shopping, where challenge and skill are product and service related, the key elements of flow; concentration, enjoyment, and control, carry over in both domains (Wang & Hsiao, 2012). More so, certain products, such as cars and furniture, were observed to be more challenging to purchase for consumers. This can produce flow for those consumers who know about cars and furniture, or anxiety for those who are not knowledgeable in such products. Understanding flow in consumers is financially important to retailers since recurrent shoppers generate more profit. Therefore, based on the knowledge of consumer flow, retailers can implement appropriate marketing strategies to attract more recurrent shoppers, such as by providing knowledgeable and helpful staff or by providing floor layouts that make the shopping experience easier for the consumer to make choices or locate products based on their level of expertise of the products (Wang & Hsiao, 2012). This shows that flow takes place when consumers have adequate knowledge (skill) when shopping, and that inadequate knowledge (skill) hinders flow in shoppers, and eventually, profit.

Just as these domains indicate a difference in flow occurring based on appropriate expertise for the challenge presented, so too in videogames is expertise an important factor for incurring flow when presented with various challenges. Additionally, if flow is experienced, the likelihood is increased that not only will the video gamers play that game, but others will as well (Knutson, 2006). This chain reaction increases profit for the videogame industry also.

Hypothesis

These articles all serve as a platform for demonstrating the effect of flow, specifically in the entertainment industry of videogames. In this study, gaming novices and experts are tasked with playing certain levels in a videogame and are then observed while playing the videogame in

order to track the experience of flow. It is hypothesized that there will be a main effect between experts and novices, and highest reported flow experiences exhibited by high experience/ high challenge level and by low experience/low challenge level.

Method

Participants

Eighty undergraduates (49 male, 31 female) with a mean age of 23 (age range 17-60) participated in the study. The 80 participants were split between 40 gaming experts (average number of hours playing video games = 16.5) and 40 gaming novices (average number of hours playing video games = 1.28). Both groups played the videogame *Super Mario Bros*. The categorization and selection of participants was based on the advice of a subject matter expert, M. Adebajo. Participants were considered experts if they played in excess of 260 hours annually (about 5 hours or more per week), and novices if they played less than 5 hours annually (M. Adebajo, personal communication, August 17, 2012). Of the total participants, 22 used console, 14 used personal computers (pc), 24 used headphones while videogaming, 26 played predominantly in teams, 51 played predominantly single player, 43 played online, 37 played role-playing games (RPGs), 50 played first-person shooter games (FPS), 20 played massively multiplayer online games (MMOGs), 46 played strategy games, 48 played action games, 44 played adventure games, 31 played fighting games, 36 played casual games, and 23 played no games at all.

Since participants may have been expert due to how long they had been playing videogames and thus amassed great skill, or due to innate hand-eye co-ordination (regardless of whether they played videogames or not), the Lafayette Instrument dexterity test was administered to reduce the influence of innate hand-eye coordination from the challenge of the

levels. This test had the impact of eliminating extremely high scores from the study that may have otherwise skewed the study's results.

Materials

The videogame, *Super Mario Bros.*, was used. This platform action game was selected in particular due to its age – meaning, older players who had played *Super Mario Bros.* were unlikely to have had recent contact time with the game and most of the younger players would have had limited exposure to this particular videogame. Finding a game that participants were fairly unfamiliar with was important to ensure that novices could be legitimately classified as novices in this game, as well as to ensure that experts would not have already played and over-played the game thus sharpening their own skills at this particular game. This is a timed game in which the player controls Mario to rescue the kidnapped Princess Peach from Bowser. To do so, the Mushroom Kingdom must be traversed, thus pitting the hero against various foes and challenges, including time. Figure 3 shows Mario (on the left) using firepower to fight Bowser (on the right) in Bowser's Castle at the end of World 1. The top of the screen displays from left to right Mario's overall score thus far, the number of gold coins collected, the World Level, and remaining time.
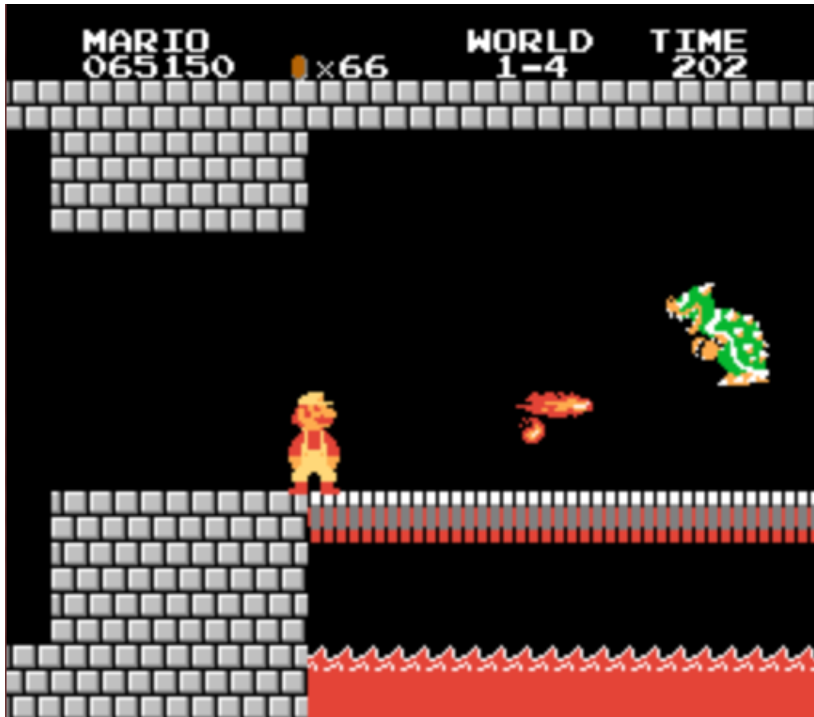
Figure 3. Mario (on the left) using firepower to fight off Bowser (on the right) in his castle. Adapted from *SuperMario Bros.*

A videogame emulator was used to ensure participants started at the assigned levels. An emulator is a computer program that allows a host computer program to be used to reproduce a particular target game on that equipment (Koninklijke Bibliotheek, n.d.).

Participants used the emulator on a Lenovo T520 laptop with Intel(R) Core ™ 15-2520M CPU @ 2.50GHz processing speed, 4.00 GB of random access memory (RAM), and 64-bit operating system to perform the test and a wired *XBOX 360* controller.

The Lafayette Instrument hand-eye steadiness test was used to control for dexterity influences in the study. This test required participants to move a stylus along a channel between two raised metal plates. The channel narrows from a gap of approximately 6mm to 2mm over a distance of 25 cm. Participants started at the widest end of the plate with the stylus and moved toward the narrowest end of the channel. The connected recording device counted how many

times the participant touched the metal plates on either side of the channel before reaching the narrowest end of the plate (see Figure 4).

Figure 4. Lafayette instrument.

Sheets and writing implements were provided for participants to respond with their quality of experience statements. Experience Sampling Method, or ESM, is a questionnaire that addresses users' feelings or state of experience, at particular moments during an activity (see Appendix A). Simply put, at particular points during an activity, users take a moment to fill out the ESM, which asks questions regarding the users' state of experience.

Design

This study was a 2x2 between design, with videogame experience (expert, novice) and challenge levels (World 1-2, World 6-3) as between factors (Table 2). Both expert and novice participants received a practice level, *World 1-1*, followed by one of the experimental challenge levels (*World 1-2* and *World 6-3*). *Worlds 1-2* and *6-3* were selected, respectively, for simplicity, and the sharp increase in timing and patience required (M. Adebajo, personal communication,

August 15, 2012). Dependent variables were overall level percentage scores, distraction task

results, and ESM survey scores (immersion, skill, and challenge question responses).

Table 2

2x2 Design; Expertise Level (Expert, Novice) x Challenge Level (Lower, Higher)

	Lower Level	Higher Level
Expert	20	20
Novice	20	20

Procedure

Participants were asked to sign an informed consent form, followed by a demographics

questionnaire. After the initial paperwork was complete the hand-eye dexterity test was

administered for post-test parsing out analysis.

All participants were given a practice session of the *Super Mario Bros. World 1-1*

videogame to familiarize themselves with the videogame and controls. A single practice session

of *World 1-1* was administered, which was concluded by either the completion of the level or the

exhaustion of allowed attempts ("lives"). Although normal gameplay starts a player off with a

standard of three lives, only the practice level was restricted to this number. The succeeding

levels were commenced with four lives with the possibility of accumulating additional lives

("extra-lives"), since the higher levels were more difficult and as such players may have needed

more attempts to achieve flow. When a player "died", then that chance was expended. When all

"lives" ran out, then the game was over. This allowed participants to familiarize themselves with

the game and controls.

At the completion of the *World 1-1* practice session, 20 expert and 20 novice participants

were administered the less challenging *Super Mario Bros.* level, *World 1-2*, and 20 expert and 20

novice participants were administered the more challenging level of *World 6-3*. Participants underwent the game session under the time restraint of 15 minutes. During these sessions, participants were tasked with not only playing the level, but also with noticing whether or not the image on a digital picture frame changed. The digital picture frame had two pictures loaded, each cycling after 5 minutes. This distraction task added a manipulation check for immersion, which occurs when experiencing flow. After gameplay completion, a modified ESM was administered.

ESM Measurement.

In Csikzenmihalyi's original lengthy study, participants responded to the ESMs throughout their day. However, due to the much briefer length of time for this study, participants did not have an ESM administered during the gaming session, but rather after the initial familiarity trial and at the gaming sessions' completion. There is a trade-off with this method, however. Though a better potential exists for capturing flow events if the ESM is administered throughout the gaming session, the crucial downside is that the interruptions of the ESM itself might interrupt the flow events, especially since the trial and gaming sessions are not as lengthy as Csikzenmihaly's original study. By administering the ESM after gameplay, though the risk of participants not recalling all flow events exists, the experiences of flow itself are not interrupted or hindered.

To ensure that the modified ESM in this study captured the occurrence of flow, questions included elements of Csikszenmihalyi's original ESM and his eight ingredients of experiencing flow as seen in Appendix A. Questions were based on a six-point Likert scale, in order to force participants to choose a particular side instead of a neutral response in the middle. If flow occurred, some, if not all, of Csikszentmihalyi's eight ingredients should be present.

After the completion of the post-experimental trial survey participants were debriefed.

Results

An independent two-tailed t-test for the Lafayette hand-dexterity test revealed no significant difference between experts ($M = 9.84$, $SD = 10.709$) and novices ($M = 7.05$, $SD = 9$) in hand-dexterity; $t(75) = 1.24$, $p = 0.058$. This is important as it demonstrated that any differences between experts and novices were not due to innate dexterity differences.

The data was analyzed for outliers and three outliers were eliminated from analysis due to extreme values. Table 3 shows the means and standard deviations of the dependent variables analyzed in this study.

Table 3

Dependent Variables' Means and Standard Deviations

		Challenge Score		Skill Score		Overall Score %		Immersion Score	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Expert	**World 1-2**	4.11	0.658	2.89	1.100	42.4807	20.71231	3.32	1.336
	World 6-1	4.58	0.838	2.95	1.311	63.6497	13.77856	4.53	1.349
Novice	**World 1-2**	3.85	0.988	2.60	1.046	36.2444	23.37931	3.60	1.635
	World 6-1	4.32	1.057	2.21	0.855	63.8524	13.51794	3.42	1.502

Separate univariate ANOVA analyses were performed to assess scores for subjective challenge, skill, and immersion state responses from the ESM in addition to overall videogame score. Chi square analyses were used to assess the distraction task scores. Correlations between perceived challenge and overall percentage score, perceived skill and overall percentage score, and between perceived immersion and overall percentage score were investigated.

Participants' responses regarding their ratings of challenge after the experimental trial were analyzed with a univariate ANOVA. Levene's test was not violated and therefore the assumption of homogeneity of variance necessary for the ANOVA test was supported, $p=0.063$. There was no significant interaction found for game level and expertise, $F(1, 73) = 0.000$, $p = 0.985$ or main effect for expertise, $F(1, 73) = 1.597$, $p = 0.210$, but there was a significant main effect found for game level (challenge level), $F(1, 73) = 5.246$, $p = 0.025$ (see Table 4). Partial eta squared shows that since the main effect for game level was significant, 6.7% of the variance can be explained by the challenge manipulation. Figure 5 displays this information in graph form.

Table 4

Challenge Score Statistics

Tests of Between-Subjects Effects

Dependent Variable: Challenge

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared	Observed Power[b]
Corrected Model	5.599[a]	3	1.866	2.306	.084	.087	.559
Intercept	1365.703	1	1365.703	1687.585	.000	.959	1.000
GameLevel	4.245	1	4.245	5.246	.025	.067	.618
Expertise	1.293	1	1.293	1.597	.210	.021	.239
GameLevel * Expertise	.000	1	.000	.000	.985	.000	.050
Error	59.076	73	.809				
Total	1428.000	77					
Corrected Total	64.675	76					

a. R Squared = .087 (Adjusted R Squared = .049)

b. Computed using alpha = .05

Figure 5. Challenge score graph showing no interaction between Game Level (challenge level) and Expertise with standard error bars.

Participants' responses regarding their ratings of skill after the experimental trial were analyzed with a univariate ANOVA. Levene's test was not violated and therefore the assumption of homogeneity of variance necessary for the ANOVA test was supported, $p=0.478$. There was no significant interaction found for game level and expertise, $F(1, 73) = 0.792, p = 0.377$ or main effect for game level (challenge level), $F(1, 73) = 0.460, p = 0.500$, but there was a significant main effect found for expertise, $F(1, 73) = 4.310, p = 0.041$ (see Table 5). Partial eta squared shows that since the main effect for expertise was significant, 5.6% of the variance can be explained by the expertise manipulation. Figure 6 displays this information in graph form.

Table 5

Skill Score Statistics

Tests of Between-Subjects Effects

Dependent Variable:ESM_Post_Skill

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared	Observed Power[b]
Corrected Model	6.526[a]	3	2.175	1.832	.149	.070	.457
Intercept	545.846	1	545.846	459.622	.000	.863	1.000
GameLevel	.546	1	.546	.460	.500	.006	.103
Expertise	5.119	1	5.119	4.310	.041	.056	.535
GameLevel * Expertise	.940	1	.940	.792	.377	.011	.142
Error	86.695	73	1.188				
Total	639.000	77					
Corrected Total	93.221	76					

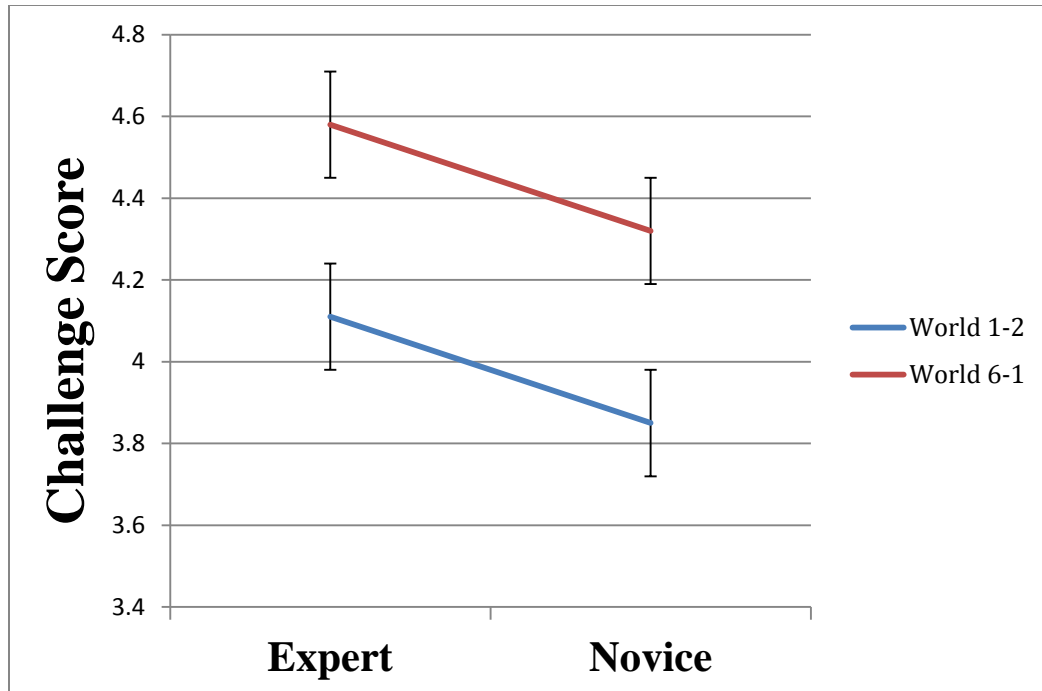a. R Squared = .070 (Adjusted R Squared = .032)

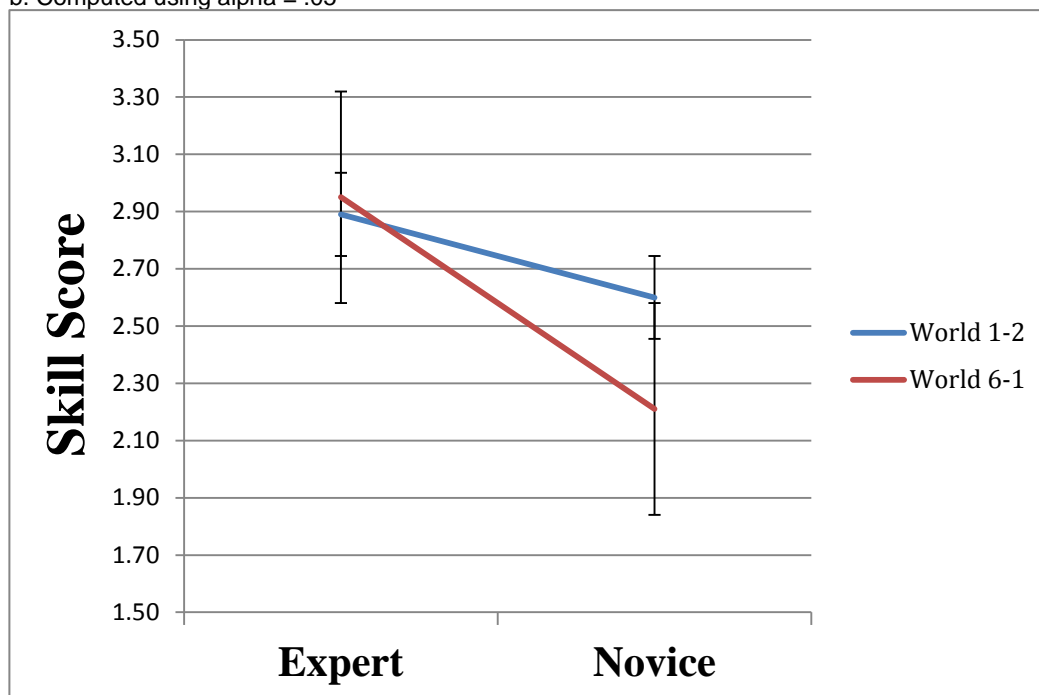b. Computed using alpha = .05

Figure 6. Skill score graph showing no interaction between Game Level (challenge level) and

expertise with standard error bars.

Participants' responses regarding their ratings of immersion after the experimental trial were analyzed with a univariate ANOVA. Levene's test was not violated and therefore the assumption of homogeneity of variance necessary for the ANOVA test was supported, $p=0.696$. There was a significant interaction for game level and expertise, $F(1,73)=4.338$, $p=0.041$, but no significant main effect found for game level (challenge level), $F(1,73)=2.391$, $p=0.126$ or expertise $F(1, 73) = 1.515$, $p=0.222$ (see Table 6). Partial eta squared shows that 5.6% of overall variance in immersion perception was due to the interaction. Figure 7 displays this information in graph form.

Table 6

Immersion Score Statistics

Tests of Between-Subjects Effects

Dependent Variable:Immersion

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared	Observed Power[b]
Corrected Model	17.441[a]	3	5.814	2.716	.051	.100	.637
Intercept	1062.622	1	1062.622	496.382	.000	.872	1.000
GameLevel	5.119	1	5.119	2.391	.126	.032	.332
Expertise	3.243	1	3.243	1.515	.222	.020	.229
GameLevel * Expertise	9.287	1	9.287	4.338	.041	.056	.538
Error	156.274	73	2.141				
Total	1236.000	77					
Corrected Total	173.714	76					

a. R Squared = .100 (Adjusted R Squared = .063)

b. Computed using alpha = .05
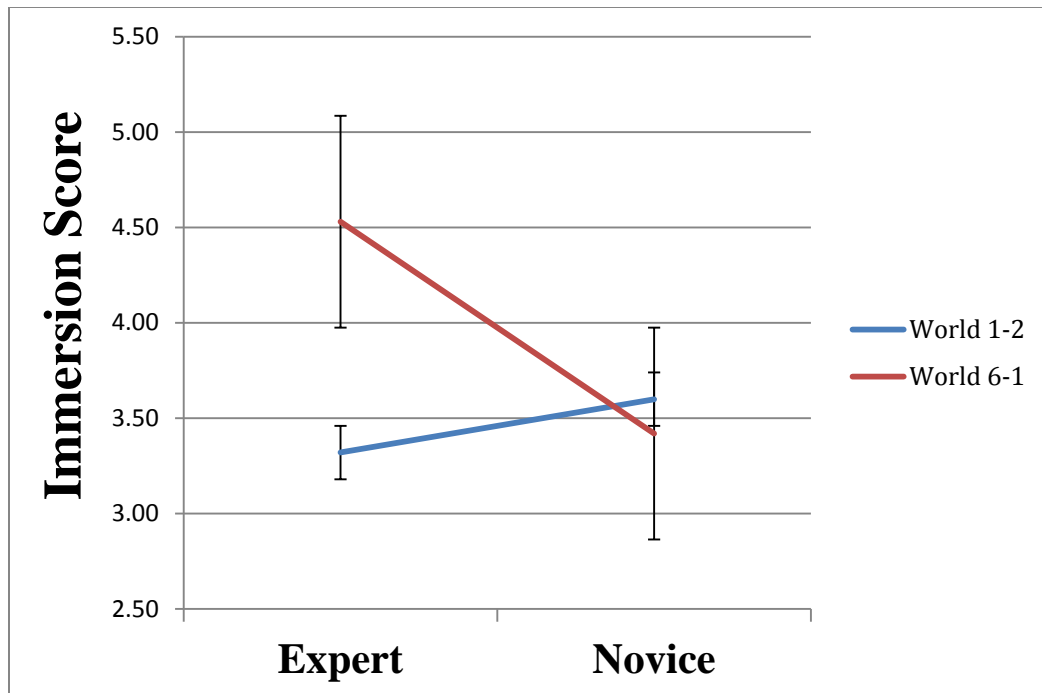
Figure 7. Immersion score graph showing Game Level (challenge level) and expertise interaction with standard error bars.

In calculating participants' overall game scores, a percentage of each condition's highest score was taken by each participant in that condition. This was done since *Super Mario Bros.* does not have a set highest score attainable and percentages from highest score allows for direct comparison of score across conditions even though they may contain differing point values that can be obtained. In analyzing these overall percentage scores, Levene's test was not violated and therefore the assumption of homogeneity of variance necessary for the ANOVA test was supported, $p=0.201$. There was no significant interaction found for game level and expertise, $F(1, 73) = 0.587$, $p = 0.446$ or main effect for expertise, $F(1, 73) = 0.515$, $p = 0.475$, but there was a significant main effect found for game level (challenge level), $F(1, 73) = 33.668$, $p = 0.000$ (see Table 7). Partial eta squared shows that since the main effect for game level was significant, 3.16% of the variance can be explained by the challenge manipulation. Figure 8 graphically displays this information.

Table 7

Overall Percentage Score Statistics

Tests of Between-Subjects Effects

Dependent Variable:Percentage from Highest Score

Source	Type III Sum of Squares	df	Mean Square	F	p	*Partial Eta Squared*	*Observed Power[b]*
Corrected Model	11902.506[a]	3	3967.502	11.672	.000	.324	.999
Intercept	204573.019	1	204573.019	601.837	.000	.892	1.000
GameLevel	11444.279	1	11444.279	33.668	.000	.316	1.000
Expertise	175.105	1	175.105	.515	.475	.007	.109
GameLevel * Expertise	199.432	1	199.432	.587	.446	.008	.118
Error	24813.747	73	339.914				
Total	239814.341	77					
Corrected Total	36716.253	76					

a. R Squared = .324 (Adjusted R Squared = .296)

b. Computed using alpha = .05
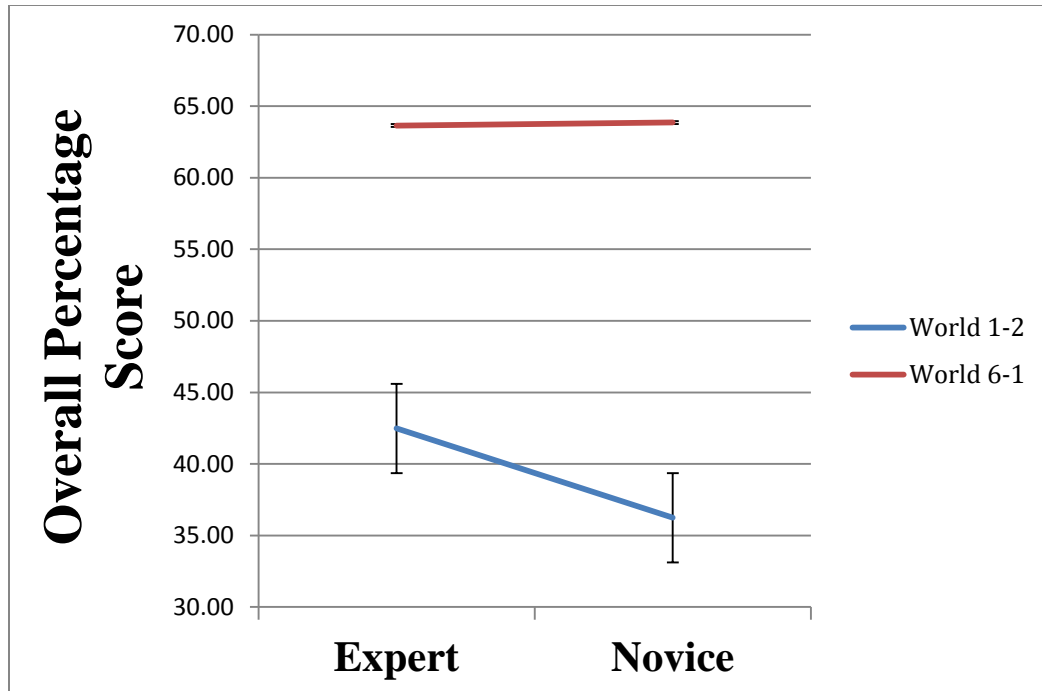
Figure 8. Overall percentage score graph showing no interaction between Game Level (challenge level) and Expertise with standard error bars.

Two chi-square analyses were performed to examine the impact of expertise and challenge on noticing the picture change the first time, one analysis for each factor. The effect of expertise in noticing the first picture change was not significant, $\chi^2(1, N=77) = 0.040$, $p = 0.842$ and the effect of challenge on noticing the first picture change was also not significant, $\chi^2(1, N=77) = 0.040$, $p = 0.842$. However, all 19 participants that did notice the change correctly identified the image. No analysis was performed on participants noticing the picture change the second time as only 2 participants out of the 77 (one in the expert group and one in the novice group) detected the change and both of those participants did not correctly report the identity of the changed image. These results suggest that there was no difference in the groups on their ability to detect the image change.

Correlations between the three ESM questions were analyzed using Pearson product-moment correlations for both experts and novices. Correlations between perceived challenge and overall percentage score for novices were non-significant, $r=0.000$, $n=38$, $p=0.998$, between perceived challenge and overall percentage score for experts were non-significant, $r=0.068$, $n=39$, $p=0.680$. A similar lack of results was found between perceived skill and overall percentage score for novices, $r=0.303$, $n=38$, $p=0.064$ and experts , $r=0.246$, $n=39$, $p=0.131$. Finally, the correlation between perceived immersion and overall percentage score was also non-significant for novices , $r=0.262$, $n=38$, $p=0.111$, and experts, $r=0.289$, $n=39$, $p=0.074$. This indicates that the score did not correlate with participant's views on their own skill, the challenge of the game, or how immersed they were after the experimental trial.

Discussion

The purpose of this experiment was to investigate flow between experts and novices in videogame playing. Results showed that experimental challenge level scores were found to have a significant main effect in game level (challenge level), meaning that challenge was perceived higher in the more difficult level of World 6-1 than in World 1-2, regardless of expertise. This indicates that the higher challenge level, World 6-1, contained more challenges than the lower challenge level of World 1-2 and implies that the choice in challenge levels was appropriate. Challenge level appropriateness for the differing needs of experts and novices has already been outlined by Bailey and Katchabaw (2005), Charles et al. (2005), and Hunicke (2005).

Reported experimental skill scores were found to have a significant main effect in expertise, meaning that experts perceived themselves as having greater skill than novices. This may be because whether experiencing the easier level of World 1-2 or the more difficult level of World 6-1, experts felt more confident of their videogame playing skills than novices did. The

differences in confidence may result from the differences in skills between experts and novices. Experts tend to be superior analysts and more resilient and quicker at problem-solving than novices (Hong & Liu, 2002) and better at adapting to situations (Ericsson & Smith, 1991). This result also indicates that novices were indeed novices, and that experts were indeed experts, thus validating correct categorization of expertise.

Immersion experimental scores showed that perceived immersion scores were influenced by expertise and the challenge levels themselves, as evidenced by the interaction of higher immersion reported by novices than experts in World 1-2 but the reverse in World 6-1. This not only implies appropriate challenge and skill level matching, since experts reported more immersion in the more challenging level of World 6-1 than the easier level of World 1-2 while novices reported more immersion in the less challenging level of World 1-2, but matches with the literature that experts and novices have different challenge needs for inducing immersion (Adebajo, 2012). Since challenge and skill matching and immersion are key for inducing and experiencing flow, this interaction of immersion implies the presence and experience of flow.

Overall percentage game scores were found to have a significant main effect in game level (challenge level), meaning that scores were higher in the more difficult level of World 6-1 than in the easier level of World 1-2, regardless of expertise. The likely explanation for this result is that the higher challenge level, World 6-1, contained more opportunities for points than the lower challenge level of World 1-2. A pilot study suggested that this might not be the case, but a closer look post-experiment suggested that the higher challenge level did indeed contain the potential for a greater score for the same amount of playing time. While this poses an issue for understanding the relationship between challenge and skill for attaining flow, it is an unavoidable issue since games that increase in challenge typically have more opportunities for points in the

more difficult levels or opportunities for scoring that are in themselves worth more points. However, the main purpose of noting the overall score was as a manipulation check to ensure that participants were involved in playing the game so regardless of results, that participants were actively involved versus just sitting there not actually playing is evident.

Correlations between each dependent variable (perceived challenge, skill, and immersion) with overall percentage scores were undertaken to investigate the possibility of peak performance (highest score) as a result of appropriate skill and challenge match along with the presence of immersion. All correlations returned non-significant results, despite the significant findings of immersion interaction due to skill and challenge and main effects of expertise for perceived skill and of game level (challenge level) for perceived challenge. As stated before, a possible problem lay with the fact *Super Mario Bros.* simply has more points available in the higher levels. However, if length of game time were extended beyond 15minutes, experts would likely end up outlasting and outperforming novices as the game difficulty increases thus expressing higher scores for novices in the lower levels and higher scores for experts in the higher levels.

The distraction task's purpose was as a manipulation check for immersion, since when immersed and therefore in flow, distraction is unlikely (Chen, 2007). However, though immersion was reported, it is not clear whether or not participants were so immersed as to be oblivious to the distraction as might be concluded from the lack of significance in the distraction analysis. Only 21 participants (out of the 80) lasted long enough in the game to experience the first picture change (5 minutes), thereby limiting any effective conclusions about immersion or distraction from this task. However, of these 21 participants, 19 participants not only noticed the picture change, but noted what the picture changed to, suggesting that if the participants actually

reached the first image change their attention was clearly on the image. Possibly, a longer playing time or more lives allowed would have provided a better opportunity for immersion and therefore flow to be observed.

As a result, these outcomes agree with the original hypotheses. Pilot studies demonstrated that the videogame, challenge levels and flow measurement choices were suitable for capturing flow, which was reflected in the actual study. Originally, the videogame was chosen to avoid the possibility of it being overplayed or played recently in order to level pre-knowledge and experience prior to the study. This meant selecting a videogame that protected against experts being too expert at the game of choice and ensured that novices were true novices and though an interaction was found between expertise and challenge, the result was based off one question given after one trial of the game. More research into this area will determine whether this result will hold for other domains, as there are many different types of videogame skills such as hand-eye co-ordination for first-person shooter (FPS) games or strategy thinking games that require deep focus not just on the present strategy and game, but also on future tactics for different strategy scenarios. Due to the wide variety of skills, the selection of a videogame that will generate flow in participants is not an obvious one, and may be dependent on the specific skills within the participants to induce the flow effect as shown in Figure 1.

Shortcomings start with the challenge in itself of measuring flow; as demonstrated by the discrepancy between the modified ESM responses and the correlational data and by the fact that though an interaction between expertise and challenge was found, power was moderate (0.538) with a small effect size (5%). This pattern of results highlights the complexity of measuring flow. Another issue with investigating flow is the indirect way flow was measured, which is by the presence of immersion. Immersion was targeted through a direct immersion ESM question in

a 6-point Likert scale which in itself has its own inherent problems of differences in point values and by using the digital picture frame as a manipulation check. However, so few participants lasted long enough to experience the first picture change that even the manipulation check makes drawing behavioral conclusions about immersion unclear. The game choice itself may have played a factor in the manipulation check failing to support the presence of immersion. *Super Mario Bros.* has inactive periods between levels, which could hinder or break flow experiences. A more appropriate, flow-inducing game should include the eight ingredients for experiencing flow (skill and challenge match, total involvement, clear goals, feedback, sense of control) with the most important being uninterruptable focus, loss of self-consciousness, and timelessness (Chen, 2007). Such games might include *Tetris*, which does not have inactive periods, or strategy games, which demand absorption in deep thought and focus. This may mean that *Super Mario Bros.* was not the ideal videogame choice for inducing flow, especially since it is possible immersion was obtained not because of the game choice *Super Mario Bros.,* but rather because participants were playing a videogame period. Both expertise groups achieving higher scores in the more difficult level of World 6-1 might be an indication that *Super Mario Bros.* was too easy to learn, and even though both groups reported that World 6-1 was more difficult than World 1-2 it is still possible to have an easy game with a level that is more difficult than a previous level, but that is still nonetheless easy. Another limitation may have been that the timeframe in which participants had to play (15 minutes) was not enough for inducing flow, despite pilot studies. Having that said, there exists the possible problem that the longer participants play the videogame, the less accurate their recollection of and therefore, their estimates of flow might actually be (if using the ESM at the conclusion of videogame playtime). Or, if implemented during the gaming session, the possibility exists of interfering with the occurrence of flow. More

research on this matter would be useful since the literature suggests that flow is likely to occur with matching challenge and skill, and with the presence of immersion. Finally, a better metric for measuring flow may be needed as well, since the ESM was adapted to the study as a result of no official measure for flow in short-term intervals.

   This study is but one of hopefully many more in the effort to understand the phenomenon that is flow and its elements of complementing skill and challenge. More research is needed not only in flow itself, but in the measurement of flow and expertise/skill level. As it stands now, there is no standard for measuring flow experiences that occur in brief intervals or for deciding what denotes a novice and what denotes an expert, but this study took some initial steps in understanding these issues. By forging on in the study of flow, videogames, and expertise, more can be understood about the different needs of experts and novices to experience flow in videogames and in turn, what videogames need to encompass for flow to occur in players of different skill levels.

References

Abilla, P. (2011, July 12). *What is flow and its role in the pillar of respect for the human*.

Retrieved from http://www.shmula.com/what-is-flow-respect-for-people/8890/

Adebajo, M. (2012, February 24). [Web log message]. Retrieved from

http://www.weseeinpixels.com/interactivity-immersion-and-innovation-can-videogames-

be-adequately-protected-by-copyright-law/

Ahmad, A., Schneider, J., Nwadei, I., Darcy, M., Farr, R., Thal, R., & Arora, V. (2012). A pilot

study of real-time experience sampling method to evaluate student engagement in a

global health rotation. *Education research international*,*2012*, doi: 10.1155/2012/241874

Angulo, J., Wästlund, E., Gullberg, P., Kling, D., Tavemark, D., & Fischer-Hübner, S. (2012,

July).*Understanding the user experience of secure mobile online transactions in realistic

contexts of use*. Symposium conducted at the meeting of the Usable Privacy and Security

Symposium on usable privacy and security, Washington, D.C.

Asakawa, K. (2004). Flow experience and autotelic personality in japanese college students:

How do they experience challenges in daily life. *Journal of Happiness Studies*, *5*(2), 123-

154. Retrieved from

http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/751313592

Bailey, C., &Katchabaw, M. (2005). An experimental testbed to enable auto-dynamic difficulty

in modern video games . Paper presented at the 2005 North American Game-on

Conference 2005 north american game-on

conference.http://www.cp.eng.chula.ac.th/~vishnu/gameResearch/AI_november_2005/A

N%20EXPERIMENTAL%20TESTBED%20TO%20ENABLE%20AUTO-

DYNAMIC%20DIFFICULTY%20IN%20MODERN%20VIDEO%20GAMES.pdf

Baker, L. B. (2011, June 6). Factbox: A look at the $65 billion video games industry. *Reuters*. Retrieved from http://uk.reuters.com/article/2011/06/06/us-videogames-factbox-idUKTRE75552I20110606

Barrett, L. F., & Barrett, D. J. (2001). An introduction to computerized experience sampling in psychology.*Social Science Computer Review*, *19*(2), 175-185. Retrieved from http://www.affective-science.org/pubs/2001/01CompExperSampling.pdf

Blood, J. A. (2006). Non-industrial textile production as optimal experience: Applicability of the flow theory to clothing and textiles subject matter.*Oregon State University*, Retrieved from http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/2580/Dissertation Janet A Blood June 2006 _2_.pdf?sequence=1

Bloomberg Businessweek. (2006, May 12). An industry shows its growing value. *Bloomberg Businessweek*. Retrieved from http://www.businessweek.com/innovate/content/may2006/id20060511_715050.htm?campaign_id=rss_innovate

Bogost, I. (2007). Persuasive games: The expressive power of videogames. Cambridge, MA: MIT Press.

Bracken, C. C., & Skalski, P. (2006). Presence and video games: The impact of image quality and skill level. Paper presented at the Ninth Annual International Workshop Presence, Cleveland, Ohia. Retrieved from http://www.temple.edu/ispr/prev_conferences/proceedings/2006/Bracken and Skalski.pdf

Caron, F. (2008, June 18). *Gaming expected to be a $68 billion business by 2012*. Retrieved from http://arstechnica.com/gaming/2008/06/gaming-expected-to-be-a-68-billion-business-by-2012/

Charles, D., McNeill, M., McAlister, M., Black, M., Moore, A., Stringer, K., Kücklich, J., & Kerr, A. (2005). Player-centred game design: Player modelling and adaptive digital games. Paper presented at DiGRA 2005 Conference Changing views – worlds in play.

Chen, H., Wigand, R. T., & Nilan, M. S. (1999). Optimal experience of web activities. *Computers in Human Behavior*, *15*, 585±608. Retrieved from http://ac.els-cdn.com/S0747563299000382/1-s2.0-S0747563299000382-main.pdf?_tid=bb8c8ac2c7bb43776364e313d18d75ec&acdnat=1340681724_de3f7020c6 7fa971d9a8306ad0138085

Chen, J. (2007). Flow in games (and everything else).*COMMUNICATIONS OF THE AC*,*50*(4), 31-34. Retrieved from http://www.ccs.neu.edu/home/lieber/courses/csu670/sp09/resources/p31-chen-flow-in-games.pdf

Clanton, C. (1998). In C. Karat (Chair). An interpreted demonstration of computer game design. In CHI '98 chi 98 conference summary on human factors in computing systems (pp. 1-2). Retrieved from http://delivery.acm.org/10.1145/290000/286499/p1-clanton.pdf?ip=155.31.55.11&acc=ACTIVE%20SERVICE&CFID=142394873&CFTO KEN=86436339&__acm__=1345224248_5f2b5ae2e5567f08bd023b8e9a6477fb

Consolvo, S., & Walker, M. (2003). Using the experience sampling method to evaluate ubicomp applications. *IEEE Pervasive Computing*, *2*(2), 24-31. doi: 10.1109/MPRV.2003.1203750

Coxworth, B. (2011, June 8). *Study suggests that relaxing video games make players happier*. Retrieved from http://cs.winona.edu/CSConference/2006conference.pdf

Csikszentmihalyi, M. (1991). Happiness revisited. In *Flow: The psychology of optimal experience* (p. 5). Retrieved from

http://books.google.com/books?hl=en&lr=&id=v2AVz3gf-F4C&oi=fnd&pg=PT11&dq=flow experiences matter&ots=qG3fh-Ez9o&sig=YLp2ZV1FF-NWD92L-Ok8jgO065s

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York, NY: HarperCollins Publishers. Retrieved from

http://books.google.com/books?hl=en&lr=&id=aci_Ea4c6woC&oi=fnd&pg=PR7&dq=Creativity: Flow and the psychology of discovery and invention 1996 Csikszentmihalyi M&ots=pf4MIU8D6t&sig=ycR8oI2qsKmhMt22hw-2LqbenCk

Csikszentmihalyi, M. (1997b).*Finding flow the psychology of engagement with everyday life*. (1 ed.). New York, NY: BasicBooks.

Csikszentmihalyi, M., & Hunter, J. (2003). Happiness in everyday life: The uses of experience sampling. *Journal of Happiness Studies*, *4*, 185–199. Retrieved from

http://search.proquest.com.ezproxy.libproxy.db.erau.edu/pqcentral/docview/751313715/13343D68B10181CC460/27?accountid=27203

Csikszentmihalyi, M., & Robinson, R. E. (1990). *The art of seeing: An interpretation of the aesthetic encounter*. (pp. 12-16). Los Angeles, CA: Getty Publishers. Retrieved from

http://books.google.com/books?id=ayWdarE6K0AC&pg=PA200&lpg=PA200&dq=the art of seeing Csikszentmihalyi M Robinson R&source=bl&ots=HJyctd8jM8&sig=6nmBc_CI8kvJQdTsRYv6KQvzw1g&hl=en&sa=X&ei=zsQOUPX3HI-y8ASixYGwBQ&ved=0CEcQ6AEwAw

Csikszentmihalyi, M., Larson, R., & Prescott, S. (1977). The ecology of adolescent activity and

experience. *Journal of youth and adolescence*,*6*(3), 281-294.

Duckworth, A. L., Steen, T. A., & Seligman, M. E. P. (2005). Positive psychology in clinical

practice. *Annual Review of Clinical Psychology*, *1*, 629-651. Retrieved from

http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/213100604

Enright, A. (2012, February 16). E-commerce sales jump 16% in 2011. *Internet Retailer*,

Retrieved from http://www.internetretailer.com/2012/02/16/e-commerce-sales-jump-16-

2011

Entertainment Software Association. (n.d.). *2010 sales, demographic and usage data: Essential

facts about the computer and video game industry*. Retrieved from

http://www.theesa.com/facts/pdfs/ESA_Essential_Facts_2010.PDF

Entertainment Software Rating Board. (n.d.). *How much do you know about video games?*.

Retrieved from http://www.esrb.org/about/video-game-industry-statistics.jsp

Ericsson, K. A., & Smith, J. (1991). Toward a general theory of expertise: Prospects and limits.

Cambridge, England: Press Syndicate of the University of Cambridge.

Fabricatore, C., Nussbaum, M., & Rosas, R. (2002). Playability in action videogames: A

qualitative design model. HUMAN-COMPUTER INTERACTION, 17, 311–

368.http://delivery.acm.org/10.1145/1470000/1466512/p311-

fabricatore.pdf?ip=155.31.68.106&acc=ACTIVE%20SERVICE&CFID=103744415&CF

TOKEN=89719922&__acm__=1337289216_7e663650b77baa5e5824a4c0d6b301eb

Fave, A. D., & Massimini, F. (2003). Optimal experience in work and leisure among teachers

and physicians: Individual and bio-cultural implications. *Leisure Studies*, *22*, 323–342.

Fox News. (2012, March 6). Hours of playing video games can change brain for the better, research finds. *Fox News*. Retrieved from http://www.foxnews.com/health/2012/03/06/hours-playing-video-games-can-change-brain-for-better-research-finds/

Gamers Daily News. (2012, May 19). 72% of american households play video games says esa report. *Gamers Daily News*. Retrieved from http://www.gamersdailynews.com/story-24157-72-of-American-Households-Play-Video-Games-Says-ESA-Report.html

George, J. (2002). The last great rts ; ensemble and microsoft strike it big with age of mythology. *Computer Gaming World*, (221), 98. Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/212831299

Ghani, J. A., &Deshpande, S. E. (1994). Task characteristics and the experience of optimal flow in human-computer interaction. The Journal of Psychology, 128(4), 381.http://search.proquest.com.ezproxy.libproxy.db.erau.edu/pqcentral/docview/2138179 60/fulltext/136C78F1BB9615D82C0/1?accountid=27203

Ho, L., & Kuo, T. (2009). How can one amplify the effect of e-learning? an examination of high-tech employees' computer attitude and flow experience. *Computers in Human Behavior*,*29*(1), 23–31. doi: http://dx.doi.org.ezproxy.libproxy.db.erau.edu/10.1016/j.chb.2009.07.007

Hoffman, D. L., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. *The Journal of Marketing*, *60*(3), 50-68. Retrieved from http://elabresearch.ucr.edu/blog/uploads/publications/Hoffman_Novak_1996_JM.pdf

Hong, J., & Liu, M. (2002). A study on thinking strategy between experts and novices of

    computer games. Computers in Human Behavior, 19(2), 245–258. doi:

    http://dx.doi.org/10.1016/S0747-5632(02)00013-4

Hunicke, R. (2005). In N. Lee (Chair). The case for dynamic difficulty adjustment in games. In

    Proceedings of the 2005 ACM SIGCHI International Conference on Advances in

    computer entertainment technology (pp. 429-433). Retrieved from

    http://delivery.acm.org/10.1145/1180000/1178573/p429-

    hunicke.pdf?ip=155.31.68.159&acc=ACTIVE

    SERVICE&CFID=105883260&CFTOKEN=42928894&__acm__=1338321472_4882ab

    7b637b95a50d7963e7e768f86f

Jackson, S. A. (1995). Factors influencing the occurrence of flow state in elite athletes. *Journal*

    of Applied Sport Psychology, *7*(2), 138-166. doi: 10.1080/10413209508406962

Jackson, S. A. (1996). Toward a conceptual understanding of the flow experience in elite

    athletes. *Research Quarterly for Exercise and Sport*, *67*(1), 76-90. Retrieved from

    http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/218494160

Jackson, S. A., Ford, S. K., Kimiecik, J. C., & Marsh, H. W. (1998). Psychology correlates of

    flow in sport. *Journal of Sport & Exercise Psychology*,*20*, 358-378. Retrieved from

    http://ess220.files.wordpress.com/2008/02/jackson-19981.pdf

Jennett, C., Cox, A. L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008).

    Measuring and defining the experience of immersion in games. International Journal of

    Human-Computer Studies, 66(9), 641–661. doi:

    http://dx.doi.org.ezproxy.libproxy.db.erau.edu/10.1016/j.ijhcs.2008.04.004

Jin, S. A. (2012). ''toward integrative models of flow'': Effects of performance, skill, challenge, playfulness, and presence on flow in video games. *Journal of broadcasting & electronic media*, *56*(2), 169–186. doi: 10.1080/08838151.2012.678516

Kennedy, B. L., & Vecitis, R. N. (2004). Contexts of the flow experience of women with hiv/aids: Occupation, participation and health. *OTJR*, *24*(3), 83-91. Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/220306383

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. The Internet and Higher Education, 8(1), 13–24. doi: http://dx.doi.org/10.1016/j.iheduc.2004.12.001

Knutson, M. (2006, April). *The correlation of immersion and user satisfaction in video games*. Paper presented at the 6th Winona Computer Science Undergraduate Research Symposium Proceedings of the 6th winona computer science undergraduate research symposium. Retrieved from http://cs.winona.edu/CSConference/2006conference.pdf

Koninklijke Bibliotheek. (n.d.). *What is emulation?*. Retrieved from http://www.kb.nl/hrd/dd/dd_projecten/projecten_emulatiewatis-en.html

Law, M. (1991). The environment: a focus for occupational therapy. *CJOT*, *58*(4), 171-180. Retrieved from http://www.caot.ca/cjot_pdfs/cjot58/58.4Law.pdf

Makuch, E. (2010, May 27). *Time spent gaming on the rise - npd*. Retrieved from http://www.gamespot.com/news/time-spent-gaming-on-the-rise-npd-6264092

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. *Aptitude, Learning, and Instruction*,*3*, 223-253. Retrieved from http://ocw.metu.edu.tr/mod/resource/view.php?id=1311

McGonigal, J. (2011, February 15). Video games: An hour a day is key to success in life. *HUFF POST*. Retrieved from http://www.huffingtonpost.com/jane-mcgonigal/video-games_b_823208.html

McMahan, A. (2003). Immersion, engagement, and presence: A method for analyzing 3-d video games. In Routledge, NY: Retrieved from

http://people.ict.usc.edu/~morie/SupplementalReadings/ch3-McMahanrev.pdf

Moneta, G. B., &Csikszentmihalyi, M. (1999). Models of concentration in natural environments: A comparative approach based on streams of experiential data. *Social Behaviour and Personality*, *27*(6), 603. Retrieved from

http://search.proquest.com.ezproxy.libproxy.db.erau.edu/pqcentral/docview/209898623/1

3343D68B10181CC460/25?accountid=27203

Monk, A. (2000). *User-centred design: the home use challenge*. In *Home informatics and telematics: Information technology and society* (pp. 181-190). Kluwer Academic Publishers.

Nacke, L., & Lindley, C. A. (2008). Flow and immersion in first-person shooters: Measuring the player's gameplay experience. Paper presented at the 2008 Conference on Future Play Research, play, share, Toronto, Canada. doi: 10.1145/1496984.1496998

Novak, T. P., Hoffman, D. L., & Yung, Y. (2000). Measuring the customer experience in online environments: A structural modeling approach.*Marketing Science*, *19*(1), 22-42. Retrieved from

http://www.jstor.org.ezproxy.libproxy.db.erau.edu/stable/pdfplus/193257.pdf?acceptTC=

true

Paras, B. (2005, June). *Game, motivation, and effective learning: An integrated model for educational game design*. Presentation delivered at DiGRA 2005 Changing views: worlds in play, Surrey, B.C. Retrieved from http://summit.sfu.ca/item/281

Pavlas, D. (2010). A model of flow and play in game-based learning: The impact of game characteristics, player traits, and player states. Retrieved from http://www.navistudios.net/Pavlas_Davin_A_201012_PhD.pdf

Perry, S. K. (1999). *Writing in flow*. Cincinnati, OH: Writer's Digest Books

Provenzo Jr., E. F. (2000). Video kids: Making sense of nintendo. (3 ed., Vol. 39, p. 491). Ann Arbor, Michigan: Michigan Quarterly Review. Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/232324426?accountid= 27203

Qin, H., Rau, P. P., & Salvendy, G. (2009). Measuring player immersion in the computer game narrative. International Journal of Human-Computer Interaction, 25(2), 107-133. doi: 10.1080/10447310802546732

Qin, H., Rau, P. P., & Salvendy, G. (2010). Effects of different scenarios of game difficulty on player immersion. *Interacting with Computers*, *22*, 230-239. doi: 10.1016/j.intcom.2009.12.004

Seeking Alpha (2008, August 5). *The video game industry: An $18 billion entertainment juggernaut*. Retrieved from http://seekingalpha.com/article/89124-the-video-game-industry-an-18-billion-entertainment-juggernaut

Sheridan, T. B. (2000). Interaction, imagination and immersion: Some research needs. Paper presented at the ACM Symposium Virtual reality software and technology, Seoul, Korea. Retrieved from http://delivery.acm.org/10.1145/510000/502392/p1-

sheridan.pdf?ip=155.31.68.159&acc=ACTIVE

SERVICE&CFID=106064310&CFTOKEN=39346832&__acm__=1338388127_2fc01e0

4df4e9616041a3ad05baa68f3

Slade, M. (2012). Mental illness and well-being: The central importance of positive psychology

and recovery approaches. *BMC Health Services Research*, *10*(26), doi: 10.1186/1472-

6963-10-26

Stelmaszewska, H., Fields, B., & Blandford, A. (2004). *Conceptualising user hedonic*

experience. In Reed, D. J., Baxter, G., Blythe, M. (Eds.), *Living and Working with*

Technology (pp. 83-89). Retrieved from

http://www0.cs.ucl.ac.uk/staff/a.blandford/docs/hsbfabECCE12preprint.pdf

Sweetser, P. & Wyeth, P. (2005, July). Gameflow: A model for evaluating player enjoyment in

games. Computers in Entertainment (CIE) - Theoretical and Practical Computer

Applications in Entertainment, 3(3), 1-24. Retrieved from

http://delivery.acm.org/10.1145/1080000/1077253/p3a-

sweetser.pdf?ip=155.31.68.159&acc=ACTIVE

SERVICE&CFID=106064310&CFTOKEN=39346832&__acm__=1338389540_df2cc49

ccb1d9aece776c5da76bafd5d

V824/7. (2009, June 23). *Global industry analysts predicts gaming market to reach $91 billion*

by 2015. Retrieved from http://www.vg247.com/2009/06/23/global-industry-analysts-

predicts-gaming-market-to-reach-91-billion-by-2015/

Wang, L. C., & Hsiao, D. F. (2012). Antecedents of flow in retail store shopping. *Journal of*

Retailing and Consumer Services, *19*, 381-389.

Wright, P., Mccarthy, J., & Meekison, L. (2004). Making sense of experience. In M. A. Blythe,

    K. Overbeeke, A. F. Monk & P. C. Wright (Eds.),*Funology From usability to*

    enjoyment (pp. 43-53). Retrieved from

    http://www.cos.ufrj.br/~jano/CSCW2008/Papers/Funology Introduction.pdf

Young, K. S. (1996). *Internet addiction: The emergence of a new clinical disorder*.

    In *CyberPsychology and Behavior* (pp. 237-244). Retrieved from

    http://www.chabad4israel.org/tznius4israel/newdisorder.pdf

Flow Survey

Appendix A

Modified Experience Sampling Method

	Not at all					*Very much*
Did you enjoy playing SuperMarioBros.?	1	2	3	4	5	6

Comments:

_____

How well were you concentrating?	1	2	3	4	5	6

Comments:

_____

How would you rate your distraction level?	1	2	3	4	5	6

Comments:

_____

Do you feel you improved during the course of playing SuperMario Bros.?	1	2	3	4	5	6

Comments:

_____

Did you feel a sense of control over Playing SuperMario Bros.?	1	2	3	4	5	6

Comments:

How long did it take you to play SuperMario Bros.? _____

Comments:

_____

Did you get a sense of timelessness?   1   2   3   4   5   6

Comments:

Indicate how you felt about the activity:

	Not at all					*Very much*
How challenging was SuperMario Bros.?	1	2	3	4	5	6

Comments:

_____

Was SuperMario Bros. important to you?	1	2	3	4	5	6

Comments:

_____

How skilled are you at SuperMario Bros.?	1	2	3	4	5	6

Comments:

_____

Did you wish you had been doing something else?	1	2	3	4	5	6

Comments:

_____

Do you feel appropriately challenged?	1	2	3	4	5	6

Comments:

_____

Do you feel your skills at SuperMario Bros. were better at the end of the game than when you started?	1	2	3	4	5	6

Comments:

| Was playing SuperMario Bros. interesting? | 1 | 2 | 3 | 4 | 5 | 6 |

Comments:

_____

| Did you lose yourself in SuperMario Bros.? | 1 | 2 | 3 | 4 | 5 | 6 |

Comments:

_____

| Were goals of SuperMario Bros. clear? | 1 | 2 | 3 | 4 | 5 | 6 |

Comments:

_____

| At any point in SuperMario Bros., were you unsure of what to do? | 1 | 2 | 3 | 4 | 5 | 6 |

Comments:

_____

| Were you unclear about what was happening in SuperMario Bros. at any point? | 1 | 2 | 3 | 4 | 5 | 6 |

Comments:

_____

| Would you be willing to play SuperMario Bros. again, for an hour? | 1 | 2 | 3 | 4 | 5 | 6 |

Comments:

_____

| Did you notice the picture change? | Yes | | | | No | |

Comments:

What did it change to?

Comments:

If you were feeling a lot of something, why did you feel that way?

Describe your mood:

	Very	*Quite*	*Some*	*Neither*	*Some*	*Quite*	*Very*	
Happy	3	2	1	0	1	2	3	**Sad**

Comments:

Disengaged	3	2	1	0	1	2	3	**Engaged**

Comments:

Ashamed	3	2	1	0	1	2	3	**Proud**

Comments:

Worried	3	2	1	0	1	2	3	**Relaxed**

Comments:

Frustrated	3	2	1	0	1	2	3	**Calm**

Comments:

Lonely	3	2	1	0	1	2	3	**Sociable**

Comments:

Excited	3	2	1	0	1	2	3	**Bored**

Comments:

Angry	3	2	1	0	1	2	3	**Friendly**

Comments: