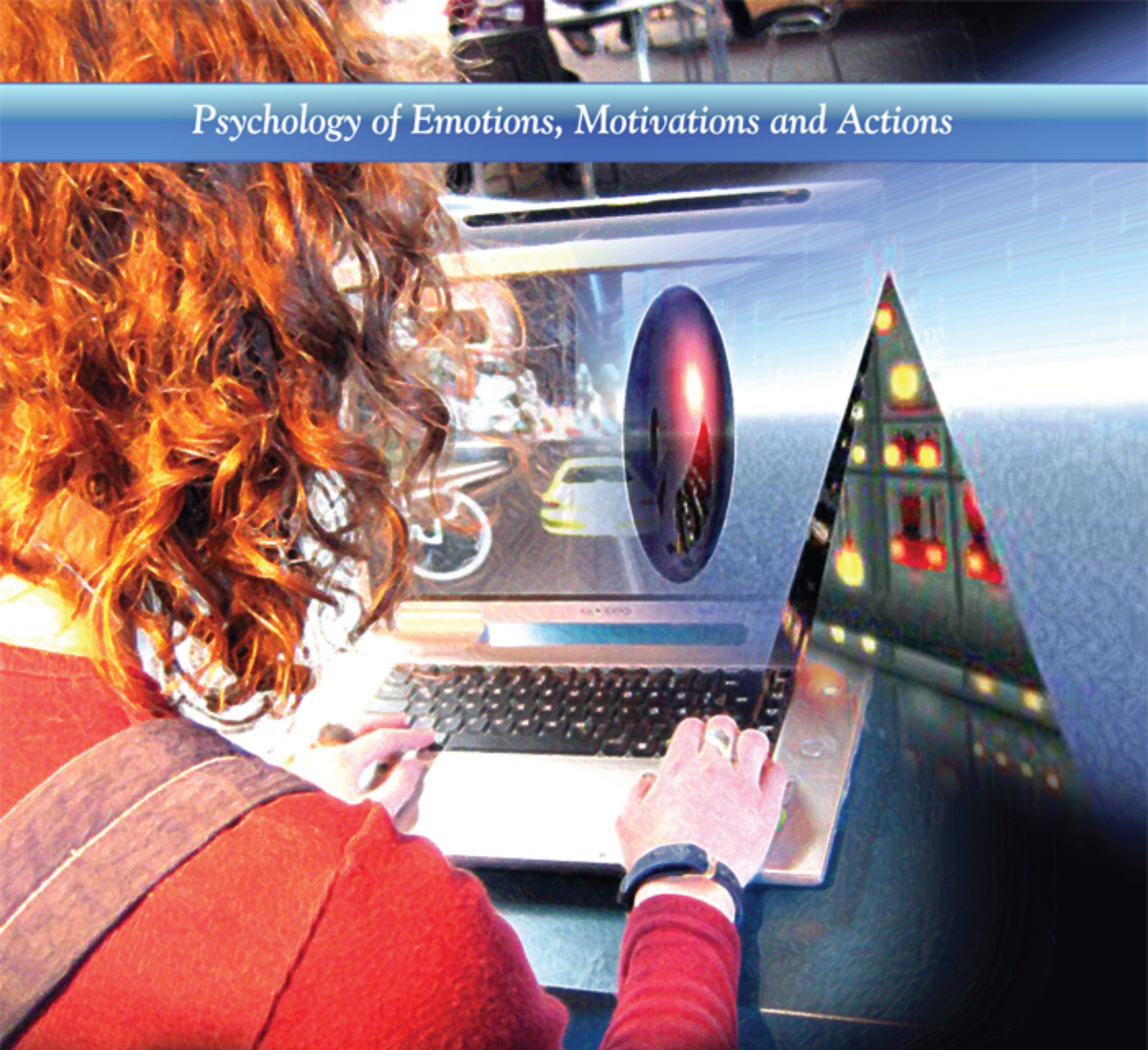
Psychology of Emotions, Motivations and Actions



Psychology of Gaming

Youngkyun Baek
Editor

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PSYCHOLOGY OF EMOTIONS, MOTIVATIONS AND ACTIONS

PSYCHOLOGY OF GAMING

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CONTENTS

PREFACE

1. PSYCHOLOGY OF GAMING

Society needs to have a better understanding of why people enjoy certain digital games so much because the increase in gaming among youth and adults has grown exponentially in recent years. Gamers share a similar feeling of euphoria while they are completely caught up in a game. When gamers are completely focused on playing they tend to forget all other things around them. In order to fully understand why gamers enjoy certain games I began to look at what lies below the surface and try to see them as a fellow gamer and researcher on gaming.

On-line games have unique formats. They can be played against other people, against yourself, against a computer, or perhaps even against the forces of nature. Computer games also have goals with set rules in common so that gamers can follow the sequence of events in order to gain the most enjoyment and of course trigger a desire to continue the game. When playing a game, gamers are learning details such as the rules, what it takes to win, and how to continue the game. There are several types of experiences that all gamers go through while playing a game. Among these experiences, there is competition, the element of chance, a feeling of vertigo, and make-believe as suggested by Caillois (1961). These activities give players engagement and pleasure. Thus, people who have played games can most likely relate to this feeling of engagement and enjoyment that Csíkszentmihályi (2008) calls, “flow” which is the state of "being completely involved in an activity for its own sake”. The feeling is very pleasurable and I believe this state of “flow” is closely related to the question of why people play games.

I am also interested in what makes people continue to play games? A seminal book on game behavior written by psychiatrist Eric Berne (1964), *Games People Play* is the most accessible and insightful book ever written about behavior patterns that reveal hidden feelings and emotions when playing games. Berne’s work shows the underlying motivations behind our relationships and provides the keys to unlock the psychology of others and ourselves. Based on Berne’s explanation of game behavior, the psychology of gaming is defined as a study of human behavior associated with digital gaming. This study specifically includes causes and effects of digital gaming, and personality traits associated with gaming.

2. RESEARCH IN THIS FIELD

This section is divided into three main areas of research on gaming. This first section includes a summary of recent psychological studies and results on digital gaming. One of the most active areas of research on digital gaming is the psychological perspective of what makes people play games. The second area includes summarized positive effects of gaming and the third section is about the negative effects of gaming.

Motivators to gameplay: People play games to have an optimal experience or flow. An optimal experience is one of the fundamental reasons for people's gameplay. Flow in gameplay helps foster an enjoyable experience increasing motivation and enticing players to continue playing. Various psychologists have explored which factors are related to gamers' optimal experience. These factors include: self-enjoyment, engagement, intrinsic motivation, and so forth. Related to game-based learning, flow plays an important role too, introducing materials, improving understanding, and increasing retention. Thus, flow in instructional games has the potential to be effective. More recently, psychologists began to concentrate on socio-cultural factors of gameplay. Recent research found social and cultural aspects including interaction, communication, community building and so forth, all have a great impact on gameplay (Murphy, 2011). Intrinsic motivation is another motivator to gameplay. Frequently, enthusiastic gamers are described as intrinsically motivated (Malone, 1981; Warren et al. 2008), engaged (Garris et al. 2003), and pathological (Chou and Ting, 2003). The engaging and intrinsically motivating nature of gameplay draws researchers' attention to investigate motivational engagement (Wang et al. 2008). Research investigating variables related to engagement can be found across multiple fields of education field (Jones, 1998; Hoffman & Nadelson, 2010; Huizenga, et al. 2009).

Positive effects of gaming: There have been pros and cons about gameplay in terms of its positive or negative effects. Although some research findings have demonstrated that violent digital game exposure is related to negative societal outcomes (Barlett et al. 2009) such as aggressive behavior (Fergerson, 2007) and adolescent hostility (Gentile et al. 2004), some empirical research also suggests that digital game exposure is related to improvements in cognition and learning particularly with visual attention (Green & Bavelier, 2003), and spatial ability (De lisi & Wolford, 2002). Online gaming research has also shown people feel psychologically better and helps raise their self-esteem (Griffiths, 2005a, 2005b). The immersive and dis-associative experience of gaming may also be very therapeutic and help people deal with everyday stress. Research has shown that many gamers enjoy gaming leading to time lost in something they feel is more meaningful (Wood & Griffiths, 2007; Wood et al. 2007). Far more positive than drug use, drinking alcohol or other activities like gambling. Green and Bavelier (2003) found that playing video games was associated with superior performance on a variety of visual attention tasks. The ability to mentally rotate or manipulate objects is related to many general learning tests and paradigms, and research has shown that gameplay and object management in cyber space are related to this spatial ability (De Lisi & Wolford, 2002; Hwang, et al. 2008). Those who performed well at digital games performed significantly better on spatial ability and experience in managing objects in cyber space.

A unique feature of cyber space gaming is communication between players is technically possible with the use of headsets and microphones. In addition, any social network games can

utilize social networks service such as Facebook in order to communicate among players. Friendship creation is another positive effect by playing such games repeatedly with the same people through maintaining a friendly dialogue. One area that needs further study is the effect that certain games have on friendships, socialization skills, leadership, and cooperative skills (Greitemeyer & Osswald, 2010; Silvern & Williamson, 1987). Williams, Caplan, and Xiong (2007) found that using a microphone to communicate to teammates in WoW (World of Warcraft) was related to building stronger relationships and trust with teammates compared to those who used the standard text-based form of communication such as typing on a keyboard. For teaching and learning, the use of digital games is promising. Educational digital games are an effective teaching tool for certain topics for children and adults, including algebra and math (Corbett, Koedinger, & Hadley, 2001; Kebritchi, Hirumi, & Bai, 2010), computer science (Papastergiou, 2009), mechanical engineering (Coller, & Scott, 2009), geography (Tüzün et al. 2009), literacy (Owston, et al. 2009; Tysseling, 2012), biology (Ybarrondo, 1984), and photography (Abrams, 1986).

Negative effects of gaming: The negative effect of playing digital games is over exposure to violent video games is causally related to aggressive thoughts (Barlett et al. 2009), addiction (Skoric, Teo, & Neo, 2009; Ng, & Wiemer-Hastings, 2005; Wan, & Chiou, 2006; Van Rooij et al. 2010; Mehroof, & Griffiths, 2010; Griffiths, 2010), aggressive behavior (Hobbs, & Yan, 2008; Lemmens, Valkenburg, & Peter, 2010; Grüsser, Thalemann, & Griffiths, 2007), and antisocial behavior (Greitemeyer, & Osswald, 2010; Silvern, S. B., & Williamson, P. A. (1987). Negative effects from digital games have shown to be caused by two factors, depiction of blood in the game (Farrar, Krcmar, & Nowak, 2006) and rewarding of violent actions in gaming (Ferguson, 2007; Ivory & Kalyanaraman, 2007). Griffiths (2010) addressed the negative effect on online gaming as an addiction whereby this type of game is potentially never ending and can be played all day every day. Research conducted by Schmierbach (2010) found gamers to be in three game modes: single player, coop, or competitive. He reported that gamers who played a coop mode were far more likely to come up with non-violent words, which he took as evidence of less "aggressive cognition" then gamers in competitive mode. Other self-reported measures of frustration and arousal (in the general physiological sense) showed similar results.

4. CHAPTERS IN THIS BOOK

In the chapter of *Psychological game theory and the role of beliefs,* Patokos indicates that psychological game theory involves the second-order beliefs of a player, and these second-order beliefs may alter the strategic structure of the game, but this is a lot more complex than a change in the players' utility functions. Patokos argues that psychological game theory allows us to define psychological games involving only one individual. In these games, someone's self-perception and self-concept might play a decisive role in what action will be chosen, and, in turn, the action chosen might shape this person's self-perception and self-concept. In the chapter of *Emotional Gaming,* Madeira et al. examine the emotions elicited by the act of playing video games, in order to explore how dimensional and categorical models of emotions have been used to identify the emotional responses of players, including their enjoyment experience. Madeira et al. also discuss the social implications of gaming and

suggest areas for future research. In the chapter on *The Taxonomy and Design Criteria for Health Game Design in the Elderly*, Harley et al. identify the relevant studies that have contributed to the development of serious health games for older adults, and based on their findings created a common taxonomy that doctors, scientists and engineers may use to solve todays cross-disciplinary challenges. Harley et al. also discuss the design criteria for serious health games that should be considered, such as health, software, and hardware constraints, and identify the current and future needs in making serious health games widely available to older adults. In the chapter on *The GlobalEd 2 Game: Developing Scientific Literacy Skills through Interdisciplinary, Technology-based Simulations,* Lawless et al. indicate positive changes in the quality of their written scientific explanation, interest in pursuing future science educational opportunities and science knowledge as results of a pilot implementations of the GE2 simulations focused on water resources and climate change with 1400, 7th and 8th grade students from both suburban and urban school systems. The research results also indicate that implementation fidelity was correlated with positive gains in student outcomes with high fidelity yielding very high outcomes and low fidelity yielding low to no gains. In the chapter on *Rethinking fantasy as a contributor to intrinsic motivation in digital gameplay,* Choi and Baek revisit the role of fantasy while playing digital games, focusing on what brings a state of fantasy in a gaming world. The purpose of this chapter is to probe factors creating a fantasy state of mind during gameplay. 153 junior high students participated in this study while playing 35 commercial off-the-shelf games. Four factors were extracted as fantasy components and labeled as identification, imagination, analogy, and satisfaction. In the chapter on *Indigenous Australian gamblers and their help-seeking behavior,* Breen et al. present and analyze the results of an investigation into help-seeking behaviors of Indigenous Australians in relation to their awareness of and preferences for professional help, non-professional help and self-help strategies for gambling-related problems. Breen et al. reveal that self-help measures could be more widely publicized and the use of professional and non-professional sources of help could be improved to help optimize recovery from gambling-related problems amongst Indigenous Australians. Romero addresses, in his chapter on *Psychological factors on Collaborative Gaming,* the key issues in the psychological factors related to collaborative Game-Based Learning (GBL). This chapter provides a comprehensive review of the research developed in collaborative learning and the specific field of collaborative GBL. The chapter begins with an analysis of the social interaction dynamics involved in collaborative learning. This is followed by a specific analysis of game dynamics in multiplayer games (such as intergroup cooperation and competition) and the efficiency of these dynamics in supporting the collaborative learning process. At the end of this chapter, the teaching and game design implications of the psychological aspects of collaborative GBL are discussed – so enabling a transfer of the most relevant knowledge and best practices. In the final chapter on *Game Changing: Developing Meet the Earthworks Builders,* Aubrecht and Ballengee-Morris explore the challenges, solutions, and methodology used to create a game that represents the Earthworks builders, ancestors of Native Americans, as sophisticated and complex, through the Flash-based video game Earthworks Builders whereby the player takes away a sense of empathy and understanding for another culture.

5. FUTURE RESEARCH IN PSYCHOLOGY OF GAMING

Digital games are becoming increasingly popular and important in people's lives. They are also gaining wide attention from scholars, parents, and teachers on their possibilities in terms for psychological, educational, and social outcomes. Yet the existing research in this field is limited in number to generate full knowledge and theories to better inform practice, design, and integration. Further research is needed in the following areas: First, quantitative and qualitative research is in needed to better inform our understanding. Strong research methodology should be applied in order to find answers to theoretically relevant questions related to the variables moderating psychological outcomes and personal traits. In addition, longitudinal research is expected to assess whether or not games impact player's psychological status positively or negatively over time. More research needs to be done that samples children across age groups and other demographic variables over longer periods of time. Second, research on the transfer of outcomes resulting from gaming experiences to individual's real world is one area of future study needed in this field. Recent studies of game transfer phenomena (Ortiz et al. 2011; Ortiz et al. 2012) will gain more attention from psychologists of gaming. Does the transfer of gaming experience like hearing, seeing or doing things in real life parallel video game behavior? As people may tend to think in the same way while gaming, they would momentarily transfer elements of the game content, or the interface, into people's real life. Third, digital game design and development should benefit from psychologists' research on what makes games even more compelling, challenging and fun. This research should focus on the comparative nature and weight of gaming elements that help people have an optimal experience while engaged in game play.

REFERENCES

Abrams, A. (1986, January). Effectiveness of interactive video in teaching basic photography skills. *Paper presented at the annual convention of the Association for Educational Communication and Technology*, Las Vegas, NV.

Barlett, C.P., Anderson, C.A., & Swing, E.L. (2009). Video game effects confirmed, suspected, and speculative: A review of the evidence. *Simulation & Gaming*, 40(3), pp. 377-403.

Berne, E. (1964). Games people play: The psychology of human relationships. New York: Grove Press.

Caillois, R. (1961). *Man, play, and games*. New York: Free Press of Glencoe.

Chou, T., & Ting, C. (2003). The role of flow experience in cyber-game addiction. *CyberPsychology & Behavior*, 6, 663–675.

Coller, B. D., & Scott, M. J. (2009). Effectiveness of using a video game to teach a course in mechanical engineering. *Computers & Education*, 53(3), 900-912. doi:10.1016/ j.compedu.2009.05.012

Corbett, A. T., Koedinger, K. R., & Hadley, W. (2001). *Cognitive tutors: From the research classroom to all classrooms*. In P. S. Goodman (Ed.), Technology enhanced learning (pp. 235-263). Mahwah, NJ: Lawrence Erlbaum.

Csikszentmihalyi, M. (2008). *Flow: The Psychology of Optimal Experience.* Harper Perennial Modern Classics.

Ferguson, C. (2007). The good, the bad and the ugly: A meta-analytic review of positive and negative effects of violent video games. *Psychiatric Quarterly, 78*(4), 309-316.

De Lisi, R., & Wolford, J. (2002). Improving children's mental rotation accuracy with computer game playing. *Journal of Genetic Psychology, 163,* 272–283.

Ferguson C.J(2007). Evidence for publication bias in video game violence effects literature: A meta-analytic review. *Aggression Violent Behaviour.* 12:470–482, 2007

Garris, R., Ahlers, R., & Driskell, J. E. (2003). Games, motivation, and learning: A research and practice model. Simulation and Gaming, 33, 441–467.

Gentile, D.A., Lynch, P.L., Linda, J.R., & Walsh, D.A. (2004). The effects of violent video game habits on adolescent hostility, aggressive behaviors, and school performance. *Journal of Adolescence*, 27, 5-22.

Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature*, 423, 534-537.

Greitemeyer, T., & Osswald, S. (2010). Effects of Prosocial Video Games on Prosocial Behavior. *Journal of Personality and Social Psychology, 98*(2), 211-221.

Griffiths, M.D. (2005a). Video games and health. *British Medical Journal*, 331, 122–123.

Griffiths, M.D. (2005b). The therapeutic value of video games. In J. Goldstein & J. Raessens (Eds.), Handbook of computer game studies (pp. 161–171). Boston, MA: MIT Press.

Griffiths, M.D. (2010). Online video gaming: what should educational psychologists know?. *Educational Psychology In Practice*, 26(1), 35-40. doi:10.1080/02667360903522769

Griffiths, M. (2010). The Role of Context in Online Gaming Excess and Addiction: Some Case Study Evidence. *International Journal of Mental Health and Addiction, 8*(1), 119-125.

Grüsser, S. M., Thalemann, R., & Griffiths, M. D. (2007). Excessive Computer Game Playing: Evidence for Addiction and Aggression? *CyberPsychology & Behavior*, 10(2), 290-292.

Hobbs, L. J., & Yan, Z. (2008). Cracking the walnut: Using a computer game to impact cognition, emotion, and behavior of highly aggressive fifth grade students. *Computers in Human Behavior*, 24(2008), 421-438.

Hoffman, B., & Nadelson, L. (2010). Motivational engagement and video gaming: a mixed methods study. *Educational Technology Research & Development*, 58(3), 245-270.

Huizenga, J., Admiraal, W., Akkerman, S., & Dam, G. T. (2009). Mobile game-based learning in secondary education: engagement, motivation and learning in a mobile city game. *Journal of Computer Assisted Learning, 25(4), 332-344.*

Hwang, J., Park, H., Cha, J., & Shin, B. (2008). Effects of Object Building Activities in Second Life on Players' Spatial Reasoning. *Paper presented at the Proceedings of the 2008 Second IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning*. DIGITEL 2008, 17-19 November 2008, Banff, Canada.

Ivory, J. D., & Kalyanaraman, S. (2007). The Effects of Technological Advancement and Violent Content in Video Games on Players' Feelings of Presence, Involvement, Physiological Arousal, and Aggression. *Journal of Communication, 57*(3), 532-555.

Jones, M. G. (1998, February). Creating electronic learning environments: Games, flow and the user interface. In Proceedings of selected research and development presentations at

the national convention of the association for educational communications and technology (*AECT*), St. Louis, MO.

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & Education*, 55(2), 427-443. doi:10.1016/j.compedu.2010.02.007

Farrar, K. M., Krcmar, M., & Nowak, K. L. (2006). Contextual Features of Violent Video Games, Mental Models, and Aggression, *Journal of Communication*, Vol. 56, No.2, 387–405. DOI: 10.1111/j.1460-2466.2006.00025.x

Lee, C., & Chen, M. (2009). A computer game as a context for non-routine mathematical problem solving: The effects of type of question prompt and level of prior knowledge. *Computers & Education*, 52(3), 530-542. doi:10.1016/j.compedu.2008.10.008

Lemmens, J., Valkenburg, P., & Peter, J. (2010). The Effects of Pathological Gaming on Aggressive Behavior. *Journal of Youth and Adolescence*, 1-10.

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

Murphy, C. (2011). Why Games Work and the Science of Learning. *Paper presented at the Modsim World 2011 Conference*, Virginia Beach, VA,USA.

Mehroof, M., & Griffiths, M. D. (2010). Online Gaming Addiction: The Role of Sensation Seeking, Self-Control, Neuroticism, Aggression, State Anxiety, and Trait Anxiety. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 313-316.

Ortiz de Gotari, A.B., Aronsson, K. & Griffiths, M. D. (2011). Game Transfer Phenomena in Video Game Playing: A Qualitative Interview Study, *International Journal of Cyber Behavior, Psychology and Learning*, 1(3), 15-33, July-September 2011.

Ortiz de Gortari, A.B & Griffiths, M.D. (2012). *An introduction to Game Transfer Phenomena in video game playing*. In J. Gackenbach (Ed.), Video Game Play and Consciousness. Nova Science. Accessed Sept 2, 2012 at http://nottinghamtrent.academia.edu/angelicaortizdegortari/Papers

Owston, R., Wideman, H., Ronda, N., & Brown, C. (2009). Computer game development as a literacy activity. *Computers & Education*, 53(3), 977-989. doi:10.1016/j.compedu.2009.05.015

Papastergiou, M. (January 01, 2009). Digital Game-Based Learning in high school Computer Science education: Impact on educational effectiveness and student motivation. *Computers & Education*, 52, 1, 1-12.

Provenzo, E.F. 1991. *Video kids: Making sense of Nintendo*. Cambridge, MA: Harvard.

Schmierbach, M. (2010). "killing spree": Exploring the connection between competitive game play and aggressive cognition. *Communication Research*, 37 (2), 256-274.

Sherry, J. (2001). The effects of violent video games on aggression. *Human Communication Research, 27*(3), 409-431.

Silvern, S. B., & Williamson, P. A. (1987). The effects of video game play on young children's aggression, fantasy, and prosocial behavior. *Journal of Applied Developmental Psychology, 8*(4), 453-462.

Skoric, M. M., Teo, L., & Neo, R. (2009). Children and Video Games: Addiction, Engagement, and Scholastic Achievement. *Cyberpsychology & Behavior*, 12(5), 567-572. doi:10.1089/cpb.2009.0079

Tüzün, H., Yılmaz-Soylu, M., Karakuş, T., İnal, Y., & Kızılkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers & Education*, 52(1), 68-77. doi:10.1016/j.compedu.2008.06.008

Wang, C., Khoo, A., Liu, W., & Divaharan, S. (2008). Passion and intrinsic motivation in digital gaming. *CyberPsychology & Behavior,* 11(1), 39–45.

Van Rooij, A. J., Schoenmakers, T. M., Vermulst, A. A., Van Den Eijnden, R. J., & Van De Mheen, D. (2010). Online video game addiction: identification of addicted adolescent gamers. *Addiction*, no-no.

Wan, C.-S., & Chiou, W.-B. (2006). Psychological Motives and Online Games Addiction: *A* Test of Flow Theory and Humanistic Needs Theory for Taiwanese Adolescents. *CyberPsychology & Behavior, 9*(3), 317-324.

Warren, S. J., Dondlinger, M. J., & Barab, S. A. (2008). A MUVE towards PBL writing: Effects of a digital learning environment designed to improve elementary student writing. *Journal of Research on Technology and Education*, 41, 113–140.

Williams, D., Caplan, S., & Xiong, L. (2007). Can you hear me now? The impact of voice in an online gaming community. *Human Communication Research*, 33, 427-449.

Wood, R.T.A., & Griffiths, M.D. (2007). Time loss whilst playing video games: Is there a relationship to addictive behaviours? *International Journal of Mental Health and Addiction*, 5, 141–149.

Wood, R.T.A., Griffiths, M.D., & Parke, A. (2007). Experiences of time loss among video game players: An empirical study. *CyberPsychology and Behaviour,* 10, 45–56.

Ybarrondo, B. A. (1984). A study of the effectiveness of computer-assisted instruction in the high school biology classroom. *Master's thesis*, Boise State University, Idaho. (ERIC Document Reproduction Service No. ED 265 015).

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Chapter 1

PSYCHOLOGICAL GAME THEORY AND THE ROLE OF BELIEFS

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ABSTRACT

In cases where individuals' behaviour in games is not consistent with what the theory predicts, it is not uncommon for game theorists to explain the discrepancies by re-modelling the preferences of the players and assume different utility functions. While this task inevitably entails making behavioural assumptions on the players, it does not fall into the realm of psychological game theory; it simply means that the game originally under study was not very well defined in the first place.

In contrast, psychological game theory involves the second-order beliefs of a player (i.e. what someone believes that other people believe about him or her). These second-order beliefs may alter the strategic structure of the game, but this is a lot more complex than a change in the players' utility functions. On another level, this chapter argues that if we accept that an individual may hold beliefs on his or her own actions, psychological game theory allows us to define psychological games involving only one individual. In these games, someone's self-perception and self-concept might play a decisive role in what action will be chosen, and, in turn, the action chosen might shape this person's self-perception and self-concept.

1. INTRODUCTION: WHAT PSYCHOLOGICAL GAME THEORY IS *NOT*

Why do some individuals choose to suffer some personal loss (financial or otherwise) to help people in need? Why do most people not succumb to the temptation of shoplifting when the shop-owner looks the other way? Why do we leave tips at restaurants we do not intent to revisit? These are the kinds of questions that, at first, seem somewhat troubling to answer

within the confines of methodological individualism and utility maximisation. Of course, none of these questions posits any real paradox, except maybe for those who have only done a superficial reading of mainstream economic theory, and it is their (inaccurate) understanding that homo œconomicus must be selfish, in the sense of the word that excludes any regard for other people.

Readers of textbooks addressed to the early undergraduate level would perhaps be excused to make this mistake; after all, what they mostly see is applications of utility functions that typically depend on quantities of different commodities (typically oranges and apples) some agent consumes, and they learn that "the more, the better". In this narrow framework, helping out a peer is irrational, and leaving a tip would indeed be inexplicable. Nevertheless, selfishness in economics can have several layers, and it all depends on the chosen domain of the utility function. Someone with a utility function that would only depend on their own consumption level would not be rational to leave a tip; however, if we extended the domain of the utility function to also include the consumption levels (or, more generally, the well-being) of the waiter – and be increasing in it, then tipping becomes a rational decision. It remains selfish, but this does not exclude it from being others-regarding as well. A typical interpretation of this behaviour is that the agent receives some kind of "warm glow" when he or she is being nice to the waiter; this "warm glow" translates to an increase in utility which makes up for the decrease caused by the actual monetary loss.

In general, expanding the domain of homo œconomicus' utility function gives us the opportunity to portrait an agent with richer preferences. At the same time, it presupposes that the modeller has made some concrete assumptions on his or her subject under study. A trivial expansion in the vein of "Anne does not only enjoy apples and oranges, but she likes bananas as well" means that her utility function will be a function u: $R^3 \rightarrow R$ (as opposed to u: $R^2 \rightarrow R$). The same applies if Anne derives more utility as she consumes more apples and oranges and as Bill consumes more apples. A technical difference between these two scenarios is that, in the case where apples are not in abundance, the apples consumed by Anne and the apples consumed by Bill should also satisfy a physical constraint. Even if it seems that there is also a conceptual difference (in the sense that in the second scenario we made a behavioural assumption or, at the very least, we introduced a positive consumer externality, while in the first scenario Anne was just assumed to want more of a third good), economic theory will not distinguish between the two: it is not the theory's job to tell us what will the agents' utility functions look like; this shall have to be decided upon by the modeller. On a purely theoretical level, the decision whether to model Anne as an altruist (even if it shall be her own utility she will ultimately be maximising) is no different from deciding whether she is a person who likes or dislikes apples. It is only when we get her utility function right that economic theory takes over and claims to predict or describe how Ann will make choices, given the utility function that we (the modellers) have provided as an input.

In this respect, game theory is no different. It begins from the moment we write down the game – the number of players, their available strategies and the corresponding payoffs from each combination of strategies. All considerations – behavioural or otherwise, must already be taken into account in the payoffs before we try to analyse the game. Therefore, if we ponder on a game like the "Prisoners' Dilemma" and wonder why a significant percentage of players do not choose to defect, the explanation is perhaps that we have got the game wrong, and that the payoff matrix we are considering is irrelevant. Maybe the players feel a "warm glow" when they cooperate (or a "cold prickle" when they defect), or it is possible that their

utility function involves the utility of their co-player. This is indeed a common explanation of the so-called paradox, in line, for example, with Sen's view that people may want to defect when they expect that the co-player will defect, but there is no reason why to assume that they would be happier to defect when they expect the co-player will cooperate (Sen, 1967). In this particular case, Sen's optimism with regards to human nature implies a transformation of the "Prisoners' Dilemma" to a "Stag-Hunt" game. But although founded on a behavioural assumption, this arrangement has nothing to do with psychological game theory; it just means that we need to write down the game correctly and approach it with the usual tools.

To know how one ranks cooperation and defection contingent on what the other player will do is no different from knowing one's utility function from the consumption of apples and oranges. It's just that, in the former case, the utility function we come up with inevitably tells a story on the kind of person this player is, while in the latter, we only have a trivial account on whether (s)he likes or dislikes two particular goods and on how (s)he substitutes one for another.

Nothing changes from a methodological point of view, however, and modelling altruistic behaviour in this way does not constitute a departure from methodological individualism, as it is sometimes wrongly believed (usually by undergraduate students).

2. PSYCHOLOGICAL GAME THEORY AND THE "BRAVERY GAME"

Psychological game theory becomes relevant when second-order beliefs enter the picture. Assume that A believes that B will play "cooperate" in the "Prisoners' Dilemma". This is a first-order belief, and according to Sen's comment above, because of this very belief, A's payoff from cooperating may be conceived to be greater that A's payoff from defecting.

However, an important question (in the mind of A) is: why would B want to "cooperate"? This is an interesting question, because, if B cooperates because he believes that A will cooperate too, then B comes forward as a nice person who does not place personal interest above collective interest. But if B cooperates while he believes that A will defect, then B emerges as nicer still: as a person whose kindness is not conditional, and who always cooperates (reminiscent of a Kantian following his or her categorical imperative). Now, if we only consider first-order beliefs, then A's utility from cooperating when she believes B will cooperate is constant, no matter what B expects of A (as anticipated by A). Nevertheless, A's perception of what B believes that A will play is likely to make a difference, which depends on how A perceives B's motivation.

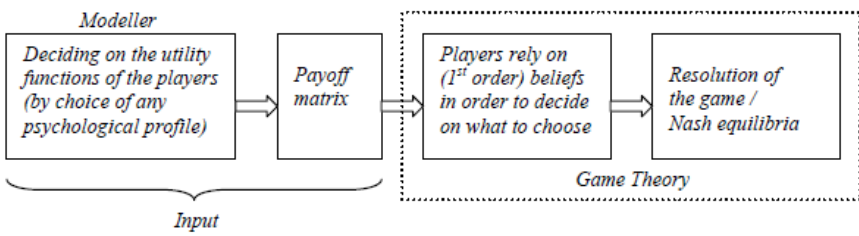

Figure 1. A (non-psychological) game theoretical model.

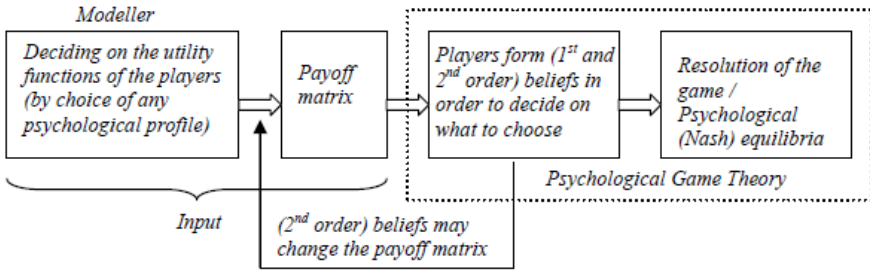

Figure 2. A psychological game theoretical model.

In one of the seminal papers on psychological game theory, Rabin (1993) incorporates such considerations (i.e. second-order beliefs) in the players' utility functions. Rabin's utility transformations, however, are fundamentally different from transformations of the kind where we just expand the domain of someone's utility function in order, for example, to incorporate altruistic behaviour: since these changes in utility levels are contingent on how players perceive their co-players' incentives, the agents actually need to check the original payoff structure of the game to form their perceptions in the first place. This means that second-order beliefs potentially change utility levels, but not in a way which we are able to foresee before writing down the payoff matrix. The difference is best seen in Figures 1 and 2.

In a nutshell, no matter what behavioural considerations we could squeeze into someone's utility function, we would need no psychological game theory unless we brought second-order beliefs into the picture (i.e. utility functions depending on beliefs). Standard utility transformations that account for various psychological features remain outside the theory's realm (and within the first box of Figure 1 labelled "Modeller"). But if second order beliefs alter preferences, then these utility changes are no longer solely the modeller's task (see the feedback arrow in Figure 2, which emerges from within the Psychological Game Theory box): the theory now inevitably has to deal with them, and can no longer leave it all to the modeller.

The precursor to Rabin's groundbreaking paper, and perhaps the foundation of psychological game theory is the 1989 paper by Geanakoplos, Pearce and Stacchetti entitled "Psychological games and sequential rationality". In this paper, the authors introduce the so-called "bravery game", where they show that second-order beliefs are likely to have a dramatic impact on the emerging equilibria. In this game, player 1 can either take a "bold" or a "timid" decision, which will be witnessed by his friends (player 2). If player 1 believes that his friends think of him as brave, then he is better off (in terms of utility) by choosing to be bold; on the other hand, if he believes that his friends expect him to duck, then he is better off by choosing to be timid. In equilibrium, the probabilities with which player 1 chooses to be "bold" or "timid" (p and $1–p$ respectively) must coincide with his friends' expectations on p and $1–p$ (denoted q and $1–q$) and with his own expectations on q and $1–q$ (r and $1–r$). In this example, the equilibrium conditions $p=q=r$ yield three equilibria, each one of which describes different expectations from both sides and final decision from player 1.

The authors note that this conclusion is unlike the traditional take (where player 1 is by himself, or just stays unaffected by anyone watching). Indeed, in a traditional setting, player 1 may be "bold" or "timid", and his mixed strategy is (p, $1–p$); he chooses the bold decision insofar u(bold decision)$\geq u$(timid decision), and ultimately, he will either choose "bold" with probability 1, "timid" with probability 1, or he'll be indifferent between the two. In the latter

case, any randomisation between "bold" and "timid" will yield the same level of utility, and therefore, there will be a continuum of equilibria. Thus, the introduction of player 2 reduced the number of possible equilibria from infinite to three.

Ironically enough, player 2 does not even participate actively in the game. Although in the original version of the "bravery game", the authors include player 2's payoffs in their example, these are quite simply irrelevant to the resolution of the game, since player 2 never gets to make a move. In other words, player 2 only acts as the catalyst that determines player 1's move. In this regard, this makes the "bravery game" resemble more an individual choice problem than a game theory problem. Player 1 feels some kind of constraint when he knows that somebody else – whose opinion he values – is watching. That the authors had to introduce an inactive player 2 means that player 1, if left completely alone, would no longer be ashamed to be timid or would no longer feel any need to live up to the expectations of his peers.

3. A SINGLE-PERSON PSYCHOLOGICAL GAME

Going through the setting of the "bravery game" analysed in the previous section, an interesting question arises: is the presence of player 2 even necessary in order to affect player 1's choice? We have seen that player 2 being at the scene matters, on the grounds that player 1 values their opinion on him, and as a result, his second-order beliefs enter his utility function directly. This, however, should not necessarily mean that, in the absence of an observer, any player 1 would choose to be timid. Quite simply, player 1 just might want to prove his worth to *himself*. This, of course, turns on the discussion on some "multiplicity" or at least a "duality" of the self. Here, this multiplicity takes the guise of an inner judge or some kind of spectator who is not a distinct player 2, but a part of the very individual who makes the decision. This practically means that we may expand psychological game theory to also cover for single-actor scenarios (Patokos, 2011).

It is not hard to rewrite the "bravery game" under this new light. We no longer need player 2, but we need a player 1 who nurtures certain perceptions on himself, which he wishes to fulfil. These perceptions take the form of first-order beliefs on the agent's actual decision: player 1 has still to decide between acting boldly and acting timidly; once again, we assume that he chooses the former with p and the latter with $1–p$; this time, nobody is watching. However, player 1 holds beliefs on what p is, summarised by q: these beliefs essentially answer the question: "could I act bravely?". If $q=1$, then player 1 is absolutely confident in himself that he shall act bravely; if $q=0$, then he is absolutely convinced that he does not "have it in him"; if $q=0.5$ then player 1 believes he might act bravely with probability 0.5, and so on.

It is interesting to note that q does not necessarily have to reflect p with accuracy (just as in the original game, player 1 does not have to know his friends' opinion on him but in equilibrium); player 1 might underestimate or overestimate himself. Now, his utility function depends on q (his first order beliefs), just like it depended on his second order beliefs in the original version of the game: if, for example, we let u(acting bravely)$=2–q$ and u(acting timidly)$=3–3q$, then player 1 will prefer to act bravely if $q>0.5$, that is, if he is sufficiently confident he will take the bold decision. If $q<0.5$, player 1 will prefer to act timidly, since he

holds no high expectations on himself that risk to be unfulfilled. In essence, player 1's preferences are affected by a need for self-confirmation, and a sense of psychological grief that would lower his utility if he thought of himself as a brave person but acted timidly instead.

This version of the "bravery game" looks almost identical (down to the choice of utility functions) to the original, bar one fundamental (and conceptual) difference: we substituted first-order beliefs on oneself for second-order beliefs. A Nash equilibrium in this case means that $p=q$, and we obtain three Nash equilibria: a) $p=q=1$, where player 1 is absolutely certain he will act bravely, and he does so with probability 1, b) $p=q=0$, where player 1 does not believe he would act bravely, and he chooses to be timid with probability 1, and c) $p=q=0.5$, where player 1 thinks that it is equally probable for him to be brave or not, which prompts him to choose either action with equal probabilities (for example, by tossing a coin).

Of these equilibria, (b) is best in terms of final utility level: the player would be best off if he acted timidly *and*, at the same time, if he had no doubt that this is indeed what he would actually do. As in the original "bravery game", if the individual of this example has a high opinion of his own courage, he is trapped in a circle where he has to satisfy it, since he would be better off if he thought less of himself and did not act bravely.

In this one-actor version, he just does it for his own sake (in order to feel good about himself), and not for the sake of anyone that might be watching and whose beliefs he would not want to upset. Moreover, q cannot be changed on cue; that is, the individual cannot form "convenient" expectations, for these expectations are already formed, and the individual is naturally unable to convince himself of something he just wants to believe but doesn't really believe it.

The individual might as well try and consciously lower q by telling himself "there's no way I'll do it" (in order to attain 'good' equilibrium (b)), but if deep inside he *really* thinks he has a good chance of pulling off the brave act, this belief shall ultimately cause psychological grief if he does not choose the bold strategy.

4. IMPLICATIONS FOR INDIVIDUAL CHOICE THEORY

The proposed extension of psychological game theory to encompass single-actor scenarios understandably has major implications for individual choice theory. It means that enriching the psychology of homo œconomicus is not always possible via an a priori transformation of their utility function. Rather, the choice problem has to be examined as to the first-order beliefs it possibly prompts, which, in turn may influence preferences in a feedback scheme similar to the one shown in Figure 2.

Now, a single person can "be in a Nash equilibrium" if his/her beliefs on his/her actions are aligned with the corresponding actions. This means that the Nash equilibrium, might as well infiltrate scenarios that feature no interacting parties.

In the case of the amended "bravery game", player 1 did not interact with any other player, and yet, by letting his beliefs influence his preferences, we were able to characterise some of his possible actions and beliefs as being in a Nash equilibrium. This could happen in any case where beliefs on oneself would play a role in affecting someone's preferences. At this point, a few examples would be illustrative.

Example 1: Self-Perception of Honesty

Suppose individual *j* finds someone else's wallet on the street. She may return it or keep it, and nobody will know what of the two happens. According to the standard theory, if *j* is only interested in the money inside the wallet, then she will decide to keep it.

Of course, not all finders are keepers, and the theory acknowledges this by claiming that *j*'s utility from returning the wallet to the authorities might be greater than her utility from keeping it for herself.

While this could probably work fine as a modelling decision, the story may be psychologically more complex, if these utilities depend on what *j* herself thinks of her own honesty. This belief might be crucial in determining action: if *j* believes she is somewhat corrupt, this might make it easier for her to keep the wallet, for the possible guilt afterwards will be less. In a sense, *j* is being watched by herself, and what she believes about herself influences her actions.

Under the standard psychological game theory framework, this would be a possibility only in the presence of somebody else (for example, a friend of *j*'s who would believe that *j* would return the wallet and whose opinion would matter to *j* a lot). A third-party is not necessary in internal game theory, for a partition of the decision maker's self plays exactly that role.

Example 2: Self-Assessment of Academic Merit

The decision on how hard to study for an exam can plausibly be thought to be influenced by the students' perceptions of their abilities or of their chances to pass. Students who are confident enough or have set the bar high are more likely to study rather than devote their time to leisure.

On the other hand, students who don't think too highly of their skills will not suffer the extra psychological cost of having disappointed themselves if they do not spend too much time on studying and perform poorly at an exam as a result.

Example 3: Reacting to Queue-Jumping

Not all people being in a queue will start a fight if someone tries to take their place. Starting a fight is associated with receiving utility from standing up for one's rights, but also with the obvious disutility from "making a scene" and being engaged in an unpleasant situation. These utility levels may be conceived to be influenced by the agent's perception on whether he or she is the kind of person who doesn't tolerate rudeness or who just "lets go".

These examples suggest that overconfident people, or people who "set the bar too high", are more likely to succumb to an action that is bound to confirm these feelings. On the other hand, too much modesty may result in underachieving. These assertions make intuitive sense, and they are consistently confirmed by experimental data; for example, Deaves et al. (2003) run an asset market experiment and show that overconfidence induces additional trading activity. Similarly, Johnson et al. (2006) study experimental war games, claiming that players with "*positive illusions*" (i.e. believing to be better than what they are in reality, hence

overconfident) are more likely to attack. Conversely, athletes with low self-confidence have been observed to perform worse than others who have fewer doubts about their ability (Krane and Williams, 1994).

Naturally, not all instances of individual choice are affected by such considerations. For example, a simple decision whether to take an umbrella or not before leaving one's house would not be affected by such first-order beliefs (unless the individual is somewhat obsessed with his or her ability to predict if it is going to rain or not). In general, first-order beliefs are possible to make a difference when it comes to making decisions that are emotionally charged in that they relate to some feature that the individuals value relatively highly (such as courage in the amended version of the "bravery game", or academic skill in example 2 above).

In all the aforementioned examples (the original "bravery game" included), there is a significant question to be asked. Where do these beliefs (1^{st}-order or 2^{nd}-order) come from? The obvious answer is that they must have been shaped by previous instances of the same (or some similar) game. Player 1 in the original "bravery game" has an idea of what his friends think of him from his previous interactions with them. Or, the individual of the single-actor bravery game knows how (s)he has acted before, and therefore, his/her beliefs have been shaped by choices (s)he made in the past. This means that it is more meaningful to view an "intra-personal game" not as static game, but rather, as an intertemporal one (Patokos, 2013).

CONCLUSION

The main argument of this chapter has been that intrapersonal perceptions might enter an individual's utility function, and as a result, they might determine this individual's actual choices. The rationale behind this assertion is that the intensity with which someone believes that (s)he is able to do something and that (s)he 'has what it takes' to choose a certain action will potentially influence whether the said action will actually be chosen. From the moment that a distinction is made between what one does and what one believes, the tools of psychological game theory are apt for analysing the situation, even if the setting comprises a single individual and, hence, there is no game in the conventional sense.

Even if an assumption for a dual self (something like an "impartial spectator", and regardless of whether or not it truly is impartial) is sufficient for this theory to take off, one need not impose the concept of several selves coexisting in the individual.

As Elster (1986) notes, a person's cognitive coordination problems or motivational conflicts 'do not sort themselves out in an inner arena where several homunculi struggle to get the upper hand'. To be sure, the very meanings of words such as self-knowledge, self-concept or self-consciousness suggest that individuals do observe themselves, pass judgments, hold expectations, and form beliefs on themselves. But while the question of whether this happens within an omniscient, unified self or within a collection of distinct selves that form the individual may be a highly interesting philosophical issue, giving a definite answer is not necessary for analysing "internal games".

The use of game theory in non-gaming contexts permits the characterisation of individuals as being in or not in a Nash equilibrium. Since the very notion of being in a Nash equilibrium involves beliefs being consistent with actual behaviour, it is interesting to notice

the analogies and assert that predicaments such as low self-confidence, self-delusions, or inaccurate self-knowledge are all instances of Nash disequilibria.

Obviously, this frameworks implies that individual choice theory needs to be enriched with elements from psychological game theory, as an attempt to also make it apply to economic actors whose beliefs might not be aligned with their actions, thus making it more realistic as a theoretical framework.

REFERENCES

Deaves, R., Lueders, E. and G. Y. Luo (2003), "An experimental test of the impact of overconfidence and gender on trading activity", AFA 2005 Philadelphia Meetings; EFMA 2004 Basel Meetings Paper, available at: http://ssrn.com/abstract=497284.

Falk, A., Huffman, D. and U. Sunde (2006), "The relevance and implications of imperfect self-knowledge for search", mimeo, IZA, Bonn.

Elster, J. (1986), *The Multiple Self* (ed.), Cambridge: Cambridge University Press.

Geanakoplos, J., Pearce, D. and E. Stacchetti (1989), "Psychological games and sequential rationality", *Games and Economic Behavior* 1: 60-79.

Johnson, D., McDermott, R., Barrett, E., Cowden, J., Wrangham, R., McIntyre, M. and S. P. Rosen (2006), "Overconfidence in wargames: experimental evidence on expectations, aggression, gender and testosterone", *Proceedings of the Royal Society B: Biological Sciences* 273: 2513-20.

Krane, V. and J. Williams (1994), "Cognitive anxiety, somatic anxiety, and confidence in track and field athletes: the impact of gender, competitive level and task characteristics", *International Journal of Sport Psychology* 25: 203-17.

Patokos, T. (2011), "The relevance of Nash equilibrium to psychiatric disorders", *Theoretical Medicine and Bioethics* 32: 245-58.

Patokos, T. (2013) (forthcoming), *Internal Game Theory*, Routledge, Taylor and Francis group.

Rabin, M. (1993), "Incorporating fairness into game theory and economics", *American Economic Review* 83: 1281-302.

Sen, A. (1967), "Isolation, assurance and the social rate of discount", *The Quarterly Journal of Economics*: 81(1): 112-24.

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Chapter 2

EMOTIONAL GAMING

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ABSTRACT

In recent years, research on the psychology of gaming has examined the negative and positive outcomes of playing video games. Thus far, a variety of affective phenomena have been investigated. In this chapter we will continue this exploration by examining the emotions elicited by the act of playing video games.

Because the study of emotions must rely on different type of methods, including subjective self-reports (e.g., description of feelings), neuropsychophysiological measurements (e.g. electromyography, skin conductance, heart rate, event-related potentials, functional magnetic resonance imaging), biological markers (e.g. cortisol, testosterone) and behaviours (e.g., facial expressions), we will cover all these distinct methods. We will explore how dimensional and categorical models of emotions have been used to identify the emotional responses of players, including their enjoyment experience. Expanding upon past research findings we will also discuss the social implications of gaming and suggest areas for future research.

INTRODUCTION

The long tradition of more than 40 years dedicated to research about media entertainment has produced a vast body of empirical studies on the positive and negative effects of exposure to different forms and contents of entertainment.

Video games, in particular, are nowadays one of the most popular forms of mass entertainment, and as such have become an object of study both from within the field of

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psychology and that of the affective computing sciences. Within psychology, research has focused on understanding the psychological processes that accompany the experience of playing, including emotions and motivations; and the positive and negative effects that these have on intra and interpersonal outcomes, including cognitive, emotional, and behavioural outcomes. The affective computer sciences meanwhile have targeted their focus on understanding how emotions can be captured, induced and integrated into the gaming experience.

Experiencing emotions tends to be one of the primary motivations for playing videogames [Ravaja, Salminen, Holopainen, Saari, and Laarni, 2004], and Freeman [2003] has stated that the evolution of computer games will be based more upon their capacity to provoke emotional experiences than on technological developments. It is therefore significantly important to understand the role of emotions in gaming.

In this chapter we intend to contribute to a systematization of how emotions have been studied in gaming, both by describing how different components of emotions have been studied and integrated, and by reviewing the emotional consequences of playing with special attention given to the role of game content on both intra and interpersonal levels.

WHAT IS EMOTION AND HOW CAN IT BE MEASURED?

Before considering any other aspect of the topic, it is first necessary to conduct a brief overview of what emotions are and how they have been evaluated. This enables us both to have a better understanding of how they can be measured and quantified.

Conceptualising emotion has always been a notoriously difficult task. In fact, when lay people are asked to define what it is, many reply saying they have an idea, but cannot give a precise definition of it [Fehr and Russell, 1984]. A variety of *possible suggestions* have been offered by theorists and researchers. Nevertheless, there is still a lack of consensus on the definition of emotion. Even recently, Frijda and Scherer [2009] stated that this term "may be one of the fuzziest concepts in all of the sciences" (p. 142). In spite of this, the need for a consensual definition has been emphasized by many authors. Kleinginna and Kleinginna [1981], for example, proposed the following definition based upon a review of 92 definitions taken from a variety of sources: "Emotion is a complex set of interactions among subjective and objective factors, mediated by neural/hormonal systems, which can:

a) Give rise to affective experiences such as feelings of arousal, pleasure/displeasure;
b) Generate cognitive processes such as perceptually relevant effects, appraisal labeling processes;
c) Activate widespread physiological adjustments to the arousing conditions; and
d) Lead to behavior that is often, but not always, expressive, goal-oriented and adaptive" (p. 355).

This definition, like many others, asserts that emotions are goal-oriented and have a functional value, in the sense that they are useful at both intra- and interpersonal levels, by affecting the individual's perception, attention, thoughts, feelings, neurophysiological reactions, and motivating action (preparing the individual for actions) in an adaptive and

effective way. Applying this functional view to video games, Tan [2008] has developed a theoretical framework which considers entertainment as an adaptive activity, involving both elementary functions such as fight or flight, social communication and other cognitive skills while experimenting with and experiencing the outcomes during gaming.

He has also outlined the role that pretense play may have in organizing these adaptive functions. An involvement in scenarios and activities of relevance to the individual allows players to experience, explore and plan several potential alternatives, encounter solutions and learn from outcomes while involved in virtual situations.

Another common thread amongst definitions of emotions is the assumption that several distinct components need to be considered when measuring the emotional response. In fact many contemporary researchers and theorists agree that emotion has a clear relation to bodily physiology, feelings and appraisals, behavioural expressions and action tendencies. Bradley and Lang [2007] have aggregated these components into a 3-system measurement, which includes:

1) Evaluative reports;
2) Physiological responses; and
3) Expressive displays and overt behaviour.

The first system relies predominantly on *judgments and subjective reports of emotions*, such as the use of adjective checklist, rating scales, questionnaires, or free description of affective experience.

The second common group of measurements involves *neurophysiological responses*. Of the physiological responses, research tends to examine heart rate, respiration, skin conductance (SC), muscle activity, and blood pressure. Neurological and biochemical responses are also commonly explored. Psychophysiology by definition investigates the relationship between psychological events and the resulting physiological activity and behaviour [Cacioppo, Tassinary and Berntson, 2007]. Many changes in physiological responses can be attributed to the human organism's attempt to identify and respond to new and relevant stimuli. These systems do not operate in isolation, but interact with higher regions of the brain [Lang, 1995], and in the last decades there has been a growing enthusiasm for the study of emotions through the use of neuroscience techniques. These techniques have been of a varied and extensive nature, but the most frequently utilized has been the continuous electroencephalogram (EEG) which extracts Event-Related Potentials (ERPs). ERPs enable researchers to assess the time course of brain's electrical activity within milliseconds. It has the advantage of a higher temporal resolution compared with many other neuroimaging techniques. The most studied ERP associated with emotions is the P3, which is a late positive potential (LPP) that peaks around 300 milliseconds after the onset of stimuli that are relevant for the individual. Many recent studies in affective picture processing have demonstrated that latency and amplitude of LPP (i.e., usually 300–1000 ms) are sensitive to affective relevant stimuli. This could be related to an allocation of attentional resources to stimuli with significant motivational value for the individual [Bradley and Lang., 2007; Cacioppo, 1994]. However, ERPs have poor spatial resolution and do not allow a robust identification of exactly which of the brain's neural generators are associated with the processing of stimuli. In contrast, functional Magnetic Resonance Imaging (fMRI) offers a higher spatial resolution, and as such it has been frequently used to identify those areas of the

brain that become more or less activated according to variations in blood flow. However, the time resolution of fMRI is weaker, because the peak of blood flow response is slower (between 6-9 seconds after the onset of stimulus) [Harmon-Jones and Harmon-Jones, 2011]. Brain connectivity and source localization methods like sLoreta [Pascual-Marqui, 2002] may identify the cortical or sub-cortical source generators of the electric activity registered in the scalp, but to our knowledge no study of video games has so far utilized these methods, which in our view could add valuable information as to which cortical areas are triggered by relevant stimulus.

Bateman and Nacke [2010] have also reviewed existing neurobiological research literature and offered several perspectives on the neural responses associated with gaming activity. Their foremost suggestions refer to several key brain structures that might be related to both cognitive and emotional experience whilst playing games. These include the nucleus accumbens and the orbitofrontal cortex, due to their close associations with the neurotransmitter dopamine, which, in turn, is related to reward-seeking behaviours, pleasure and interest; the amygdala and the neurotransmitters epinephrine and norepinephrine, which usually relate to excitement and are active during the fight and flight response; and the release of the corticosteroid hormone cortisol, which is often considered an index of stress response. Since games can involve competitive elements, the release of testosterone can occur due to its relationship with dominance behaviours in competitive situations [Gonzalez-Bono, Salvador, Ricarte, Serrano and Arnedo, 2000; van der Meij, Buunk, Almela and Salvador, 2010]. In contrast, the hormone oxytocin has been consistently associated with prosocial behaviours and also with the facilitation of negative social emotions [Kemp and Guastella, 2011]. Arguably, therefore, it would also be pertinent to study their release during games that mimic social interaction, as a means of studying both social emotions and approach and withdrawal behaviours in competitive and cooperative games.

With regards to the third system – *overt actions* – the most common way to infer emotions is to measure different forms of what we can consider 'overtly' expressive behaviour. Such behavior includes facial expressions, gestures, vocalizations, and postures. Other less common actions can also be assessed, such as fighting, freezing, running and jumping. These behaviors are often surveyed through objective observational analysis. For example, Lazzaro [2004] evaluated emotions during gameplay amongst hard-core gamers, casual gamers, and non-players by video-recording their verbal and non-verbal emotional cues during play. Such cues included body language, facial expressions, verbal comments, and self-report responses on a questionnaire.

The multiplicity of components reflects the complexity of emotional responses. Nevertheless it is important to consider several indicators, as each system plays different adaptive roles that, in conjunction, may prepare the organism for action. Many researchers also expound upon the difficulties of relying on a study of any single component, in light of the inconsistent relationship usually found both between and within components.

CLASSIFICATION OF EMOTIONS: DIMENSIONAL AND CATEGORICAL APPROACHES

Many theoretical models have been put forward in an attempt to classify emotions. Of these, we will briefly consider the value of dimensional and categorical models.

The identification of the emotional structure is the main goal of the *dimensional model*. Of all the dimensional models, we will pay special attention to the circumplex model, on the basis it has made the most significant contribution towards empirical research in the area of emotions and entertainment [e.g., Ravaja, Saari, Salminen, Laarni, and Kallinen, 2006]. Originally proposed by Russell [1980], this model asserts that the structure of emotions is based on two linear independent dimensions: valence and arousal. Valence corresponds to the hedonic dimension of emotion (from negative to positive pleasantness) and several authors have argued it bears a clear relation to the motivational parameter of direction, such as approach or avoidance. The arousal dimension is linked with degrees of emotional intensity [Bradley and Lang, 2007]. Although the arousal dimension has been extensively used to assess the entertainment appeal of games, it is also valuable when considering the hedonic component of emotion. In our opinion, in order to incite people to play video games, motivation and emotions must be key factors.

Several physiological and neural systems are associated with these two motivational parameters of emotion. For example, skin conductance (SC), i.e., an increase in sweat gland activity, which results from activity in the peripheral nervous system, is considered a good index of augmented sympathetic arousal. Several studies in affective processing of visual images have also found that pupil dilation and the amplitude of the LPP correlate both with self-reports of arousal and electrodermal response amplitude. Facial EMG activity is related to the hedonic valence dimension. More specifically, the zygomaticus major and orbicularis oculi muscle regions are together often indexes of positive valence, and the corrugator supercilii muscle is frequently used as an index of negative valence [Bradley and Lang, 2007].

We also believe that this biphasic organization of emotions is especially useful for understanding several aspects of game playing. For example, it can be relevant to capture the continuous changes in emotional responses that may occur during the gameplay experience, and also to analyse the effects of play on emotional responsiveness to stimuli in the real world and their linkage to interpersonal responses.

Aside from the biphasic organization of emotions, we should also consider *categorical models*, which can help us understand and capture the specific emotions that manifest during game activity. Used in conjunction, dimensional and categorical approaches are complementary and should be viewed as different hierarchical levels of emotional systems [Hamm, Shupp and Weike, 2003]. With regards to categorical models, several researchers have emphasize the existence of a limited number of specific discrete emotions, including sadness, fear, disgust, anger, and surprise [e.g., Ekman, 1992], while others have proposed more candidates, such as pride, shame, guilt, envy, embarrassment, interest, hope, or frustration [e.g., Keltner and Buswell, 1997; Silvia, 2008]. Some authors have made a conceptual distinction between basic and other secondary emotions. Frijda [1986], for example, has theorized that basic emotions should be distinguishable from one another both as a result of their social-communicative and their behavioral functions. Secondary emotions

may be comprised of blends or composites of basic emotions or other tendencies. Although it is beyond the scope of this chapter to address this controversial distinction [for a review of this topic see Ortony and Turner, 1990; Panksepp, 1992] a consideration of discrete emotions offers us a valuable insight into the subject of emotional reactions during game play.

EMOTION-RELATED RESPONSES TO VIDEO GAME EVENTS

Many studies have combined an analysis of self-report, neurophysiological activity and behavioural expressions while studying emotions during game activity. Some studies have considered only the physiological tonic measures, or rather, the mean of physiological response during a certain period of time, to compute the overall emotional response. However, examining the different emotional components and the phasic physiological responses to specific video game events can be especially useful, as there is typically a dynamic flow of events and actions during games that resemble the real world. In this vein, many neurophysiological devices and methods, as well as the examination of expressive behaviors could represent valuable tools for recording responses to phasic, rapid and instantaneous events during gaming [Ravaja, Turpeinen, Saari, Puttonen and Keltikangas-Jarvinen, 2008].

We will review the literature that has looked into these different emotional components by considering the dimensional and/or the categorical models of emotions. Poels, van den Hoogen, Ijsselsteijn and de Kort [2012], for example, have differentiated the role of emotional arousal and valence dimensions during initial game-play in predicting game preferences and player behaviour at later stages, both in the short and long-term. The authors also considered both subjective reports and physiological responses of these dimensions. SC was used as an indicator of arousal, whilst zygomaticus and corrugator EMG were used as indexes of displeasure and pleasure. They found that the hedonic dimension of pleasure was a predictor of short-term game preference and playing time, whereas arousal was most predictive of long-term game preferences.

Lazzaro [2004] has also contributed by identifying several specific emotional responses based on self-reported experiences and on the video recordings of verbal and non-verbal emotional cues exhibited during play. Some emotions were specific to the individual experience, such as frustration, fear, surprise, curiosity, disgust, relaxation, absorption and feelings of achievement. Other emotions meanwhile were associated with membership of a social group and related to bonding, social recognition and pride, along with a sense of delight at others' misfortune during competitive interactions.

van Reekum et al. [2004] have also evaluated eight discrete emotions (surprise, anger, shame, pride, interest, joy, tenseness, and helplessness) and their intensity using self-report methods. They also analyzed physiological responses, such as SCL, cardiovascular activity, finger temperature, and muscle activity during game play experiences, in which goal conduciveness and intrinsic pleasantness were manipulated. The two conditions of goal conduciveness were passing to the next level after successfully completing the previous one (conducive events) and hitting an obstacle or being shot by the enemy (obstructive events). To manipulate intrinsic pleasantness, the authors used a pleasant or an unpleasant sound that was displayed in both conduciveness conditions. For the intrinsic pleasantness manipulation,

only skin conductance was affected; however, they did find that higher joy and pride were affected by conducive events. In contrast, high anger, surprise and tenseness were reported in obstructive situations. With regards to physiological responses, the magnitude of SCR was higher after obstructive conditions, while finger temperature was more sensitive to conducive events. In the conducive events, there was also a faster HR immediately before players passed to the next level and a slower HR after the event; results that were interpreted as an anticipatory response.

Mandryk and Atkins'study [2007] is also noteworthy. They have developed a novel method for continuously modeling emotion using physiological data. Their analysis takes into account both the dimensional and the discrete categorical models. Firstly, they computed arousal and valence values from the normalized physiological signals of SC, HR, and zygomatic and corrugator muscle regions. SC and HR were used to measure arousal, and zygomatic, corrugator and HR were used to generate valence. Then, arousal and valence values were used to calculate specific emotions of boredom, challenge, excitement, frustration, and fun. Subjective measures of emotions were also analyzed. The authors view this method as able to provide valuable physiological indexes of players' emotions, which could also be worthwhile when assessing user experiences of other entertainment technologies.

Weber, Behr, Tamborini, Ritterfeld and Mathiak [2009] have also analyzed event-related content of playing sessions, as well some physiological indicators of arousal (HR and SC) during play. They found that changes in physiological responses throughout the game took place at specific times, particularly in situations of imminent danger to the game character. According to the authors, the level of arousal during gameplay is a function of uncertainty and perceived levels of control over a situation. In situations where the location of the enemy is unknown, the level of perceived control diminishes and arousal increases; however, when the location of the opponents is known but the potential threat from them is not, perceived control increases and arousal decreases. To some extent these findings suggest that physiological arousal increases in order to deal more effectively with threats, and therefore it could be associated with activation of the defense system [Lang and Bradley, 2010]. With regards to neural responses, Ivanitsky, Kurnitskaya, and Sobotka [1986] have found differences in the topographic distribution of four ERPs (P300, N600, P800, and N1000) in two different circumstances, those of winning and losing during a video tennis game. In the author's opinion winning the ball is causative of positive emotional reactions and losing of negative ones. According to their findings an increase of N600 in the left posterior associative cortex occurred when the participant won and a decrease of P800 in the right frontal area occurred when the ball was lost, suggesting that positive and negative emotions are associated with *specific spatiotemporal* patterns of *cortical* activity. However, as already mentioned, the ERP have low spatial resolution. In order to gain a better understanding of neuronal activity, some authors have used fMRI. Cole, Yoo, and Knutson's study [2012] is one such recent example. These authors analysed the brain activity inferred indirectly from blood flow during the onset, the offset and the interactive gameplay of a serious video game. The overall results revealed an activation of the reward-related mesolimbic neural circuits, which, in turn, again suggests the involvement of motivational processes during gameplay. These results are also consistent with other studies that have found dopamine release whilst gaming [Koepp et al., 1998]. Through the recording of phasic psychophysiological responses of emotional valence (zygomatic and orbicularis oculi muscle activities for positive emotions and corrugator

muscle activity for negative emotion) and arousal (SCL and cardiac interbeat interval), Ravaja and colleagues [2006] were also able to identify which specific events during the game elicited positive emotions. As expected, positive emotions occurred in rewarding events, such as when the game character reached the goals, or earned points for example. Being very sucessful in specific ocasions also triggered high arousal. However, a especially interesting finding was that some negative game events caused both positive emotions and arousal, which may suggest that players have the capacity to experience positive feelings despite being confronted with negative but challenging situations. Nevertheless, replaying a negative event on subsequent occasions was related to negative affect. Overall, these results indicate that being confronted with both negative and positive events during games can be perceived emotionally as positive. This raises several questions, that we will address in greater detail later. One of these relates to the player's overall experience of enjoyment and the paradoxical view that negative experiences in media entertainement are often regarded as a significantly positive experience. Another question considers the effects that engaging in violent games may have at both individual and interpersonal levels.

ENJOYMENT IN GAMING

One important line of research for the understanding of emotions in gaming is that of personal evaluations made by players after experiencing specific emotions over the course of the game play time. Several authors have developed the concept of meta-emotion in order to explain how experiencing intense, negative emotions (anger, fear, or sadness) can sometimes be felt as a rewarding experience, thereby contributing to an overall experience of enjoyment [e.g., Bartsch, Vorderer, Mangold and Viehoff, 2008; Jäger and Bartsch, 2006; Olivier, 1993].

Meta-emotion has been explained both in terms of affective reactions toward one's own emotions [e.g., Gottman, Katz and Hooven, 1997; Jäger and Bartsch, 2006] and of meta-level mental processes, including emotional self-awareness, normative evaluation of emotions and emotion regulation [e.g., Mayer and Stevens, 1994]. However, the complexities of meta-emotion and their consequences have not yet been integrated into an overarching conceptual framework within the field of videogame research.

According to some authors, enjoyment, considered as a positive meta-emotion, is at the heart of the entertainment experience [Tan, 2008; Vorderer et al. 2004]. The concept of enjoyment has been used to describe and explain positive emotional reactions toward videogames and its contents [Klimmt, Schmid and Orthmann, 2009; Vorderer, Hartmann and Klimmt, 2003], and it is considered a complex construct that also involves physiological, affective and cognitive dimensions [Vorderer et al., 2004].

Several factors are associated with the experience of enjoyment; some relate to individual differences, while others relate to specific game features. Research in this area is vast and by consequence, limitations of space prevent us from reviewing this topic in full. Instead we will focus on some emotional experiences and game features that are specifically associated with enjoyment and motivations for playing.

Ryan, Rygby and Przybylski [2006; 2009; 2010] have applied self-determination theory to a study of intrinsic motivational factors that are relevant to game enjoyment. They evaluated the motivational role of autonomy, competence and relatedness and found that all

three made an independent contribution to game enjoyment, but also to immersion and estimations of future engagement [Ryan, Rigby, and Przybylski, 2006]. Relatedness and satisfaction were also correlated with positive well-being outcomes, but only autonomy and competence contributed to an increase in player's positive affect following play. Playing games to address a need for competence is consistent with theories of flow which considers challenge as an important element of game enjoyment [Ravaja et al., 2006; Vorderer et al., 2003].

In fact, people may seek games that stimulate optimal emotional responses or response patterns such as flow experiences [Sherry, 2004]. A flow state occurs when an individual is deeply involved in something that is perceived as intrinsically motivating and depends on a successful balance between the perceived level of the challenge and the skills of the person. Empirical research regarding flow states in videogames has shown that reports of flow experiences predicted such factors as engagement in the game [Wood, Griffiths, Chappell and Davies, 2004], an interest in continued playing [Choi and Kim, 2004], and the perceived skills that are challenged by a given task [Keller and Bless, 2008]. Flow experience is therefore a valuable component of videogame entertainment.

Many studies have used self-report scales to measure the experience of flow, but there are also some recent studies that have used neurophysiological indexes to capture this experience. In a recent study, Klasen, Weber, Kircher, Mathiak, and Mathiak [2012] analysed fMRI data during game play and related them to several components of game activity that might correspond to the experience of flow, such as engaging in activity which balanced using existing skills and facing some challenges, concentration/ focus; clear goals; control over the activity; and immediate feedback about the progress that the individual makes. They found specific brain activation patterns for these components, and highlighted the activation of the reward-related dopaminergic *midbrain* structures as well as other cognitive and sensorimotor networks. These results also make a strong case for the view that playing games involves a flow experience which is associated with appetitive motivational states.

Another relevant game feature associated with enjoyment experience is that of competition. According to Vorderer and colleagues [2003], playing video games is expected to be enjoyable only if there are sufficient numbers of competitive situations in which the player can potentially arrive at success. In the author´s view, the experience of success may lead to an intensive positive affect, which in turn may increase motivation to continue playing. In contrast, a dissatisfactory outcome may elicit adverse emotions (e.g., anger, frustration) and yet potentially motivate players to continue playing, on the basis that it encourages them to try and solve the problems at hand.

Social competition also seems to be a key factor in enjoyment and can play a valuable social adaptive role. Social comparisons can be associated with specific emotional states, such as stress and frustration, but also joy that varies according to a player's perceived status during the game. During this process self-esteem can also be affected. The concept of social value orientation might be relevant in terms of explaining these emotional reactions, such as competitive orientation (i.e., the general tendency to maximize the individuals' own benefits in comparison with the benefits obtained by others), individualistic orientation (i.e., general tendency to maximize one's own benefits) or cooperative orientation (i.e., to care both for one's own as well as that of others).

Identification with a game character has been also suggested as a determinant of video game enjoyment [Hefner, Klimmt and Vorderer, 2007; Klimmt, Hefner and Vorderer, 2009].

Identification has been described as the illusion of becoming the character within the game's universe, and the notion of wishful identification (a desire to emulate the character) has been suggested as one reason why violent, strong, and hyper-masculine characters are particularly attractive to adolescent males [e.g., Konijn, Bijvank and Bushman, 2007]. Alongside this, it is important that the character is able to accomplish the missions attached to their role [Przybylski, Rigby and Ryan, 2010].

Another factor that has contributed to the far-reaching theoretical frameworks on enjoyment and game preferences is the role of fantasy, curiosity and personality traits [e.g., Johnson and Gardner, 2010; Seger and Potts, 2012; Witt, Massman and Jackson, 2011]. Witt and colleagues [2011], for example, have analyzed whether the descriptive model of *big five* factors of personality could be useful to *predict* videogame playing. They found that only openness to experience predicted high gaming time. Bartsch, Appel and Storch [2010] studied the role of the need for affect as an important predictor of the experience of emotions and meta-emotions in response to drama or horror films. High need for affect, defined as an individual's tendency to be motivated to approach emotionally events, was related both with a strong intensity of negative and ambivalent emotions, and a higher positive evaluation of their experiences in terms of meta-emotion enjoyment. In our view, it would be interesting to further test the role that this emotional trait may play on emotional playing motivations and enjoyment. In addition, other components of emotions, such as physiological and behavioral measures should be included, so as to offer stronger conclusions about the emotions that were experienced and the relevance of this affective trait on specific emotions and meta-emotion experiences.

As has already been mentioned, many emotions are evoked during the process of playing video games. Some of these are intense and positive, while others are negative. At the end of the game, many players may look back and judge the experience as an enjoyable and rewarding activity.

So far we have explored how distinct components of emotions can be used to measure their occurrence during game activity. We have also surveyed some of the game features and differences unique to the player that can increase enjoyment. We should not end this chapter however without also considering the content element of games, and examining the way exposure to this can affect a player both on an inter- and intrapersonal level.

VIDEO GAME CONTENT: EMOTIONAL EFFECTS AND INTERPERSONAL OUTCOMES

Heavily drawn on social-cognitive and social-learning theories, the General Learning Model (GLM) has recently been used to explain both the short and long term effects of playing videogames on cognition, affect, arousal, empathy, emotional desensitization, and interpersonal behaviour. In this way, it provides a conceptual framework for understanding the learning and the developmental processes involved in shaping behaviour [Buckley and Anderson, 2006; Gentile et al., 2009]. Several experimental studies, conducted in both Eastern and Western contexts, have consistently demonstrated the short term effects of playing violent games. These have been found to prime aggressive cognitions, trigger hostile/angry feelings, increase physiological arousal, promote highly aggressive behaviour,

and reduce prosocial behaviour [for meta-analyses, see Anderson, 2004; Anderson and Bushman, 2001; Anderson et al., 2010]. Many nonviolent games also increase arousal and negative affect, such as anger and hostility, frustration, and anxiety [e.g., Arriaga, Esteves, Carneiro and Monteiro, 2006; Anderson and Ford, 1986]. However, in violent games these negative emotions can contribute indirectly to increase the likelihood of aggression. In addition, violent games also prime aggressive thought and other negative social consequences have been found such as a reduction on prosocial behaviours. Moreover, in the long-term, repeatedly playing violent games has been found to contribute to an emotional desensitization towards real-life violence, compounded with a reduced empathy for its victims [Anderson et al., 2010]. The core idea therefore is that an automatic aversive response tends to occur when people are initially confronted with violence. Continued and repeated exposure to it however may attenuate or reduce these responses. This phenomenon is usually defined as emotional desensitization [Arriaga, Gaspar and Esteves, 2011].

The majority of studies in this area have used physiological indexes of arousal to examine the desensitization effect. Carnagey, Anderson and Bushman [2007] have shown that playing a violent video game can cause people to become less physiologically aroused by real-life violence. In their study, participants who played violent games had lower HR and SC when later shown a 10-min videotape depicting authentic scenes of violence, than with those who had previously played nonviolent games. Bartholow, Bushman and Sestir [2006] meanwhile investigated whether repeated long-term exposure to violence would lead to lower emotional responsiveness to real violence, using ERPs as a physiological index of emotional desensitization, due to their association with the activation of the aversive motivational system. P300 evoked potential was recorded when neutral, violent, and negative nonviolent images were presented. A lower amplitude and increased P300 latency occurred amongst heavy players of violent video games compared to with the level elicited by the nonviolent game players. These differences were only evident when violent images were presented but not when subjects were exposed to other negative yet nonviolent images. This therefore suggests that the act of playing games with specifically violent content has a direct impact on emotional desensitization to violence. In the author's perspective, this result may indicate a "relaxation of avoidant motivational processes specifically associated with violence" (p. 538).

Engelhardt and colleagues [2011] used a similar paradigm to test acute desensitization following violent or a nonviolent video game play. P300 amplitude was again used as an index of emotional desensitization. They found that P300 amplitude elicited by violent images was reduced in individuals exposed to violent video games for short, acute periods of time, but not in individuals with high, chronic exposure. This suggests that short exposure may be insufficient in terms of causing changes in neural responses, as individuals with high chronic exposure could already be emotionally desensitized to violence.

Arriaga, Monteiro and Esteves [2011] have contributed to an understanding of desensitization to real-life violence by looking at both the arousal levels and emotional valence. Psychophysiological measures of arousal (SCR) and self-reported arousal and valence were used to measure emotional desensitization towards real-life affective stimuli which included images with violent, positive and neutral content. Their results indicated that playing a violent game contributed to a reduction both in feelings of displeasure towards violent stimuli and of pleasure towards pleasant stimuli, suggesting that the emotional desensitization effect was not specifically to violent content. In this vein they suggested that playing videogames may affect both motivational systems of avoidance and approach in such

a way that it could reduce both the natural avoidance of violent emotional stimuli but also the approach to positively affective events. In the long-term, therefore, this could develop as emotional numbness. Before decisive conclusions can be reached on this particular subject,a further longitudinal study is necessary. In addition to this, the authors also found that for participants with higher videogame habits, this affective attenuation mediated the effect of playing the violent game on aggression, providing further evidence of the negative effects that violent gaming may have at the interpersonal level.

Weber, Ritterfeld and Mathiak [2006] conducted a study of the association between playing violent video games and neural activity by collecting fMRI data of experienced game players during a violent game play. Based on previous studies that suggested the involvement of the orbital frontal cortex, the anterior cingulated cortex (ACC), and the amygdala in emotions, the authors have analysed the role of ACC (part of the medial frontal cortex) in particular, because it seems to be involved in both cognitive and affective processing. Both the activity of the dorsal ACC (dACC) and the rostral ACC (rACC) were analysed, given their distinct association to cognitive and emotional processing respectively. In addition, the activity variation in the dACC, in combination with a reduced activation of the rACC and reduced activity in the amygdala seems to be associated with aggression. In order to test whether involvement in virtual game violence causes distinct neural patterns, the authors developed a within-subject design in which these neural activity patterns were matched to specific game events on a frame-by-frame analyses, by coding nonviolent and violent events into several distinct actions, such as no interaction, safe interaction, imminent danger, under attack, and fighting and killing. In line with their predictions that were based on the association between these structures and aggression, the authors found there to be decreased activity in the affective areas, such as the rACC and the amygdala, and increased activity in the cognitive dACC area. Having said this, several other arguments were advanced to explain this pattern of activation and deactivation during violent actions, amongst which was the possibility that empathy is suppressed when aggressiveness is activated. These results are significant, because they suggest the long-term impacts for experienced game players with this type of game content and the consequent neural patterns that could be associated with a suppression of affective information processing.

Future studies in this line of research would be crucially valuable for understanding the neural brain structures associated with video gaming and the negative effect that violent content in particular could have in the long-term.

In conclusion, research conducted until now has clearly shown that videogame content does matter. Specifically, playing games which portray scenes of violence can have a detrimental effect on emotions (increasing negative affect but also reducing emotions towards others) affective processing, cognitions, and finally, interpersonal relations.

CONCLUSION AND FUTURE DIRECTIONS

Throughout this chapter we have looked at how emotions are experienced and can be measured during gameplay activity; the paradoxical enjoyment of experiencing negative emotions during play; the game features and individual differences that are associated with enjoyment; and the important role of game content on intra and interpersonal outcomes. In

particular, we have focused on the short-term effects of playing violent games on anger states, aggressive thoughts and aggressive behavior, and on the problem of desensitization, reduced emotional empathy and suppression of affective information processing.

As advocated by many researchers, emotions, like many other basic processes, are embodied phenomena [Cacioppo, Tassinary and Bertson, 2007], and in any attempt to measure them we should take into account their different components, and analysing the way they interact and contribute towards capturing emotions during play. For example, several limitations have been identified when relying solely on evaluative reports of emotions. These include the (a) difficulties that some individuals face in recognizing, describing or remembering their emotions; (b) the *social desirability bias* that may exist in self-reports and interviews; and (c) the dilemma researchers have of choosing the precise words to include in a survey, while attempting to measure affective feelings, associated with the inherently imperfect relationship between language and its capacity to accurately describe emotion [Sloboda and Juslin, 2001].

Physiological and neurological responses meanwhile are continuous and involuntary, thereby reducing the subjectivity of self-reports and some of the bias in researchers' interpretations of responses. Despite the clear potential of physiological, neurological, biochemical, and behavioural expressions as objective evidence of emotions, several concerns have also been raised. Many authors emphasize that to be considered a valid indicator of affective experience, biological and physical responses should match the subjective experience of individuals. However, research has suggested several difficulties in finding a robust relationship with the experience of emotion by the individual and physical indicators of emotion [Vul, Harris, Winkielman and Pashler, 2009]. Researchers attempting to capture players' emotional responses while gaming have reported difficulties in matching the physiological data to the player's subjective emotional experience [Boyle, Connolly, Hainey and Boyle, 2012]. It is possible, for example, that a player might be emotionally aroused for varying reasons and these may or may not be related to the game itself [Ravaja et al., 2006]. Each physiological system also fulfils several functions within the organism independent of their relation to emotions. The often described 'many-to-one' relationship between psychological processing and physiological response [Cacioppo et al., 2007] allows for physiological measures to be linked to a variety of psychological processes besides emotions (e.g., perception, attention, thoughts). Therefore we should keep in mind that physiological responses are not direct indexes of well-characterized feelings. Also relevant are the research findings indicating that many emotional processes can also occur without an individual's awareness, suggesting that an implicit processing may also take place [Berridge and Winkielman, 2003]. Consequently it is unsurprising that in several circumstances there is no clear relationship between neural and physiological responses and the experience of emotion. Furthermore, it is also possible that some physiological activity can occur for instrumental reasons, such as the way faking an emotion's expression can activate some major facial muscles. For example, the zygomaticus major muscle is often activated when an individual is smiling, but the individual may express a fake smile for numerous reasons, and therefore it is not accurate to conclude that the simple existence of a physiological indicator denotes the underlying existence of an emotion [Bradley and Lang, 2007].

Modern neuroscience approaches to emotion have also found that there is no single region of the brain reserved for emotion as many distinct emotional processes have distinct brain circuitry [Davidson and Scherer, and Goldmith, 2003]. In addition to this, most

physiological and neurological measures rely on specific changes that are affected by many other factors. For example, fMRI techniques rely on blood blow changes in brain areas that might be involved in neural activity, but many factors (e.g., oxygen consumption, blood volume) also influence the results of fMRI, besides neural activity [Harmon-Jones and Harmon-Jones, 2012]. Cardiac activity is also innervated by both the sympathetic and parasympathetic nervous system and therefore phasic and tonic responses of HR could be related to different emotional processes; in many studies phasic HR is used to assess valence [Mandryk and Atkins, 2007], while tonic HR is often used to measure arousal [Arriaga, Esteves, Carneiro and Monteiro, 2008]. Nevertheless, several other processes, such as attention, also tend to be associated to HR responses. For example, a decrease in HR tends to be associated with the beginning and termination of attentional engagement to stimuli events [Andreassi, 2000]. Consequently, some caution should always be made when considering each system response as evidence of emotional processes, and concurrent measures of these three systems can be valuable for the study of emotions in gaming in a more dynamic and integrated way. It is therefore important to continue examining the phasic emotional responses of relevant events during the game activity, as well as their relation to motivational systems and meta-emotions.

Another interesting venue is the work that has been developed in the field of human–computer interaction (HCI) research in a new area of investigation that was recently called "affective gaming" [Liu, Agrawal, Sarkar, and Chen, 2009]. Scholars working in this field have developed models for continuously modeling emotion during virtual interaction with technologies to accommodate individual player's characteristics [Mandryk and Atkins, 2007]. By studying the dynamic difficulty adjustment (DDA) mechanisms to tailor game-playing experiences automatically to the individual characteristics, Liu and colleagues [2009] developed an affect-base DDA model for video games that was capable of recognizing physiological responses of anxiety in each player. In their study, several physiological responses (cardiovascular activity, electrodermal activity – both tonic and phasic responses - and EMG activity) were analyzed so as to measure anxiety, while participants were playing a video game. The level of difficulty was changed in accordance with the levels of anxiety that were being recorded. Their results suggested that gaming experience was enhanced when the game was capable of recognizing player's affective states and adjust the game difficulty levels accordingly. The majority of participants reported feeling firmly satisfied and perceived the affect-based DDA as more challenging than a performance-based DDA. Modelling affective states during video games is at an early stage, but we expect this to be a rich area of research in the coming years.

The rapid *development* in computer *technology* can bring more realism and sense of presence to virtual environment games, and so special concern must be attached to the game content in which players engage. In this chapter we have reviewed the negative consequences of playing with violent games, but we are also keen to emphasize that playing prosocial games can have the opposite effect by increasing pro-social behavioural tendencies, as several recent studies have shown [Gentile et al., 2009]. Because content really does matter and interferes with our emotional experience in both virtual and real environments as well our interpersonal relationships, we should *envision the development of challenging and enjoyable games that can bring valuable and healthy* benefits for all players.

REFERENCES

Anderson, C. A., and Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science*, 12 (5), 353–359.

Anderson, C. A., and Carnagey, L. (2004). Violent evil and the general aggression model. In A. Miller (Ed.), *The social psychology of good and evil* (pp. 168-192). New York: Guilford Publications.

Anderson, C. A. (2004). An update on the effects of playing violent video games. Journal of Adolescence, 27(1), 113-122.

Anderson, C. A., and Ford, C. M. (1986). Affect of the game player: Short-term effects of highly and mildly aggressive video games. *Personality and Social Psychology Bulletin*, 12 (4), 390–402.

Anderson, C., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., Sakamoto, A., Rothstein, H. R., et al. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in eastern and western countries: a meta-analytic review. *Psychological bulletin*, 136 (2), 151-73.

Andreassi J. L. (2000). *Psychophysiology: Human behavior and physiological response*. Mahwah, N. J.: Lawrence Erlbaum Assoc.

Arriaga, P., Esteves, F., Carneiro, P., and Monteiro, M. B. (2008). Are the effects of unreal violent videogames pronounced when playing with a virtual reality system? *Aggressive Behavior*, 34 (5), 521-538.

Arriaga, P., Monteiro, M. B. and Esteves, F. (2011). Effects of playing violent computer games on emotional desensitization and aggressive behavior. *Journal of Applied Social Psychology*, 41(8), 1900–1925.

Bartholow, B. D., Bushman, B. J., and Sestir, M. (2006). Chronic violent video game exposure and desensitization to violence: Behavioral and event-related brain potential data. *Journal of Experimental Social Psychology*, 42 (4), 532-539.

Bartsch, A., Appel, M., and Storch, D. (2010). Predicting emotions and meta-emotions at the movies: The role of the need for affect in audiences' experience of horror and drama. *Communication Research*, 37 (2), 167-190.

Bartsch, A., Vorderer, P., Mangold, R., and Viehoff, R. (2008). Appraisal of emotions in media use: Toward a process model of meta-emotion and emotion regulation. *Media Psychology*, 11 (1), 7-27.

Bateman, C., and Nacke, L. E. (2010). The neurobiology of play. In B. Kapralos, A. Hogue and S. Xu (Eds.) *Proceedings of the International Academic Conference on the Future of Game Design and Technology* (pp.1-8). New York, N. Y.: A. C. M.

Berridge, K. C., and Winkielman, P. (2003). What is an unconscious emotion: The case for unconscious 'liking'. *Cognition and Emotion*, 17 (2), 181-211.

Boyle, E. A., Connolly, T. M., Hainey, T., and Boyle, J. M. (2012). Engagement in digital entertainment games: A systematic review. *Computers in Human Behavior*, 28 (3), 771-780.

Bradley, M. M. and Lang, P. J. (2007). Emotion and motivation. In J. T. Cacioppo, L. G. Tassinary, and G. Berntson (Eds.*), Handbook of Psychophysiology* (3rd ed) (pp. 581-607). New York: Cambridge University Press.

Buckley, K. E., and Anderson, C. A. (2006). A theoretical model of the effects and consequences of playing video games. In P. Vorderer and J. Byrant (Eds.), *Playing video games: Motives, responses, and consequences* (pp. 363-378). Mahwah, N. J.: Lawrence Erlbaum Assoc.

Cacioppo, J. T. (1994). Social neuroscience: Autonomic, neuroendocrine, and immune responses to stress. *Pychophysiology*, 31, 113-128.

Cacioppo, J. T., Tassinary, L. G., and Berntson, G. (eds) (2007). *Handbook of psychophysiology* (3rd Edition). New York: Cambridge University Press.

Carnagey, L., Anderson, C. A., and Bushman, B. J. (2007). The effect of video game violence on physiological desensitization to real-life violence. *Journal of Experimental Social Psychology*, 43 (3), 489-496

Choi, D. and Kim, J. (2004). Why People Continue to Play Online Games: In Search of Critical Design Factors to Increase Customer Loyalty to Online Contents. *CyberPsychology and Behavior*, 7 (1), 11-24.

Cole, S. W., Yoo, D. J., Knutson, B. (2012) Interactivity and reward-related neural activation during a serious videogame. *PLoS ONE* 7 (3), e33909.

Davidson, R. J., Goldsmith, H. H., and Scherer, K. (2003). *Handbook of affective science.* New York: Oxford University Press.

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion*, 6, 169-200.

Engelhardt, C. R., Bartholow, B. D., Kerr, G. T., and Bushman, B. J. (2011). This is your brain on violent video games: Neural desensitization to violence predicts increased aggression following violent video game exposure. *Journal of Experimental Social Psychology*, 47 (5), 1033-1036.

Fehr, B., and Russell, J. A. (1984). Concept of emotion viewed from a prototype perspective. *Journal of Experimental Psychology*, 113 (3), 464-486.

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

Frijda, N. H. (1986). *The emotions*. Cambridge: Cambridge University Press.

Frijda N. H. and Scherer K. R. (2009) Emotion definition (psychological perspectives). In D. Sander and K. R Scherer (Eds), *Oxford companion to emotion and the affective sciences* (pp. 142–143). Oxford, U. K.: Oxford University Press.

Gentile, D., Anderson, C., Yukawa, S., Ihori, N., Saleem, M., Ming, L. K., Shibuya, A., et al. (2009). The effects of prosocial video games on prosocial behaviors: international evidence from correlational, longitudinal, and experimental studies. *Personality and Social Psychology Bulletin*, 35 (6), 752-63.

Gonzalez-Bono, E., Salvador, A., Ricarte, J., Serrano, M. A., and Arnedo, M. (2000). Testosterone and attribution of successful competition. *Aggressive Behavior*, 26 (3), 235-240.

Gottman, J. M., Katz, L. F., and Hooven, C. (1997). *Meta-emotion: How families communicate emotionally*. Mahwah, N. J.: Lawrence Erlbaum Assoc.

Hamm, A. O., Schupp, H. T., and Weike, A. I. (2003). Motivational organization of emotions: Autonomic changes, cortical responses, and reflex modulation. In R. J.

Davidson, K. R. Scherer, and H. H. Goldstein, *Handbook of affective sciences* (pp.187-211). New York: Oxford University Press.

Harmon-Jones, E. and Harmon-Jones, C. (2011). Social neuroscience of asymmetrical frontal cortical activity: Considering anger and approach motivation. In A. B. Todorov, S. T. Fiske, and D. A. Prentice (Eds.), *Social neuroscience: Toward understanding the underpinnings of the social mind* (pp.210-214). New York: Oxford University Press.

Harmon-Jones, E., and Amodio, D. M. (2012). Electroencephalographic methods in psychology. In H. Cooper, P. Camic, R. Gonzalez, D. Long, A. Panter, and K. Sher (Eds.), *A. P. A. Handbook of research methods in psychology* (pp. 503-522). Washington, D. C.: American Psychological Association.

Hefner, D., Klimmt, C., and Vorderer, P. (2007). Identification with the player character as determinant of video game enjoyment. In L. Ma, M. Rauterberg and R. Nakatsu (Eds.), *Entertainment Computing – ICEC 2007* (pp. 39-48). Berlin / Heidelberg: Springer.

Ivanitsky, A. M., Kurnitskaya, I. V., and Sobotka, S. (1986). Cortical topography of event-related potentials to winning and losing in a video tennis game. *International Journal of Psychophysiology*, 4 (2), 149-155.

Jäger, C., and Bartsch, A. (2006). Meta-emotions. *Grazer Philosophische Studien*, 73, 179–204.

Johnson, D., and Gardner, J. (2010). Personality, motivation and video games. *In OZCHI 2010 Proceedings* (pp. 276-279). Brisbane, Queenslan: A. C. M. Press.

Keller, J., and Bless, H. (2008). Flow and regulatory compatibility: An experimental approach to the flow model of intrinsic motivation. *Personality and Social Psychology Bulletin*, 34 (2), 196-209.

Keltner, D., and Buswell, B. N. (1996). Evidence for the distinctness of embarrassment, shame, and guilt: A study of recalled antecedents and facial expressions of emotion. *Cognition and Emotion*, 10 (2), 155-171.

Kemp, A. H., and Guastella, A. J. (2011). The role of oxytocin in human affect: A novel hypothesis. *Current Directions in Psychological Science*, 20 (4), 222-231.

Klasen, M., Weber, R., Kircher, T. T. J., Mathiak, K. A., and Mathiak, K. (2012). Neural contributions to flow experience during video game playing. *Social Cognitive and Affective Neuroscience*, 7(4), 485-495.

Kleinginna, P., Jr., and Kleinginna A. (1981). A categorized list of emotion definitions, with suggestions for a consensual definition. *Motivation and Emotion*, 5 (4), 345-379.

Klimmt C., Hefner D. and Vorderer, P., (2009). The video dame experience as "true" identification: A theory of enjoyable alterations of players' self-perception. *Communication Theory*, 19 (4), 351–373.

Klimmt, C., Schmid, H., and Orthmann, J. (2009) Exploring the enjoyment of playing in browser games. *CyberPsychology and Behavior*. 12(2), 231-234.

Koepp, M., Gunn, R., Lawrence, A., Cunningham.V., Dagher, A., Jones, T., Brooks, D., Bench, C. and Grasby P. (1998). Evidence for striatal dopamine release during a video game. *Nature*, 393, 266-268.

Konijn, E. A., Bijvank, M. N., and Bushman, B. J. (2007). I wish I were a warrior: the role of wishful identification in the effects of violent video games on aggression in adolescent boys. *Developmental psychology*, 43 (4), 1038-44.

Lang, P. J., and Bradley, M. M. (2010). Emotion and the motivational brain. *Biological Psychology*, 84 (3), 437–450.

Lang, P. J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist*, 50 (5), 372–385.

Lazzaro, N. (2004). Why we play games: Four keys to more emotion without story. X. E. O. Design, Inc. Retrieved from: *http://xeodesign.com/ xeodesign_ whyweplaygames.pdf*.

Liu, C., Agrawal, P., Sarkar, N., and Chen, S. (2009). Dynamic difficulty adjustment in computer games through real-time anxiety-based affective feedback. *International Journal of Human-Computer Interaction*, 25(6), 506-529.

Mandryk, R. L., and Atkins, M. S. (2007). A fuzzy physiological approach for continuously modeling emotion during interaction with play technologies. *International Journal of Human-Computer Studies*, 65 (4), 329-347.

Mayer, J. D., and Stevens, A. (1994). An emerging understanding of the reflective (meta-) experience of mood. *Journal of Research in Personality*, 28 (3), 351–373.

Olivier, M. B. (1993). Exploring the paradox of the enjoyment of sad films. *Human Communication Research*, 19 (3), 315–342.

Ortony, A., and Turner, T. J. (1990). What's basic about basic emotions? *Psychological Review*, 97 (3), 315-331.

Panksepp, J. (1992). A critical role for affective neuroscience in resolving what is basic about basic emotions. *Psychological Review*, 99 (3), 554-560.

Pascual-Marqui, R. D. (2002) Standardized low resolution brain electromagnetic tomography (sLORETA): Technical details. *Methods and Findings in Experimental and Clinical Pharmacology*, 24 (supplement D), 5-12.

Poels, K., van den Hoogen, W., Ijsselsteijn, W., and de Kort, Y. (2012). Pleasure to play, arousal to stay: The effect of player emotions on digital game preferences and playing time. *Cyberpsychology, Behavior and Social Networking*, 15 (1), 1-6.

Przybylski, A. K., Rigby, C. S., and Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology*, 14 (2), 154-166.

Przybylski, A. K., Ryan, R. M., and Rigby, C. S. (2009). The motivating role of violence in video games. *Personality and social psychology bulletin*, 35 (2), 243-59.

Ravaja, N., Salminen, M., Holopainen, J., Saari, T., and Laarni, J. (2004). Emotional response patterns and sense of presence during videogames: potential criterion variables for game design. *Proceedings of the Third Nordic Conference on Human-Computer Interaction*, (pp. 339-347). Tampere: A. C. M.

Ravaja, N., Saari, T., Salminen, M., Laarni, J., and Kallinen, K. (2006). Phasic emotional reactions to video game events : A Psychophysiological Investigation. *Media Psychology*, 8 (4), 343–367.

Ravaja, N., Turpeinen, M., Saari, T., Puttonen, S., and Keltikangas-Järvinen, L. (2008).The psychophysiology of James Bond: Phasic emotional responses to violent video game events. *Emotion*, 8 (1), 114-120.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39 (6), 1161–1178.

Ryan, R. M., Rigby, C. S., and Przybylski, A. K. (2006). Motivation pull of video games: A Self-determination theory approach. *Motivation and Emotion*, 30 (4), 347-365.

Seger, J., and Potts, R. (2012). Personality correlates of psychological flow states in videogame play. *Current Psychology*, 1-19 Advance online publication. doi: 10.1007/s12144-012-9134-5.

Sherry, J. L. (2004). Flow and media enjoyment. *Communication Theory*, 14 (4), 328–347.

Sloboda, J., and Juslin, P. N. (2001). Psychological perspectives on music and emotion. In P. Juslin and J. Sloboda (Eds.), *Music and emotion theory and research* (pp. 71-104). New York: Oxford University Press.

Silvia, P. J. (2008). Interest: The curious emotion. *Current Directions in Psychological Science*, 17(1), 57-60.

Tan, E. S.-H. (2008). Entertainment is emotion: The functional architecture of the entertainment experience. *Media Psychology*, 11(1), 28-51.

van der Meij, L., Buunk, A. P., Almela, M., and Salvador, A. (2010). Testosterone responses to competition: The opponent's psychological state makes it challenging. *Biological Psychology*, 84(2), 330-335.

van Reekum, C. M., Johnstone, T., Banse, R., Etter, A., Wehrle, T., and Scherer, K. R. (2004) Psychophysiological responses to appraisal dimensions in a computer game. *Cognition and Emotion*, 18 (5), 663-688.

Vorderer, P., Hartmann, T., and Klimmt, C. (2003). Explaining the enjoyment of playing video games: The role of competition. In D. Marinelli (Ed.), *Proceedings of the Second International Conferenceon Entertainment Computing* (pp. 1–8). Pittsburgh: A. C. M.

Vorderer, P., Klimmt, C. and Ritterfeld, U. (2004), Enjoyment: At the heart of media entertainment. *Communication Theory*, 14 (4), 388–408.

Vul, E., Harris, C., Winkielman, P., and Pashler, H. (2009). Puzzlingly high correlations in fMRI studies of emotion, personality, and social cognition. *Perspectives on Psychological Science*, 4 (3), 274-290.

Weber, R., Behr, K.-M., Tamborini, R., Ritterfeld, U., and Mathiak, K. (2009). What do we really know about first-person-shooter games? An event-related, high-resolution content analysis. *Journal of Computer-Mediated Communication*, 14 (4), 1016-1037.

Weber, R., Ritterfeld, U., and Mathiak, K. (2006). Does playing violent video games induce aggression? Empirical evidence of a functional magnetic resonance imaging study. *Media Psychology*, 8 (1), 39-60.

Witt, E. A., Massmann, A. J., and Jackson, L. A. (2011). Trends in youth's videogame playing, overall computer use, and communication technology use: The impact of self-esteem and the Big Five personality factors. *Computers in Human Behavior*, 27 (2), 763–769.

Wood, R. T., Griffiths, M. D., Chappell, D., and Davies, M. N. (2004). The structural characteristics of videogames: A psycho-structural analysis. *Cyberpsychology and Behavior*, 7 (1), 1–10.

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Chapter 3

THE TAXONOMY AND DESIGN CRITERIA FOR HEALTH GAME DESIGN IN THE ELDERLY

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ABSTRACT

The numbers of older Americans are rapidly increasing. The World Health Organization predicts that by the year 2050 the percentage of individuals over the age of 60 is set to double from 7.4 to 16.1%. This projected increase is already impacting social policy, economics, social work, and health care organizations today. These demands are causing more people to choose to age at home. Therefore, now more than ever, there is a need to design inventions for the home to monitor, assess, and engage older adults. The field of serious health gaming for older adults is relatively new and seeks to address some of these challenges. The purpose of this chapter is to:

1) Identify the relevant studies that have contributed thus far to the development of serious health games for older adults, and based on the findings create a common taxonomy that doctors, scientists and engineers may use to solve todays cross-disciplinary challenges.
2) Discuss the design criteria for serious health games that should be considered, such as health, software, and hardware constraints.
3) Identify the current and future needs in making serious health games widely available to older adults.

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INTRODUCTION

The World Health Organization (WHO) predicts that by the year 2050 the world's population aged 60 and over will triple from 600 million to 2 billion. More people will live to see their 80s and 90s than ever before. This trend is likely due to improved health care policies, health care awareness, and health care technologies that are prolonging the lives of individuals. Good health is the key to ensuring that these older adults remain independent and participate in their families and communities while aging at home. The Center for Disease Control (CDC) reports that the most common chronic conditions that older adults experience include diabetes, arthritis, kidney and bladder problems, dementia, cardiovascular disease, Alzheimer's disease, and macular degeneration. In order to enable older adults to age in their homes, new innovations are needed to monitor and assess their health and engage them on a daily basis to assist with cognitive and social decline. Serious health gaming is one possible solution and seeks to address some of these challenges.

Older adults believe that smart home technology installed in their homes may enhance their lives [1]. Demiris et al. found that the most prominent areas where they see this being useful is in emergency help, prevention and detection of falls, monitoring physiological parameters, and so forth. However, older adults have concerns about technology and in order for it to be accepted by this population it would have to be user friendly, and have training oriented towards older learners [1]. Most studies on smart home technology examine the use of specific sensors that could be monitored remotely via telecommunications. These may include wearable accelerometers [2-4], video monitoring [5-7], blood pressure [8, 9], heart rate monitors [10], implantable diagnostics [11], magnetic switches [12], robotic devices [13, 14], and intelligent wearable textiles [15-16]. These sensors may be used passively to collect data from the older adult while they go about their daily life [17]. An emergency agency or a care-giver could be notified if a change in life style is detected or an event is recognized that would trigger immediate response. Although these sensors may be useful around the home to monitor an individual in and off themselves they are unobtrusive but does not engage the older adult in a meaningful manner. Gaming can be used to monitor and assess an older adult's performance, but can also serve as a vehicle for social interaction with family and their community and may include health benefits, such as increasing their physical and mental activity.

Health games have had positive and negative outcomes on individuals. Some positive outcomes have been, rehabilitation of injured limbs [18, 19], increased social engagement [20], increased cognitive function [21], and so forth. In one study it was demonstrated that the Wii helped increase the physical activity levels in older adults, which affected their depression, cognitive function and self-rated health measures [22]. Some negative outcomes have mostly resulted due to the individual not following directions or over exerting themselves; this has led to injuries like rotator cuff injury [23]. In the rare events where individuals have neglected their basic life needs in exchange for playing a game 18 hours a day, every day, have led to hospitalization and even death [24]. However, those games were not designed for health purposes but pure entertainment. The risk associated with playing health games is minimal if the individual uses the game as prescribed and in moderation. In order to have a health game that is focused on improving the health of an individual, it is important that the game be patient-centered. Patient-centeredness is a dimension of health

care quality that says the person should be the center of the design [25]. Mayo Clinic defines it as "The needs of the patient come first" [26]. There are four different communities involved with creating health games that are patient-centered: medical community, game designers, hardware designers and policy makers (see figure 1). The medical community includes physicians, nurse practitioners, hospitals, research universities and so forth. This community assists in identifying what the needs may be of a patient and what the health literature and knowledge suggests the patient should do in order to improve their health outcome.

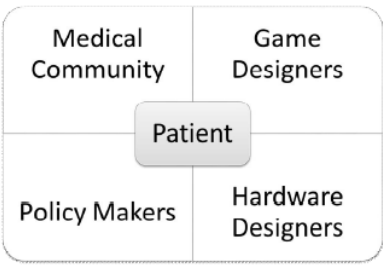

Figure 1. Patient-centered design concept for health games.

The medical community would be responsible for monitoring and assessing the patients' health via the game. The game designers create the game software that is based on the health benefits that are defined by the medical community and desires of the patient. The hardware designers create the sensors and equipment that the person would use to interact with the game. These interfaces may depend on the goal of the game and the health limitations of the patient. Lastly, the policy makers such as the FDA should approve health games so that these games may be used as a therapeutic intervention to improving the health of the patient. All of these players must come together in order to ensure that the health game has a positive health outcome, is enjoyable by the patient and is easy to use.

One of the difficulties in making successful health games is the problem of communication. The medical community uses anatomically and physiologically correct terminology, while game designers speak in JAVA, C++, and Unity. Policy makers speak in legalese while hardware designers talk about gyroscopes. This complexity makes it almost impossible for the patient to participate in the process of designing games. The design of successful health games is truly an interdisciplinary task. All of these parties have a vested interest in developing these health games, yet alone they will not be able to accomplish the goal.

The purpose of this chapter is to establish a common language that is a Taxonomy that all parties can use to describe their games in such a manner that even the patient would be able to understand. Then using the Taxonomy as a basis, each of the requirements for the design criteria of a health game will be discussed for each community. Based on an evaluation of current research and technology, future directions for research and development in serious health gaming will be highlighted.

TAXONOMY

Health games are games that seek to improve quality of life by means of interaction through a digital system for patients suffering a health disorder. Video games for health and therapeutic games have existed for decades performing a wide variety of functions on a similarly wide array of formats [27]. In the early 1990s, the popularity of the Super Nintendo Entertainment System (SNES) led to several games being released for health purposes. One of these initial games with the most promising results was *Packy and Marlon*, released for SNES and Windows computers [28]. Playing a diabetic elephant, the player had to successfully manage the elephant's diabetes while finding the food and medical supplies stolen by a gang of rats. Children diagnosed with diabetes responded positively to this game, playing an average of 34 hours over a trial of 6 months.

Not only did these children enjoy playing the game, they also experienced positive health outcomes. Children playing *Packy and Marlon* were 77% less likely to require an urgent health care hospital visit, as compared to children playing a different popular game [28].

Other health games have been designed to treat eating disorders [29], teach children how to cope with bullying [30], rehabilitate stroke patients [31, 32], treat Post Traumatic Stress Disorder [33], and halt or improve cognitive decline in older adults [34]. Despite a wide spectrum of health issues, player special needs, game design goals, and technologies – all health games strive to introduce some benefit to a user for their specific issue.

However, one challenge presented for game designers, clinicians and patients is a centralized taxonomy for describing the elements of a therapeutic game and what that means for its implementation. A morphological analysis was used as a method to classify and describe key domains inherent in every health game. This shared vocabulary will provide a clear dialogue between the various disciplines that design, implement, and assess therapeutic games.

General morphological analysis (GMA) is a technique that allows for investigations into relationships between multi-dimensional and non-quantifiable variables [35]. GMA has been applied to a number of fields including human-computer interactions [36, 37], astronomy [38], and policy analysis [39]. Using this method, complex relationships are presented in clear graphical formats that both game designers and the health community can use to describe their game. Additionally, this structure will be used to describe health games already in use demonstrating its effectiveness and application.

First, the formal elements of video games need to be addressed [40]. The formal elements are an established construct that provide a lens with which to view all significant aspects that make something a true game. The nine formal elements are: players, objective, procedures, rules, resources, conflict, boundaries, and outcome.

Player

The player is a critical part to any game and there are a number of different ways that they may be able to interact during play. A game may allow for one player, such as *Solitaire* [41], or involve huge numbers of people as seen in *World of Warcraft* [42].

Additionally users may play against each other, the computer, or cooperate in small groups or large teams. Games also vary in the role a player assumes that controls different character abilities and overall game play experience.

Objective

A game's objective describes what a player must do to accomplish a goal or task. The tone of a game is often set with this element. For example, a racing game where the objective is to reach a certain location before other players (e.g. *Mario Kart: Double Dash!!* [43]) is often more stressful and exciting than another game where the objective is to explore and build a world (e.g. *Minecraft* [44], *The Sims* [45]).

Procedures

Procedures are the what, when, where, and how questions of a game. In video games, this often describes how a player interacts with any controller or device that begins the game, carries out their actions, and finalizes play.

Rules

Rules limit the actions available to a player and create an environment where well-planned strategies can maximize play performance. Specific attention to rule development is critical because too many, too few, and poorly described rules all limits enjoyment and playability of a game.

Resources

All games possess resources available to a player that help them achieve a goal. Examples of game resources are lives, health, money, time, or special moves that must be conserved and utilized to perform well and complete game goals.

Boundaries

Like rules, boundaries distinguish what may and may not occur in game play. Boundaries are often physical edges, such as the "end of the world" or lines on a sports field. There are also social boundaries, described in Fullerton [40] with the game, *Truth or Dare*, where those not having agreed to play are outside the boundaries and rules of the game, though they may share the same physical space as others playing.

Conflict

As a player attempts to accomplish goals within the rules and boundaries of a game, a struggle emerges. This conflict makes a game challenging, interesting and heightens the overall experience. Conflict necessitates an employment of skills and strategies to more easily and successfully solve a task. Players may encounter obstacles, opponents, and dilemmas as examples of conflict within a game.

Outcome

Many games produce a measurable outcome as winners, losers, or a ranking of these in between. Arcade games assess play performance through points and sum up the player with a number to be ranked against the top previous users. Some games are "zero sum", such as tic-tac-toe and chess. A winner is a +1, while a loser is a -1 leading to a sum of zero regardless of which player won the round. Other games operate differently and lack the "winner concept". Simulation games and many massively multi-player online worlds may go on indeterminately so must offer other rewards and incentives to their players in lieu of winning. *Lord of the Rings Online* for example has a reward system where the best character enhancement items drop from the most complex battles in the game [46].

While health games may not contain the sweeping story lines and huge production values of traditional video games, they are not exempt from satisfying these formal elements. We can use the formal elements to describe any health game existing today. For example, *Age Invaders* [20, 47] is a game designed to bridge an age gap and promote relationships between grandparents and grandchildren.

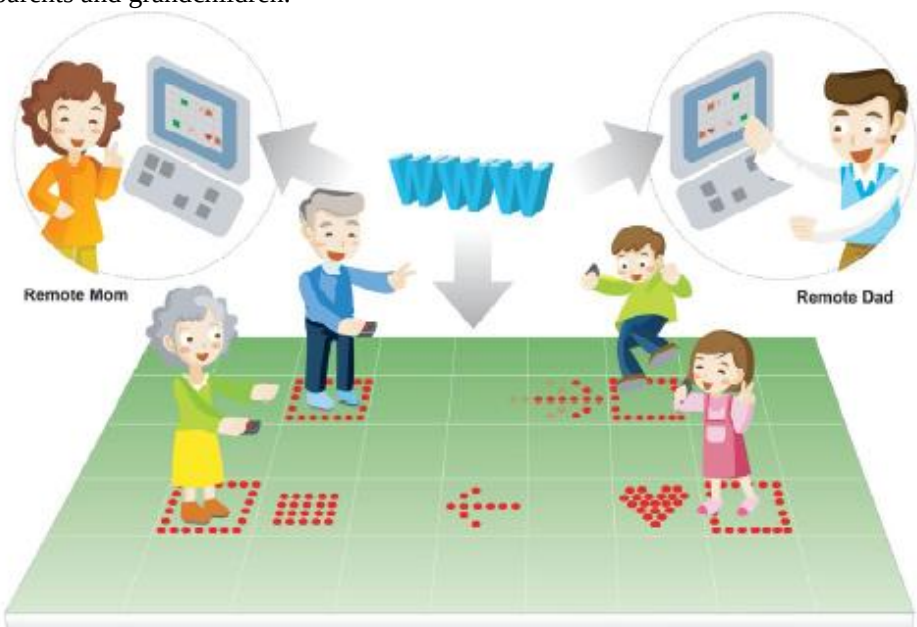

Figure 2. *Age Invaders* is an innovative game designed to bring the entire family together to play according to their own abilities, even if some members are not co-located.

Age Invaders lets up to four people play in a team competition environment (*Player*) where they shoot missiles attempting to knock out their fellow players (*Objective*) using a large light-emitting diode (LED) gridded floor platform (*Procedures*, see figure 2). Players may only step on grids that have been previously lit (*Rules*) or else their health bar drops dramatically (*Resources*) while remaining within the confines of the grid (*Boundaries*). Players can develop skills at firing missiles and rockets while also jumping over incoming assaults (*Conflict*). The player with the most points at the end of the round wins (*Outcome*).

At the same time, health games possess their own unique attributes which may be presented in the following format to inform designers, clinicians, and patients on the game type and usage.

Dimensions

The development and implementation of health games may be viewed in three distinct dimensions: game design, the player, and reporting. Within each dimension are sub-dimensions for further clarification.

Game Design

This first dimension of Game Design refers to specific elements relevant to the game. The Game Design sub-dimensions relate to the structure, goals and applications of the health game in question. These factors are not only relevant to the designers of the game, but are also important considerations for health care specialists and patients as they choose the game most appropriate for their health goals.

Domain

By definition, a health or therapeutic game is designed to affect positive changes in a user. The aspect of the user's health that is targeted by the game is its domain. We utilize the widely accepted six dimensions of health to describe a health game's domain. These dimensions are physical, mental, emotional, social, occupational and spiritual [48].

A game that does not seek to affect one of these dimensions is not a health game. However, it is also true that there are games intended for commercial success, created with entertainment as the overriding goal that can be utilized in ways that improve health.

In this case the players and health professionals repurpose such games to meet health goals. For example, *Dance Dance Revolution* was a mainstream arcade game that became the center of a large movement of users who were utilizing it as a mechanism for weight loss [49]. Whitlock et al. had older adults participants play the MMO *World of WarCraft* in order to achieve cognitive benefits [21, 42]. There is a large body of research on the use of commercial games as cognitive interventions like *Brain Age* [51], motivators for physical exercise like *Dance Dance Revolution* [50], *WiiFit* [52], and *Yourself! Fitness* [53], and emotional support [54].

A health game is not required to only address a single dimension either. For example, *WiiFit* is a health game falling in the physical domain, though it may also simultaneously contribute to other dimensions of health [52]. For example, a *WiiFit* player may experience emotional benefits as they become more confident in their ability to manage their physical fitness. However, most games built with health goals in mind are targeted at not just a particular dimension but a particular sub-category as well. Examples include, stroke rehabilitation [32, 55], diabetes management like *Glucoboy* [56], depression therapy like *SPARX* [57], pain distraction as in *Snow World* [58], generational social ties like *Age Invaders* [20, 47].

Type

While the domain of a health game describes the type of health changes the game is designed to affect, the *type* captures the approach the game takes to affecting health. The approach can range from providing educational information about a disease, training on management of the disease, exercise to reduce the symptoms, to reducing isolation felt by those with the disease. This dimension captures an important distinction between the purpose of the game and the approach it uses.

For example, a game could address issues related to diabetes, but that game could do so in a variety of ways.

- *Education.* A game that presents the player with facts about the disease and information on general nutrition guidelines, symptoms, lasting health implications and so forth. MedlinePlus provides a lengthy list of games that are aimed at health education [59].
- *Training.* A game that trains a player how to do a specific task related to their diabetes manage, such as how to use a blood glucose meter. This game would include motor learning or hands on interaction with the device as part of the game.
- *Exercise.* A game that helps the player manage their blood glucose levels and weight through physical exercise. The main interaction in this game would be related to physical movement of the player e.g. it could even be a commercial game such as *Dance Dance Revolution* [50] that is not intended for use just by people with diabetes. However, the game would not be focused on monitoring and/or critiquing the player's movements; the main goal is not train them on a specific task or skill, but rather, to promote physical activity in general.
- *Social relations.* A game that helps elementary school students (both those with and without diabetes) understand the disease and the challenges faced by their fellow students with diabetes. The goal of the game is to foster positive social interaction between the groups of students.
- *Diagnostic.* A game that provides a motivation for the player to track their food consumption during the day. The game mechanics might have little to do with diabetes specifically, but the goal is to gather information on the players' nutrition so that either an automated system or a doctor could use the information to provide guidance on improving the player's eating habits and choices.

Certainly a game could incorporate several of these types within this sub-dimension creating a more complex approach to tackling a health issue. At this time, few health games are developed to tackle more than one of these types at a time. For example, *Glucoboy* is solidly a diagnostic type of game [56]. To increase compliance in children for blood sugar testing, the game rewards children for regular testing and maintenance of good blood sugar levels by unlocking new games on their GameBoy. *Glucoboy* operates purely as an incentive to children to monitor their health.

On the other hand, *Packy and Marlon* [28] educate children about diabetes and affect social relations by helping diabetic children not feel as isolated by their disease.

Some health games may not fall neatly into any of these types. For example, *Snow World* [58] seeks to distract a patient from pain and may not be categorized exactly in one of the five types.

Intervention Timing

A disorder or disease progresses through stages and health games may be created to intervene at any of these points. This sub-dimension captures the temporal aspect of the game's design. As seen in figure 3, there are four intervention timing categories: prevention, rehabilitation, chronic care, and decline.

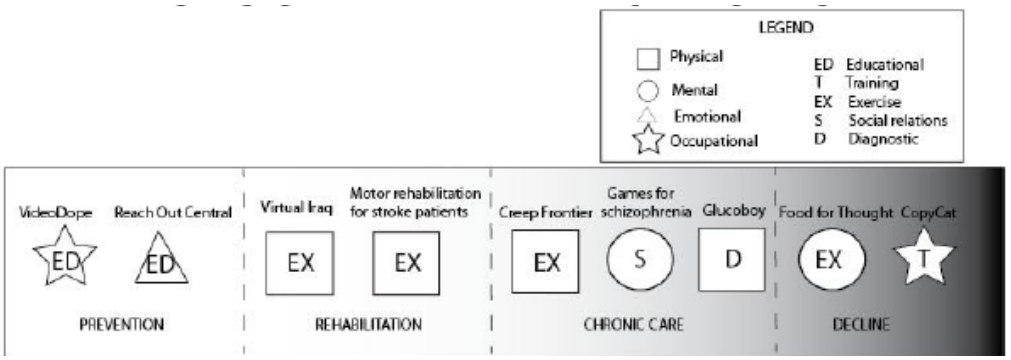

Figure 3. Health games may target one or more of these four intervention timing points.

VideoDope [60] and *Reach Out Central: the game* [61] are both preventative games designed to, respectively, teach adolescents the harmful effects of drug use and how their emotions and actions affect those around them.

Virtual Iraq [62], a game designed to treat post-traumatic stress disorder, and games for motor rehabilitation in stroke patients [32] are examples of rehabilitation games. *Creep Frontier* [63] (a game for those with cystic fibrosis), games that help treat schizophrenia, and *Glucoboy* [56] are all examples of games that would be played indefinitely as part of a chronic care regimen.

Food for Thought [64] and other cognitive games seek to aid in mental decline. *CopyCat* [65] a game that can teach sign language, could be used for someone experiencing hearing loss.

To return to the diabetes management example, a game could be targeted at multiple points along the temporal spectrum of diabetes from pre-onset to long term management.

- *Prevention.* The game would focus on activities that would be preventative and thereby reduce the risk of a disease occurring. An education or training game could provide children with information or healthy activities that would help prevent the onset of diabetes.
- *Rehabilitation.* A person with diabetes could play a game intended to help them to physically rehabilitate following a serious wound or an amputation that was the result of their diabetes. Rehabilitation may fall into any of the six dimensions of health: physical, mental, emotional, occupational, social and spiritual. The GT Stroke game aims to rehabilitate the upper extremity of a stroke survivor by playing a Peggle like game [32].
- *Chronic care.* The game would focus on ongoing activities that may involve management of a disease or disorder. As discussed above, a training or exercise game could help the patient learn how to monitor their blood sugar levels, motivate them to exercise, or guide them into better nutrition choices. *ElderQuest* is an example of a chronic care game that aims to assist older adults with realizing the importance of managing their medication [66].
- *Decline.* As a person experiences increasing vision impairment due to diabetes, or as the disease worsens as the person ages, a game could help them develop mental and physical skills to adapt to these changes, or possibly to help flatten the angle of downward decline.

Prescribed Use

Games as medical interventions require a direction for prescribed use; the frequency and duration for how long and how often a health game is played. As a doctor might prescribe medication, a health game is intended to be used for a particular amount of time per session over a particular period of time in order to have the greatest benefit for that individual. This, of course can range from a rehabilitation game where it might literally be prescribed for a set amount of time per day for a definite number of days, to a game targeted at a chronic condition that should be used indefinitely. As an example, Saposnik [31] conducted a meta-analysis of virtual reality health games for stroke victims and found most studies required patients to play 20 to 30 hours for duration of four to six weeks of therapy.

Platform

The platform dimension describes the hardware, software and sensors that are required to deploy the game. The platform can range from a simple smart phone and a website to a full virtual reality Cave (see figure 4). The platform of a game is one of the most important considerations for feasibility of deployment. Clinicians and patients must assess the hardware requirements and if the devices are available. While the goal of a health game is often

widespread and low-cost deployment that is not to say that useful games will always utilize simple platforms. There is a tradeoff between the availability, physical footprint, and cost of equipment and software with the target user experience. A more advanced system may enable applications, user interactions, diagnostics and so forth that would otherwise be impossible on a simpler system. Also, these custom systems may become cheaper as advanced gaming technology penetrates the commercial market. The Kinect is a good example of this as developers create new software development kits, such as skeletal tracking, that are proving useful in scientific research [67]. The Kinect is a collection of custom hardware and software that provide what, previously, were expensive components and complicated algorithms only accessible to computer science researchers. Now the hardware is inexpensive and accessible through easy to use software libraries, allowing developers who are not computer vision experts to create gesture controlled games. These developers are also able to expect that their solution will be available to thoUSnds (if not millions) of potential users due to the ubiquity of the Xbox hardware.

Other examples include; *Lumosity* which is a web-based cognitive training game [68], *Georgia Tech's mobile Dance Dance Revolution* that has a mobile platform and uses simple custom accelerometers, *Age Invaders* uses a custom interactive floor [20, 47], and *VR Stroke game* has a CAVE environment [18, 19].

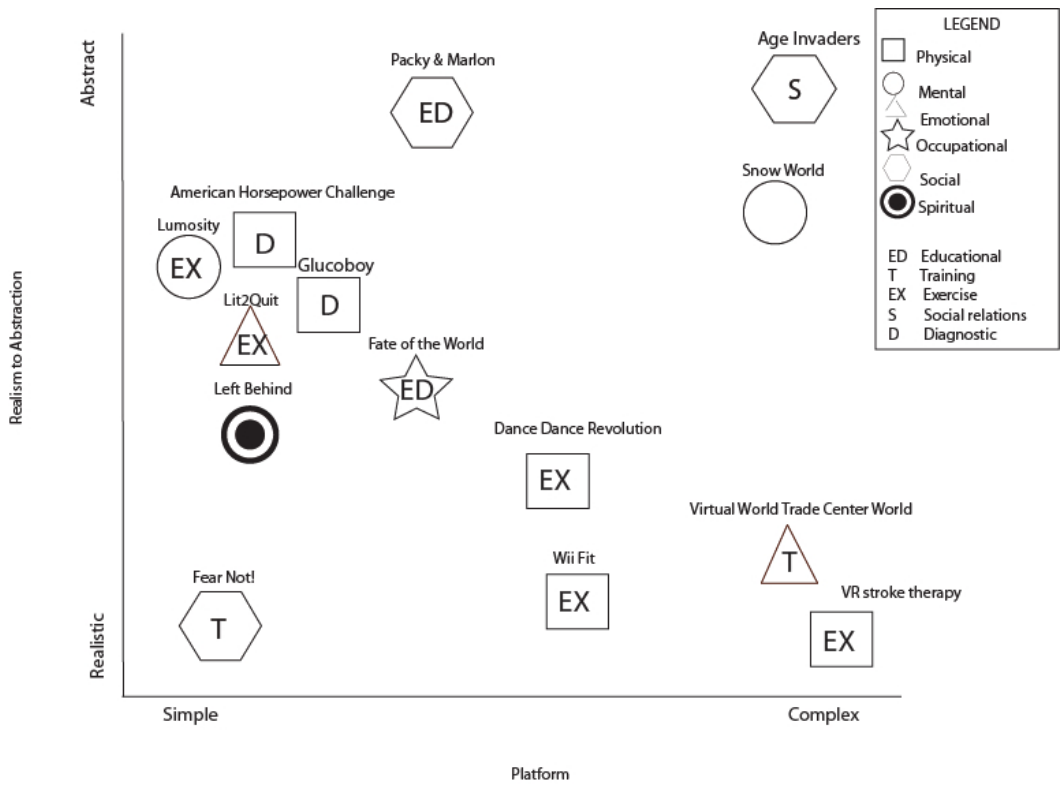

Figure 4. All computer games vary in the complexity of their operating platform and their level of abstraction or realism.

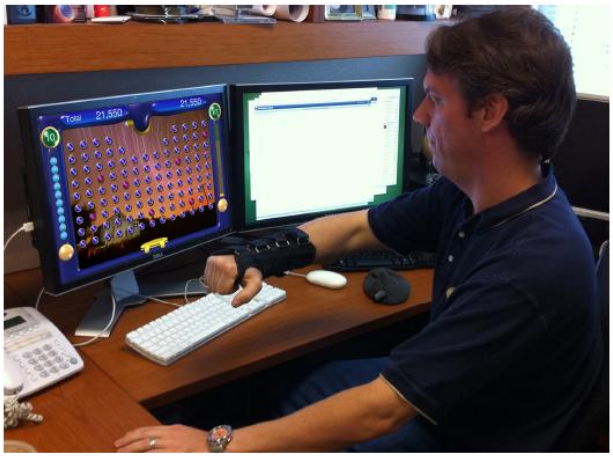

Figure 5. *GT Stroke game* involves playing a fanciful pinball game by repetitively moving the affected stroke arm repetitively in a manner that would be comparable to an exercise in stroke therapy.

Realism Versus Abstraction

Health games vary in their level of abstraction versus realism. This is defined as how closely the game world is linked to the real world. Abstraction can be applied to:

- *Game theming.* The extent to which the game is a simulation of the real world objects and environments.
- *Interface.* The level to which the required interactions mimic physical movements or mental processes the player does in the real world.
- *Game mechanics.* How similar the activities and behaviors in the game are to the real world ones.

Real world simulation is not always the ideal design. If the game approaches becoming a literal replication of a real world exercise, then why is a computer game needed? One answer to this may be access in that it allows the player access to activities that otherwise require visiting a set location, collocating with others (such as doctors and specialists), and specialized equipment. However, simulations can require specialized hardware and software as well that may be harder and more expensive to deploy and install. Choices depend on goals of game, types of players, environment in which it will be played. Here are some examples (also shown in figure 4.):

- *Realistic.* Stroke VR examples mimics real world setting in that the movement's performed are realistic and replicates traditional stroke rehabilitation therapy [18, 19]. *Fear Not!* allows young children to interact virtually with bullies and teaches them real world strategies to prevent social exclusion and mobbing [69].
- *Realistic and Abstract.* In the *GT Stroke game* the movement is realistic, but the game environment is a fanciful pinball/pachinko scene (see figure 5). The game mechanics (moving arm to aim cannon) is abstracted from traditional rehab activities

[32]. *Food For Thought* [64] has a realistic setting and activities (cooking in a kitchen), but is mechanically abstract. The goal is not to teach you to cook, but to exercise executive control function. Some *Brain Age* activities involve real world skills like arithmetic, but are presented in abstract setting [51].

- *Abstract.* Re-Hand, is a stroke game that involves the user squeezing an upright joystick that controls a Super Man character flying through the air [70]. *Lumosity*, a brain training game, features several mentally taxing mini-games designed to a player's visual attention as well as memory. Players watch bird silhouettes flash on a screen and must click on only the correct silhouette while also reporting a number that appeared briefly in a different location [68].

These sub-dimensions within Game Design are obviously important considerations for game designers creating new health games. Additionally, the Game Design dimension is an important one for physicians to consult as they make decisions regarding which health game is most appropriate for their patients.

Player

Many of the player aspects of a health game reiterate the importance of the nine formal elements, but they should be analyzed in the unique context of health games. The player dimensions are critical to a health game because the primary purpose is intended to directly affect their health.

Social Versus Individual

This is a reiteration of the formal elements. However, it must be emphasized in a health game as often the fact that it is multiplayer and thus social is an important component of the therapy. For example, some cognitive intervention studies have shown the importance of social interaction to the success of the intervention [71].

Similarly, in games of the social relations type a social component is likely intrinsic. Therefore a health game should be categorized by whether it is intended for solo play or social. Also, social games may require physical co-location or remote multiplayer support via a network. Here are some examples:

- *Social and Co-located.* Age Invaders is an example of a game that has no meaning without the social component. While the game has a feature that enables parents to remotely interact with the game, the main purpose of the project is to create a shared physical space for grandparents and grandchildren to play in, thereby bridging a generational gap. There is no "one player" version of this game and players must be in the same place using the same floor board to play [20, 47].
- *Social and Co-located and Individual Modes.* BoomBlox involves both social and individual play modes. The game features a "hot seat" style of turn taking play in its multiplayer setting (see figure 6), but players must still be collocated using the same Wii system and game disc. Alternatively, someone could also play the game by themselves [72].

- *Social and Remote.* World of Warcraft involves playing by oneself, but is in a Massive Multiplayer Online environment [42]. *Lord of the Rings Online* allows players to progress through the game in an individual manner, however in order to play the end-game content requires teams of up to 24 players [46].
- *Individual.* Lumosity involves only individual play in all aspects of the game [68]. Many of the first health games like *Packy and Marlon* [28] and *Captain Novolin* [73] only allowed for a single person to play.

Figure 6. Two women play *Boom Blox* in the social "hot seat" multi-player mode.

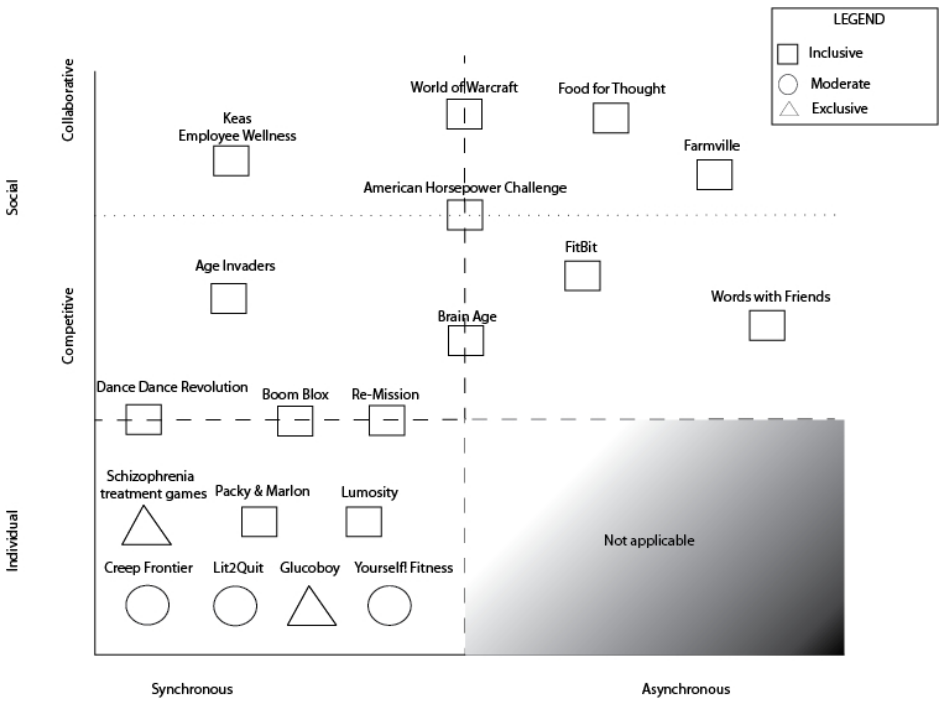

Figure 7. Games offer a range of co-located and remote play options and some offer both potentialities for players. Social games have succeeded in developing a reliable player community through asynchronous player options and health games could benefit similarly by employing this element.

Synchronous Versus Asynchronous

A health game can also either be played synchronously or asynchronously. In a synchronous play game, participants interact with the game at the same time – though they need not be in the same place to do so. Social games are often thought to be synchronous (e.g. *World of Warcraft* [42] and *Age Invaders* [20, 47]), but people have been engaging in asynchronous social games long before computing (e.g. chess played by mail). In an asynchronous game, players interact with the game and each other at different times. In the past few years, supported by the increased use of social networks, there has been a rise in casual social asynchronous games such as *Farmville* [74], *Words with Friends* [75], and *Draw Something* [76]. The Pew Research Center found in 2010 that the demographic with fastest growth for social network sites are adults over the age of 50 [77]. This may be in no small part due to the rising popularity of social games and the adoption of tablet devices (such as iPad) by this generation. PopCap, a game publisher, found social gamers over the age of 50 were 48% of all players [78]. Therefore a health game may support social play of either type (see figure 7). Here are some examples:

- *Synchronous.* Re-Mission, is a game for young adults and teenagers battling cancer. It is a third person shooter with a synchronous multi-player mode. Players can sit together using the same system playing this game together. Researchers found young people with cancer playing this game experienced a faster acquisition of knowledge on cancer and had higher treatment compliance rates than those not playing *Re-Mission* [79].
- *Synchronous and Asynchronous.* Some games support both synchronous and asynchronous play. For example, *Brain Age* is a cognitive training game that allows players to compete against each other for high scores at the same time or at different times [51]. *The American Horsepower Challenge* game is an example of asynchronous social play. Children wear pedometers that wirelessly report their steps on the online *Horsepower* game. The more steps a child takes, the more activities they can complete with their friends in the online game, however friends need not participate in the game at the same time [80].
- *Asynchronous.* The *FitBit* a wearable health tracker device collects activity information by the wearer and uploads it to the participant's profile [81]. The FitBit incorporates social game elements fostering a competitive spirit between friends to achieve higher activity scores. This social aspect is purely asynchronous.

Competitive Versus Collaborative

Fostering competition or collaboration can be an important part of a health game. Older adults often cite that they enjoy playing with spouses or members of their community [82]. A health game that leverages this social element either through cooperation or collaboration is more likely to be more "fun" and played more often. Supporting these aspects may be part of the prescription of the game and key to achieving health benefits. Here are some examples (see figure 7):

- *Competitive.* Some games pit players against one another in a competition for points or rankings. For example, in *Dance Dance Revolution* [50] players compete for the highest score that is based on the highest number and best combination of correct steps.
- *Both competition and collaborative.* The American Horsepower Challenge [80] allows children to form collaborative teams that compete against rival teams. This is an example of a game that supports both collaborative and competitive play.
- *Collaborative*. *The Keas: Employee Wellness Program* [83] is a social game that seeks to promote healthy lifestyles and interactions within a company. Employees work together to encourage everyone to get healthier while the system employs many successful elements from social online games.

Inclusiveness

Certain health games have been designed only for the patient's benefit in mind, such as some cystic fibrosis (e.g. *Creep Frontier* [63]) and stroke rehabilitation [32] games. This inclusivity based on one facet of a player appears to be an aspect that is unique to health games. However, some games are designed to include other players to varying degrees. While inclusion is not required or desirable for all health games, it may have positive outcomes, such as:

- *Economy of scale.* A game with proven beneficial consequences has an easier time of getting developed and deployed to a large number of people, such as commercial games for therapy.
- *Acceptance by the intended user.* They may be more eager to play if the game does not feel like a required medicine. If others can and do want to play it they may feel less isolated and singled out by their use of the game.
- *Unintended health benefits.* Some games, even though they may be designed originally for chronic care or diagnostics they may be useful for prevention or early diagnostics if other types of players are engaging with it.
- *Social Benefits.* As discussed in the earlier sections. Social play can have mental and physical benefits. If there is a greater population of potential players there is a greater likelihood that the players will be able to find someone to play with.

Inclusion falls on a spectrum:

- *Exclusive.* A game that should only be played by those for whom it is prescribed and designed. An example of this is a computer program intended to train cognitive skills in medicated patients with schizophrenia [84].
- *Midway.* A game that a person not in need of the health benefits could play but probably would not want to. An example is *Lit2Quit*, which is a game developed by Columbia University [85], uses replacement therapy to emulate smoking while also helping the player to quit. Another example is a game that welcomes other players with the interface and design, but does not specifically seek to include them. An

example of a motor rehabilitation stroke therapy game designed by the Georgia Institute of Technology [32].

- *Inclusive.* Games where inclusion is a component of the therapy, like *Age Invaders* where the goal is to include disparate age cohorts [20, 47] (see figure 2).

Ability Requirements

While any commercial game does have ability requirements, typically the assumption is that only healthy able bodied users are playing it. There is not much concern about accessibility, although the Wii benefited from becoming more accessible to older or less experienced players whether it was intentional or not. However, with a health game, accessibility or designing of the game interface to be USble by the intended demographic is critical. Therefore a health game should also be characterized by its ability requirements. Games requiring the use of visual display require the ability of sight in order to play. Even for sighted individuals, however, there is a wide range of visual ability such as acuity and the capability to see color. *AudioDoom* is a game designed for blind children and heavily relies on 3D audio cues used to navigate a maze [86]. This is an example of game where hearing is critical to play. Other games require physical abilities, such as the ability to raise an arm, use a mouse, or stand.

This is not to say that every health game must be fully accessible to a wide range of abilities. It depends on the goals of the game. However, the health game will be unsuccessful if the target users struggle. This will be based on the inclusion dimension as well.

Gandy and colleagues found that older adults experienced difficulties with both the game remote and play interface in the commercially available *BoomBlox* game for the Wii [34]. Adults with shoulder injuries or arthritis struggled with throwing motions and fine motor control to find the right remote buttons. Picking out features from the game environment proved tricky when the edges of shapes were not well defined and similarly colored shapes were overlapped on the screen. Ability requirements fall on a spectrum (see figure 8), as described below:

- *Widely accessible.* To be truly helpful the health game may need to support a wide range of abilities. The stroke games are a good example because in the beginning the player may be barely capable of playing, but their abilities will improve. However, if that game is inaccessible to those who recently experienced a stroke it may not be of use. *Yourself! Fitness* is a highly customizable exercise game that can be personalized based on the physical abilities and goals of the player [53].
- *Narrow requirements related to abilities of a particular demographic*. AudioDOOM [86] is an example of a game that demands a relatively higher level of mental acuity than a more accessible game. The game was designed for blind children so does not require visual ability, however a player must process and utilize complex 3D audio cues to navigate a maze. An interesting problem to consider is that games requiring literacy may be considered narrowly accessible. The blind, children who have yet to learn to read or read poorly, and illiterate individuals may all be at a disadvantage if a game relies heavily on text. *Pikmin* is an example of a game that relies heavily on

color [87]. An individual with color perceiving difficulties would not be able to play this game.

- *High level of ability requirements*. Some games require a high level of physical ability. These games might require extreme skill in mobility, dexterity and sensory perception. Additionally, a game may require a high level of mental acuity in the realms of memory, spatial reasoning, problem solving and mathematics. *StarCraft* [88] is an example of a mentally taxing game as well as requiring a player to have fast reflexes. Advanced levels in *Dance Dance Revolution* [50] require a high level of mobility and dexterity by a player. *QWOP* is a flash game that requires a high level of dexterity to run the character, but falls only in the narrow requirements for physical ability [89].

Reporting

Having explained the Game Design and Player dimensions that lead the discussion to the data that the game collects and what it does with this information. All computer games collect input from the player to assess performance in the game. The way health games gather and report this information is dependent on the Game Design factors specific to it. The data and information fed into the game can be a boon to guiding the health goals and progress of the player for health care specialists.

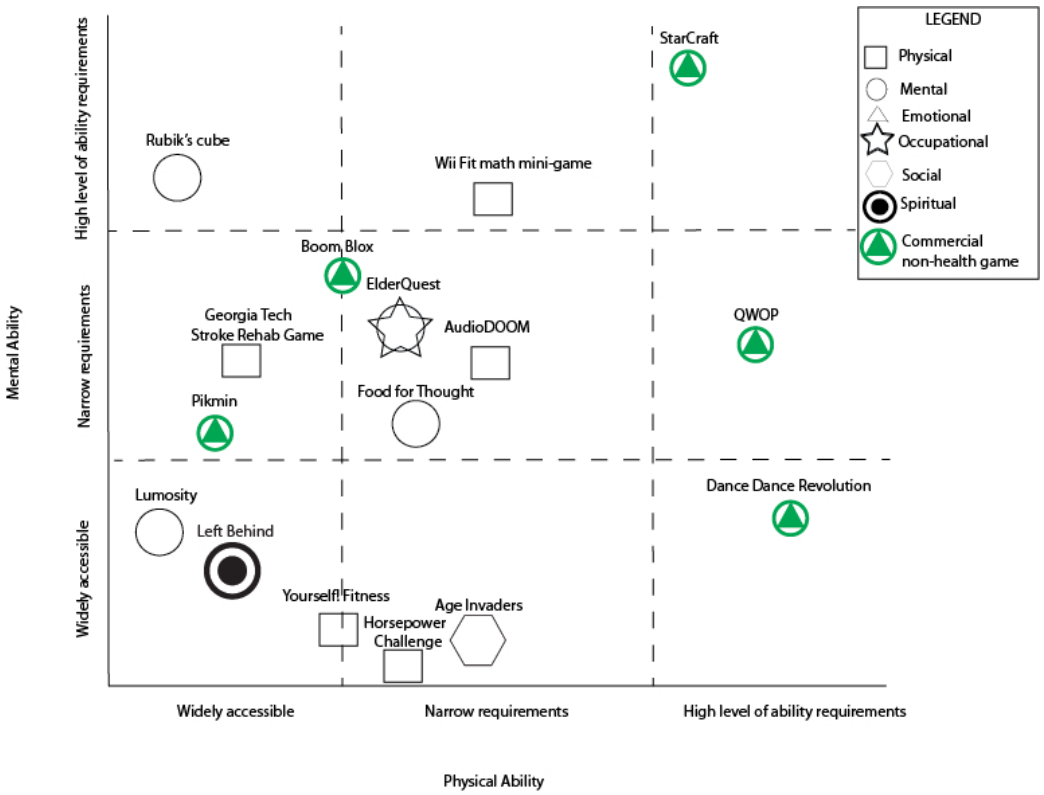

Figure 8. Ability requirements, both physical and mental, necessitated by computer games fall on a spectrum between widely accessible and those requiring a high level of ability.

Performance Variables

By definition a health game is having the player perform some sort of physical or mental activities that will serve as input to the game. While this is true of all games, the input from the player in a health game is related to the type, domain, and health goals of the game. Therefore, a health game should be characterized by what performance variables of the player it collects: movement time, distance, angles, time, reaction time, cognitive scaling, precision, memory and so forth.

Many physical health games, and in particular health games, collect performance variables on movement time, distance, and precision. Cognitive games, and many psychological tests, measure reaction time, memory and use indices of cognitive scaling. Games focused on education often measure the number of correct answers by a player, such as *Trivial Pursuit*.

Assessment

Many games utilize the performance variables to assess game performance. For example, a stroke game would assign a greater score if the player can extend her arm more freely [32]. This dimension captures to what extent the performance variables determine success in the game. Other formal elements of the game can be used to magnify or downplay the effect the variables have on success. Random elements can be added to the game to support better novice performance and to add an element of luck that counteracts pure performance. The following examples fall on a spectrum:

- *Performance variables determine success.* Performance variables directly control how well the player does. For example, the *Lumosity* mini-games test a variety of mental abilities and better performance on these tests directly translates to a higher score. Most commercial games players are familiar with work along this method. The fastest racer in *Mario Kart: Double Dash!!* [43] will receive more coins and points than a slower one.
- *Performance variables unrelated to game success.* The children's board game, *Chutes and Ladders*, is rooted entirely in luck. Random chance, instead of skill, determines whether a player will climb to the top first for a win or slide down a chute and lose. Many commercially available puzzle block games, such as *Peggle* [90] and *Bejeweled 2* [91], have a strong component of luck involved in their play. Health games, particularly those designed to exercise or train a skill would rarely be based so strongly on luck like *Chutes and Ladders*. However, small elements of randomness and chance can be important factors in making an enjoyable game. Variable schedules of chance reward can entice a player to reliably come back for more. A game with some amount of luck could be particularly important where the patient is struggling to carry out the activity be measured, as in stroke rehabilitation games.

External Reporting

The reporting sub-dimension characterizes how the performance values are used either by the game or external people. In essence, where is this input going once the game collects it? And what does the game do with the variables versus what the doctor or caregiver does?

External reporting captures whether the performance variables are passed on to external people such as doctors, nurses or caregivers. They may be more interested in the performance of the individual over time, and receiving notifications if the user is for example not following the prescribed intervention.

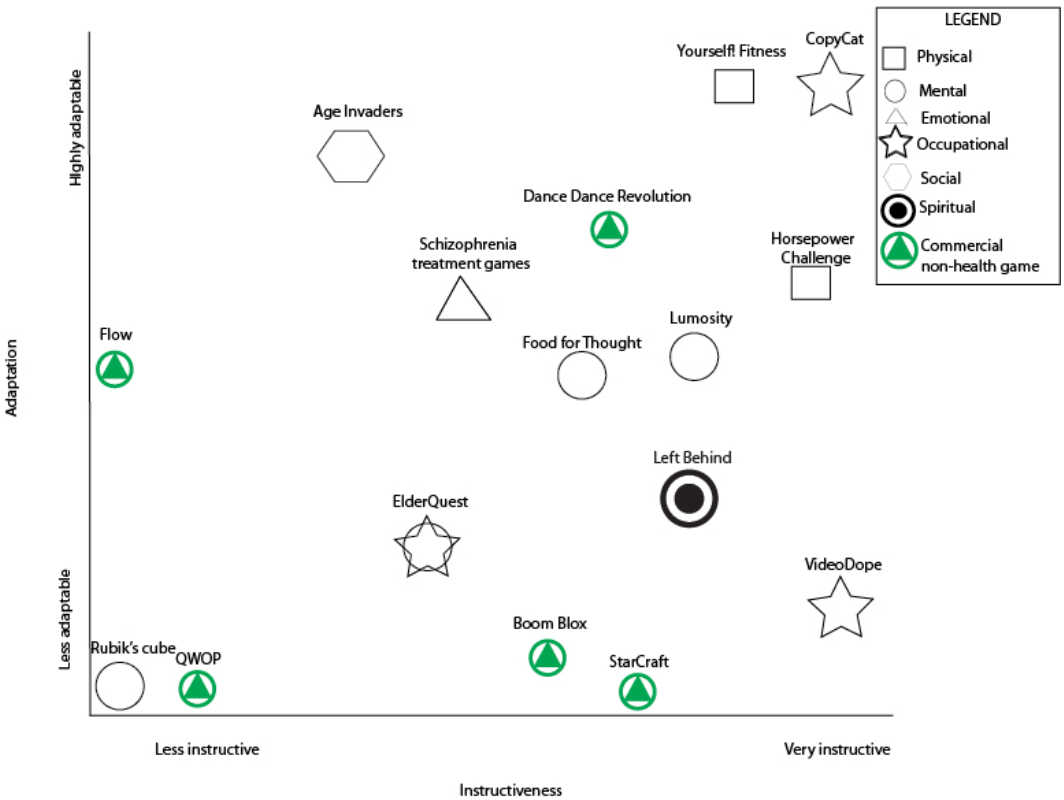

Figure 9. Both commercial and health games provide players with a varying amount of instructiveness. Additionally, some games adapt to the player to better suit their needs.

One of the objectives of the *ElderGames* project was to allow physicians and family to monitor cognitive ability over time, as reported by the game [92]. Jimison et al found that the presence of cognitive decline in older adults can be identified by using an index of game performance [93]. External reporting to health care specialists could be a powerful tool in monitoring and guiding the health goals of a patient.

Adaptation

As the performance variables vary for a player, the game may automatically adapt or be manually modified by a physician to present an appropriate level of difficulty or type of game

mechanics. Adaptation is based on the amount to which a game changes based on the variables it receives, and also how the game is making that adaptation. A game may change based on algorithms or programmed heuristics or it may be manually altered by a person, such as a health care specialist (see figure 9).

- *Automatic adaptation*. Mario Kart has a normalizing feature that adapts based on player performance [94]. The worse a player races, the more power-ups they will receive to boost ahead and catch up to the pack. On the other hand, a first place racer may experience more obstacles as the game seeks to level the playing field. A health game that senses a player is becoming proficient in a skill could benefit the patient by augmenting the difficulty so a task never becomes too easy or old.
- *Simple adaptation.* Many games feature an ability to play on an easy, medium or hard mode. Once selected at the beginning of a level, the player then experiences the game at one of those levels. *Rock Band* allows a player to choose the difficulty modes of easy, medium, hard and expert, for example [95]. Because not all players must play at the same level of difficulty, everyone involved can optimize their game experience while still playing together. *Age Invaders* also allows players to differentially adapt the game based on their personal needs [47].
- *Manual adaptation by external person.* Cardiovascular stress tests are an example of an external force controlling the level of difficulty. A health game could also make use of this by allowing the health care specialist to control certain game dynamics in order to see how the individual responds.
- *No adaptation.* Some games retain the same level of difficulty throughout play and never adjust based on a player's performance. *QWOP* retains the same level of difficulty whether you only run your player two feet or for the entire race [89]. Likely a health game lacking an adaptation may not be as beneficial health-wise or interesting play-wise.

Scaffolding

Based on the reporting the game may provide scaffolding. Scaffolding can be considered like training wheels that aid someone in playing a game until they become proficient. Tutorials are an example of game design scaffolding where the player is assisted through learning a new skill. As a player advances, they then are challenged with new skills and abilities to add to their previous toolset.

For example *Boom Blox* introduces new blocks, projectiles, and concepts slowly eventually reaching a point where the player is familiar with all of them. *Lumosity* mini-games often introduce small cognitive tasks in the beginning, only to complicate them further as they are combined in more advanced levels. Allowing a player to build on skills in a gradual progression appropriate to their own advancement can instill an important sense of confidence and self-achievement.

Instruction Level

Based on the reporting the game may provide varying levels of instruction and direction to the player. Often, some amount of direction is preferable to optimize a player's experience with a game. However, some health games may benefit their players by requiring them to figure things out without help from the game itself.

Cognitive games that push a player into "desirable difficulties", or moments of struggle requisite for cognitive benefit [96], may be a more successful cognitive intervention than a game that holds the player's hand more often. As seen in figure 9, games fall on a spectrum with the amount of instructiveness they provide:

- *Very Instructive*. In the exercise game, *Yourself! Fitness*, the trainer Maya provides frequent guidance as she leads players through exercises suited for a player's health goals.
- *Moderately Instructive. Boom Blox* gives instructions at each level, but does not provide direction once the level is in progress.
- *Less Instructive.* Some games provide little to no instruction and simply allow a player to figure out the play mechanics on their own. *Flow* is an artistic game that thrusts a player immediately into play without menus or directions to instruct play [97].

Design Criteria Considerations

The taxonomy is needed in order to assist in the communication between relative parties (see figure 1) who are involved with the design of a health game. However, each party also has to consider specific issues that will affect the design criteria of a health game developed for older adults. At the center of this discussion is the idea of a patient-centered design.

Health Considerations

As mentioned in the introduction, the Center for Disease Control (CDC) reports that the most common chronic conditions that older adults experience include diabetes, arthritis, kidney and bladder problems, dementia, cardiovascular disease, Alzheimer's disease and macular degeneration.

These disorders and others that older adults experience affect their six dimensions of health. These dimensions are physical, mental, emotional, social, occupational and spiritual [48](see figure 10). These dimensions affect the domains for which the game may be designed. Older adults have a unique set of deficiencies such as slower reaction times, slower cognition, slower movements, inability to perform fine motor tasks, and so forth. These deficiencies make them a unique group to design health games for, since they fall outside the standard healthy and abled definition and expectation of the game designers. The purpose of this section is to discuss each of the six dimensions of health and to paint a picture of some of the deficiencies that an older adult may have in that health dimension.

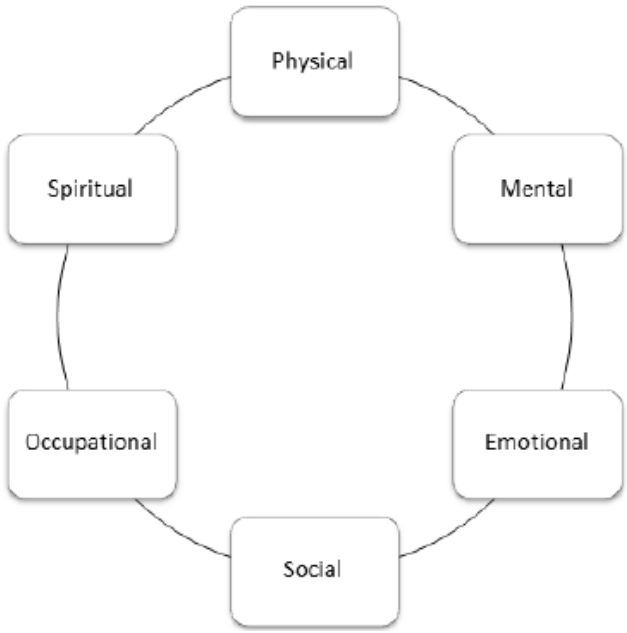

Figure 10. The Six Dimensions of Health.

Physical

Older adults in general tend to move slower, are unable to perform fine motor tasks because of a lack of dexterity, have hearing and visual impairments, and so forth, which makes the games designed for entertainment less accessible to them. Disorders such as strokes, muscular dystrophy and cerebral palsy reduce the older adult's ability to move even further. In these cases movement may be improved through exercise, and this is where health games can be beneficial. However, as has been noted previously the older adults ability may start at not being able to move at all and progress to full range of motion. If the purpose of the game is to physically rehabilitate them, then this entire spectrum of difficulty has to be considered during the game design. Hearing and visual impairments are often design criteria for health games for older adults. The level of audio should be adjustable to a comfortable level to the older adult. For visual impairment, simpler is best, in the sense that text should be large, and images should not blur into one another. These are but mere examples of some physical requirements that should be considered, and there are many more that depend on the typical disorders of older adults. Therefore, it is important to involve a health professional who works with these older adults on a daily basis as part of the game design team so that they may provide a realistic set of physical capabilities to be considered. The same is true for all of the dimensions of health.

Mental

Dementia is caused by various diseases that damage brain cells. Alzheimer's disease is the most common type of dementia. The Alzheimer's Association reports that "an estimated 5.4 million people have Alzheimer's disease that results in 183 billion dollars in annual costs" [98]. 1 in 8 older Americans have Alzheimer's disease, where older American is defined as an individual over the age of 65. Clinical symptoms of Alzheimer's include: difficulty remember

names and recent events, apathy, depression, impaired judgment, disorientation, confusion and so forth. Alzheimer's not only affects an older adult's mental state but also their ability to socialize with others and even emotional aspects of health since they experience changes in mood and personality. When designing a health game for an individual with Alzheimer's special care as to be given to the level of complexity for the game. The rules should be easy to understand and the instructions should be clear to follow, since typically these individuals will in mild cases have a short attention span.

Emotional

Geropsychology is a field within psychology that studies the affect that aging has on emotional, physical and mental states of older adults [99]. It is estimated that approximately 13.5 percent of older adults who require home healthcare suffer from depression [100]. Depression is the most common condition associated with suicide in older adults [101]. Depression is not a normal part of aging, especially when it starts to affect the ability of daily living. Individuals, who are depressed, have no desire to improve their lives and retreat from the world. Often they need to be incentivized to even play a game. This will influence the reward system of the game design.

Social

The 2000 Census revealed that 30 percent of older adults were living alone. Older adults are choosing to age at home, and often times this means that they live in social isolation. Therefore, health games need to be designed in such a way that the hardware architecture is easy to implement, since they will likely have to do it alone. There is great potential to involve these isolated older adults by involving them in social games, so that they may interact with their peers, community and family.

Occupational

The US census found that in 2008 the number of older adults, over the age of 65, in the labor force was 6.2 million individuals. It is projected that by the year 2016, this number will reach 10.1 million [102]. The median income of older adults in 2008 was $29,744. From this it may be deduced that older adults are working until later in life and yet have limited resources. Therefore, there is a desire to for health games to be cost effective and not cost an exorbitant amount.

Spiritual

The spiritual dimension is not only about religion, it is about spirituality and religion is a part of that for many people. MaKinlay defined spirituality as "that which lies at the core of each person's being, an essential dimension which brings meaning to life. Constituted not only by religious practices, but understood more broadly, as relationship with God, however God or ultimate meaning is perceived by the person, and in relationship with other people" [103][104]. Understanding ones meaning of life is at the core of who you are. This may vary from one person to another, and may influence the context in which a health game is designed. For example, older adults may be appalled to play a health game that requires them to kill their opponents, but they may like a health game where they served their opponent.

This dimension speaks to what the internal desires of the heart of the older adult when they play a health game. An example of a spiritual game may be *Praise Champion 2* [105].

What makes designing a health game complex, is the ability to recognize that older adults have specific needs in each of these six dimensions of health. If any of these special needs are not addressed or violated, then the older adult is likely to not engage with the health game, no matter whether it has been proven to have a health benefit or not. There is much development of health games that need to occur in order to fully comprehend the ever moving target of the dimensions of health in older adults.

Software Considerations

There are two main software considerations, those related to the practicalities of deployment and those related to the user interface and experience of the game. A shortcoming of many academic health game projects is that it is rare for a large population of the target users to have access to the finished product. While scientific validation of games via studies in the lab or in a few target communities can provide strong research contributions that inform future commercial games, it is a shame that so many games that could benefit the public at large remain unreleased. Even into the late 1990's, deployment of games to a wide audience, by those not associated with a large game studio or software company, was challenging. Deployment meant making your software available, in large quantities, on physical media, which required money, and distribution channels. However, the ubiquity of web browsers and broadband internet access has meant that now it is possible to provide the game experience to an unlimited number of users quite easily. In the past few years the creation of mobile "app stores" such as Apple's iTunes has meant that now it is possible to easily deploy mobile applications in a similar manner.

These easy distribution channels only work for games with traditional and simple software and hardware requirements (e.g. a generic computer and a WIMP interface, or a smart phone that typically uses touch-based interaction). Health games often require less-traditional interfaces, which are not as easy to make available to a large number of users. Fortunately, the recent surge of game consoles, which provide motion, gesture, and speech-based control, and an increase in the number of add-on sensors and devices for smartphones and consoles made possible through new wireless protocols such as BlueTooth, have meant that a health game that utilizes these relatively inexpensive, widely available input devices and sensors can provide a sophisticated interface and data collection. Lastly, there are numerous examples where a normal commercial game, not intended for health applications, has been studied, modified, and repurposed with health benefits in mind. These range from the use of first-person-shooter games, MMO, and arcade games for cognitive benefits (ex. *World of Warcraft* [42], *BoomBlox* [72]), to the introduction of Wii Sports games into elementary schools to promote fitness (e.g. *WiiFit* [52]). While this approach can be limiting (e.g. it may be difficult or impossible to modify the game, the game as designed might function in ways that are at odds with the health goals, the game genre and theming may not appeal to the target users), it can be worthwhile to leverage a game that already exists and that is widely available, as long as its benefits can be scientifically validated.

In short, the issue of how to deploy the software of a health game is an important one and must be considered early on in the design process as it can have a major impact on the choice

of platform, software development tools, and user interface. It is not the case that every health game research project must be made available to thoUSnds of users in order to contribute to the field, but the field will benefit from an increased focus on making the work available to target users.

The user experience and interface of a health game is critically important to its success. Some interface guidelines can be gleaned from the large body of research on non-game interfaces for older adults [106] that capture the sensory, perception, and motor issues that a developer must be aware of. However, these guidelines do not address game-centric issues. Creating a game with the necessary ingredients to affect cognitive change is only the first challenge. The scientifically proven interventions often require extensive time commitment and focus of attention from the user [??]. Not unlike physical exercise, health games of all types require participants to push themselves, working at the limits of their abilities for as long as possible. Therefore, a game intervention must not just be palatable to the player, it must be sufficiently compelling that the player will be willing to devote significant time to it, even when they are not part of a research study. The design of computer games that are both compelling and accessible to older adults is an under-explored area [82]. There is a need to study the dimensions of participant enjoyment, accessibility of input devices, and understanding of game mechanics. A health game that no one wants to play will not be effective. For example, as part of a cognitive intervention study of Nintendo's *BoomBlox* (a motion-controlled 3D puzzle game) [72] the researchers identified eight general game design guidelines informed by qualitative (video/audio coding, questionnaires) and quantitative analysis of participants over 65 years old playing the game:

- *Obvious interactions.* Strive to make it clear, via visual/auditory design and affordances, to the player, what parts of the interface are decorative, which are meaningful to game play, and which can be interacted with directly. It might also be necessary to provide extra feedback regarding *how* to interact with the active elements in the game world.
- *Playful content.* Older gamers are interested in fun playful content and can be motivated by compelling visuals and sounds. However, the theming should be familiar and not patronizing.
- *Multi-modal instructions.* Clear instructions should be presented in multiple ways throughout game play. Consider using visuals rather than just text.
- *Accessible motion control.* The role-play aspect of motion control is fun for many older players, but there is a possibility of fatigue and pain after extended play. The motions must be designed carefully, considering differeing physical abilities and should leverage real-world experience. Feedback is needed to help the players learn the motions.
- *Time for planning.* The game should give the player time to survey the situation and plan before starting a new level/puzzle/mechanic in to encourage strategic play.
- *Leverage experience.* When possible the game should leverage the player's knowledge of the real world. This allows them to utilize their intuition about how the game world operates and helps them understand how success is defined in the game.

- *Clear goals.* Provide clear goals/win conditions so players can gauge their progress. The score keeping should be accessible and grounded in reality when possible. Many levels of achievement will provide frequent milestones for the player to meet.
- *Expose difficulty level.* The game should be explicit about the current difficulty of the game and make changes transparent.

However, it is difficult to provide a single definitive set of quantitative guidelines related to older adult user experience and game design as the goals of the game, the genre, the interface, etc. are all variables that must be considered. Therefore, there is a need for more researchers to include play-testing techniques and user evaluation/engagement measures in their studies.

Hardware Considerations

The hardware choices made when designing a game have a big impact on some aspects of the game, from how the graphics processor and CPU affect the rendering graphics and physics modeling, to the types of physical input and interactions available to the player. One of the first choices to make relates to the "console" system choice; this can be one of the commercial gaming systems such as the Nintendo Wii [107], Sony Playstation [108], or Xbox [67], a general purpose PC or laptop, or even a tablet or smartphone. A second choice to be made is related to the input device or devices that should be used with the game. In some cases the input device could be the overriding concern for a game, driving the console or other hardware considerations. In other cases, such as with a tablet or smartphone, the input device might be the touch screen of the device itself and not even a second hardware device.

Main Console or Processing System

The hardware capabilities of modern gaming systems are quite advanced with respect to graphics rendering and other processing, so the main consideration when making this choice is likely to be related more to the software interfaces and licensing that are required. This can make using a personal computer (PC) a good choice by providing more flexibility in that area. If portability or ease of installation are important, tablets and smartphones make sense. These devices have processors that rival desktop PCs and they are completely self-contained. One key issue when considering a tablet or smartphone is its compatibility with external input devices, since only a small number of input devices are currently compatible. The choice of console, PC or tablet also has an impact on the software that can be used to create the game since many of them have only a limited set of software development environments available.

Input Devices

Gaming hardware has changed over the years, but one of the most interesting areas of change is in the input devices available. From the Wiimote or Wii Motion [107] to the Kinect [67], the systems are allowing for new ways of interacting physically with the games people are playing. In previous years, designing a game for older adults might mean designing and building a special input device to accommodate limited mobility, but these recently released input devices are useful to consider due to their ubiquity and low cost.

Motion monitoring remotes like the Nintendo Wiimote [107] or the Sony Playstation Move [108] contain accelerometers and other technologies to assess the game player's motion and then relay this information to the game console wirelessly.

The Wiimote Plus also contains rate gyros to gather more accurate information about rotational movements of the remote. It contains an infrared camera on the remote itself to measure the position and orientation of the remote relative to the IR LEDs on a bar near the game console. The Sony Playstation Move detects information about the relative location of the remote by tracking the location of a ball on the remote containing LED lights with a camera connected to that console.

The Kinect works by tracking the player with cameras in a device that is stationed near the console. It projects an infrared pattern on the player that can be tracked by a camera at a fixed distance from the projector. It also contains microphones and a visible camera to gather further information about the player's actions.

The capacitive touch screens of tablets and smartphones are also a relatively new input system available to games. These touch screens require the player to be able to physically touch the screen area, but depending on how the game is designed, this input can be range of gross motions to highly accurate screen location selections.

How this Fits with Older Adults

These newer technologies are interesting in relation to older adults due to the more natural interaction they allow from the player with the game. They move beyond the joysticks and buttons of past game inputs by tracking the motions of the players.

For players experiencing difficulty making delicate motions these systems can record the more deliberate motions of the players hand, arm, or entire body. While the Wiimote can be used to recognize gestures that are sports related, like swinging a racket or hitting a ball, they also can be used to detect motions that are slower. The Kinect allows for tracking the arm and body movements of players, which again can be useful for players who have difficulty with precise motions, but also avoid the need to hold a device. This is important for anyone with hand impairment. The Kinect also has cameras with the ability to do face tracking, as well as the capability to record audio for use in the game.

Touch screens are generally thought of input devices where high accuracy is expected, but they can be used as gesture tracking devices where the screen position is less important than the overall motion. They also can track multiple touches at the same time, opening up new possibilities for games involving multiple finger or hand motions.

Pros and Cons to Older Adults

When comparing systems like the Wiimote versus Kinect, there are some aspects of each that are better than the other. While the Kinect makes it easy to track body position and posture, it is less accurate at tracking gestures, slight motions or orientation of a player's limbs. The Kinect can detect and calculate joint locations of a player's limbs and detect the location and distance of the player's face, but has difficulty accurately estimating the location and motions of the hand. The accelerometers and rate gyros of the Wiimote allow for gesture recognition that can be important to assessing the motions of the player. These gestures are accurate on a short time scale, but are harder to use to calculate the global position of the player or even the player's hand over longer time scales like seconds; this can be important when the player is elderly and the game allows for longer times to accomplish tasks.

Something else to consider when comparing the Wiimote with the Kinect is the aspect of holding something tangible like the Wiimote and monitoring the body motions using the Kinect. In some cases it can be helpful to have the player actually hold the device. Games where the player is manipulating a virtual piece of hardware on the screen like a stick or bat can feel more natural to the player when they are moving something tangible in their hand. Kang et al. devised a game for older adults where the interaction with tangible objects was a main component of the interface [109]. This required creating a specialized piece of hardware that allowed the player to swing a stick similar to a crochet bat and strike a ball connected to an arm that allowed it to rotate around an axis and measure the impact.

Availability and Cost

It is hard to beat the availability and cost of input devices that are manufactured to work with the current game consoles manufactured. One-of-a-kind input devices like the sensory gate system explained above are expensive and unlikely to be manufactured in the quantities required to bring the price down significantly.

The Wiimote is one of the first complex sensory input devices to be available off-the-shelf at a relatively cheap price. This device is also well characterized, with the ability to connect to computers other than the Wii console itself. This is an important consideration when constructing a game that is not intended to be sold in the numbers needed to be sold through game company channels.

While more expensive than the Wiimote as an input device, the Kinect system is also available now and the cost is low when compared to other body tracking systems. There are a number of ways to use the Kinect device apart from its designed interface with the Xbox 360, from the initial hacking of the interface immediately after its release, to the API provided by Microsoft. This allows for a number of new ways to use the system in the design of specialized games.

Other input devices such as the big trackball used in the sensory gate-ball game are expensive, but are worth considering if they are useful to overcome the problems of older adults dealing with more complicated devices with small buttons for setup and use [109].

Choosing a tablet or smartphone as the hardware system for a game provides a compact, portable and easy manner to setup the game environment. Since the tablet or smartphone most likely contains all of the hardware components all in one unit, this also may make it a cost-effective platform for the game.

The hardware choices made when designing a game can have a big impact on how easy it is to interact with a game, how fast and accurate the graphics are, as well as what sensory elements are available to the player, so it is important to consider them carefully. It is also important to consider some of the advances made recently when it comes to input devices, as many of the changes not only make input devices faster and more accurate, but they also open up new avenues for player interactions that are especially important when creating games for the elderly.

Policy Considerations

Currently there is no Food and Drug Administration (FDA) or any other federal regulations that video games have to adhere to, in order to substantiate their claims. In a first

of its kind, *Brain Game* has sought FDA approval for a game that they developed for people with schizophrenia to improve their attention and memory [110]. Currently there is a political debate under way as to whether or not FDA approval for computer games would be beneficial. Some believe that a stamp of approval from the FDA would add integrity to the controversial industry that is health games. The jury is still out on whether or not there need to be policies in order to regulate the claims made by therapeutic health games. Any policy decisions should be made carefully, as they could have significant impact on the future development and potential impact of therapeutic games.

FUTURE WORK

While extensive work is already underway in this domain, there are areas that require more attention to future work. First there is a need for more efforts in the public policy realm. There are still decision makers and members of the public that view video games as trivial and wasteful. It is important to help people outside of the research world to understand that there can be real quantifiable health benefits from playing games. This is also important in terms of practical issues such as future research funding and health insurance reimbursement. Secondly, there is a need for an even greater focus on scientific validation of health games, especially commercial games developed in industry. Just as other health related products, such as supplements, weight loss programs, homeopathic remedies may present health claims that are not validated; there are games, which are marketed as having health benefits that may not be proven. This is a complicated issue with many solutions including FDA approval of certain health games. However, just as with other health products, one solution may be to improve education in our society, helping people understand the issues related to health and therapy, producing citizens who are informed about current research, the scientific basis underlying health game designs, and a consciousness of which products have been scientifically validated.

Finally, as discussed in the software considerations, it is critical that researchers being to pay more attention to individual users and their experiences, behaviors, and strategies within the health games. While much effort is being put towards understanding the types of activities that result in positive health changes, less thought is given to the game design and player experience. The player can be viewed as an interchangeable part in the machine that is a therapeutic intervention, with little of the investigation focusing on how varying player personalities, attitudes toward games, and their responses to game mechanics and design elements might affect their experience and, thus, their cognitive outcomes. The philosophy can be that if you present someone with a proven therapy then they will engage with it thoroughly and in the ideal manner of the required time in order to achieve results. Whitlock et al. found the massively multiplayer online role playing game *Word of Warcraft* to yield cognitive benefits in older players [21, 42], yet the participants struggled with the game mechanics, interface, and theming. The *Lumosity* team highlights the critical role that engagement and reward play in effective brain games [68]. Also, Hansen et al. note that it is critical for technology design to address older adults' values and not just their USbility requirements [111]. The realities are that, given the amount of time players must engage with these games in order to achieve results, people many not get the maximum value out of these

interventions if they are bored, frustrated, unmotivated, or if they play the game in an unintended manner.

CONCLUSION

There is much still to be learned from the design and implementation of health games. This interdisciplinary effort has many challenges to face in order to produce optimal patient-centered health games that have positive health outcomes. This chapter has suggested a taxonomy that may be used by the medical community, game designers, hardware designers, policy makers and patients to describe the health games that they are designing or using. This taxonomy is not meant to be an exhaustive list of all possible dimensions of health games, but instead a first pass at creating a language to facilitate communication between all interested stakeholders. Furthermore, this chapter discussed briefly the current state of the art and challenges that each of the interested parties face. There is an ever increasing need to develop monitoring and assessment systems to manage the health of older adults as they age at home. Health games can make a difference in the lives of older adults in a fun and engaging manner, and keep them connected with their family, friends and community.

REFERENCES

[1] G. Demiris, M. J. Rantz, M. A. Aud, K. D. Marek, H. W. Tyrer, M. Skubic and A. A. Hussam, *Med. Inform*. 29, 2 (2004).
[2] R. Y. W. Lee and A. J. Carlisle, *Age and Ageing* (2011).
[3] E. Sardini and M. Serpelloni, *Eurosensors Conference* (2010).
[4] F. Bianchi, S. J. Redmond, M. R. Narayanan, S. Cerutti and N. H. Lovell, *I. E. E. E. Transactions on Neural Systems and Rehabilitation Engineering* 18, 6 (2010).
[5] Leone, G. Diraco and P. Siciliano, *Medical Engineering and Physics* 33, 6 (2011).
[6] Gomez-Conde, D. N. Olivieri, X. A. Vila and L. Rodriguez-Linares, *Sistemas Y. Technologias De Informacion* (2010).
[7] S. T. Londei, J. Rousseau, F. Ducharme, A. St-Arnaud, J. Meunier, J. Saint-Arnaud and F. Giroux, *Journal of Telemedicine and Telecare* 15, 8 (2009).
[8] Mallick, et al.*American Journal of Medicine* 122, 9 (2009).
[9] S. D. Reed, Y. Li, E. Z. Oddone, A. M. Neary, M. M. Orr, J. M. Grubber, F. L. Graham, M. K. Olsen, L. P. Svetkey, R. J. Dolor, B. J. Powers, M. B. Adams and H. B. Bosworth, *American Journal of Hypertension* 23, 2 (2010).
[10] E. Sardini, M. Serpelloni, Eurosensors XXIV Conference 5 (2010).
[11] L. Klack, T. Schmitz-Rode, W. Wilkowska, K. Kasugai, F. Heidrich and M. Ziefle, *Annals of Biomedical Engineering* 39, 12 (2011).
[12] M. Ogawa, S. Ochiai, K. Shoji, M. Nishihara and T. Togawa, *Proceedings of the 22nd Annual International Conference of the IEEE EMBS* 22 (2000).
[13] Y. H. Wu, V. Faucounau, M. Boulay, M. Maestrutti, A. S. Rigaud and V. Quo, *Health Informatics Journal* 17, 1 (2011).
[14] K. Schilling, *2009 ICICI BME* (2009).

[15] P. Rai, P.S. Kumar, S. Oh, H. Kwon, G. N. Mathur and V. K. Varadan, *Nanosensors, Biosensors, and Info-Tech Sensors and Systems Proceedings of S. P. I. E*. 7980 (2011).
[16] C. C. Chiu, T. W. Shyr, H. C. Chu, Y. C. Chung and C. Y. Lan, *World Congress on Medical Physics and Biomedical Engineering* 14 (2007).
[17] M. Cole and B. Q. Tran, *Proceedings of the Second Joint EMBS/BMES Conference Houston Texas*, (2002).
[18] K. Morrow, C. Docan, G. Burdea and A. Merians, *Proceedings of Virtual Rehabilitation, International Workshop* (2006).
[19] D. J. Reinkensmeyer, J. L. Emken and S. C. Cramer, *Annual Review of Biomedical Engineering* 6, (2004).
[20] E. T. Khoo, T. Merritt and A. D. Cheok, *Interacting with Computers* 21, (2009).
[21] L. A. Whitlock, A. C. McLaughlin, *Thirteenth Cognitive Aging Conference* (2010).
[22] E. Ayers, *The Gerontological Society of America* (2009).
[23] D. A. Sparks, L. M. Coughlin and D. M. Chase, *The Journal of Family Practice* 60, 7 (2011).
[24] K. Carollo, ABC Good Morning America, at: *http://abcnews.go. com/Health.*
[25] D. M. Berwick, *Health Affairs* 28, 4 (2009).
[26] L. L. Berry, *Organizational Dynamics* 33, 3 (2003).
[27] E. K. Hollander and H.R. Plummer, *Activities, Adaptations and Aging* 8, 1 (1986).
[28] Business Wire, (1998) at: *http://findarticles.com/p/articles/mi_m0EIN/is_1998_Oct_12/ai_53074401/.*
[29] G. Riva, *Cybertherapy: Internet and Virtual Reality as Assessment and Rehabilitation Tools for Clinical Psychology and Neuroscience*, Amsterdam: I. O. S. Press.
[30] L. Hall, S. Woods and K. Dautenhahn, *Proceedings of the 13th I. E. E. E. on Robot and Human Interaction Communication*, ROMAN (2004).
[31] G. Saposnik, *Stroke* 41, (2010).
[32] L. R. Harley, M. Gandy, S. Robertson, S. D. Harbert and D. F. Britton, *H. C. I. International* (2011).
[33] J. Difede, *CyberPsychology and Behavior* 5, 6 (2002).
[34] McLaughlin, M. Gandy, J. Allaire and L. Whitlock, *Ergonomics in design: the quarterly of human factors applications* 20, 13 (2012).
[35] F. Zwicky, *New Methods of Thought and Procedure*, Springer-Verlag, New York (1967).
[36] S. K. Card, J. D. Mackinlay and G. G. Robertson, *A. C. M. Transactions on Information Systems* 9, 2 (1991).
[37] J. Alvarez, D. Djaouti, R. Ghassempouri, J. Jessel and G. Methel, *Proceedings of the 3rd Australasian conference on Interactive entertainment* (2006).
[38] F. Zwicky, *The Observatory* 68, 845 (1949).
[39] T. Ritchey, *Proceedings of the 5th European Conference on Information Systems* 3 (1997).
[40] T. Fullerton, Published by C. M. P. Books (2004).
[41] *Solitaire*, developed by Microsoft, (1990).
[42] *World of Warcraft*, developed by Blizzard Entertainment, (2007).
[43] *Mario Kart: Double Dash!!*, developed by Nintendo Entertainment Analysis and Development, (2003).
[44] *Minecraft*, developed by Markus Persson, (2009).

[45] *The Sims*, developed by Maxis, (1996).
[46] *Lord of the Rings Online*, developed by Turbine Inc., (2007).
[47] E. T. Khoo and A. D. Cheok, *The International Journal of Virtual Reality* 5, 2 (2006).
[48] B. Hettler, *National Wellness Institute*, (1976).
[49] K. A. Madsen, S. Yen, L. Wlasiuk, T. B. Newman and R. Lustig, *Archives of Pediatrics and Adolescent Medecine* 161, 1 (2007).
[50] *Dance Dance Revolution*, developed by Konami, (1998).
[51] *Brain Age*, developed by Nintendo Software Planning and Development for Nintendo D. S., (2005).
[52] *WiiFit*, developed by Nintendo, (2007).
[53] *Yourself! Fitness*, developed by Portland, (2006).
[54] B. Stover, *Games for Health, Boston, M. A.* (2010).
[55] J. Broeren, M. Georgsson, M. Rydmark and K. S. Sunnerhagen, *Proceedings of the 4th International Conference on Disability, Virtual Reality and Associated Technologies* (2002).
[56] *Glucoboy*, developed by Guidance Interactive for Nintendo, (2007).
[57] S. N. Merry, K. Stasiak, M. Shepherd, C. Frampton, T. Fleming and M. F. G. Lucassen, *B. M. J.* 344 (2012).
[58] S. Sharar, *S. P. A. Annual Meeting, Chicago, I. L.* (2006).
[59] MedlinePlus, at http://*www.nlm.nih.gov/medlineplus/games.html.*
[60] L. Gamberini, L., L. Breda and A. Grassi, *H. I. C. '07, Beijing* (2007).
[61] Reach Out Central, (2005).
[62] Rizzo, B. Newman, T. Parsons, J. Difede, G. Reger, K. Holloway, G. Gahm, R. McLay, S. Johnston, B. Rothbaum, K. Graap, J. Spitalnick and P. Bordnick, *I. E. E. E Explore: Virtual Rehabilitation*, (2009).
[63] P. M. Bingham, J. H. T. Bates, J. Thompson-Figueroa and T. Lahiri, *Clinical Pediatrics* 49, (2010).
[64] Interactive Media Center at the Georgia Institute of Technology, *Food for Thought Currently under development* (2012).
[65] Z. Zafrulla, Z., H. Brashear, H. Hamilto and T. Starner, *I. E. E. E. Conference on Computer Vision and Pattern Recognition* (2010).
[66] *ElderQuest*, developed by Brainstorm Rising, (2010).
[67] Kinect, released for Xbox 260, (2010).
[68] *Lumosity*, developed by Lumos Labs, (2007).
[69] *FearNot!*, developed by V. I. C. T. E. C. T. (Virtual Information and Communication Technologies with Empathetic Characters), (2002).
[70] *Re-hand*, developed by Re-hand team at Georgia Tech, under development.
[71] H. Noice and T. Noice, *Current Directions in Psychological Science* 15, 1 (2006).
[72] *BoomBlox*, developed by Amblin Interactive, (2008).
[73] *Captain Novolin*, developed by Sculptured Software, (1992).
[74] *FarmVille*, developed by Zynga, (2009).
[75] *Words with Friends*, developed by Zynga, (2009).
[76] *Draw Something*, developed by Omgpop, (2012).
[77] M. Madden, *Pew Center* (2010).
[78] PopCap Games Information Solutions Group, *2010 Social Gaming Research* (2010).
[79] P. M. Kato, S. W. Cole, A. S. Bradlyn and B. H. Pollock, *Pediatrics* 122, (2008).

[80] D. Miller, E. Poole, Y. Xu, E. Eiriksdottir, D. Kestranek, R. Catrambone and E. Mynatt, *Proceedings of the 2012 A. C. M. Conference on Computer Supported Cooperative Work* (2012).
[81] *FitBit*, developed by FitBit Inc., (2008).
[82] H. H. Nap, Y. A. W. de Kort and W. A. Ijsselsteijn, *Gerontechnology* 8, 4 (2009).
[83] *Keas: Emplyee Wellness Program*, developed by Keas, (2012).
[84] S. Bender, *Schizophrenia Research* 60, 1 (2003).
[85] *Lit2Quit*, developed by Columbia University, (2011).
[86] M. Lumbreras and J. Sanchez, *Proceedings of the 3rd International Conference on Disability, Virtual Reality and Associated Technology,* (2000).
[87] *Pikmin*, developed by Nintendo E. A. D., (2001).
[88] *StarCraft*, developed by Blizzard Entertainment and Mass Media Interactive, (1998).
[89] *Q. W. O. P.*, developed by Bennett Foddy, (2008).
[90] *Peggle*, developed by PopCap games, (2007).
[91] *Bejeweled 2*, developed by PopCap games, (2004).
[92] L. Gamberini, M. alcaniz, G. Barresi, M. Fabregat, F. Ibanez and L. Prontu, *Psychology Journal* 4, 3 (2006).
[93] H. B. Jimison, M. Pavel, J. McKanna and J. Pavel, *I. E. E. E. Transactions on Information Technology in Biomedicine* 8, 3 (2004).
[94] *Mario Kart*, developed by Nintendo and Retro Studios and Namco, (1992).
[95] *Rock band*, developed by Harmonix Music Systems, (2007).
[96] R. A. Bjork, In *Attention and performance XVII. Cognitive regulation of performance Interaction of theory and application* Cambridge, M. A.: M. I. T. Press (1999).
[97] *Flow*, developed by Thatgamecompany and Super Villian Studios, (2006).
[98] Alzheimer's Association, *Alzheimer's and Dementia* 7, 2 (2011).
[99] American Psychological Association, *Psychology and Aging* (2012).
[100] C. F. Hybels and D. G. Blazer, *Clinics in Geriatric Medicine* 19, (2003).
[101] Y. Conwell and D. Brent, *International Psychogeriatrics* 7, 2 (1995).
[102] US Bureau of Labor Statistics as cited in the Statistical Abstract of the United States: 2010 at http*://www.census.gov/compendia/statab*.
[103] E. B. MacKinlay, *London: Jessica Kingsley Publishers,* (2001).
[104] E. B. MacKinlay, *The Haworth Press, Inc.*, (2006).
[105] *Praise Champion 2*, developed by Inspired Media Entertainment, (2010).
[106] D. Fisk, W. A. Rogers, N. Charness, S. J. Czaja and J. Sharit, *Older Adults: Principles and creative human factors approaches (2nd Ed.)* Boca Raton: C. R. C. Press.
[107] Nintendo, "Wii" http://*www.nintendo.com/wii*.
[108] "PlayStation®Move Motion Controller - PlayStation®3 Move Info, Games and Updates." at http://*us.playstation.com/ps3/playstation-move/*.
[109] K. Kang, J. Kim and D. Kim, *The Visual Computer* 25, 12 (2009).
[110] S. Gupta, *NewScientist* 13, 19 (2011).
[111] V. L. Hanson, L. Gibson, A. Bobrowciz and A. MacKay, *ACM CHI*, Atlanta, G. A. (2010).

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Chapter 4

THE GLOBALED 2 GAME: DEVELOPING SCIENTIFIC LITERACY SKILLS THROUGH INTERDISCIPLINARY, TECHNOLOGY-BASED SIMULATIONS

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ABSTRACT

GlobalEd 2 (GE2) is a set of technology-mediated, problem-based learning (PBL) simulation "games" for middle grade students that capitalizes on the multidisciplinary nature of the social sciences as an expanded curricular space for students to learn and apply scientific literacies and concepts, while simultaneously also enriching their understanding of the social sciences. This chapter reports the results of pilot implementations of the GE2 simulations focused on water resources and climate change with ~1400, 7th and 8th grade students from both suburban and urban school systems. Results indicate positive changes in the quality of their written scientific explanation, interest in pursuing future science educational opportunitiesand science knowledgeafter participating in a GE2 simulation. Further results indicate that implementation fidelity was correlated with positive gains in student outcomes with high fidelity yielding very high outcomes and low fidelity yielding low to no gains.

Traditional science instruction has tended to construe science teaching as the transmission of knowledge through the delivery of information from teacher to student [Aydeniz and Hodge, 2010; Kolodner et al., 2003; Taylor, Gilmer and Tobin, 2002]. Amid

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growing concerns that traditional pedagogical approaches to science education were failing to prepare students adequately for the demands of the 21st century, The National Research Council (NRC) released the *National Science Education Standards (NSES)*.The intent of these standards was to shift the emphasis in the teaching of science away from rote memorization and de-contextualized experiences to the development of concepts, processes and skills that promote scientific literacy in our nation's students. Scientific literacy is achieved when:

> "A person can ask, find, or determine answers to questions derived from curiosity about everyday experiences.... Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed… Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately" [NRC, 1996, p. 22].

Further, scientific literacy involves much more than just content knowledge. It involves critical thinking, cognitive and metacognitive abilities, collaborative teamwork and the effective use of technology to solve problems, engage in logic and scientific discourse around global issues, synthesize disparate concepts and persuade others to take informed action based on scientific evidence [Hand et al., 2010; Hurd, 1998; Webb, 2010]. These conceptions of scientific literacy are echoed to the new common core for the next generation of science standards proposed by the College Board [Vasavada, et al., 2010].

These skills also parallel those employed in the authenticwork of 21st century scientists [Chinn and Malhotra, 2002; Newcombe, et al., 2009; Schwartz, et al., 2004]. Contemporary scientists need to be able to bring their knowledge, insights, and analytical skills to bear on matters of public importance. Often they can help the public and its representatives understand the likely causes of events (such as natural and technological disasters) and to estimate the possible effects of projected policies (such as the ecological impacts of various water conservation methods). In playing this advisory role, scientists are expected to be especially careful in distinguishing fact from interpretation, and research findings from speculation and opinion [Millar and Osborne, 1998; Monk and Osborne, 1997], as are the citizens who are consuming this information to develop their own positions – the essence of a scientifically literate citizen [NRC, 2011].

However, in report after report, it is alarmingly clear that our educational systems are failing to prepare students to meet the demands of the 21st century (e.g., Borgman et al., 2008; NRC, 2006; US Department of Labor, 1991). For example, recent standardized test results indicate that only 21% of twelfth-graders performed at or above the Proficient level in science [NAEP, 2009]. Our ranking internationally on the scientific literacy of our students, measured on tests like PISA, has rapidly fallen [NCES 2011]. Data from the National Center for Education Statistics [2010] indicate that only 17.4% of high school students engage in coursework beyond the compulsory level. Moreover, the decline in science course participation and achievement is even more pronounced in female students [Beghetto 2006] and Black and Hispanic students [Rascoe and Atwater, 2005; Sorge, Newsom and Hagerty, 2000].

In a review of more than 1000 articles related to students' participation in science, Tytler, et al. [2008] concluded that policies aimed at requirements to get students to take more

rigorous programs in science, or creating a standardized progression of courses, will not necessarily lead to an increase in science achievement or curriculum participation. Rather, these authors argued that increasing interest in these subjects and demonstrating their utility to students in their current and future roles would likely yield greater dividends. In science, compared to other subjects, students' interest has decreased dramatically over time [Todt and Schreiber, 1998]. Lack of interest in science is of particular concern among middle school students, since it is in these years that attitudes regarding engagement science courses and future science-based careers are formed [Speering and Rennie, 1996]. In their 2010 reports, the Presidents' Council of Advisors on Science and Technology (PCAST) and the National Science Board (NSB) both echoed this sentiment stating that in order to effect real change in science education, interest must be at the forefront and be addressed early in students' school-based experiences. When asked about their lack of interest in science, the most common response from students tends to point to disenchantment with the pedagogical practices used to teach science in formal school settings and the lack of relevance school based science has in their everyday lives [Holbrook, 2010; Hurd, 1998; Lindahl, 2003; Osborne and Collins, 2001].

Theory of Change

Our theory of change stems from Bandura's model of Reciprocal Determinism [Bandura, 1986]. Within this framework, students are neither driven by inner forces nor automatically shaped and controlled by external stimuli. Rather, learning is explained in terms of a model of triadic reciprocity in which behavior, personal factors, and environmental events all operate as mutual determinants of each other [Pajares, 1996].

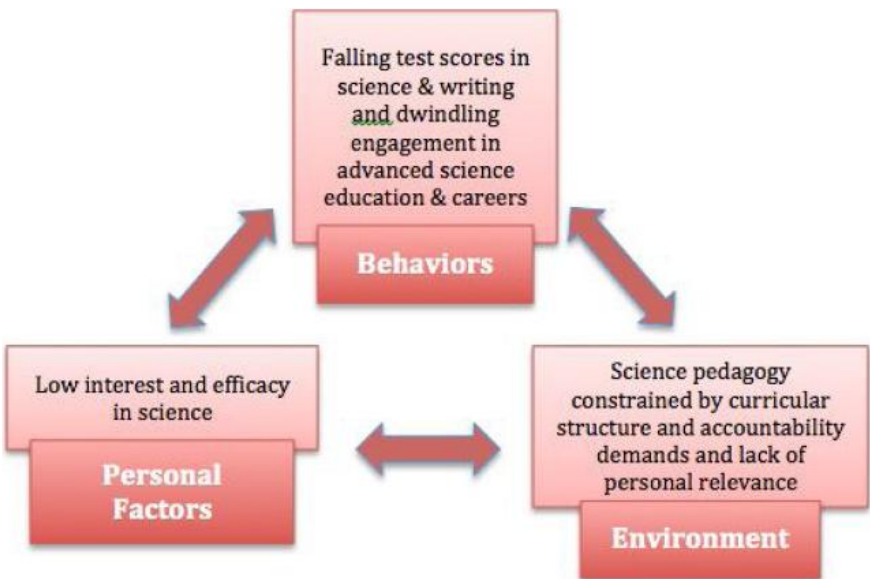

Figure 1. Model of Current Issues in Science Education According to Triadic Reciprocity.

As depicted in Figure 1, poor performance and low engagement in science (behaviors) both contribute to, and are effected by, low student affect in science (personal factors), which is further influenced by constraints on the pedagogical approaches to teaching of science and lack of personal relevance of the content being taught (environment). Research has shown that effecting positive change in this systemic model of learning requires changes across all three interacting elements [Zimmerman, 1989].

From this perspective, to increase science achievement and engagement and reach the goal of a scientifically literate citizenry, we must develop new venues within our schools to engage students in science that nurture students' interest in science by implementing pedagogical approaches that incorporate a real world rationale for the importance and personal relevance of science.

In order to accomplish this, it has been argued that science education needs to be grounded in meaningful socio-scientific contexts [Anderson, 2002; Sadler, 2011; Sadler et al., 2007]. Socio-scientific issues are complex in nature and often do not have a single clear-cut solution.

Such issues confront students with situations in which they have to engage in formulating their own stances based on data, their own experiences and values, and collaborative decision-making. They are regarded as real-world problems that afford the opportunity for students to participate in the negotiation and development of meaning through scientific argumentation promoting epistemic, cognitive, and social goals, as well as enhancing students' conceptual understanding of science [Chinn and Malhotra, 2002; Osborne, et al., 2001; Schwartz, et al., 2003].

Unfortunately, inquiry-based approaches to teaching and learning science that involve socio-scientific issues are not often employed within typical science classrooms [Chinn and Malhotra, 2002; Driver et al., 1996; Taber, 2008; Turner, 2008]. The lack of socio-scientific inquiry tasks in science classrooms likely results from fact that the shift in the science standards towards scientific literacy and related pedagogical reform was set forth without commensurate alteration of the curricular space devoted to the teaching of science in the schools [Sadler, et al., 2007]. Inquiry-based curricula, especially programs that immerse learners in active investigations of contemporary issues, can consume significant chunks of classroom time. Given the standardized test-driven culture of today's educational system, the allocation of scarce instructional time and resources is a major concern for both teachers and administrators [Sadler, et al., 2006]. Further, research on science teachers has found that they feel under prepared and often lack the confidence necessary to implement and manage socio-scientific inquiry within the science classroom context [Alozie, 2010; Bartholomew et al., 2004; Bennett et al., 2005; Levinson and Turner, 2001]. So, while it appears that we know what to do develop a scientifically literate citizenry and address dwindling science interest and participation among our students in STEM, we are simply not doing it as much as we should or could.

Rather than compete for the already overburdened curricular space devoted to science instruction, GlobalEd2 (GE2) expands the curricular space afforded to the teaching of science by building upon the interdisciplinary nature of the social sciences. PBL researchers have illustrated that leveraging interdisciplinary contexts, like the social sciences, as a venue to engage in real world problem solving can deepen students' understanding, flexibility in application and transfer of knowledge [Jonassen, 2009; Koschmann, et al., 1996; Mergendoller, et al., 2000; Strobel and Barneveld, 2009]. Because PBL consists of a

presentation of authentic problems as a context for learning, it increases student motivation and integration of knowledge [Pease and Kuhn; 2010]and when working cooperatively in groups within a PBL environment, students learn how to plan and determine what they need to solve problems, pose questions, and decide where they can get these answers as they make sense of the world around them [Hmelo-Silver, 2004].

How Globaled 2Works

GlobalEd2 (GE2) is a set of socio-scientific, role-playingsimulations that capitalize on the multidisciplinary nature of *social studies* as an expanded curricular space to engage middle school students with science-based content. Making use of an Oracle-based Internet communications system and a simulation-specific, web-based research environment, GE2 links classrooms of students, otherwise isolated from one another by physical distance and socio-economic boundaries, in synchronous and asynchronous communications. The simulations for GE2 are based on the general PBL principles and design components of Goodnough and Hung [2008], Jonasssen, [2009]; Koschmann et al., [1994], Savery and Duffy [1996], and Greening [1998], which stated that the PBL environment must:

- Anchor the learning activities to the larger task or problem presented in the situation;
- Support the learners in developing ownership and control over the problem;
- Be based on authentic, real-world, global problems;
- Be challenging;
- Provide alternative views and solutions; and
- Require the students to reflect on both the content and the process.

Further, GE2 is consistent with the *How People Learn* (HPL) framework [Bransford, et al., 1999], incorporating what the research base illustrates are important elements of successful learning environments (e.g., knowledge, student, assessment and community centers). Both the PBL design and HPL framework are unpacked below through the description of GE2 and its instructional components.

Within each GE2 simulation, approximately 12-18 middle-school classrooms are recruited and assigned to represent specific countries (role play). Each classroom is assigned one country to represent throughout the simulation. The countries are carefully selected by GE2 staff to maintain diversity across economic development, geography, political structures, and centrality to the science issues being discussed in the simulation. This diversity provides an opportunity for students to experience global science issues from a wide variety of perspectives (i.e., geographic, economic, cultural, political).

Each simulation is supported by a set of three curricular components:

a) The problem scenario;
b) The simulation resources and materials; and
c) Four issue areas within the simulation.

The problem scenario is a document that provides background information about a current problem somewhere (or multiple places) in the world with specific scientific details that would lead the participating countries in the simulation to have to take timely action. It sets the common context for all the countries in the simulation, anchoring interactions among students. The scenario details are scientifically accurate and present data about the situation in multiple formats (i.e., text, photos, video, tables and charts) related to concerns the countries will be facing in the very near future. The scenario is set six months into the future to minimize social and scientific events that may occur during the GE2 simulation. The scenario is provided to the students participating in the simulation during the first phase of the simulation so that they can research their country's policies and positions, learn further about the science concepts associated with the scenario, prepare their positions and plan a strategy for addressing the problem.

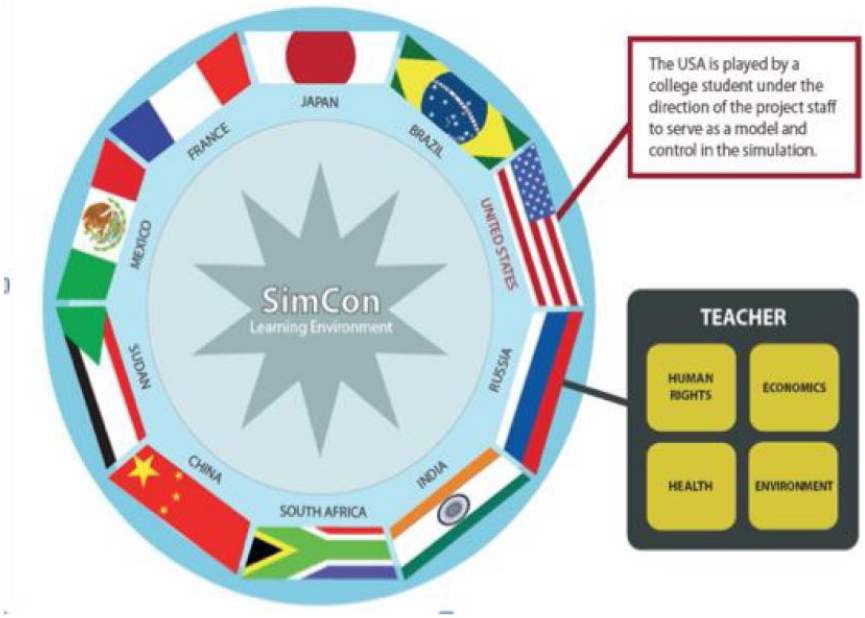

Figure 2. The GE2 Environment.

The resources and materials for each simulation consist of documents, online sources and websites pertaining directly to various aspects of the problem scenario, as well as country resources, provided on the GE2 website. For example, in the water resources scenario, materials report actual data on water consumption, pollution, irrigation, and access to fresh, clean water, as well as the issues currently facing each of the countries involved in the simulation. Students are also availed the opportunity to interact with experts outside the classroom and simulation structure, through podcasts and interactive online sessions. These experts include environmental scientists, political scientists and individuals who have first-hand knowledge of the countries represented within the simulation. Students use the resources in the online database in concert with their own prior knowledge and their understanding of the scenario as they begin to formulate a course of action and negotiation plan for the upcoming simulation. All resources and materials are accurate and actual documents, though scaffolds developed by the project team to increase middle-school students' accessibility and

comprehension, support many of these materials. This resource database is used recursively over the course of the entire simulation, as students refine and solidify their country's position.

There are four (4) issue areas embedded within each simulation that address dimensions of the socio-scientific negotiations. These issue areas form the basis upon which a participating classroom breaks into smaller collaborative working groups to prepare for the simulation and to engage in the negotiations (as illustrated in Figure 2). These four issue areas are consistent across all the classrooms in the simulation, enabling the students from one issue area to communicate with their counterparts in another classroom. For example, one issue area that is consistent across all simulations is Economics. This issue area addresses the economic implications of the science policy being developed for their specific country. As a result, this issue group within the class must focus on the cost and effect on the their local economy of reducing pollution, opening access to fresh water to their neighbors, or entering into agreements with neighbors about accessing fresh water for their own citizens. The other three issue areas are Human Rights, the Environment, and Health. It is important to note that the collaborative group work occurs both within the issue groups and across the entire country-team. From a decision-making perspective, the simulation goal for each country is the development of an agreement addressing the scenario problem with at least one other country (or multiple countries), but a country's proposed approach must address, and have the support of, all four, issue area groups within their country. Thus, although negotiations may take place between the specific issue groups across countries, it is necessary that these four issue groups are also negotiating within the class/country and come to consensus in representing the unified policy stance of the entire country.

There are three phases of the simulation lasting 14 weeks (see Figure 3 illustrating the three phases of GE2). The first phase, the Research Phase, is six weeks and requires the students to use text and web resources to research the simulation scenario issues. During this phase, students must identify the key scientific issues of concern, as well as how their assigned country's culture, political system, geography and economy influence their science perspectives. Additionally, students must also become familiar with the policies of the other countries included in the simulation in order to develop initial arguments and plan for potential collaborations. As the outcome of the Research Phase, students in each classroom work collaboratively to develop an opening policy statement (scientific arguments) containing their national position across each of the four issue areas and how they wish to start addressing the international problem presented in the scenario with other countries who will also be negotiating within the simulation. These opening statements range in length from 200-500 words, though some detailed statements may be longer. Statements are then shared as documents within the online GE2 communication system and serve to launch Phase 2, the interactive negotiations among countries.

Throughout the six weeks of the Interactive Phase (Phase 2), students work within their class to refine their arguments and negotiate international agreements with the other "countries," sharing them online, in an asynchronous format similar to email. Based on prior implementations, the number of communications exchanged during the Interactive Phase can exceed 8,000 (though length varies from a single sentence to longer multi-paragraph exchanges).

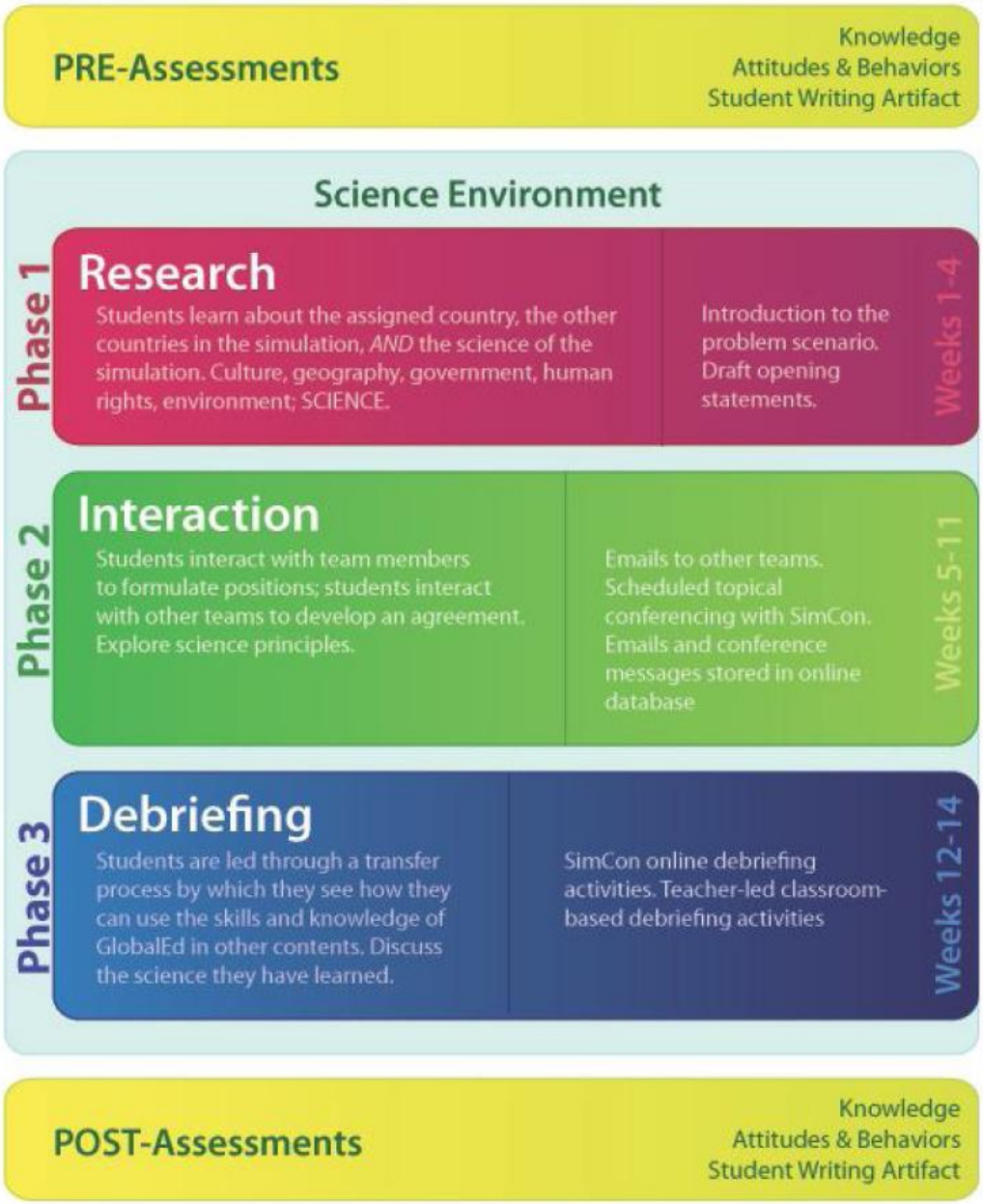

Figure 3. The phases of GE2.

Both the content and negotiations among the countries participating within this phase of the simulation are student-driven and dynamic, as the simulations are designed to engage participants in ill-structured and dynamic problem solving. As such, while the larger context for the simulation is set by the problem scenario, what and how students negotiate emerges from their interactions with one another.

In order to provide some control and flow in this phase, a trained simulation coordinator, "SimCon," monitors the flow of e-messages between teams and also facilitates scheduled "real-time" web-based multilateral conferences through an instant messaging-like interface in

GE2. SimCon's role is similar to that of a virtual teacher/facilitator in an active learning classroom, in which SimCon oversees all aspects of the learning process and coaches students to think critically about the complex issues central to their scientific arguments. Further, SimCon monitors and provides feedback to students regarding the content (scientific and political), argument structure and tone of their communications with other countries as a means of formative evaluation on a weekly basis. In past simulation, participating students have adopted SimCon's strategy, providing these evaluative cues to each other, resulting in a peer feedback system.

Within the Interactive Phase of the simulation, we also employ social modeling [Bandura, 1997] as a mechanism to facilitate student development of scientific argumentation. Unbeknownst to either the teachers or the students, the United States team is played by a trained doctoral student in every simulation. The sophistication of the language, concepts and written CER structures posted by the US serve as a model for participating middle grade students. Based on prior simulations, students often comment on how well written the US messages and policies are, and they try to emulate the structures.

The culminating event of the Interactive Phase is the posting of each country's closing statement, reflecting the final position of each country-team on the four issue areas.Students work collaboratively within their country-team issue area to construct these closing arguments, articulating points of agreement and topics where continued work is necessary among the participating countries. These closing arguments are then shared with the other participants in the simulation, marking the start of the third phase of the GE2 experience, Debriefing.

The Debriefing Phase lasts two weeks and is designed to activate metacognitive processes in students as they review what they learned and how they can apply this new science content knowledge and associated skills in other contexts and domains. SimCon facilitates a scheduled on-line debriefing conference with all students and countries represented in the simulation, exploring issues related to learning outcomes, simulation processes, transfer, and feedback. Teachers are also trained to perform multiple debriefing activities within their classrooms to promote metacognition, learning and transfer. These include educational activities, such as analyzing the "behind-the-scenes" negotiations available to students after the simulation ends, writing final essays about the experience, examining local water resource issues or completing other tasks aimed at relating the experience back to the educational context and the real world of environmental sustainability in both local and global affairs.

It is extremely important to note, all interactions in GE2 are text-based – a purposive design decision for two reasons. First, the written artifacts the students produce (e.g., opening/closing statements and online negotiations) are a means of making students' thinking visible on a consistent basis, providing an avenue for teachers and researchers to formatively assess students engagement, scientific thinking, writing, leadership and problem solving. GE2 teachers are trained in the use of these written interactions as an evaluative tool during their PD and are provided assessment rubrics in the GE2 curricular materials to facilitate this process. Secondly, the use of this anonymous written communication mode allows educators to hold some factors in the educational context neutral (e.g., personal appearance, gender, race, verbal communication abilities and accents). Students only identify themselves within GE2 as country, issue and initials; for example, "ChinaEnvSWB" (China's environmental negotiator SWB), blinding their actual identities to students outside their classroom. As a

result, typical stereotypes, associated with gender, race or socio-economic class are minimized as factors influencing the interactions among participants.

Empirical Support for the Intervention

To date, the GE2 curriculum has been implemented in urban and suburban 7th and 8th grade social studies classrooms for the past three years. In total, GE2 has serviced approximately 1400 middle grade students and their respective social studies teachers. The program has been piloted in both suburban middle income and urban low-income schools, using a mixed model. Geographic sites are distinguished in terms of their proportion of students of color and socio-economic status. Urban schoolswere comprised of approximately 92% students of color and 85% of the student body is considered low income. By contrast, the sampleofsuburban school participantswas predominately Caucasian (~82%) with only 7.9% living below poverty level. Table 1 presents the demographics of students who participated in one of the GE2 pilot implementations.

In the section below, we provide evidence of GE2's promise for impacting two critical proximal outcomes; scientific literacy (operationalized as written scientific explanationand science knowledge) and interest in pursuing future science education and career opportunities [see Brown et al., 2012 and Lawless et al., 2012 for supplemental findings]. The findings reported also suggest that GE2 could potentially close known male/female and urban/suburban achievement gaps in these areas.

Prior to implementing the GE2 simulation in their classrooms, social studies teachers from both sites (urban and suburban) attended a 3-day professional development (PD) seminar to learn the specific foci of the curriculum, including how GE2 works, the science concepts embedded within the scenario, written scientific explanation and management of GE2 in the classroom. Before, and immediately after engaging in the GE2 curriculum, students in the pilot studies responded to an open-ended measure ofscientific explanation patterned after those collected on standardized state tests of writing. It required students to respond to a prompt (e.g., "The world is in danger of running out of fresh water. Do you agree or disagree with this statement? Why?"). Instructions directed students to use scientific evidence and reasoning to support their responses.

Table 1. Demographics for past GE2 implementations in aggregate across districts

District	Total*	Gender	Race
Urban	723	Male = 279 Female = 295	White = 31 Black = 248 Hispanic = 245 Other = 59
Suburban	624	Male = 298 Female = 282	White = 468 Black = 20 Hispanic = 26 Other = 52

* total N=1410, variance in totals reported in table reflect missing responses to demographic items.

Two independent raters, blinded to student identity and time of administration, scored student essays. An adapted version of the argumentation rubric developed by Midgette, Haria and MacAuthur [2008] was used to rate essays for quality of argumentation. The basic gist of this rubric examines the presence of claims, evidence and reasoning, the completeness of these argumentation chains, as well as whether they addressed the opposition in their explanations (possible range 0-4, with a higher score reflecting higher quality explanations). Independent rater scores reached 95% agreement, with differences being resolved in conference. Empirical findings from pilot work during the development of GE2 indicate significant positive outcomes for written scientific explanation with moderate to strong effects (*d*=.43-.69). Results also indicated a differential impact of GE2 between urban and suburban students with respect to written explanation quality. Effect sizes ranged from *d*=.30 for suburban females to *d*=.69 for urban males.

Table 2. Sample Science Interest and Knowledge Items

Interest in science pursuits (5 –point Likert scale1=Not at all interested, 5=Very interested):
I plan to become a scientist when I graduate school.
When I graduate, I would like to work with people who make discoveries in science.
A career in science interests me.
I am interested in pursuing a science career in the future.
I am interested in pursuing a college degree in science.

Science Topic Knowledge:
Water Resources.
Porous water-saturated layers of underground rock are known as:

a) Aquifers.
b) Recharge areas.
c) Watersheds.
d) Runoff areas.

Climate Change.
The greenhouse effect is due to:

a) Holes in the ozone layer.
b) Increased use of nuclear energy.
c) Increased occurrence of acidic precipitation.
d) The pollution of the oceans.

In addition to written scientific explanation, in the 2010 implementations of GE2, we also assessed knowledge gains in science related to the simulation scenario topics. Students were administered short multiple-choice tests on either water resources or climate change in pre and post format. Items were selected publically available science knowledge assessments and are specifically linked to one of the two scenario topics (Water Resources and Climate Change). Items were reviewed by content experts in science education and educational assessment for appropriateness. Each topic knowledge assessment contained 12 items (see Table 2 for sample items).Small effect sizes indicating positive change were noted (*d*=.2, average). However, differential effects were again noted between genders, with a particularly

large effect size for females (*d* =.93). While these effects were smaller than we had anticipated, it should be noted that the measure of knowledge implemented was short (11 items) and was potentially inadequate for sampling the full range of content. Based on the pilot data, the knowledge measure will be revised for future use.

Finally, across implementations,an increase in interest in pursuing science educational opportunities and careers in the future was also identified [see Brown et al., 2012; Lawless et al., 2012 for additional information]. The interest scale consisted of eight Likert-type items with a five-point response scale (1=not at all interested, 5=very interested). Table 2 contains sample items from this measure.

Based on data obtained from an independent sample of middle school students, Cronbach alpha reliability estimates for this instrument were found exceeding .85 [Brown, et al., 2011]. As was the case with the scientific explanation and knowledge measures, the interest measure was implemented in a pre-post format. Although data across all strata indicated small overall increase in interest (d~.15), larger impacts were obtained among female students (d=.21) and urban males (d=.35). Other positive outcomes from the prior simulations include gains in self-efficacy (writing and science) and increased use of scientific vocabulary [see Lawless et al., 2012; and Lynn et al., 2012 for more details].

Based on our classroom observations and teacher interviews, a significant variation in implementation fidelity was noted that appeared correlated with effect sizes. In classrooms where fidelity was high, effect sizes for written scientific explanation were quite large (*d*=1.16), whereas classrooms with low fidelity teachers exhibited no significant change in performance pre to post intervention (*d*=.12). With respect to subgroup analyses for scientific explanation, variations in implementation fidelity were once again correlated with the magnitude of the effects. Particularly large effect sizes for scientific explanation were noted for suburban females and urban males (*d*=2.44 and 1.71, respectively) in high fidelity classrooms. Similar fidelity trends were noted for interest in future science education and career opportunities, with high fidelity classrooms yielding larger effects, while lower fidelity classrooms saw little to no change in interest levels (d=.5 and .09, respectively). However, there was little to no change in low fidelity classrooms (*d*=.15-.26). The findings related to fidelity led to the development of new curricular scaffolds for teachers and students to more directly support fidelity of implementation and will be implemented in all future enactments of the GE2.

DISCUSSION

Through the theoretical framework of Triadic Reciprocity [Bandura, 1986], based on the interaction of personal, environmental and behavior variables, GE2 simulations engage students in a science environment requiring interactions both within teams and across teams to address a significant global problem. All GE2 simulations leverageinteractive role playing, scaffolded and anchored by a simulation controller, to facilitate the development of students' scientific literacies in general and specifically target written scientific explanation, science knowledge and interest in the pursuit of future science educational and career opportunities for middle school students.As described previously, a scientifically literate person is one who uses science content knowledge to make informed decisions, either personally or socially,

about topics or issues that have a connection with science. A scientifically literate individual is also one who not only knows science content, but who can use this knowledge of science and additional information gathered to reason from evidence and argues a position on a given topic.

The findings presented here speak to the potential of GE2 as a meaningful educational gaming context within which students can learn and practice science, and vital 21st century STEM literacies while working in a team format. Students who participated in the GE2 simulation significantly improved their ability to construct written scientific explanations andtheir science knowledge related to the simulations over the course of their 14-week participation. Furthermore, the simulations had a positive impact on their interest in pursuing future educational and career opportunities in science. Although the lack of a control group prevents us from making caUSl claims about the impact of GE2, the results do provide support that interactive role-playingsimulations, like that provided by GE2, have the potential to facilitate student development in written scientific explanation, knowledge and interest within the context of a social studies classroom.

Over the course of the Interactive Phase of an individual GE2 simulation, students generate and share approximately 4500 messages, ranging in length from a single sentence to longer passages in excess of 250 wordsin their roles as science advisors for their country-team. Given that research indicates that the typical student spends less than an hour a week on average writing in standard classroom settings [Applebee and Langer, 2006], the amount of writing produced by students in GE2 was substantial – particularly considering the domain was science where instructional time spent on writing tends to be significantly less than many other domains.

We believe it is this increase in opportunity to construct and review written arguments within an authentic role-playing simulation that is contributing to student gains in scientific explanation skill.Moreover, the significant improvement in students' written scientific explanations was obtained over a very short span of time, six weeks of interactive, online writing (Interactive Phase of simulation).

GE2's written online interactions provide students with not only increased exposure to writing arguments within the curriculum, but also afford students the opportunity to experience success in written argumentation,within an authentic environment, through the give and take of the negotiations both within and across country-teams during the Interactive Phase of the simulation. During this phase, students not only post information, but react to, and in some cases challenge, the posts of their peers. Through this back and forthrole-playing simulation, students revise and clarify their positions as they progress towards meeting the goal of reaching agreement on a course of action to take regarding water with at least one other participating "country."As a result of this process, students were able to experience success with at least some of their writing efforts. The finding that students' written scientific explanation improved speaks to potential of immersive, online simulations like GE2 as a valuable work space to develop scientific literacy skills.

Finally, results of the study also indicate that GE2 positively impacted students' interest in pursuing endeavors related to science in the future. The decline in both the quantity and quality of students pursuing careers in science is widely noted in policy reports, the popular press, and by higher education. Fears of increasing global competition compound the concerns about the drop in the supply of high-quality students moving up through the STEM pipeline in the United States. Educators today are faced with enormous pressures to guarantee

students' competence with a growing body of STEM content knowledge [Gredler, 2004]. In response, academic standards in these areas have changed, requiring teachers to cover more material [NRC, 1996] in a curricular space that has not grown commensurately. GE2's innovative approach to expanding the time devoted to the teaching of science by leveraging social studies as a venue to explore socio-scientific issues helps alleviate issues related to curricular space while addressing interest in science related career paths.

Moreover, GE2's role playing simulation, afforded a departure from traditional pedagogy, allowing students the opportunity to experience the relevance of science in the world in which they live – a necessary ingredient for stimulating disciplinary interest for future engagement as a 21st century citizen.

CONCLUSION

Better understanding how to maintain and cultivate middle school students' interest in STEM education and careers paths it vital to addressing the STEM pipeline issues in the US. The instructional gaming approach proposed by GE2 not only addresses this need, but also broadens the focus on what, where and how STEM literacy can be cultivated and enhanced. The GE2 simulations specifically focuson environmental sciences as socio-ecological systems, that can best be studied and understood as coupled human and natural systems [Willig, 2003]. The repositioning of naturally interdisciplinary spaces, like the social sciences, as an expanded curricular space to engage students in STEM learning opportunities is innovative because it adds value to both disciplines, without disrupting learning in either.More over, the use of role-playing simulations provides and opportunity for students to find personal relevance in what they are learning.

While we are encouraged by the results of this study of the GE2 simulation approach, there is still a great deal to learn about its direct and long-term impact on student learning, as well as the critical components ofGE2 simulations that optimize student, learning outcomes. Specifically, our next step is to conduct more controlled quasi-experimental researchthat includes a control group for comparison purposes, to allow us greaterconfidence inthe findings attributable to participation in GE2 simulations and other similar educational games.

REFERENCES

Alozie, N. M. (2010). Collaborative professional development and curriculum enactment: Teacher reflection to inform inquiry-based discussions in high school science classrooms. (Doctoral dissertation). Retrieved from DeepBlue Dissertations and Theses. (*http://hdl.handle.net/ 2027.42/75893*).

Anderson, R. D. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education*, 13, 1-12.

Applebee and Langer, (2006). Retrieved December 2, 2011 from *http://www.albany.edu/aire /news/StateofWritingInstruction.pdf.*

Aydeniz, M., and Hodge, L. L. (2010). Is it dichotomy or tension: I am a scientist. No, wait! I am a teacher! *Cultural Studies of Science Education,* 6(1), 165-179.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, N. J.: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman and Company.

Bartholomew, H., Osborne, J. F. and Ratcliffe, M. (2004). Teaching students 'Ideas-About-Science': Five dimensions of effective practice. *Science Education*, 88, 655-682.

Beghetto, R. A. (2006). Creative self-efficacy: Correlates in middle andsecondary students. *Creativity Research Journal*, 18, 447–457.

Bennett, J., Lubben, F., Hogarth, S., and Campbell, B. (2005). Systematic review of research in scienceeducation: Rigour or rigidity. *International Journal of Science Education*, 27(4), 387-406.

Borgman, C., Abelson, H., Dirks, L., Johnson, R., Koedinger, K., Linn, M., and Szalay, A.(2008). Fostering learning in the networked world: The cyberlearning opportunity andchallenge. *Report of the N. S. F. Task Force on Cyberlearning.* National Science Foundation, Washington, D. C.

Bransford, J. D., Brown, A. L., Cocking, R. R., Donovan, M. S., and Pellegrino, J. W. (Eds.). (2000). *How people learn: Brain, mind, experience, and school* (Expanded ed.). Washington, D. C.: National Academy Press.

Brown, S. W., Lawless, K. A., Boyer, M. A., Mullin, G. P., Yukhymenko, M., Cutter, A., Brodowinska Bruscianelli, Powell, N., Enriquez, M. F., Rice, J. and Khodos, G. K., (2011, November). Impacting middle school students' science knowledge with problem-based learning simulations. In D. Sampson, J. M. Spector, D. Ifenthaler and P. Isaias (Eds.*) Proceedings of The I. A. D. I. S. International Conference Cognition and Exploratory Learning in Digital Age (C. E. L. D. A.)*, p. 181-187. Rio de Janeiro, Brazil: International Association for Development of the Information Society.

Brown, S. W., Lawless, K. A., Boyer, M. A., Yukhymenko, M. A., Mullin, G. P., Brodowinska, K., Khodos, G., and Lynn, L. (2012, May). The impact of simulation games on science knowledge: The GlobalEd 2 Project. Paper presented at the 2012 Association for Psychology Science: Annual Convention, Chicago, I. L.

Chinn, C. A., andMalhotra, B. A (2002). Epistemologically authentic inquiry in schools: A theoretical framework for evaluating inquiry tasks. *Science Education*, 86(2), 175-218.

Driver, R., Leach, J., Millar, R. and Scott, P. (1996).*Young people's images of science*. Philadelphia: Open University Press.

Goodnough, K., and Hung, W. (2008). Designing effective problems: Evaluation of 3C3R 9-step design process. *Interdisciplinary Journal of Problem-based Learning*, 2(2), 61–90.

Gredler, M. E. (2004). Games and simulations and their relationships to learning.*Educational Technology Research and Development*, 21, 571-582.

Greening, T. (1998). Scaffolding for success in problem-based learning. *Medical Education Online*,3(4), 1-15.

Hand, B., Yore, L. D., Jagger, S., and Prain, V. (2010). Connecting research in science literacy and classroom practice: a review of science teaching journals in Australia, the U. K. and the United States, 1998–2008. *Studies in Science Education*, 46(1), 45–68.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235-266.

Holbrook, J. (2010). Education through science as a motivational innovation for science education for all.*Science Education International*, 21 (2), June, 80-91.

Hurd, P. (1998). Science literacy: New minds for a changing world. *Science Education*, 82, 407-418.

Jonassen, D. H. (2009) Assembling and Analyzing the Building Blocks of Problem-Based Learning Environments, in *Handbook of Improving Performance in the Workplace, Volume One: Instructional Design and Training Delivery* (Eds. K. H. Silber and W. R. Foshay), John Wiley and Sons, Inc., Hoboken, N. J., US. doi: 10.1002/9780470587089.ch11.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S. and Ryan, M. (2003.) Problem-based learning meets case-based reasoning in the middle school science classroom: Putting Learning by Design™ into practice. *The Journal of the Learning Sciences,* 12(4) p. 495-547.

Koschmann, T., Kelson, A. C., Feltovich, P. J., and Barrows, H. S. (1996). Computer-supported problem-based learning: A principled approach to the use of computers in collaborative learning. In T. Koschmann (Ed.), *C. S. C. L.: Theory and Practice of an Emerging Paradigm,* 83-124. Mahwah, N. J.: Lawrence Erlbaum.

Koschmann, T. D., Myers, A. C., Feltovich, P. J., and Barrow, H. S. (1994). Using technology to assist in realizing effective learning and instruction. *Journal of the Learning Sciences*,3, 227–264.

Lawless, K. A., Brown, S. W., Boyer, M. A., Brodowinska, K., Mullin, G. P., Yukhymenko, M., Khodos, G., Lynn, L., Cutter, A., Powell, N. and Enriquez, M. F. (2011). Expanding the science and writing curricular space: The GlobalEd2 Project. In D. Sampson, J. M. Spector, D. Ifenthaler and P. Isaias (Eds.*) Proceedings of The I. A. D. I. S. International Conference Cognition and Exploratory Learning in Digital Age (C. E. L. D. A.),* p. 154-160. Rio de Janeiro, Brazil: International Association for Development of the Information Society.

Lindahl, B. (2003). Lust attläranaturvetenskapockteknik? En longitudinellstudieomvägen tillgymnasiet [A desire to learn science and technology? A longitudinal study of pathways to uppersecondary school]. Doctoral thesis, Göteborg Studies in Educational Sciences, Göteborg.

Lynn, L., Lawless, K. A., Brown, S. W., Brodowinska, K., Mullin, G. P., Powell, N., Richards, K. A., Yukhymenko, M. and Boyer, M. A. (2012, May). Development of science vocabulary in an online learning environment. Poster presented at the Association for Psychological Science, Chicago, I. L.

Levinson, R. and Turner, S. (Eds.). (2001). The teaching of social and ethical issues in the school curriculum, arising from developments in biomedical research: a research study of teachers. London: Institute of Education.

Mergendoller, J. R., Maxwell, N. L., and Bellisimo, Y. (2000). Comparing problem-based learning andtraditional instruction in high school economics. *Journal of Educational Research,* 93(6), 374-382.

Midgette, E., Haria, P., and MacArthur, C. A. (2008). The effects of content and audience awareness goals for revision on the overall persuasiveness of fifth and eighth grade students' argumentative essays. *Reading and Writing: An Interdisciplinary Journal*, 21, 131-151.

Millar, R. and Osborne, J. (Eds.). (1998). *Beyond 2000: Science education for the future*. London: King's College, School of Education.

Monk, M., and Osborne, J. (1997). Placing the history and philosophy of science on the curriculum: A model for the development of pedagogy. *Science Education, 81*, 405-424.

Newcombe, N. S., Ambady, N, Eccles, J., Gomez, L., Klahr, D., Linn, M., Miller, K. and Mix, K. (2009).Psychology's role in mathematics and science Education. *American Psychologist*, 64(6), 538-550.

National Center for Education Statistics (2007). *http://nces.ed.gov/ pubsearch/pubsinfo.asp? pubid=2005016*. Retrieved December 1, 2011.

National Center for Education Statistics (2010). *http://nces.ed.gov/pubs 2010/2010028.pdf.*

National Center for Education Statistics (2011). *http://nces.ed.gov/pubs 2011/2011033.pdf.*

National Research Council (1996). *National science education standards*. Washington, D. C.: National Academy Press.

National Research Council (2009). *Science in Action Hands-On and Interactive Computer Tasks from the 2009 Science Assessment: National Assessment of Educational Progress at Grades 4, 8, and 12.*

National Research Council (2011). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.*

Osborne, J. F., and Collins, S. (2001). Pupils' views of the roleand value of the science curriculum: a focus-groupstudy. *International Journal of Science Education*, 23(5), 441-468.

Osborne, J. F., Erduran, S., Simon, S. and Monk, M. (2001). Enhancing the quality of argument in school science. *School Science Review*, 82(301), 63-70.

Pajares, F. (1996). *Review of Educational Research*, 66(4), 543-578.

Pease, M. A., and Kuhn, D. (2010. Experimental analysis of the effective components of problem-based learning. *Science Education*, 95(1), 57-86.

President's Council of Advisers on Science and Technology (P. C. A. S. T.) (2010). Prepare and Inspire: K-12 Science, Technology, Engineering, and Math (S. T. E. M.) Education for America's Future. *http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stem-ed-final.pdf.* Retrived March 18, 2012.

Rascoe, B. and Atwater, M. M. (2005). Black males' self-perceptions of academic ability and gifted potential in advanced science classes. *Journal of Research in Science Teaching*, 42 (8), 888-911.

Sadler, T. D. (Ed.) (2011). *Socio-scientific issues in the classroom*. N. Y., N. Y.: Springer.

Sadler, T. D., Amirshokoohi, A., Kazempour, M. and Allspaw, K. M. (2006). Socioscience and ethics in science classrooms: Teacher perspectives and strategies. *Journal of Research inScience Teaching*. 43(4), 353-376.

Sadler, T., Barab, S. and Scott, B. (2007). What do students gain by engaging in socioscientific inquiry? *Research in Science Education*, 37(4), 371-91.

Savery, J. R., and Duffy, T. M. (1996). Problem based learning: An instructional model and its constructivist framework. *Educational Technology*, 35(5), 31-37.

Schwartz, R. S., Lederman, N. G., and Crawford, B. A. (2004). Developing views of nature of science in an authentic context: An explicit approach to bridging the gap between nature of science and scientific inquiry. *Science Education*, 88, 610-645.

Schwarz, B. B., Neuman, Y., Gil, J., and Ilya, M. (2003). Construction of collective and individual knowledge in argumentative activity: An empirical study. *The Journal of the Learning Sciences*, 12(2), 221-258.

Sorge, C., Newsom, H., andHagerty, J. (2000, August). Fun is not enough: Attitudes of Hispanic middle school students toward science and scientists. *Hispanic Journal of Behavioral Sciences*, 11(3), 332–346.

Speering, W. and Rennie, L. (1996). Students' perceptions about science: The impact of transition from primary to secondary school. *Research in Science Education*, 26, 283–298.

Strobel, J., and van Barneveld, A. (2009). When is P. B. L. more effective? A meta-synthesis of meta-analyses comparing P. B. L. to conventional classrooms. *Interdisciplinary Journal of Problem-based Learning*, 3(1), 44-58.

Taber, K. S. (2008). Towards a curricular model of the nature of science. *Science and Education*, 17(2-3), 179-218.

Taylor, P., Gilmer, P. and Tobin, K. (Eds.) (2002). *Transforming undergraduate science teaching: Social constructivist perspectives*. New York: Peter Lang.

Todt, E., and Schreiber, S. (1998). Development of interest. In L. Hoffmann, A. Krapp, K. A. Renninger, and J. Baumert (Eds.), *Interest and learning: Proceedings of the Seeon conference on interest and gender*, 25-40. Kiel, Germany: Institute for Science Education.

Turner, S. (2008). School science and its controversies; or, whatever happened to scientific literacy? *Public Understanding of Science*, 17(1), 55-72.

Tytler, R., Symington, D., Smith, C., and Rodrigues, S. (2008). An innovation framework based on best practice exemplars from the Australian School Innovation in Science, Technology and Mathematics (A. S. I. S. T. M.) Project. Canberra: Commonwealth of Australia.

United States Department of Labor (1991). What work requires of our schools: A SCANS report for America 2000. *http://wdr.doleta.gov/SCANS/ whatwork/whatwork.pdf.* Retrived March 22, 2012.

Vasavada, N., Carman, E., Hart, B. andLuisier, D. (2010). Common Core State Standards Alignment (Report 2010-5A). *http://professionals. collegeboard.com/profdownload/pdf/ 10b_2901_Comm_Core_Report_Complete_WEB_101117.pdf* . Retrived March 2, 2012.

Webb, P. (2010). Science education and literacy: Imperatives for the developed and developing world. *Science*, 328, 448-450.

Willig, M. R. 2003. Challenges to understanding dynamics of biodiversity in time and space. *Paleobiology* 29, 30-33.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81, 329-339.

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Chapter 5

RETHINKING FANTASY AS A CONTRIBUTOR TO INTRINSIC MOTIVATION IN DIGITAL GAMEPLAY

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ABSTRACT

Playing digital games is a part of life for current natives. Games make people engrossed, and are optimized environments where fun prevails. Of making people motivated in gameplay, fantasy is a paramount element. Research has discovered that fantasy plays a critical role in enhancing intrinsic motivation. This chapter thus revisits the role of fantasy while playing digital games, focusing on what brings a state of fantasy in a gaming world. Specifically, the purpose of this chapter is to probe factors creating fantasy state while gameplay. To this end, 153 junior high students aged from 11 to 13 were participated in this study, and 35 commercial off-the-shelf games including most game genres were utilized. Exploratory factor analysis (EFA) was employed to extract the factors making fantasy state while gameplay. As a result, four factors were extracted as fantasy components, and labeled as identification, imagination, analogy, and satisfaction. By thinking about such subcomponents, fantasy in gaming can be understood as the individualized psychological state, which is satisfied with certain gaming situation and/or events being evoked by identifying in the game world from both extrinsic and intrinsic stimuli.

INTRODUCTION

Playing games is a vital part of daily life for recent digital natives. Since games provide a lot of fun, people want to continuously play games. When people play digital games, they are extremely engrossed in the game world. Such extremely enjoyable experiences often refer to as ‘flow’ or ‘engagement’, enabling people to experience deep concentration and a feeling of spontaneous joy, even rapture. Digital games actually are captivating environments in which

stimulate the immersed mental state. As such, many researchers have been interested in learning through games (Gee, 2003; Prensky, 2001; Squire, 2006; Van Eck, 2006). For last decade, empirical research has shown that games enhance motivation (Cordova and Lepper, 1996; Lopez-Morteo and Lopez, 2007; Tüzün, YIlmaz-Soylu, Karakus, Inal, and KIzIlkaya, 2009). Games appear inherently to motivate users intrinsically by its environmental features (Thomas and Macredie, 1994). According to Garris, Ahlers and Driskell (2002), there are six characteristics of games: fantasy, rules/goals, sensory stimuli, challenge, mystery, and control. They stressed that such game characteristics should be activated within instructional context so as to enhance learning. Additionally, Malone and Lepper (1987) stated that game features, such as challenge, curiosity, fantasy, control, cooperation, competition and recognition, make learning fun in terms of game-based learning.

Of these game features, fantasy in particular, plays a pivotal role in enhancing motivation (Crawford, 1982; Malone and Lepper, 1987), and is a key factor in making people engaged in gameplay. As with its inherent value, fantasy also plays a predominant role in distinguishing games itself from other media in terms of attributes of media. According to Malone and Lepper (1987), fantasy is an environment that "evokes mental images of physical or social situations not actually present" (p. 240). They noted that fantasy fosters intrinsic motivation in computer games. Crawford (1982) also indicated that fantasy is the main reason for playing game; that is, people want to fulfill their needs from fantasy in games. Taken as a whole, fantasy is a crucial factor that fertilizes intrinsic motivation while gameplay.

Despite its significance, it is surprising that fantasy, one of most predominant component of intrinsic motivation, has received little attention from researchers in game-based learning. Even though fantasy is a predominant factor affecting intrinsic motivation, it's still ambiguous to practically measure or explore, and even define. Many people have a propensity to look at fantasy as being intuitional and extraneous (e.g., imagination, illusion). Malone (1981) already mentioned these attributes as an emotional aspect of fantasy. Furthermore, he addressed a cognitive aspect of fantasy, such as metaphor and imaginary. Although these two aspects are subset of fantasy environments, such a clarification provides an insight into how we should look at the concept of fantasy in a holistic approach. In short, fantasy can be considered as the inclusion of diverse subcomponents. For this debate, we further might be able to think about an essential aspect of fantasy as a holistic approach, comparatively sustainable in accordance with game genres. This research thus aims to identify fantasy components contributing to intrinsic motivation in gaming, as well as to provide a solid framework for exploring fantasy with respect the holistic concept in digital gameplay.

FANTASY AND INTRINSIC MOTIVATION IN GAMES

Many researchers have agreed that fantasy is not only one of the striking games feature, but also a crucial key component of making games fun. Games are the imaginary world where is portrayed people's desire and needs. Players are willing to dive into such a new world spontaneously; that is, they play games in fantasy world with getting intrinsically motivated. Of various game features, fantasy might be the first catalyst by far that catches players' eyes on gameplay. All the tangible entities existing in games evoke fantasy, enabling players to get engaged in gameplay. Fantasy thus plays a crucial role in keeping and provoking players'

interest and engagement in gameplay. In this regard, Asgari and Kaufman (2004) addressed how important fantasy is in gameplay, saying that "game with no fantasies involve only abstract symbols (p. 4)."

Many empirical research have shed light on the relationship between fantasy and intrinsic motivation in gameplay (Cordova and Lepper, 1996; Parker and Lepper, 1992; Vos, Meijden, and Denessen, 2011). These studies concluded that fantasy is a critical factor in increasing intrinsic motivation in gameplay. Such research, albeit partially, have accounted for the role of fantasy in gameplay in light of intrinsic motivation. Driskell and Dwyer (1984) said that fantasies facilitate focalization of attention and the self-absorption that users become immersed in game activity. Although fantasy rests on environmental features of games, it is by no means visible and tangible embellishments. What makes players act something intrinsically might be determined by diverse fantasy contributors. For instance, thinking about the reasons why people enjoy role-playing games and action games, chances are that the answer definitely could be very diverse. Embellished environmental entities obviously evoke fantasy, contributing players' motivation. Far beyond such tangible entities, other side of game features such as story and role also play a pivotal role in making players motivated in such game genres. In such games, players are the heroes of that game; they make the story through their action in the game world. What make play such games are their personal identities assigned in games and missions given to them so that continue to make the game story. These intangible but truly striking attributes make players engrossed in gameplay, so to speak, provoking intrinsic motivation. Malone (1980) has already described this attribute as an intrinsic fantasy, which is an activity related to games.

Overall, through revisiting the relationship between fantasy and intrinsic motivation in games, it turns out that fantasy is a cardinal and paramount component in making players engaged in gameplay needed to consider as a holistic view of environmental attribute of games not only tangible entities but also intangible ones.

CONSTRUCT OF FANTASY

Piaget (1951) explains fantasy in children's play primarily as an attempt to assimilate experience into existing structures in the child's mind with minimal needs to accommodate to the demands of external reality. In a somewhat similar vein, Freud's (1950) explanation of symbolic games that children invent for themselves emphasizes an attempt by the ego to actively repeat traumatic events. Psychiatric researchers define fantasy as a "defense mechanism for the fulfillment of wishes and the resolution of conflict (Caughey, 1984; Hume, 1984). According to Hume (1984), fantasy is any departure from consensus reality, an impulse native to literature and manifested in innumerable variations, from monster to metaphor. Furthermore Garris et al. (2002) stated fantasy as and activity in which has no impact on the real world.

Malone and Lepper (1987) defined fantasy as one that evokes mental images of physical or social situations not actually present. They indicated that fantasy plays a crucial role of contributing to intrinsic motivation in several ways. They made a significant theoretical claim by attributing educational benefits produced by the positive affect of fantasy to the distinction between intrinsic and extrinsic fantasy (Habgood et al., 2005) According to them, in

designing instructional environment, it is important to distinguish between intrinsic and extrinsic fantasies. Malone and Lepper (1987) explained such a distinction by the relationship between fantasy and skill in game environment: an intrinsic fantasy is defined as "one in which the skill being learned and fantasy depend on each other" and " there is an integral and continuing relationship between the fantasy context and the instructional content being presented".

In contrast to this, extrinsic fantasy is defined as "one in which the fantasy depends on the skill being learned but not vice versa" and the relationship is arbitrary and periodic. Based on the number of empirical studies it was proposed that, intrinsic fantasies are both more interesting and more educational than extrinsic fantasies (Malone and Lepper, 1987).

Malone (1981) said that fantasy have two important aspects for designing user interfaces: emotions and metaphors. And these aspects apply only to intrinsic fantasy, not to extrinsic fantasy. Malone and Lepper (1987) further stated this aspect as emotional aspect of fantasy and cognitive aspect of fantasy. When it comes to emotional aspect of fantasy, it almost derives much of their appeal from emotional needs they help to satisfy. In fact, it is very difficult to know which fantasies might be appealing to particular individuals. However one general mechanism that may explain these differences is identification.

Namely fantasies are most likely to fulfill emotional needs when they provide imaginary characters with whom the individual can identify, such as perceived similarity between the self and the character, admiration for the character, and salience of that character's perspective. In addition to the emotional needs that fantasies may serve, there is also a cognitive component to involvement with fantasy.

In the cognitive aspect of fantasy, fantasies frequently offer analogies or metaphors that may provide learner with leverage for better understanding new information by relating it to past knowledge.

Reiber (1996) has further noted that fantasy contexts can be exogenous or endogenous to the game content. An exogenous fantasy is simply overlaid on some learning content. For example children nay learn fractions and by doing so slay a dragon in and enchanted forest. This type of game is likely to be more engaging than a long page of fraction.

However, the fantasy in this case is external to and separate from learning example. In contrast and endogenous fantasy is related to the learning content. For example, students may learn about physics by piloting a spaceship on reentry earth's orbit. He noted that because endogenous fantasies are more closely tied to the learning content, if the fantasy is interesting, the content become interesting.

Although its definition varies from each scholar, fantasy, in turn, is a mental image evoking imagination, identification and satisfaction. Such fantasy in game environments may technically arise from an action with ostensible attributes of games, such as graphics, sound, story, events, and control.

In a sense, fantasy in games should take into account the control under this game environment, not only tangible entities (i.e., embellishment) but also intangible ones (e.g. game story, role and so forth). We thus focus on the game features as beaning able to evoke a mental image. So to speak, the extent to which game features evoke imagination, identification and satisfaction will provide us with an understanding of the state of fantasy in games.

METHOD

Initial Item Development

Items were developed from the definition of fantasy by various scholars (Crawford, 1982; Caughey, 1984; Hume, 1984; Malone and Lepper, 1987; Garris et al., 2002) and experimental research on fantasy (Parker and Leper, 1992; Cordova and Lepper, 1996; Habgood et al., 2005). Afterward, five researchers who are familiar with the fantasy concept evaluated an initial pool of 36 items independently.

In this process, several negatively or ambiguously worded items were found to be less effective in item analyses. These weak items were replaced with more clearly stated, positively worded items. These items were also evaluated by a group of experts.

The expert group consisted of five faculty members and four research assistants all studying games for learning at either the department of education or the department of educational technology from two universities in united State and South Korea. These evaluators rated each item in terms of perceived relevancy to its proposed dimension and provided feedback in terms of item wording.

Items rated as less relevant was removed, and the wording of items was improved based on the feedback from these evaluators. This review resulted in the removal of six items for similar meaning. As a result, 30 items were generated to administer for this study.

Participants and Procedures

In order to examine construct of fantasy state, 153 respondents were participated in this study. Participants are from South Korea and varied in age from 11 to 13. 53 % of the students were male and 47 % of the students were female. 19 % of the participants were 11 years, 22 % of them were 12, and 59% of them were 13 years olds. In this study, 35 commercial off-the-shelf games were used to analyze: 12 online action games, 7 massively multiplayer online role-playing games (MMORPG), 5 first-person shooter (FPS) games, 5 social network games (SNGs), 3 adventure games, 2 real time strategy (RTS) games, and 2 online sports games. Participants first answered one of their favorite games, and then they replied to the questionnaires as underlying their preference game. When answering fantasy state, participants were asked to think of one specific game and write down in which is their favorite game. They then responded to the fantasy items using five-point Likert scales anchored by 1=strongly disagree to 5=strongly agree.

Measures

In order to explore construct of fantasy state, exploratory factor analysis (EFS) was conducted. Principal component analysis was used to determine the number of extracted factors, and varimax structure was used as a suitable method of orthogonal rotation. The

criterion for valid variables was decided at 1.00 of eigen value and factor loading above .50. In the exploratory analysis, factor loadings are generally considered to be meaningful when they exceeded .30.

Table 1. Factor loadings for EFA with varimax rotation of Fantasy

Items	Factors			
	1	2	3	4
Item 23	.778			
Item 8	.685			
Item 28	.677			
Item 27	.632			
Item 18	.624			
Item 20	.602			
Item 19	.585			
Item 22	.582			
Item 26	.552			
Item 12		.712		
Item 7		.676		
Item 3		.668		
Item 10		.642		
Item 1		.634		
Item 2		.627		
Item 30		.571		
Item 17		.531		
Item 6			.803	
Item 15			.652	
Item 24			.638	
Item 11			.636	
Item 29			.580	
Item 4			.557	
Item 16				.745
Item 14				.713
Item 25				.657
Extraction Method: Principle Component Analysis Rotation Method: Varimax with Kaiser Normalization				

RESULTS AND INTERPRETATIONS

Exploratory Factor Analysis of the Fantasy in Gameplay

For factorability of the data for the fantasy, an exploratory factor analysis (EPA) was adopted. To validate the communality, the Kaiser-Meyer-Olkin measure of sampling

adequacy (KMO) and the Bartlett's test of sphericity were utilized. As a result, the KMO measure of sampling adequacy was .91, and the Bartlett's test of sphericity was 2445.195 (df = 325, p =.00) at significance level .01.

Table 2. Extracted factors and items determined by EFA

Dimen-sions	No.	Items	
Identifi-cation	ID1	Item 23	I can control myself and use my will as I do in my real life.
	ID2	Item 8	I am satisfied to be able to control of this game.
	ID3	Item 28	I feel satisfied that this game continues as I control.
	ID4	Item 27	The story of this game makes me feel like hero.
	ID5	Item 18	I can go around here and there according to my will.
	ID6	Item 20	I feel it's real me in this game, while playing.
	ID7	Item 19	The sound of this game makes me immersed.
Dimen-sions	No.	Items	
	ID8	Item 22	I am the main character during the course of this game.
	ID9	Item 26	The graphics of this game are realistic.
Imagi-nation	IM1	Item 12	The story of this game is mysterious.
	IM2	Item 7	The story of this game includes an ideal entity which does not exist in real life.
	IM3	Item 3	I can control the events in the game in which I can only imagine in my real life.
	IM4	Item 10	Environment exhibited in this game reflects well my desired image.
	IM5	Item 1	The graphics help me imagine a new world.
	IM6	Item 2	The story of this game gives me clues at what happens later in this game.
	IM7	Item 30	Various game activities, which I cannot do in my real life, make me enjoy this game.
	IM8	Item 17	This game leads me to a new experience that I've never had before.
Analogy	AN1	Item 6	The game scenes make me imagine something.
	AN2	Item 15	The tasks within the game help me imagine something in real life.
	AN3	Item 24	The sound in the game makes me feel that I am in the real world.
	AN4	Item 11	The tasks in this game recall me certain ways to solve problem.
	AN5	Item 29	The sound in this game makes me imagine something.
	AN6	Item 4	The game sound constantly makes me imagine something in real life.
Satisfac-tion	SF1	Item 16	The environment of this game makes me satisfied.
	SF2	Item 14	The sound of this game adds enjoyment to the game.
	SF3	Item 25	A variety of game activities add to my satisfaction with this game.

Thus, it could be interpreted as fit for factor analysis, and that there were common factors. The number of factors to be retained was guided by three decision rules: Kaiser criterion (eigen value above 1), inspection of the Scree plot and comprehensibility. Principle

component analysis (PCA) with varimax rotation was performed to extract factors. Table 1 shows factor loadings after varimax rotation.

To eliminate insignificant item for the fantasy, first the items with statistically insignificant factor loadings at the 0.05 level were deleted. Second, the items with communality less than 0.50 were dropped because they did not meet acceptable levels of explanation and were poorly represented in the factor solution. Lastly, the items with the difference of the factor loadings less than 0.10 were deleted. Although PCA of the 30 items revealed five factors with eigenvalue above 1, according to inspection of the Scree plot four factors were chosen as it exhibited simple structure and clearly defined factors. To shorten the factor, items were removed from these processes, a rotated factor matrix generated after each removal. At the end of this process 26 items were retained (see Table 1). The four factors were extracted resulting in EFA, factor 1 was organized in nine items, factor 2 was eight items, factor3 was six items, and factor 4 was organized in three items. The four factors were labeled as identification, imagination, analogy, and satisfaction.

Each factor can be described as follows: Identification refers to as "the psychological state in which identify oneself with the game world." Imagination is defined as "the psychological state in which is able to constantly experience and imagine diverse events that is unlikely to happen in real world." Analogy, in contrast to Imagination, refers to as "the extent to which evokes diverse experience related to real world." And lastly, satisfaction refers to as "the level of satisfaction being given to environmental factors."

Among the extracted factor to be able to examine fantasy state, identification accounted for 21.53% of the total variance explained, imagination was 17.068%, analogy was 13.933%, and satisfaction accounted for 10.073% of the total variance explained. The result from the extracted factors and items were shown in table 2.

CONCLUSION

Fantasy is a catalyst for getting engrossed in gameplay. A variety of research related to fantasy and gaming have been focused on its role in playing games. Many researchers have agreed that fantasy plays a pivotal role in gameplay, which is a critical factor increasing intrinsic motivation. Despite its consensus and significance, fantasy in gaming is still regarded as a vaguely psychological concept such as illusion. Broadly speaking, it is true that fantasy is an intuitively psychological concept. However, when we narrow down this concept as being encountered in gameplay, we might generalize this concept as a gaming-specified psychological concept. And this specified concept could account for how fantasy occurs in gameplay and further what is the role of fantasy in gameplay in terms of intrinsic motivation. The study thus aims to identify fantasy components as features contributing to intrinsic motivation in gaming.

In light of the results, conclusions of this study are as follows: First of all, this study identified fantasy concept, resulting in exploring fantasy subcomponents in such ways that not only glean from relevant literature but also empirically analyze its components. That is, this study presented the generalized fantasy concept existing in game environments. This finding might provide more specific approach, which is able to understand and account for fantasy in gaming. Secondly, the extracted factors were named as identification, imagination,

analogy and satisfaction. Identification refers to as "the psychological state in which identify oneself with the game world." Imagination is defined as "the psychological state in which is able to constantly experience and imagine diverse events that is unlikely to happen in real world." Analogy, in contrast to Imagination, refers to as "the extent to which evokes diverse experience related to real world." And lastly, satisfaction refers to as "the level of satisfaction being given to environmental factors." By thinking about such subcomponents, fantasy in gaming can be understood as the individualized psychological state that is satisfied with certain situation and events being evoked by identifying in the game world from both extrinsic and intrinsic stimuli. Thirdly, since a variety of previous research about fantasy in game environments stated that fantasy plays a critical factor in enhancing intrinsic motivation, the proposed components of fantasy, such as identification, imagination, analogy, and satisfaction, should be critically considered when we develop an educational game as a motivational learning environment.

REFERENCES

Asgari, M.,and Kaufman, D. (2004). *Relationships among computer games, fantasy, and learning*. International Conferences on Imagination and Education 2004 2nd International Conference on Imagination in Education. Vancouver, BC.

Caughey, John L. (1984). *Imagery Social Worlds: A Cultural Approach*. Lincoln. NE, University of Nebraska Press.

Cordova, D. I., and Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology, 88(4)*, 715-730.

Crawford, C. (1982). *The art of computer game design*. Vancouver, WA: Washington State University.

Driskell, J. E., and Dwyer, D. J. (1984). Microcomputer videogame based training. *Educational Technology*, 24 (2), 11-17.

Freud, S. (1950). *Beyond the pleasure principle*. New York: Liveright.

Garris, R., Ahlers, R. and Driskell, J. E. (2002) Games, motivation, and learning: a research and practice model, *Simulation and Gaming, 33*, 441–467.

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

Habgood, M. P. J., Ainsworth, S., and Benford, S. (2005). Endogenous fantasy and learning in digital games. *Simulation and Gaming, 36*(4), 483-498. doi: 10.1177/1046878105282276.

Hume, K. (1984). *Response to reality in western literature, Fantasy and mimesis*. New York: Methuen Inc.

Lopez-Morteo, G., and Lopez, G. (2007). Computer support for learning mathematics: A learning environment based on recreational learning objects. *Computers and Education, 48*(4), 618-641. doi:10.1016/ j.compedu.2005.04.014.

Malone, T.W. (1980). *What makes things fun to learn? A study of intrinsically motivating computer games*. Palo Alto, CA: Xerox.

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

Malone, T.W.,andLepper, M. R. (1987). Making learning fun: Ataxonomy of intrinsic motivations for learning. In R. E. Snow and M. J. Farr (Eds.), *Aptitude, learning, and instruction*: Vol. 3. Conative and affective process analyses (pp. 223-253). Hillsdale, NJ: Lawrence Erlbaum.

Parker, L. E., and Lepper, M. R. (1992). Effects of fantasy context on children's learning and motivation: Making learning more fun. *Journal of Personality and Social Psychology, 62,* 625-633.

Piaget, J. (1951). *Play, dreams, and imitation in childhood*. New York: Norton.

Prensky, M. (2001). *Digital game-based learning*. New York: McGraw-Hill.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development, 44*(2), 43-58.

Squire, K. (2006). From content to context: Videogames as designed experience. *Educational Researcher, 35*(8), 19-29. doi: 10.3102/ 0013189X035008019.

Thomas, P.,andMacredie, R. (1994). Games and the design of human-computer interfaces. Educational and Training Technology International, 31(2), 134-142.

Tüzün, H., YIlmaz-Soylu, M., Karakus, T., Inal, Y., and KIzIlkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers and Education, 52*(1), 68-77. doi:10.1016/j.compedu.2008.06.008.

van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE Review, 41*(2), 16-30.

Vos, N., Meijden, H., and Denessen, E. (2011). Effects of constructing versus playing an educational game on student motivation and deep learning strategy use. Computers and Education, 56(1), 127-137. doi:10.1016/j.compedu.2010.08.013.

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Chapter 6

INDIGENOUS AUSTRALIAN GAMBLERS AND THEIR HELP-SEEKING BEHAVIOR

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ABSTRACT

Help-seeking for gambling problems can involve professional help (formal treatment), non-professional assistance (family and friends) and self-help. While several studies have examined gambling help-seeking behavior amongst mainstream populations, little is known in relation to specific cultural groups, particularly Indigenous and First Nations populations. Yet knowledge about help-seeking for gambling problems by these groups, along with associated motivators and barriers, is vital for guiding the development of culturally appropriate public health strategies and treatment services to try to ameliorate the negative impacts of gambling-related problems.

This chapter presents and analyses the results of an investigation into help-seeking behaviors of Indigenous Australians in relation to their awareness of and preferences for professional help, non-professional help and self-help strategies for gambling-related problems. While part of a larger project, this study involved a non-random sample of 36 Indigenous regular gamblers in two areas of northern Australia with high Indigenous populations. Taking an interpretive, qualitative stance, semi-structured face-to-face interviews were conducted by an Indigenous male researcher, with help from a non-Indigenous female research assistant.

Results showed that awareness of professional gambling help services was low and questions were raised around the cultural appropriateness of online and telephone services, self-exclusion, mutual support groups and non-Indigenous face-to-face services.

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Those providing non-professional help for Indigenous gamblers included partners, family, friends, colleagues and community leaders, although family and friends were often gamblers themselves, which could be problematic. Common self-help strategies used were taking up new hobbies and interests, learning new skills, taking care of health, employing budgeting skills, avoiding gambling venues, and avoiding family and friends who gamble. This research revealed that these Indigenous gamblers preferred self-help strategies initially to avoid the shame and embarrassment of other treatments. These self-help strategies were followed by informal sources of help, then professional or formal help. Thus self-help measures could be more widely publicized and the use of professional and non-professional sources of help could be improved to help optimize recovery from gambling-related problems amongst Indigenous Australians.

INTRODUCTION

Indigenous Australians comprise about 2.5% of Australia's population of 22 million people [Australian Bureau of Statistics [ABS], 2010]. While about 75% of Australian adults participated in some form of gambling activity in the past year and 0.5% to 1.0% are estimated to have significant gambling problems [Productivity Commission, 2010], the participation and problem gambling rates for Indigenous Australians are unknown [Breen, Hing and Gordon, 2010]. However, the limited evidence available suggests that the prevalence of gambling problems amongst Aboriginal Australians is disproportionately high [Breen, Hing and Gordon, 2010]. Given their history of post-colonial dispossession, discrimination and racism [Atkinson, 2002], Indigenous Australians are more likely than non-Indigenous Australians to suffer from structural disadvantages such as poverty, unemployment and low education, making many more vulnerable to health problems and social struggles [Atkinson, 2002].

One public health problem facing some Indigenous Australians is problem gambling [Aboriginal Health and Medical Research Council of New South Wales [AHMRC], 2007; McMillen and Donnelly, 2008], fuelled by the wide availability of gambling and its associated risks [QLD Department of Corrective Services, 2005; Stevens and Young, 2009]. Higher gambling risks are usually the precursor for gambling-related problems, which in turn create a need for gambling treatment services and other sources of help.

However, little is known about awareness and use of different types of gambling help by Indigenous Australians although they are likely to be low. Even amongst the general population, only about 10% of problem gamblers seek professional treatment for their gambling problem, despite the availability of a variety of free gambling treatment services in all Australian jurisdictions [Delfabbro, 2009].

Gambling treatment services include individual, group, telephone, email and online services and can include financial, legal, relationship and addictions counselling, along with cognitive behavioral and other types of therapies. Gamblers appear to use these services only when their problems become so serious that there are few options left, and many use self-help and informal sources of help instead, such as turning to family and friends [Delfabbro, 2009; Productivity Commission, 2010]. However, little is known about the help-seeking activities of Indigenous Australian gamblers except that few present to formal treatment services [Breen, Hing and Gordon, 2010]. This raises two questions:

1) When faced with gambling-related problems, what help services or sources are preferred by Indigenous Australian gamblers; and
2) Which ones would be most useful?

Problem Gambling

Gamblers who are unsuccessful in controlling their gambling activities usually experience harmful consequences, reflected in the Australian national definition of problem gambling as 'characterized by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community' [Neal, Delfabbro and O'Neil, 2005, p. i]. However not all gamblers experiencing gambling-related problems behave the same way or experience the same consequences. Research has identified a continuum of risky gambling behavior and severity of gambling-related harms [Shaffer, 2005], with individuals experiencing gambling problems typically shifting between levels of no risk, at-risk, problem and pathological gambling over time [Abbott, 2007; Slutske, Jackson and Sher, 2003]. The accepted instrument for measuring problem and at risk gambling in Australia is the *Problem Gambling Severity Index* (PGSI) which forms part of the *Canadian Problem Gambling Index* (CPGI), [Ferris and Wynne, 2001]. The PGSI contains nine statements that the gambler rates on a four-point scale (from 'never' to 'almost always'; scored 0-3). The higher the summed score on this scale the greater the risk of a gambling problem, with validated cut-off scores used to categorize individuals as a non-problem gambler, low risk gambler, moderate risk gambler or problem gambler [Ferris and Wynne, 2001]. Even though the gambling involvement of problem, moderate risk and low risk gamblers varies in terms of gambling frequency, expenditure and session duration, most are regular gamblers and all experience disordered gambling and gambling harms at least sometimes. For many, the personal, interpersonal, financial, legal and work-related impacts can be particularly severe [Delfabbro, 2009] and sometimes prompt a search for help to address the gambling problem.

Sources of Help for Gambling Problems

Alternative sources of help for gambling problems can be categorized into professional treatment services, informal sources of help such as friends and family, or self-help strategies that do not necessarily involve other people.

Professional Treatment Services

Professional treatment services include seeking help from medical practitioners, addiction practitioners (counsellors and social workers) and psychological therapists. Treatment services base their intervention on their professional philosophical position. Thus, problem gambling can be considered as pathological (an impulse disorder), an addiction (a medical condition) or as a result of psychosocial factors (mood and coping disorders). For those in the general population who complete professional treatment for problem gambling, the outcomes

are generally good [Pallesen, Mitsem, Kvale, Johnson and Molde, 2005]. Yet Indigenous peoples appear reluctant to use these services.

For instance, in the United States of America, the Oregon Problem Gambling Treatment Services provide 28 regional and statewide residential programs, minimal interventions, prison-based minimal intervention education programs, gambling help-lines and community prevention programs [Moore, 2008]. During 2007-2008, the service reported 2,012 gamblers and 353 family members enrolled in gambling help services of whom 2.6% or 54 were Native American people. With a national gambling prevalence rate of about 5% [Petry, 2005d] and Belanger [2011] suggesting that Native American peoples are three times more likely to become problem gamblers, there appears a disparity in the number of Native American people presenting for treatment.

Similarly in Canada, Rush, Moxam and Urbanoski [2002] examined the characteristics of people seeking help from 44 Ontario problem gambling treatment programs from 1998-2000. Of 2,224 clients, nearly 5% or 110 were First Nations people. With an estimated prevalence of Canadian Aboriginal problem gambling between 10%-20% [Williams, Stevens and Nixon, 2011], the authors concluded that the under-representation of First Nations people needed further research [Rush et al., 2002].

Low professional help-seeking rates amongst Aboriginal gamblers suggests that mainstream treatment services may not suit the cultural or other needs of Indigenous gamblers. Concerns over language barriers, confidentiality issues, value conflicts and types of support may discourage attendance [Dyall, 2010; McMillen and Bellew, 2001]. Thus, consideration of cultural values, beliefs and practices may be vital for underpinning any professional help services designed for Indigenous groups. However in Portland Oregon (US), the Native American Rehabilitation Association established an outpatient clinic in 2007 with a culturally specific treatment program for Native American gamblers [Moore, 2008]. In 2007-08 it had only 15 gamblers and one family member as clients. Thus, despite efforts to provide culturally specific treatment programs it seems that few Native Americans use them [Moore, 2008], suggesting there are other barriers to this form of help-seeking. In contrast, in New Zealand where Maori and Pacific people are over-represented amongst problem gamblers, a dedicated Maori Gambling Helpline and Pasifika Gambling Helpline have experienced increased client numbers since 2008, although numbers are slowly stabilizing [Mason, 2009]. These examples illustrate the wide variation in take-up of culturally-specific gambling help services amongst Aboriginal people, but provide no explanation for this variation. Not only is there little research into the motivators and barriers for Indigenous people to attend these services, but basically nothing is known about the effectiveness of these services.

Informal Channels of Gambling Help

Informal channels of gambling help include social, emotional, financial and physical support from community, family, friends, clergy, peers and influential others. Whilst social support plays a role in recovery in general health and addiction, less is known about social support in the recovery of problem gamblers [Gomes and Pascual-Leone, 2009]. Some research has reported family and friends as important referral sources to gambling help. In Scotland, Anderson, Dobbie and Reith [2009] found that friends and family were active in promoting formal treatment for problem gamblers and helping to manage the gambling treatment (e.g. controlling finances). In New South Wales (NSW), client data from problem

gambling treatment services indicate that 16% of clients report family and friends as the referral source [Productivity Commission, 2010]. In the Australian Capital Territory (ACT), problem gamblers are significantly more likely to talk to friends or family (34.8%) than to access a help service (16.9%) (Davidson and Rodgers, 2010). In New Zealand, Clarke, Abbott, DeSouza, and Bellringer [2007] report that as many as 50% of problem gamblers rely on informal help from concerned significant others.

However, the type, quality and efficacy of gambling help provided by family, friends and other non-professionals has attracted little research and the complexity of intimate relationships means this type of help may not always be consistent or have positive consequences [Krishnan and Orford, 2002]. For example, Patford's qualitative research with 13 male [2008] and 23 female [2009] partners of problem gamblers found they engage in processes of denying, caring, monitoring, controlling and sometimes facilitating their partner's gambling. Nevertheless, Kalischuk's [2010] research with 37 participants showed that family members can co-create life pathways through processes involving transition, tension and turmoil, transformation, transcendence and termination. Similarly, other research has found that problem gamblers and their families sometimes use adaptive and innovative ways of supporting and treating themselves, often successfully [Clarke et al., 2007; McMillen et al., 2004].

Nevertheless, little is known about the methods used by family and friends to encourage and support problem gamblers in improving their situations and in seeking professional help, how best to equip them with the knowledge, skills and support they need, and the role of social support as part of a range of interventions [Clarke et al., 2007; Delfabbro, 2009]. Further, no research has been conducted into non-professional gambling help used by Aboriginal Australians. An additional type of informal help is provided by mutual support groups, such as Gamblers' Anonymous (GA). GA is popular in North America where it originated [Gomes and Pascual-Leone, 2009; Petry, 2005a, 2005b], as well as in other countries including Australia. Yet mixed research results on the benefits of participation in GA have been found. In Scotland, with records from 232 attendees over 16 years, Stewart and Brown [1988] found that only 7.5% of GA attendees were not gambling at one year follow-up. In contrast, Petry [2005a; 2005b] found that problem gamblers who had been GA attendees and who presented for treatment showed significantly better outcomes than those with no GA history. More recently GA involvement was found to be associated with a readiness for change, but not with any other facilitator of change in a study of 60 problem gamblers presenting for treatment [Gomes and Pascual-Leone, 2009]. A more recent development is the growth of Internet-based peer support programs [Monaghan and Wood, 2010]. Reports from self-selected samples on these sites shows that the support provided is very helpful in maintaining changes to gambling behavior [Cooper, 2004; Wood and Wood, 2009]. This may be important for people unable or unwilling to access face-to-face treatment or peer support groups. However, it is not known whether Aboriginal people in Australia or elsewhere utilize Internet or land-based mutual support services.

Self Help Measures

Gamblers are known to use a range of self-help measures to assist in controlling their gambling. These measures are diverse and can include budgeting, limiting access to cash, taking up diversionary activities, avoiding gambling venues and friends who gamble, moving to jurisdictions where gaming machines are less easily accessible, and use of blocking

software for Internet gambling sites. Other measures have been the subject of research, including online support materials [Monaghan and Blaszczynski, 2009] and professionally designed workbooks for self-paced completion. The latter are mostly based on cognitive-behavioral and motivational techniques and are compiled by professionals to follow a similar progression to that practised in face-to-face sessions [Hodgins, Mararchuk, el-Guebaly and Peden, 2002; Petry, 2005c]. However, the efficacy of self-help measures is difficult to assess because they are often used in tandem with other sources of help.

A popular form of self-help is self-exclusion. Gamblers sign an agreement with a gambling operator that they will not enter the venue or gambling area and, if detected, the venue has the right to exclude them. With approximately 15,000 self-exclusion agreements in place [Productivity Commission, 2010], between 9 to 17% of problem gamblers in Australia are excluded. Self-exclusion is generally found to be somewhat effective at promoting abstinence from gambling [Ladouceur, Jacques, Giroux, Ferland and Leblond, 2000], and in reducing gambling [Townshend, 2007]. However breaches of agreements and participants receiving additional treatment confound these results. For example, all participants in the Townshend [2007] study were also in contact with a treatment service, while in the Tremblay, Boutin and Ladouceur [2008] research, 70% attended a mandatory meeting and 37% attended a meeting to receive voluntary evaluation. Self-exclusion is difficult to evaluate as a sole treatment and little is known about use or efficacy of self-exclusion and of other types of self-help, amongst Indigenous peoples.

Cultural Influences on Help-Seeking for Gambling Problems

Internationally, cultural influences on gambling behavior have been analyzed in the work of Belanger [2011], Mason [2009], Petry [2005d], Raylu and Oei [2004] and Schluter, Bellringer and Abbott [2007], amongst others. In multicultural societies such as Australia, non-Caucasian ethnicity has been reported as a risk factor for gambling-related harm [Cultural Perspectives, 2005a, 2005b; McMillen, Marshall, Murphy, Lorenzen and Waugh, 2004; Productivity Commission, 1999; Stevens, Golebiowska and Morrison, 2010]. The Productivity Commission [2010] suggested that cultural differences can affect how gambling and gambling help are perceived. Gambling help-seeking may be reduced due to perceived or actual lack of culturally and linguistically appropriate services for some minority groups. Others may not have a high awareness of the availability of problem gambling services or lack the language skills to sufficiently access information and treatment [Cultural Partners Australia, 2000; Cultural Perspectives, 2005a; Raylu and Oei, 2004]. Cultural Perspectives [2005b] noted that Indigenous people may not be comfortable with the communication style that most counselling situations involve (i.e., direct and open). A lack of Indigenous counsellors is also a barrier to help-seeking for this population [Breen et al., 2010]. This point was also made in New Zealand by Bellringer, Pulford, Abbott, DeSouza and Clarke [2008]. They recommended greater Maori involvement in raising awareness of help services and destigmatising help-seeking behavior, along with greater involvement in the design and provision of services. As well, Indigenous people may not identify gambling problems even when gambling-related harm is impacting their lives [McMillen and Bellew, 2001; McMillen et al., 2004]. These research reports highlight the need for well-informed public health strategies to optimize access to gambling help for all groups in society, including Indigenous Australians.

Help-Seeking amongst Indigenous Australian Gamblers

International evidence suggests that Indigenous people under-present to formal gambling help services [Abbott, 2001; Dyall, 2010; Moore, 2008; Rush et al., 2002]. This under-presentation is also apparent in Australia. There is often a lack of awareness about these services and the services and treatment offered may not be seen as culturally appropriate [Breen et al., 2010;McMillen et al., 2004]. The AHMRC [2007] maintain that shame and stigma prevent Indigenous Australians from seeking gambling help while Cultural Perspectives [2005a] report that denial, embarrassment, hiding gambling problems, lack of comfort with counselling, little confidence in services, and confidentiality concerns are barriers. Yet, the proportion of Indigenous problem gamblers who seek formal treatment for their gambling problems is not known. Hunter [1993:242] wrote, 'Not surprisingly, the poorest in society stand to lose most, even when losing less. At the bottom of the Australian economic ladder, Aborigines attract little contemporary attention to their gambling'.

Culturally, Australian Indigenous communities take a whole of community approach towards the resolution of some issues compared to a more individualistic approach in non-Indigenous societies. The collective good is important [Taylor, Cheers, Weetra and Gentle, 2004]. However, problems that are dealt with communally may take some time before they are recognized as a crisis. Further, community solutions are difficult to implement [Taylor et al., 2004]. For example, in a Community Corrections survey [QLD Department of Corrective Services, 2005]; Indigenous participants reported that gambling winnings were used to support their families. Support for families is important for Indigenous Australians, some of whom live with disadvantage and in poverty. Poverty is often associated with greater financial risk-taking due to the psycho-economics of gambling [Shaffer, Freed and Healea, 2002]. Winning is perceived as having the potential to radically change lives, potentially much more so for the poor than for the wealthy. This psycho-economic drive underpins attempts that disadvantaged people make to support their family and improve their lives. However this drive may be a barrier for getting help for gambling problems and even lead to more gambling.

In terms of professional treatment, the opportunity to attend free gambling-help programs was supported in a Corrective Services survey by 50% of the Indigenous participants (109 people) and only 37% of the non-Indigenous participants (380 people) [QLD Department of Corrective Services, 2005].

Unfortunately, there are very few Indigenous counsellors providing gambling help services across Australia. The AHMRC [2007] called for culturally specific gambling services that emphasize preventative strategies. The provision of culturally appropriate counselling and gamblers' help services for Indigenous people has also been advocated by Breen et al. [2010], McMillen and Donnelly [2008] and Stevens and Young [2009].

Yet, informally, a willingness to take action has been documented by Christie and Greatorex [2009]. Aboriginal people of the Yolgnu community in the Northern Territory (NT) suggest that community-based negotiated development projects would alleviate structural conditions which lead to excessive gambling in their community. They propose that, with the restoration of traditional lands, authority and the help of their kin folk, they could deal with gambling so that it is less problematic [Christie and Greatorex, 2009]. This proposal indicates a community willingness to look after its own people in preventing and overcoming gambling-related problems.

Additionally, at an informal level and as a self-help measure, Breen [2011] has shown that the capacity to address gambling problems is higher when gamblers have cultural support

from their family and kin. In north Queensland, gamblers obtained support by turning to family for assistance, by self-efficacy and exercising control while gambling, through the support of religious faith and traditional spirituality, and through relatedness and engagement with their collective culture.

Thus, a combination of personal competence and social and cultural support from significant others appeared to foster resilience for some gamblers. Similar results were found in a NSW study which interviewed 169 Indigenous people [Breen et al., 2010]. This study also found that, of the numerous suggestions for potential gambling interventions, the most important appeared the need for relevant and appropriate community education and awareness programs, culturally appropriate gambling help services, Indigenous specific responsible gambling resources, Indigenous trained counsellors and more flexible venue exclusion options [Breen et al., 2010].

What is clear from these studies is that information on gambling help-seeking by Indigenous Australians is sparse. Their issues and concerns may be lost or diluted in national gambling surveys yet Indigenous Australians appear to face particular barriers to gambling help-seeking. In-depth knowledge about gambling help-seeking could inform and underpin culturally relevant and practical services and resources for Indigenous at-risk and problem gamblers.

METHOD

Ethical approval for this project was gained from a university ethics committee. Ethical and cultural issues were important considerations for selecting an appropriate research design. Although part of a larger mixed methods study, a qualitative research design was chosen as a culturally sensitive approach for this section of the project. Being based on appropriate communication styles and respectful cooperation, this approach provided rich in-depth data and valuable information for all. This research was conducted in 2010 in two northern Australian locations, the Darwin and Cairns regions, both with high proportions of Indigenous Australian residents. The gambling help services and most Indigenous health, welfare and community organizations in these regions were asked for assistance in recruiting Indigenous regular gamblers as research participants. After some publicity, an initial list of contacts was formed. Each person who agreed to be interviewed was asked if they could identify others who may be interested in participating in the research.

This process resulted in 36 Indigenous Australians who consented to an interview. They were all regular fortnightly gamblers, with most gambling at least weekly. No participants were accessing a gambling help service or any other professional help for gambling concerns at the time. On a cautionary note, the results of this self-selected sample cannot be interpreted as being representative.

Semi-structured interviews were conducted by an Indigenous male researcher (also a gambling counsellor and community educator) and a non-Indigenous female research assistant. All interviews were conducted face-to-face in community centers. Each interview was recorded with the participants' permission and lasted about 20-30 minutes. Participants were reimbursed for their time with a $20 shopping voucher. All participants were assured of the confidentiality and anonymity of their individual responses.

An interview schedule was designed to examine the help-seeking experiences of people who gamble regularly (Appendix A). It included guiding questions about the participant's

awareness and use of professional help, non-professional help and self-help strategies for any gambling-related problems, and motivators and barriers to accessing these types of help.

Thematic analysis was used to analyze and interpret the interview data. Thematic analysis is a method for identifying, analyzing and reporting patterns (themes) within data, by organizing and describing the data set in rich detail and by interpreting the various aspects of the research topic [Braun and Clarke, 2006:79]. It involves six identifiable stages:

1) Familiarisation with the data by transcribing, then reading and re-reading;
2) Generating initial codes by coding pertinent features of the data in a systematic fashion across the entire data set and then collating data relevant to each code;
3) Searching for themes by collating codes into potential themes and gathering all data relevant to each potential theme;
4) Reviewing the themes by checking to see if the themes work in relation to both the coded extracts and the entire data set;
5) Refining the specifics of each theme; and
6) Writing up the results by relating the analysis back to the research objectives and the literature [Braun and Clarke, 2006:87].

Use of thematic analysis helped to protect participant anonymity, because results are grouped and presented by themes and sub-themes, rather than by case or narrative analyses of individual responses.

Of the 36 participants, 22 were women and 14 were men. Their ages ranged from 18 to 80 years. Eight were aged between 18 and 30 years, 14 were in their thirties, eight were in their forties, five were aged in their fifties and one was 80 years of age. Twenty-five participants were employed, nine were not in paid employment, one participant was retired and two did not disclose their employment status. Thirteen of those interviewed were married, one was in a de facto relationship, one was divorced, 12 were single and nine did not make their marital status known. Twenty participants lived in the Darwin region while 16 lived in the Cairns region. The majority (27) reported that their most frequent gambling activity was playing gaming machines. Other gambling activities included wagering, sports betting and playing blackjack and keno.

RESULTS

Awareness of and preferences for professional help, non-professional help and self-help strategies for gambling-related concerns as described by the research participants are presented here.

Telephone and Face-To-Face Counselling

When asked about their awareness of help services for people with gambling problems, most participants said they knew about the telephone Gambling Helpline, with only six participants reporting they had not heard of it. Around one-third of participants said they had also heard of Lifeline, a national not-for-profit organization that provides crisis support for many problems including those related to gambling. For the Darwin participants,

approximately half had heard of specific gambling help services in the region, with an additional four participants noting that, while they were aware of local gambling help services, they could not recall their names. In contrast, there was only one Cairns participant who had heard of any gambling help service in that region. Participants were then asked how they had first heard of these services. A common response across both regions was:

> 1800 Gambling Helpline, it's advertised at the casino, pubs … there's stickers, posters, pamphlets; you see them in the toilets.

Others reported they had:

> … Heard of the services through the media … in local papers, they used to be on TV too.

And:

> The numbers for the Gambling Helpline are sitting around everywhere, on the back of pub toilets, posters on the walls as you're walking in or walking out of the gaming rooms, business cards.

In relation to whether any of the services were identified as more culturally appropriate than others, respondents predominantly saw the services as inclusive, as indicated by this comment:

> They're for everybody, not just Indigenous people; it's for everybody who needs help.

Nevertheless, around one-third of respondents in both Darwin and Cairns commented that they would rather speak to someone face-to-face than on the telephone. This view, at least in part, appeared to reflect a cultural preference for face-to-face counselling as reflected in this response:

> I wouldn't access them [the Gambling Helpline] because I don't know who is on the line … I'd rather face-to-face because I would never, ever trust them because I don't know who I'm talking to. I'd rather talk to a black person in person, only as long as they could keep confidentiality though.

Similarly, another participant was unsure if telephone counselling services are culturally appropriate for Indigenous people because:

> Some Indigenous people prefer to talk to an Indigenous person. And Aboriginal people can feel more comfortable speaking to them face-to-face.

One person noted that:

> Indigenous people need things in front of them, to be visual.

In contrast, other respondents noted they would be willing to seek help over the telephone from non-Indigenous telephone counsellors as long as they were culturally aware of Indigenous people's needs, with one participant commenting that:

> I would speak to a non-Indigenous person but only if they're aware of the cultural needs and how to talk to Aboriginal people, if they were culturally sensitive or they knew … say they grew up with Indigenous people, it doesn't matter with me.

A reason identified by several participants for telephone helplines being considered inappropriate for Indigenous people was the shame that could be associated with problem gambling, especially if the person does not know who they are talking to. For instance, one participant asserted:

> It's the shame and admitting to saying you have got a problem and spending the time to make that call. I would be too ashamed.

Internet Counselling Services

Only two respondents, both from Cairns, had heard of Internet-based counselling services.

When asked to comment on whether such services would be helpful, the participants generally believed Internet services would be inappropriate for Indigenous problem gamblers. This inappropriateness was mainly concerned with lack of access to Internet services, because:

> Not everyone has access to the internet. Like, I don't have access to an Internet outside of work hours so I'm not going to be going to have a look.

Once again it was noted that face-to-face counselling is the preferred type of counselling for Indigenous people:

> Indigenous people would rather talk to a counsellor face-to-face, not the Internet.

Mutual Support Groups

When asked about awareness of mutual support groups such as Gamblers Anonymous, more than half the respondents said they had never heard of any. Furthermore, there was a common belief that such groups would not be culturally appropriate. For instance, one participant said:

> They're not run by Aboriginal people. Indigenous people need their own support groups because there are a lot who don't feel comfortable talking with non-Indigenous people.

Another explained:

> I had a bad gambling problem there for a bit and I never used to go into the group because they were all non-Indigenous people … I felt embarrassed. I would rather talk to somebody that was in the community, somebody I knew.

When asked how they had first heard of gambling support groups, for those who had, three Cairns participants reported they had seen them advertised in gaming venues.

Venue-Based Help

Around two thirds of the participants believed that gambling venues provided only limited help for people with gambling problems, mainly restricted to providing the Gambling Helpline number. This view is reflected in the following response:

> The venues don't go out of their way to discourage gambling because it's an income for them and part of their revenue. They only provide support in terms of information and where to go if you need help. They mostly just promote the number but that's it.

Seventeen respondents (six from Darwin, 11 from Cairns) knew about self-exclusion but many had limited knowledge about what the process involved, with obvious confusion reflected in participants' responses. For instance, participants variously thought the length of time that people could exclude from venues ranged from three months to two years. One person explained that:

> You can write a letter. The casino is the main place. You can go there and tell them you don't want to be gambling. You can do that for two years. You can go there for nightclubs or for a drink or whatever. If security sees you gambling they can kick you out.

And:

> I've heard of self-exclusion, it is for three months …

Several people believed that self-exclusion is not culturally appropriate for Indigenous people and this cultural inappropriateness could act as a barrier to seeking this type of help. This cultural inappropriateness was largely concerned with the shame involved when admitting a gambling problem, especially to a non-Indigenous person:

> The self-exclusion isn't culturally appropriate for our people because they make you feel shame.

General Help Services

It was widely suggested there are few general help services available and no-one identified any general help services specifically for Indigenous people. Most participants acknowledged they do not know enough about services available in their region. However, general services offering information about gambling help were identified by around one-quarter of participants and these included Lifeline, financial services, relationship counsellors, medical centres, and doctors.

Some comments included:

> As for general services around here there's nothing that addresses gambling, nothing unless it's hidden within the help services, not that I'm aware of anyway.
> There's Lifeline but not much else.
> There's no-one around here that I know of that actually specifically targets that [gambling].

Motivators for Professional Help-Seeking

None of the participants were currently using any professional source of help for gambling-related problems. However, insights into their likely use and what might motivate this were gauged by asking how to recognize a gambling problem and what they would do if they developed one. Most people said they would know if someone was experiencing gambling-related problems and suggested some signs would be: having no money; being nervous; becoming secretive; having no food; unpaid bills; neglecting children; asking for loans; hocking or pawning items; losing track of time when gambling; absenteeism from work; anxiety; and relationship problems.

One participant explained that for them:

> The sign would be definitely with the family, not feeding the family, not taking care of my own responsibilities at home first and shifting the priorities … instead of schooling, education, home, I'm shifting it in other directions. Because you're spending too much time there at the gambling venue and you forgot everything else you want to do; it's something too when you can't provide for your family.

Another two respondents also indicated that a sign of problem gambling would be 'a shift in priorities' such as not paying bills, the rent and so forth:

> Probably if I'm spending money before putting food in the kids' mouth or paying my rent and obviously priorities changing. As soon as my priorities change, I guess that would be it … those bills, things like that ... my priorities changing of where I spend the money.
> It's definitely a wakeup call if you're evicted from your house if you're not paying the rent or you get behind in car payments where they could re-possess your vehicle, so when it starts impacting the family in that way, shape or form.

When participants were asked what they would do if they noticed these signs in themselves, a variety of comments were related to self-help strategies including budgeting, setting limits and keeping busy.

Some comments included:

> I would try to help myself by setting a money limit and budgeting my money.
> I'd do other things to keep myself busy; like just stay home and clean.

Another said she would ask the family to help:

> If I see I'm starting to get a problem then I just back off, but if it comes to that stage where I start borrowing money, what I do, I give my children my keycard because they don't gamble.

Only around one-third of the interviewees said they would seek professional help if they noticed signs of having a gambling problem themselves. Commonly, people said they would speak to family first rather than accessing professional help.

Most participants believed it would take a crisis situation for them to seek professional help and that they would need to hit 'rock bottom'. For instance, one said:

> That's when you hit rock bottom … realizing things are really getting to rock bottom and you've got nowhere to turn. … That's the last resort to seeking that professional help because it's that self-evaluation, people sit on that all their life, that denial, they'll deny it all the time.

Barriers to Professional Help-Seeking

There were mixed responses when participants were questioned about why they might delay or avoid seeking professional help for a gambling problem. Reasons included denial of the problem, shame and embarrassment, lack of Indigenous counsellors and confidentiality concerns.

Some comments about lack of problem recognition as a barrier to help-seeking included:

> That is the hardest thing, the biggest thing. The first step to getting help is admitting you have a problem.

And:

> A lot of our people won't admit to having a [gambling] problem.

Of equal concern was the shame associated with gambling problems. Many participants were opposed to seeking professional help due to shame and embarrassment, with one noting:

> I would be too ashamed to go and talk to someone and I'd probably be too embarrassed.

And:

> There is the shame of going for help. Shame is a big thing.

To encourage Indigenous people to seek professional help for a gambling problem it was generally reported that services needed to be culturally appropriate and aware of Indigenous people's needs, including the importance of confidentiality. Confidentiality was said to be particularly important in small communities as evidenced by the following comment:

> I have to be comfortable with who I'm talking to and that it'll be confidential. Confidentiality is really important in a community like this one.

Informal Sources of Help

More than three-quarters of the interviewees agreed they would seek help from other people, such as family members, friends and other Indigenous people, before seeking professional help. Comments included:

> I would go to immediate friends and family because you're close [to them].
> My first port of call would be best friends, closest friends that you've grown up with because we don't get judged from friends.
> Definitely family and friends. I would trust them.

However, concern was raised by several participants about the reaction from family members if help was sought. For instance, one participant said:

> I'd be worried what families would say if I told them I had a serious gambling problem. There's also that shame factor too … as soon as they knew the gossiping [would] start ripping through the family.

Similarly several participants said that they would not seek help from families due to other members of the family having gambling problems themselves. One respondent spoke about this aspect thus:

> I would never ever go to my family because I will get a negative feedback because they all gamble too.

Several participants commented that, because gambling is seen as a normal and acceptable social activity by many in their communities, this can act as a barrier to seeking help from family and friends.

Self-Help Strategies

Several self-help strategies to control or abstain from gambling were identified by participants including: taking up new hobbies or interests; learning new skills, especially budgeting skills; avoiding gambling venues; and avoiding family and friends who gamble.

Taking up new hobbies or interests in an attempt to control gambling was the most common response with suggestions including bushwalking, fishing, undertaking volunteer work, playing sport and learning new skills.

One typical response was:

> To get over the urge [to gamble] I go out bush, go fishing.

In relation to budgeting, one respondent said:

> It would help maybe sitting down figuring out how much I do spend and not just on a fortnightly basis, but on a yearly one because when you look at it it's pretty scary especially if you go and you spend like $100 a fortnight which is $200 a month which is $2400 a year. If I

> knew that before I went in [gambling], then maybe I could go okay, I could save up $2400 for a holiday or save it up for a car or let it sit in a bank.

Avoiding gambling venues was another strategy mentioned by more than half the participants, in both the Darwin and Cairns regions. A typical response was:

> I'd avoid the venues, just stay away from them. I would certainly just not go near the place.

However, five participants (three from Cairns and two from Darwin) said that avoiding the venue would not be a useful strategy for them. For these five, gambling was thought of as a social activity that they do with family and friends. One of these participants explained that:

> I don't think I could stay away because it's a social place and you go there and you know everyone and you chat with them so I probably wouldn't do that [avoid the venue]. That's what we do, me and my friends, we go to the casino.

Several participants spoke about avoiding family and friends who gamble as a self-help strategy with one participant stating that:

> I would avoid being with family and friends who gambled; I'd just have to stop being with them because they were everyday going in there just wasting more money and time.

However, some people noted the difficulty of avoiding family and friends who gamble, as succinctly summed up in the following response:

> It's pretty hard to avoid people if they're close friends and family because it's part of our culture to be close knit.

Suggestions to Improve Gambling Help-Seeking

There were several suggestions to encourage Indigenous people to seek help for a gambling problem. These included: education and community awareness campaigns; teaching of budgeting skills; knowledge of available services; restricting accessibility to poker machines; and making gambling reforms a government priority.

Most participants felt that education and community awareness campaigns that are culturally appropriate, respectful and relevant would be beneficial and encourage help-seeking, particularly for the younger generation. Comments included:

> We need more community awareness, posters, TV telecasts and make the information more user friendly for Indigenous people so they can understand. This needs to be culturally appropriate too. And respectful [because] we've got a lot of pride too in our culture as well …
> More education campaigns so that our people learn what can happen with gambling.
> Have a big day about it [gambling], to educate people. You're bound to get black fellas coming.

Another also emphasized the need for cultural relevance:

> We need Aboriginal programs, Aboriginal counsellors. We need to have better support within the community, preferably with people we're familiar with.

Participants explained that education needs extending to raise awareness about services available to people with gambling-related problems, including financial and relationship problems. Indeed, the lack of awareness about available services was identified as a key barrier to help-seeking. This point was succinctly spoken about by one person thus:

> People need to know where the services are, where the help is. Maybe set up a health center that would link gambling help in with the local services and promote them more.

Several younger participants in both Darwin and Cairns believed there should be school education for students on budgeting skills, the harms of gambling and erroneous beliefs about the likelihood of winning large sums of money. For instance, one participant said:

> There should be education at school with some financial budgeting so the kids know at high school that gambling is a problem and you might start off socially doing it and then you … it's like you've got nothing else to do so you get into the habit where every time you get money you go and gamble.

Another participant highlighted the erroneous beliefs that some gamblers she knows have about gambling and the hope it raises about solving their financial difficulties. She believes that education campaigns need to be directly targeted so that people have realistic expectations about winning money and knowledge that gambling is most likely not going to be the solution to financial problems:

> Many Indigenous people gamble to win money to pay bills because they think if you actually do win some money you're like wow, you can relax for a fortnight or a month with that money. We might think its entertainment but it's not, because for the majority of the time, you've got to put thousands of dollars in before you win a couple of hundred back.

Community support networks are important and needed as summed up in the following comment:

> There needs to be lots of support to help to monitor our money … more awareness for Indigenous people and support networks [to] help in communities, along with education on the impacts it has on family and friends.

Some participants commented that people are socialized by family to gamble and so education and community awareness campaigns need to be targeted at a broad community level, as noted by one participant:

> To break the gambling cycle.

Many interviewees reported that gambling activity was handed down from generation to generation and that families tend to gamble together as a normal social activity. One participant explained 'the gambling cycle' thus:

> Our mother and father, they never did anything else, they just had their card games. And then bingo came along so they all went to bingo and they're not doing the card games anymore and then pokies came along. That's how they all start off.
> Just the mothers and the fathers and grownups play and they let the little ones sit in with them and then they learn to play cards. They know how much money is brought in. That's where it all starts off.

Several participants believed the most helpful approach to education is for Indigenous people who have experienced gambling problems themselves to tell their stories, including how they stopped gambling. For instance, one participant said:

> If you found someone who has hit rock bottom and they went back out, they got themselves out of that hole and stopped gambling, bring them along to a group and get them to talk to the people.

It was suggested that some people develop gambling problems due to lack of alternative activities.

Providing a range of community activities may encourage some people to take up these alternatives. Further, gambling awareness education could be incorporated into such activities. The younger participants considered boredom problematic within their communities, as reported in the following comments:

> There are no things set up where people can go and do stuff around here and it's pretty sad that it's so boring. We'd like a place where you could just go in and have a chat and afternoon tea and have group things and do activities, go out together. It could also encourage them to learn and talk about it [problem gambling].

And:

> Our people just like gambling because there's nothing else for them to do. Even out on communities there are gambling rings. And there are kids involved in the community gambling as well … no-one stopping them. They learn from school age and it continues on.

Gambling was viewed by many participants as entertainment, and as a way to relax and forget their problems.

Consequently, this view obscured the realization for some that their gambling had become problematic. Some participants noted that education about gambling should include information about pathways to gambling-related problems, that gambling can begin as a social activity and is indeed often considered as such, but may develop into a problem for some people.

This view was summed up by the following participant, who also said that gambling provides people with the opportunity to win money:

> Many Indigenous people use gambling as a way to get away from those other problems, and to be social to begin with. Gambling is fun, you've got the big screen … and you could win. So we need education to show people the problems [with gambling].

Conversely, it was understood by the following participant that:

> It's not social when you're sitting there zoned into that machine because quite often people don't want to talk to anybody else. They don't want anybody to bump, annoy them, talk or anything …

Several participants asserted that gambling problems amongst Indigenous people were due to the ready availability of poker machines at venues. Thus, restricting access was considered beneficial. The following comment reflects a view that poker machines should be banned entirely from venues:

> The government should take all the machines away because there are too many pokie machines everywhere for people, it's too easy to access them, too easy to press, it's just too easy.

One participant wanted government policy to concentrate on and prioritize gambling reforms as had occurred with alcohol policies, as explained here:

> Actually working and concentrating on gambling is vital because at the moment there are alcohol reforms ... and things like gambling doesn't get the respect or the acknowledgement from state and federal and territory governments.

All participants agreed that Indigenous gambling is related to a range of complex issues and needs. One participant described the situation thus:

> Gambling is linked to other issues such as domestic violence and alcoholism. But it gets lost with all the other things like alcohol and drugs and doesn't seem to be taken as serious as some of the other issues.

In a similar vein, another said:

> Gambling causes a raft of issues. Gambling is actually affecting all that broader stuff, whether it's through housing, overcrowding along with other stuff that could be also seen as the stress related stuff. It's all that stuff you don't see directly sitting at a poker machine that affects big time such as health, eating … going away during your lunch break to try win an extra $50.

Thus education and community awareness campaigns, improved budgeting skills, awareness about available services, restricting poker machine access and gambling policy reforms were seen as a way forward by many of these participants.

DISCUSSION

The results reveal that the regular Indigenous gamblers who participated in this study prefer self-help gambling strategies, followed by non-professional or informal sources of help before seeking formal gambling help.

Professional Help-Seeking

Awareness of professional gambling help services amongst the Indigenous regular gamblers was generally low, with their use likely precipitated only by a financial crisis. Online and telephone services, exclusion from venues, mutual support groups including non-Indigenous people, and non-Indigenous face-to-face services were generally considered not to be culturally appropriate. For example, self-exclusion presents a cultural and kinship conflict for gamblers if they usually socialize in gaming venues. Exclusion often prevents them from congregating with family, friends and their community in a venue because it attracts public scrutiny about their control over gambling. This is a shameful and embarrassing admission for most Indigenous people.

This low awareness and likely low usage of professional gambling help services aligns with findings from other studies amongst Indigenous populations [Breen et al., 2010, Cultural Perspectives, 2005b; McMillen and Bellew, 2001; Moore, 2008; Rush et al., 2002]. This is in contrast to the reported support for opportunities for free gambling help services by Indigenous people in corrective services [QLD Department of Corrective Services, 2005]. However, cultural issues may underpin some of this reluctance if mainstream help services do not recognize the foundations of Indigenous society as collective, with the family and community as core units [Taylor et al., 2004]. This is in stark comparison to individual autonomy and personal responsibility, seen as the foundations of many western societies, and may result in low cultural understanding. If families are seen as nuclear rather than extended for Indigenous clients, then cultural awareness will be minimal. As well, if mainstream services expect Indigenous people to be open, articulate and expressive about their problems in a non-Indigenous setting [Cultural Perspectives, 2005b], then cultural sensitivity will be absent. Thus, providing culturally appropriate professional sources of gambling help and encouraging their use may assist more Indigenous gamblers to seek help, and some to seek help earlier before reaching a crisis.

However, findings from this study indicate that the advertising of gambling helplines is probably an effective current strategy for raising awareness of professional gambling help, as concluded earlier by Delfabbro [2009]. This does not suggest that advertising of other types of professional help for gambling-related problems should be ignored, but evidence from New Zealand suggests that a dedicated Indigenous helpline could be useful [Mason, 2009]. Gamblers who seek help are likely to use more than one type and there is evidence that Indigenous gamblers would prefer culturally appropriate types of professional help over others.

Informal Help-Seeking Behavior

From the interviews, these Indigenous gamblers reported they would prefer gambling help from partners, family and friends rather than professional treatment. The supportive role family and friends play was clearly significant for Indigenous gamblers in the Cultural Perspectives [2005b] study and that by McMillen and Bellew [2001]. Extended family support through kin group and cultural relatedness was considered a protective factor for Indigenous gamblers by Breen [2011]. This is especially significant for Indigenous gamblers because informal help-seeking from friends and family sits comfortably within Indigenous

collective traditions of cultural reciprocity and meeting kinship obligations. However, the effectiveness of this help is questionable when the gambler's family and friends are also keen gamblers [Breen et al., 2010]. Peer pressure to join in collective gambling can be strong so not all types of informal help may be appropriate to help the gambler recognize and address a gambling problem. Further, an important cultural and traditional expectation of Indigenous Australians is to help and support their extended family and kin relations who are in need of assistance. Thus, financial help for Indigenous gamblers can be provided by loved ones due to cultural reciprocity and strong kinship ties [McDonald and Wombo, 2006]. Extending money to the gambler may exacerbate the problem and may delay professional help-seeking. A more complete picture of pathways to gambling help would be formed with a better understanding of the important role of family and friends in identifying gambling problems and help seeking [Davidson and Rogers, 2010].

Self-Help Gambling Strategies

Some participants used self-help gambling strategies such as becoming engaged in alternative activities, developing new skills and avoiding gamblers and gaming venues, regardless of whether they were problem or non-problem gamblers. Such self-help measures appear to be used for preventative and harm minimization purposes, as well as to regain control after a gambling problem has developed. There was a strong preference for self-help as the first type of help to be used if a gambler became concerned about their gambling. This appears largely due to the shame associated with experiencing a gambling problem and the embarrassment if this information is publicly known.

The Productivity Commission [2010] concluded that people can recover from gambling problems without professional help. They noted that relatively low-cost interventions have the capacity to increase self-recovery, with self-help measures being one possible intervention tool. While self-help gambling strategies have received minimal research attention, just providing automatic, tailored feedback to responses to a problem gambling questionnaire, including a summary of how one's gambling compares to a peer group has been shown to encourage mainstream gamblers to modify their behavior and reduce gambling [Cunningham, Hodgins, Toneatto and Cordingly, 2009]. As seen here, self-help approaches vary and are potentially accessible, cost-effective and less stigmatizing alternatives to professional treatment. They may become a major tool in preventing gambling problems, minimizing harm from gambling and assisting recovery.

Motivators and Barriers for Help-Seeking

Serious financial, emotional and relationship issues appear as major factors that reportedly would prompt gamblers to seek help. The importance of financial problems in triggering help-seeking was obvious in these interviews with regular Indigenous gamblers. Motivators for help-seeking from prior studies reporting that mainstream gamblers do not tend to seek help until their problems become severe and they hit rock bottom [Delfabbro, 2008; Productivity Commission, 2010; Tavares, Martins, Zilberman and el-Guebaly, 2002] appear supported in this current research with Indigenous gamblers.

These Indigenous participants identified barriers to help-seeking as a lack of problem recognition, shame, a lack of culturally appropriate services, and concerns over confidentiality as undermining professional help-seeking. With limited ability to recognize gambling as the problem source, the issue was often framed as a financial problem which then appeared the most likely to prompt help-seeking. Shame and stigma were equally important barriers.

These barriers confirm some earlier research findings for Indigenous gamblers. Shame acts as a barrier to accessing gambling help [AHMRC, 2007] and increases negative gambling outcomes by a lack of information about, and some unwillingness to access gambling help services [Breen et al., 2010]. As identified by Cultural Perspectives [2005b], some Indigenous gamblers were uncertain about the availability and confidentiality of gambling-help services. These barriers intensify negative outcomes of gambling.

Enhancing Gambling Help-Seeking

Drawing on findings from these Indigenous participants, several suggestions have been made to assist help-seeking by those at some risk with their gambling. These suggestions may also assist jurisdictions by informing policy on this matter.

Very low recognition and use of professional gambling help was apparent to these Indigenous gamblers. Despite existing efforts by governments, venues and professional gambling help services, there is an urgent need to raise the awareness of both gambling-specific and generalist services that can assist people with gambling-related problems.

The Indigenous participants appeared to have a strong aversion to counselling, particularly if not provided by a culturally appropriate person. One response may be to increase the availability of Indigenous counsellors and services to provide help for gambling problems. This could be provided through gambling-specific help services or through existing Indigenous health services. Co-locating gambling help services within medical centers may also heighten public confidence that these services are professional and confidential. As well, public education about the counselling process, and its confidential and non-judgmental approach, may help to encourage more professional help-seeking.

While problem gambling was not directly measured amongst the participants in this study, there is little doubt that gambling problems are causing concern and hardship for some Indigenous gamblers, families and communities. Negative impacts of gambling problems extend more widely in Indigenous than non-Indigenous circles, partly due to cultural reciprocity and kinship obligations. Along with low awareness of help services, reticence to use many types of help and limited availability of Indigenous gambling help services, gambling problems amongst Indigenous Australians seem difficult to address.

However, these results reveal that greater awareness is needed about how to recognize a gambling problem, the availability of gambling help services and practical self-help strategies.

This may involve culturally relevant community awareness and gambling education campaigns using prominent, widespread media. Stories from those seriously affected by gambling with hard hitting messages could encourage open discussion of gambling problems. Campaigns need to also feature alternative activities to replace gambling. School education

on managing finances and budgeting with follow up education programs on gambling, erroneous beliefs about making money by gambling and the harms gambling can cause were advocated. Some wanted venues to play a more proactive role in monitoring gambling behavior, especially with poker machine gambling. They wanted gambling access to be limited and for venues to assist gamblers with appropriate help for gambling-related problems. The participants also called for government reforms, including limiting access to poker machines and recognition that gambling is related to a complex array of social issues, not to be treated as just a single Indigenous concern. In relation to service provision, participant suggestions included cultural awareness training for counsellors and for more culturally specific services for Indigenous populations.

In terms of research limitations, this study has provided a snapshot of preferred gambling help-seeking strategies by regular Indigenous gamblers. Yet the development of and recovery from gambling problems is often a lengthy process. Prospective studies with regular gamblers are needed to enhance our understanding of this process.

Additionally, interviews with recovered problem gamblers would be a useful inclusion to this research. Further, the study relied on self-reported data, both in terms of describing behaviors and in identifying motivators and barriers to help-seeking. Self-reported data can suffer from problems of recall, interpretation and bias. Quantitative research within a longitudinal timeframe may further explain help-seeking preferences and behaviors. Limitations of the sample include not knowing how representative it was of the broader Indigenous population.

CONCLUSION

In answer to the two questions raised at the start of this chapter:

1) When faced with gambling-related problems, what help services or sources are preferred by Indigenous Australian gamblers; and
2) Which ones would be most useful? The regular Indigenous gamblers interviewed for this study preferred self-help strategies first, non-professional or informal sources of help second, and formal or professional gambling help third.

In terms of usefulness, many issues raised in this research are incorporated into the following guidelines for help-seeking enhancement.

- Working with Indigenous communities and services to develop formal, informal and self-help strategies appears the most appropriate way forward to address the concerns and hardship related to problem gambling amongst Indigenous Australian gamblers;
- Indigenous participants in this study advocated providing culturally appropriate education about problem gambling, budgeting, help services and what counselling is to remove perceptions of judgment and lack of confidentiality, provision of cultural awareness training for counsellors and more Indigenous-specific helplines, signage and other materials;

- More Indigenous counsellors and services that provide help for gambling problems are needed. These could be provided through existing Indigenous health services;
- Indigenous communities should be engaged in developing culturally specific programs relevant for their own communities; and
- Programs and services developed for Indigenous gambling help need regular evaluation for effectiveness.

APPENDIX A

Guiding Interview Questions

Professional sources of help:

- Awareness of professional sources of help (face-to-face, Internet, telephone, mutual support groups, from gambling venues, generalist services).
- Preferences for professional sources of help.
- Current and previous use of professional sources of help (types used, most helpful type, satisfaction with outcome, how they found out about the service).
- Motivators for using professional sources of help.
- Barriers to using professional sources of help.
- How use of professional sources of help could be further encouraged.

Non-professional sources of help:

- Current use of non-professional sources of help (types used, most helpful type, satisfaction with outcome).
- Motivators for using non-professional sources of help.
- Barriers to using non-professional sources of help.
- How use of non-professional sources of help could be further encouraged.

Self-help strategies:

- Use of self-help gambling measures (types used, most helpful type, how they found out about the measure, satisfaction with outcome).
- Motivators for using self-help gambling strategies.
- Barriers to using self-help gambling strategies.
- How use of self-help measures could be further encouraged.

Pathways to help-seeking:

- Progression of using professional, non-professional and self-help measures.

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REFERENCES

Abbott, M. (2001). Problem and non-problem gambling in New Zealand: A report on phase two of the 1999 national prevalence survey. Wellington: Department of Internal Affairs.

Abbott, M. (2007). Prospective problem gambling research: Contribution and potential. *International Gambling Studies*, 7, 123-144.

Aboriginal Health and Medical Research Council of NSW (AHMRC). (2007). Pressing problems, gambling issues and responses for NSW Aboriginal communities. Sydney: AHMRC of NSW.

Anderson, S., Dobbie, F., and Reith, G. (2009). Recovery from problem gambling: A qualitative study. Edinburgh: Scottish Centre for Social Research.

Atkinson, J. (2002). Trauma trails recreating song lines: The transgenerational effects of trauma in Indigenous Australia. Melbourne: Spinifex Press.

Australian Bureau of Statistics (ABS). (2006). 4715.0 - National Aboriginal and Torres Strait Islander health survey 2004-05. Canberra: ABS.

Australian Bureau of Statistics. (2010). 4704.0 - The health and welfare of Australia's Aboriginal and Torres Strait Islander Peoples. Canberra: ABS.

Belanger, Y. (2011). (Ed), First Nations gaming in Canada. Winnipeg: University of Manitoba Press.

Bellringer, M., Pulford, J., Abbott, M., DeSouza, R., and Clarke, D. (2008). Problem gambling: Barriers to help seeking behaviours. Auckland: Gambling and Addictions Research Centre Auckland University of Technology.

Blaszczynski, A., Ladouceur, R., and Nower, L. (2007). Self-exclusion: A proposed gateway to treatment model. *International Gambling Studies*, 7(1), 59-71.

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3, 77-101.

Breen, H. (2011). Risk and Protective factors associated with gambling consequences for Indigenous Australians in north Queensland. *International Journal of Mental Health and Addiction*, 10(2), 258-272.

Breen, H., Hing, N., and Gordon, A. (2010). Exploring indigenous gambling: Understanding Indigenous gambling behaviour, consequences, risk factors and potential interventions. Melbourne: Gambling Research Australia.

Christie, M., and Greatorex, J. (2009). Workshop report: Regulated gambling and problem gambling among Aborigines from remote Northern Territory communities: A Yolgnu case study. Darwin: Charles Darwin University.

Clarke, D., Abbott, M., DeSouza, R., and Bellringer, M. (2007). An overview of help seeking by problem gamblers and their families. *International Journal of Mental Health and Addiction*, 5(4), 292–306.

Cooper, G. (2004). Exploring and understanding online assistance for problem gamblers: The pathway disclosure model. *International Journal of Mental Health and Addiction*, 1, 32-38.

Cultural Partners Australia Consortium. (2000). The impact of gaming on specific cultural groups. Melbourne: Victorian Casino and Gaming Authority.

Cultural Perspectives Pty. Ltd. (2005a). Problem gambling research report for CALD communities. Melbourne: Victorian Department of Justice.

Cultural Perspectives Pty. Ltd. (2005b). Problem gambling research report for Indigenous communities. Melbourne: Victorian Department of Justice.

Cunningham, J., Hodgins, D., Toneatto, T., Rai, A., and Cordingley, J. (2009). Pilot study of personalized feedback intervention for problem gamblers. *Behavior Therapy*, 40, 219-224.

Davidson, T., and Rodgers, B. (2010). *The nature and extent of gambling, and problem gambling, in the Australian Capital Territory: Final report.* Canberra: Australian National University.

Delfabbro, P. (2009). Australasian gambling review (4th ed.). South Australia: Independent Gambling Authority.

Dyall, L. (2010). Gambling: A poison chalice for indigenous peoples. *International Journal of Mental Health and Addiction*, 8(2), 205–213.

Ferris, J., and Wynne, H. (2001). The Canadian Problem Gambling Index: Final report. Ottawa, Ontario: Canadian Centre on Substance Abuse.

Gomes, K., and Pascual-Leone, A. (2009). Primed for change: Facilitating factors in problem gambling treatment. *Journal of Gambling Studies*, 25(1), 1-17.

Hodgins, D., Makarchuk, K., el-Guebaly, N., and Peden, N. (2002). Why problem gamblers quit gambling: A comparison of methods and samples. *Addiction Research and Theory*, 10(2), 203-218.

Hunter, E. (1993). Aboriginal health and history, power and prejudice in remote Australia. Cambridge: Cambridge University Press.

Kalischuk, R. G. (2010). Cocreating life pathways: Problem gambling and its impacts on families. *The Family Journal: Counselling and Therapy for Couples and Families*, 18(1), 7-17.

Krishnan, M. and Orford, J. (2002). Gambling and the family: From the stress-coping-support perspective. *International Gambling Studies*, 2, 61–83.

Mason, K. (2009). A focus on problem gambling: Results of the 2006/07 New Zealand health survey. Wellington: Ministry of Health.

McDonald, H., and Wombo, B. (2006). Indigenous gambling scoping study: A summary. Darwin: Charles Darwin University.

McMillen, J., and Bellew, N. (2001). ACT needs analysis: Gambling support services. Sydney: Australian Institute for Gambling Research (AIGR).

McMillen, J., and Donnelly, K. (2008). Gambling in Australian Indigenous communities: The state of play. *Australian Journal of Social Issues*, 43(3), 397–426.

McMillen, J., Marshall, D., Murphy, L., Lorenzen, S., and Waugh, B. (2004). Help seeking by problem gamblers, friends and families: A focus on gender and cultural groups. Canberra: ACT Gambling and Racing Commission.

Monaghan, S., and Blaszczynski, A. (2009). Internet-based interventions for the treatment of problem gambling. Toronto: Centre for Addiction and Mental Health.

Monaghan, S., and Wood, R. T. A. (2010). Internet-based interventions for youth dealing with gambling problems. *International Journal of Adolescent Health and Medicine*, 22(1), 113-128.

Moore, T. (2008). Oregon gambling treatment programs evaluation update 2008. Salem: Department of Human Services, Addictions and Mental Health Division.

Neal, P., Delfabbro, P., and O'Neil, M. (2005). Problem gambling and harm: Towards a national definition. Melbourne: Gambling Research Australia.

Pallesen, S., Mitsem, M., Kvale, G., Johnsen, B., and Molde, H. (2005). Outcome of psychological treatments of pathological gambling: a review and meta-analysis. *Addiction*, 100(10), 1412-1422.

Patford, J. (2008). For poorer: How men experience, understand and respond to problematic aspects of a partner's gambling. *Gambling Research*, 19 (1 and 2), 7–20.

Patford, J. (2009). For worse, for poorer and in ill health: How women experience, understand and respond to a partner's gambling problems. *International Journal of Mental Health and Addiction*, 7,177–189.

Petry, N. M. (2005a). *Recovery without professional interventions Pathological gambling: Etiology, comorbidity, and treatment.* (pp. 153-173). Washington, D. C.: American Psychological Association.

Petry, N. M. (2005b). Gamblers Anonymous and cognitive-behavioral therapies for pathological gamblers. *Journal of Gambling Studies*, 21(1), 27-33.

Petry, N. M. (2005c). *Brief and motivational interventions Pathological gambling: Etiology, comorbidity, and treatment.* (pp. 257-265). Washington, D. C.: American Psychological Association.

Petry, N. M. (2005d). *Demographic correlates Pathological gambling: Etiology, comorbidity, and treatment.* (pp. 57-83). Washington, D. C.: American Psychological Association.

Phillips, G. (2003). Addictions and healing in Aboriginal country. Canberra: Aboriginal Studies Press.

Productivity Commission. (1999). *Australia's Gambling Industries* (Report No. 10). Canberra: AusInfo.

Productivity Commission. (2010). Gambling (Report no. 50). Canberra: Australian Government.

Queensland Department of Corrective Services. (2005). Games people play: Problem gambling in Queensland community corrections. Brisbane: Queensland Government.

Raylu, N., and Oei, T. (2004). Role of culture in gambling and problem gambling. *Clinical Psychology Review*, 23(8), 1087-1114.

Rush, B., Moxam, R., and Urbanoski, K. (2002). Characteristics of people seeking help from specialized programs for the treatment of problem gambling in Ontario. *Journal of Gambling Issues*, 6, Available at: http://jgi.camh.net/doi/full/10.4309/jgi.2002.6.9.

Schluter, P., Bellringer, M., and Abbott, M. (2007). Maternal gambling associated with families' food, shelter, and safety needs: Findings from the Pacific Island families study. *Journal of Gambling Issues*, 19, 87-90.

Shaffer, H. (2005). From disabling to enabling the public interest: Natural transitions from gambling exposure to adaptation and self-regulation-Commentary. *Addiction*, 100, 1227-1230.

Shaffer, H., Freed, C., and Healea, D. (2002). Gambling disorders among homeless persons with substance use disorders seeking treatment at a community centre. *Psychiatric Services*, 53(9), 1112-1117.

Slutske, W., Jackson, K., and Sher, K. (2003). The natural history of problem gambling from age 18 to 29. *Journal of Abnormal Psychology*, 112, 263-274.

Stevens, M., and Young, M. (2009). Reported gambling problems in the Indigenous and total Australian population. Melbourne: Gambling Research Australia.

Stevens, M., Golbebiowska, K., and Morrison, P. (2010). Correlates of reported gambling problems in the CALD population of Australia. Melbourne: Gambling Research Australia.

Stewart, R. M., and Brown, R. I. (1988). An outcome study of Gamblers Anonymous. *British Journal of Psychiatry*, 152, 284-288.

Tavares, H., Martins, S. S., Zilberman, M., and el-Guebaly, N. (2002). Gamblers seeking treatment: Why haven't they come earlier? *Addictive Disorders and Their Treatment*, 1(2), 65-69.

Taylor, J., Cheers, B., Weetra, C., and Gentle, I. (2004). Supporting community solutions to family violence. *Australian Social Work*, 57(1), 71-83.

Townshend, P. (2007). Self-exclusion in a public health environment: An effective treatment option in New Zealand. *International Journal of Mental Health and Addiction*, 5(4), 390-395.

Tremblay, N., Boutin, C., and Ladouceur, R. (2008). Improved self-exclusion program: Preliminary results. *Journal of Gambling Studies*, 24(4), 505-518.

Williams, R., Stevens, R., and Nixon, G. (2011). Gambling and problem gambling in North American Aboriginal People. In Y. Belanger (Ed), *First Nations gambling in Canada: Current trends and issues* (pp. 166-194). Winnipeg: University of Manitoba Press.

Wood, R. T. A., and Wood, S. A. (2009). An evaluation of two U. K. online support forums designed to help people with gambling issues. Journal of Gambling Issues. Accessed 20/2/2012 Available at: *www.camh.net/ egambling/issue23/pdfs/01wood.pdf.*

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Chapter 7

PSYCHOLOGICAL FACTORS ON COLLABORATIVE GAMING

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ABSTRACT

This chapter addresses the key issues in the psychological factors related to collaborative Game Based Learning (GBL). The first part of the chapter provides a comprehensive review of the research developed in collaborative learning and the specific field of collaborative GBL. It begins with an analysis of the social interaction dynamics involved in collaborative learning.

This is followed by a specific analysis of game dynamics in multiplayer games (such as intergroup cooperation and competition) and the efficiency of these dynamics in supporting the collaborative learning process.

In closing this chapter, the teaching and game design implications of the psychological aspects of collaborative GBL are discussed – so enabling a transfer of the most relevant knowledge and best practises.

INTRODUCTION

Playing is one of the most powerful learning activities for children and adults. Games are activity systems that allow players to engage in a universe of decision-making and interactions constrained by the game rules.

In this respect, Osborne and Rubenstein (1994, p.2) define a game as 'a description of strategic interaction that includes the constraints on the actions that players can take and the players' interests, but does not specify the actions the players do take'.

The game defines the rules within which players can develop a certain level of decision-making and interactions with the computer-based game or other players.

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Because certain human activities have developed a system with a universe of rules for decision-making and interaction, game playing is being used for researching interactive human behaviour in gamified situations. Gamification has brought the use of game design elements into non-game contexts (Deterding, Khaled, Nacke and Dixon, 2011) in order to increase the levels of engagement, raise awareness of the system rules, and analyse performance as a game score.

However, the use of gamification for educational purposes can only be understood under the field of Game Based Learning (GBL), where games are used as learning activities for educational objectives.

An increasing number of the GBL activities in formal and informal education are nowadays supported by computer-based environments that enable the games to take advantage of technology features for the gameplay.

For this reason, in this chapter we focus on digital GBL, and we use the term GBL for computer-based games with educational purposes; and we use the term face-to-face game for non-computer based games.

In parallel with the emergence of digital games for education, we have seen in recent years the development of collaborative methodologies in the classroom.

We consider simultaneously these two educational trends as a synergic opportunity to further develop the GBL approach by considering the support of collaborative learning through the use of educational games or Serious Games (SG).

In this chapter we study collaborative GBL as a support for collaborative learning through the use of GBL. In the following section we describe the collaborative learning process, before analysing the requirements of GBL for supporting collaborative learning.

1. COLLABORATIVE GAME BASED LEARNING

Collaborative game based learning (GBL) could be considered as the use of GBL activities for supporting collaborative learning. The main objective in collaborative GBL is educational and the analysis of game characteristics that could facilitate the learning objectives. Because two participants are not enough to ensure collaborative learning, neither a multiplayer educational game nor a serious game (SG) can guarantee collaborative learning in a GBL situation. Moreover, individual games used in group-based learning activities could promote collaborative learning. Collaborative learning involves intra-psychological and inter-psychological factors such as the group design in terms of group size and member knowledge, the nature of the learning task, and the social and knowledge construction processes within the group. Before focusing on these factors we will describe the concept of collaborative learning based on a review of the term.

Many authors have proposed a definition of collaborative learning from differing perspectives. We can simplify and identify two approaches. The first approach describes collaborative learning as a learning situation from an instructionalist point of view. Collaborative learning involves at least two participants in a learning situation where they seek to reach a ‘common goal’ (Johnson, Johnson and Smith, 1991) or ‘shared learning goals’ (Barkley, Cross and Major, 2005) that can be achieved by joint efforts, coordination, ‘positive interdependence’ (Johnson and Johnson, 1975), and participating and working together (Wilczenski, Bontrager, Ventrone and Correia, 2001) to achieve a ‘joint solution’ (Dillenbourg and Schneider, 1995). In this sense, Roschelle and Behrend (1995, p. 70) define

collaborative learning as 'the mutual engagement of participants in a coordinated effort to solve [a] problem together'.

In the use of games for collaborative learning, the instructional approach has led to an analysis of computer-based characteristics. This analysis supports the instructional design of a collaborative learning situation, enabling more than one player to participate in the game through the use of multiplayer games.

Such games can propose a common goal to the players that encourages group cooperation and allows a certain level of coordination of efforts and solutions. SimPort (Warmerdam et al., 2006) is an example of an SG where learners develop a joint solution to expand the Dutch port of Rotterdam.

The second approach to collaborative learning focuses on the knowledge transactions occurring during the learning situation. In this sense, collaborative learning is the acquisition of knowledge, skills, or attitudes through group interaction where group members share work and develop shared meanings about the group task (Derycke and D'halluin, 1995). Johnson and Johnson (1999) focus on the group interactions that lead to a shared understanding, a deeper learning level, and the development of critical thinking skills. From a socio-cultural point of view, Bluemink and Järvelä (2011) analyse the interest of virtual multiplayer games for providing a shared context for collaborative interaction that enables learners to share and construct knowledge together. From a socio-cognitive perspective, Romero, Usart, and Almirall (2011) have designed a collaborative decision-making game called MetaVals that encourages knowledge elicitation by students, peer knowledge awareness, and joint decision making in the collaborative phase of the game. These different phases of the game facilitate support for individual and collaborative knowledge elicitation, as well as sharing and construction processes during the joint activity. The game has been applied in the field of finance to differentiate assets and liabilities (Usart, Romero and Almirall, 2012) and for learning the types of variables used in psychology (Romero, Usart, Popescu and Boyle, 2012).

2. COLLABORATIVE GBL REQUIREMENTS

Collaborative GBL requires different factors to achieve the educational objectives. We analyse firstly the computer-based requirements and then analyse in subsequent sections the game mechanics that support social interaction in the use of GBL for collaborative learning.

2.1. Computer-Based Support for Collaborative GBL

Most traditional face-to-face games are collective activities where the individuals play with or against other individual or groups. Playing *hide-and-seek* in the playground involves one pupil hiding and others searching. Coordination and cooperation is required in *Teddy Bear* – where one pupil starts by jumping to a skipping rope and singing the Teddy Bear song while miming the actions. Group coordination and role playing is also involved in *Duck, Duck, Goose,* where one child designates a goose to challenge him from among the ducks. There are hundreds of examples of traditional games worldwide based on small group

cooperation or competition in face-to-face contexts. The player roles, game rules, and cooperative and competitive dynamics of traditional games were too complex for the early generations of digital game machines. Early computer-based games developed basic interactions between the player and the computer-based game, mostly on an individual basis. Because of the initial limitations of computer-based games, the player could play alone or against the machine. Playing against the machine was one of the first attempts to introduce a virtual peer to create an illusion of multiplayer gameplay. The virtual peer is limited to the artificial intelligence of the computer software; nevertheless, the learner could try to learn from his interaction with the machine and from the strategies used by the virtual peer. In this respect, games such the Psion Chess ROM Game (1982) for the ZX Spectrum were used as a way to learn chess by playing against a machine. The tennis game Pong (1972) was the first game to allow two players to play competitively using a device with two controls. The limitations of computer-based environments did not enable the reproduction of complex collaborative settings in digital environments until the 70s and 80s. Multiplayer games with distant players started in 1972 with PLATO, a project of the University of Illinois and Control Data Corporation, which enabled students to interact with distant computers. The first objective of PLATO was to support course materials by sharing between different locations, but beyond this initial use, the PLATO interfaces enabled students to create multiplayer games, such as the spaceship war game Spasim (1974).

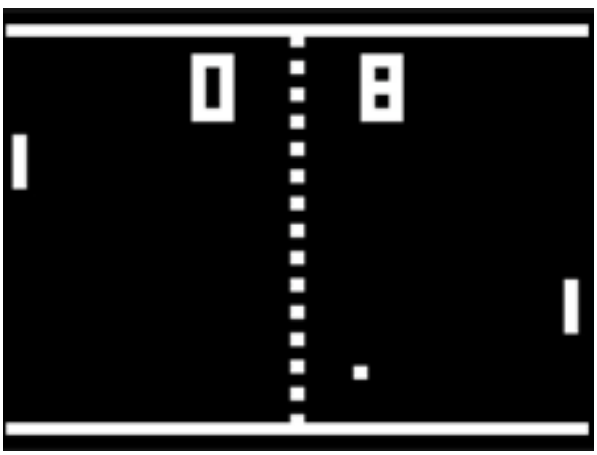

Figure 1. Pong game (1972).

This could be considered as pre-Internet multiplayer game as students were not required to be in the same place while using the same device. While multiplayer games continued to be developed for home consoles, simulations continued to spread for educational purposes, without considering the gamification of the simulation.

However, in 1985 a simulation of a flight program, SGI Flight, combined the educational purposes of the flight simulator with a shooting interaction in a first attempt to combine the *serious* part of the flight simulator program and the fun part of the shooting *game*. Since the pioneer attempts of SGI Flight, many other SGs have been developed based on simulation and for playing in a Local Area Network (LAN).

The revolution in multiplayer games is made possible with the emergence of Internet and the development of wireless technologies from the late 90s onwards. Doom (1993) led the

way to networked multiplayer games and Massively Multi-player Online Games (MMOGs) that support a large number of simultaneous players in a pervasive world. Most of these games were war games that encouraged players to cooperate against other teams. Some authors have discussed the collaboration skill development in MMOGs such World of Warcraft (Hagel, Brown and Davison, 2009; Nardi and Harris, 2006). In the study of Pirius and Creel (2010) students were asked to organise themselves into an inter-dependent and cooperative clan to investigate the topics of subjective culture, personal and group identity, gender and stereotypes, language, citizenship, and technology.

Figure 2. Code of Everand.

Students showed strong engagement in the game but the teachers faced a challenge in managing the class and dealing with the distributed and dispersed knowledge developed through the use of this MMOG. Despite the potential of MMOGs for educational purposes, most educational stakeholders and parents worry about the intrinsic values of the games and the effects of the time devoted to entertainment MMOGs (Peters and Malesky Jr., 2008). There are a growing number of MMOGs developed for educational purposes, such *Code of Everand*, a game designed to improve road crossing behaviour. In this serious MOOG players must learn to safely navigate across roads and the game has been played by about 100,000 11-16 year-olds online and in groups. Serious MMOGs have also take advantage of social networks such Facebook for educational purposes – such as raising ecological awareness in the serious MMOG *Trash Tycoon*. Gameplay in Trash Tycoon includes cleaning rubbish or trash, recycling, and constructing products and decorations out of recycled material in order to win points and display a 'greenness' score to game peers.

2.2. Social Interaction Dynamics for Collaborative GBL

Social interaction is one of the key aspects of collaborative learning. Jehng (1998) further noted that 'collaborative learning involves social interactions between participants, and the

psycho-social processes underlying collaborative interactions could be an important factor that impacts on learning' (p. 22). According to Van den Bossche, Gijselaers, Segers and Kirschner (2006, p. 495) the interaction among members of the group is 'the process through which mutual understanding and shared cognition is reached'. Moreover, some authors consider that social interaction is required for collaborative learning to take place (Garrison, 1993; Soller, Lesgold, Linton and Goodman, 1999). Although we can consider the importance of social interaction in the context of collaborative GBL, we cannot take it for granted and we should analyse the characteristics that encourage social interaction development and sustainment. The activity design and the group dynamics are two components to consider in the support of social interaction in collaborative learning. According to Dillenbourg (1999, p. 7) collaborative learning involves a 'social contract' specifying 'conditions under which some type of interaction *may* occur'. Such social contract development will depend both on the group of player dynamics and the collaborative GBL rules. The group dynamics depends on the group size, the familiarity between members, as well as perceptions, attitudes, and relations towards the other members of the group. Among these factors, trust is one of the essential components for social interaction in collaborative GBL, enabling the group to play together without conflict. Individual and inter-individual affective factors also influence the collaborative learning process (Jonnes and Issrof, 2005). Mutual commitment in the shared activity is also required in an effective team (Cohen and Prusak, 2001) in order to avoid the worst difficulty in collaborative learning: a commitment imbalance among group members (Capdeferro and Romero, 2012). As the quality of social interaction is so important, we must take into consideration that this does not usually happen spontaneously. As highlighted by Kreijns, Kirschner and Jochems (2003) social interaction among learners engaged in multiplayer activities cannot be taken for granted and should be supported by the activity design. Social interaction can be encouraged by supporting opportunities for interaction in textual and audio-visual modalities, and creating the collaborative GBL contexts that require learners to interact with peers. Social interaction could be encouraged in ill-structured learning situations by enabling learners to decide on their organisation, decision-making, and actions.

Team member interdependence and the complexity of the collective challenge require learners to socially interact to achieve their objectives. Analysing the social interaction in multiplayer games, Voida, Carpendale and Greenberg (2010) observed different types of informal group interactions – including the construction and reinforcement of shared awareness, shared success and failure, engagement in interdependence, and interactions related to self-sacrifice in benefit of the group. In collaborative GBL, social interaction can even be rewarded through the game mechanics by encouraging these interactions and enabling learners to explicitly share and construct knowledge during the activity.

We analyse in the following sections of this chapter three types of game mechanics that facilitate support for collaborative learning by combining cooperative and competitive dynamics at the individual and small group level.

2.2.1. Cooperation towards a Common Goal

The underlying premise of collaborative learning is based upon consensus building through cooperation among group members (Bruffee, 1995). Cooperation is a voluntary attitude and implies working with others for shared advantage (Smith, Carroll and Ashford,

1995). Cooperation requires a shared goal and organising team member activity towards the achievement of a goal.

In cooperative groups, joint efforts by members to achieve the group objectives involve sharing knowledge and developing tasks for group objectives. However, designing a collaborative GBL activity as a cooperative activity does not guarantees that all the team members will engage in cooperative attitudes and behaviour. Positive interdependence could foster cooperative behaviour among teammates by encouraging inter-dependent situations where teammates are critically dependent on each other; they need the knowledge of their peers to complete their own part of the task and achieve the group goal (Lipponen, Rahikainen, Lallimo and Hakkarainen, 2003; Dillenbourg, 1999).

In collaborative learning, individuals may be responsible for their actions, including learning, and must respect the abilities and contributions of their peers (Panitz, 1997).

According to Johnson, Johnson, and Holubec (1998, p.4), 'when students clearly understand positive interdependence, they understand that each group member's efforts are required and indispensable for group success and each group member has a unique contribution to make to the joint effort because of his or her resources and/or role and task responsibilities'. Help among teammates and information flow can be defined and guided by collaborative game rules. Positive interdependence could also be related to the assessment (Kao, 2012) or incentive systems implemented in the collaborative GBL that encourage cooperation.

For instance, the game score could be defined as a combination of the cooperative behaviour of the students during the game and the individual and group commitment. An example of cooperative game is the multiplayer SG SimPort (Warmerdam et al., 2006) where the learners work together to develop a joint solution to the expansion of the Port of Rotterdam. Achievement in the joint solution of the expansion of the port is shared by all the teammates.

2.2.2. Inter-Individual Competition

In cooperative games the student always wins or loses within a team. While this situation could reduce motivation and challenge at the individual level, it nevertheless represents a valuable educational setting for collaborative learning. Cooperation could reduce the degree of challenge and result in a loss of engagement in games.

According to Prensky (2001, p.106) games should provide 'conflict, competition, challenge and opposition' to encourage learner engagement. Competition dynamics are considered as one of key elements for explaining the level of player engagement with games (Vorderer, Klimmt and Ritterfield, 2004).

Games are assumed by learners to be intrinsically competitive. Competition raises the level of engagement and challenges the player against the computer-based system, the learner himself, or other players or groups.

In competitive games, players are required to form strategies that oppose the other players in the game (Zagal, Rick and Hsi, 2006). According to Barron (2003) humans tend to be oriented towards a competitive mind-set, mistaking collaborative and cooperative situations for competitive situations. Inter-individual competition is based in social comparison mechanisms (Whittemore, 1925) and these mechanisms lead learners to engage in multiplayer inter-individual competitive games to overcome the other players in the game.

However, inter-individual competition could be counter-productive for knowledge sharing and the joint construction of knowledge because of the concurrent game and learning objectives of each player in a multiplayer GBL situation. Despite this risk, games could be designed to enable learning from other learners' mistakes and achievement by sharing the knowledge produced by each player.

Figure 3. *Ennercities* player scores.

In inter-individual competitive games, group awareness is an important feature that ensures a learner's social comparison with the other players of the game. Dourish and Bellotti define group awareness as 'an understanding of the activities of others, which provides a context for your own activity' (1992, p. 107). In inter-individual competitive games, group awareness could enable the learners to compare their development and achievements with other player achievements during the game. Without a certain level of group awareness, players could have the impression of being alone and not receive cues for preparing a competitive game strategy. SG Ennercities enables players to engage in an inter-individual competition for better managing energy in a city. As shown in Figure 3, the game shows the current scores of the players and invites the learner to compete against or challenge his friends. A second example of inter-individual competition is the SG *Play the News* game (Zapusek, Cerar and Rugelj, 2011). This multi-player GBL is a web-based activity of interactive gaming based on world news. Although users access the game and play it individually, there is a virtual community around the game where players can comment and access their rankings. The game's purpose is to help players create snapshots of a socio-political profile over time on a range of issues.

2.2.3. Intragroup Cooperation and Intergroup Competition

In multiplayer games that allow students to play in groups, the game dynamics could combine the positive inter-dependence and competition at different levels of the game activity (see Figure 4). At the first level, a cooperative approach of the learner toward other teammates is developed at the small group level as part of the dynamics of intragroup cooperation. At a second level, intergroup competitive dynamics are developed between different small teams engaged in the activity. Individuals playing against other individuals are engaged in an inter-individual competition. This dynamic can be considered as extraneous to collaborative GBL, as it entails competition among individuals to reach the final individual goal.

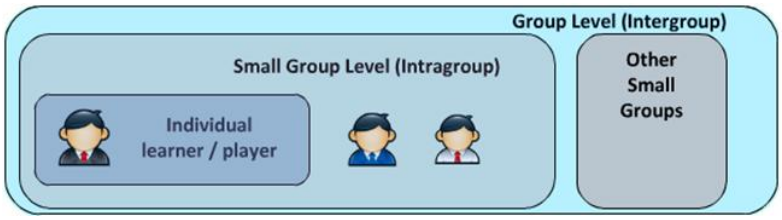

Figure 4. Individual level, small group level, and intergroup level.

In this case, the game provides a multi-player situation, but the game rules of inter-individual competition avoid the collaborative learning dynamics developed among rival teammates. In intragroup cooperation and intergroup competition dynamics, the learners play together (intragroup) against other groups (intergroup). This dynamic corresponds to gaming activities in which students play in a group against other groups, applying the dynamics of intragroup cohesion and the intergroup hostility principle in line with the *realistic conflict theory* of intergroup relations (LeVine and Campbell, 1972; Sherif and Sherif, 1953). Some games are designed to motivate students to collaborate with their teammates in order to compete against other teams. This type of GBL enables both collaboration and competition processes and is expected to create a greater sense of community inside one's group but also a greater motivation to win the game (Romero, 2011). In these multi-player dynamics, the group pursues collaboration for a final, common objective. There is a positive interdependence factor within the intra-group to compete at the inter-group level. We could consider this game dynamic as enhancing intra-group interdependence and knowledge-sharing among group teammates. Inter-individual competition within the members of the group is low, but the inter-group competition is as its peak.

3. COLLABORATIVE GBL DESIGN RECOMMENDATIONS

From the examples and research outlined herein, we can postulate the need to support collaborative learning by creating instructional contexts in terms of teammate profiles, group size, game activity, and cooperative and competitive game dynamics at intragroup and intergroup levels. This should be achieved through the design of techniques aimed at increasing common knowledge and setting the context for students to share different kinds of

information in multi-player GBL activities. Most collaborative GBL supports the instructional approach of collaborative learning by supporting multiplayer activity, creating a certain awareness of the state and actions of teammates, and providing scores during the game. However, the collaborative learning process involving previous knowledge elicitation, the metacognitive judgements of this knowledge (e.g. levels of certainty), knowledge sharing, and knowledge construction is less supported in GBL in general – and specifically in collaborative GBL. It is necessary to analyse the collaborative learning process through the use of games and then design the computer-based features, game rules, and dynamics that encourage knowledge elicitation, construction, sharing, and judgement by learners.

A specific challenge in computer-mediated environments in such digital games is the mediation of collaboration. While face-to-face game activities present a natural field for interaction, in computer-mediated multi-player GBL, contextual cues are fewer and little information about peers is available (Kiesler, Siegel and McGuire, 1984). Research results in CSCL demonstrate that awareness tools providing information about highly cooperative group members encourage participants to trust one another (Cress and Kimmerle, 2007). GA could therefore allow groups to be more effective both in inter-individual competitive games and intragroup cooperative situations. GA tools can also provide feedback about peer knowledge. Feedback has a special role to play in effective game-based learning environments, and immediate feedback may be one of the central reasons for efficacy (Dunwell and de Freitas, 2011). Finally, the GA could provide new insights into both the influence processes in group awareness and the connection of these processes to learner differences with respect to contribution behaviour (Dehler, Bodemer, Buder and Hesse, 2011).

Depending on the collaboration skills of learners, teachers should consider the level of external regulation most appropriate for collaborative learning purposes. The teacher role could add value to the feedback received by the learners during the collaborative GBL, as well as influencing an increase or reduction in the cooperative and competitive dynamics developed during game activity. Teachers could also help learners with immediate feedback during gameplay.

CONCLUSION

We should consider that collaborative GBL develops on a spectrum between competitive and collaborative dynamics at different stages of the game or different modalities of the game. Because learners are increasingly required to adapt to different settings of collaboration, learners could take advantage of different game modalities to become efficient co-operators or competitors depending on the game rules. The level of learner skills could be heightened by using the collaborative GBL characteristics that support cooperation, competition, strategy, and tactical support. The result would be gameplays open to inter-individual and intergroup complexity and open scenarios of action and decision-making. Social interaction should be supported both by synchronous, asynchronous, and pervasive technologies – and orchestrated from the collaborative GBL design to the instructional design of the use of the collaborative GBL in a formal or informal learning context. For achieving these objectives, game design should consider more collaborative and interdisciplinary design

approaches (de Freitas and Jarvis, 2006) and iterative design approaches that build on intragroup and intergroup dynamics, technological support for these dynamics, and an analysis of the effective impact of these interdependent and competition dynamics on learning processes and outcomes.

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REFERENCES

Barkley, E.F., Cross, K.P., and Major, C.H. (2005). *Collaborative Learning Techniques: A Handbook for College Faculty*. San Fransisco, CA: Jossey-Bass.

Barron, B. (2003). When smart groups fail. *The Journal of the Learning Sciences*, 12(3):307–359.

Bluemink, J. and Järvelä, S. (2011). Elements of collaborative discussion and shared problem-solving in a voice-enhanced multiplayer game. *Journal of Interactive Learning Research*. 22(1), 21-49.

Bruffee, K., (1995). Sharing our toys. Cooperative learning versus collaborative learning. *Change*, 12-18.

Capdeferro, N., and Romero, M. (2012). Are online learners frustrated with collaborative learning experiences?. *The International Review Of Research In Open And Distance Learning*, 13(2), 26-44.

Cohen, D. and Prusak, L. (2001). *In Good Company. How Social Capital Makes Organizations Work*. Massachusetts: Harvard Business School Press.

Cress, U., and Kimmerle, J. (2007). A theoretical framework of collaborative knowledge building with wikis – a systemic and cognitive perspective. *Paper presented at the 7th International Computer Supported Collaborative Learning Conference*, July 16-21, 2007, New Brunswick, NJ, USA.

de Freitas, S. and Jarvis, S. (2006). A framework for developing serious games to meet learner needs. *Paper presented at Interservice/Industry Training, Simulation and Education Conference*, 2006, Orlando, FL.

Derycke, A.C., and D'Halluin, C. (1995). Co-operative Learning in the Distance Education of Adults: Why, How, and First Results from the Co-learn Project. In B. Collis and G. Davies (Eds.), *Innovative Adult Learning with Innovative Technologies*. New York: Elsevier.

Deterding, S., Khaled, R., Nacke, L., and Dixon, D. (2011). Gamification: Toward a definition. CHI 2011. *Presented at the Computer Human Interaction*, Vancouver, British Columbia, Canada: ACM.

Dillenbourg P., and Schneider D. (1995). Mediating the mechanisms which make collaborative learning sometimes effective. *International Journal of Educational Telecommunications*, 1 (2-3), 131-146.

Dillenbourg P. (1999) What do yuo mean by collaborative leraning?. In P. Dillenbourg (Ed). Collaborative-learning: Cognitive and Computational Approaches. (pp.1-19). Oxford: Elsevier.

Dourish, P., and Bellotti, V. (1992). Awareness and Coordination in Shared Workspaces. *Proceedings of the ACM Conference on Computer-Supported Cooperative Work CSCW'92*, 107-114. New York: ACM.

Dehler, Z. J., Bodemer, D., Buder, J., and Hesse, F. (2011). Partner Knowledge Awareness in Knowledge Communication: Learning by Adapting to the Partner. *The Journal of Experimental Education*, 79(1), 102-125.

Dunwell, I. and de Freitas, S., (2011). Four-dimensional consideration of feedback in serious games. In *Digital Games and Learning*, de Freitas, S. and Maharg, P., Eds., Continuum Publishing, 42-62.

Garrison, D. R. (1993). Quality and theory in distance education: theoretical consideration. In D. Keegan (Ed.), *Theoretical principles of distance education*. New York: Routledge.

Hagel, J., Brown, J. S., and Davison, L. (2009). Introducing the Collaboration Curve, *Harvard Business Review*, 8 April.

Johnson, D., and Johnson, R. (1975). *Learning together and alone*. Englewood Cliffs, NJ: Prentice Hall.

Jonnes, A and Issrof K. (2005). Learning technologies: affective and social issues in computer-supported collaborative learning. *Computers and Education*. Volumen 44. 395-408. 2005.

Jehng, J. J. (1997). The psycho-social processes and cognitive effects of peer-based collaborative interactions with computers. *Journal of Educational Computing Research*, 17(1), 19 – 46.

Johnson, R.T., Johnson, D.W., and Holubec, E.J. (1998). *Cooperation in the Classroom*. Boston: Allyn and Bacon.

Johnson, D.W., and Johnson, R.T. (1999). *Learning together and alone: cooperative, competitive, and individualistic learning* (5th ed.). Boston: Allyn and Bacon.

Johnson, D.W., Johnson, R.T., and Smith, K. (1991). *Active Learning: Cooperation in the College Classroom*, Edina, MN: Interaction Book Company.

Kao, G. Y.-M. (2012), Enhancing the quality of peer review by reducing student "free riding": Peer assessment with positive interdependence. interdependence. *British Journal of Educational Technology*. doi: 10.1111/j.1467-8535.2011.01278.x.

Kiesler, S., Siegel, J. and McGuire, T.W. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist*, 39(10), 1123-1134.

Kreijns, K., Kirschner, P. A., and Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, 19(3), 335–353.

LeVine, R. A., and Campbell, D. T. (1972). *Ethnocentrism: Theories of conflict, ethnic attitudes and group behavior*. New York: Wiley.

Lipponen, L., Rahikainen, M., Lallimo, J. and Hakkarainen, K. (2003). Patterns of participation and discourse in elementary students' computer-supported collaborative learning. *Learning and Instruction*, 13, 487–509.

Nardi, B., and Harris, J. (2006). Strangers and friends: collaborative play in world of warcraft. *CSCW 2006*, 149-158.

Panitz, T. (1997). Collaborative versus cooperative learning: Comparing the two definitions helps understand the nature of interactive learning. *Cooperative Learning and College Teaching*, 8(2).

Peters, C. S., and Malesky Jr, L. A. (2008). Problematic Usage Among Highly-Engaged Players of Massively Multiplayer Online Role Playing Games. Cyberpsychology and Behavior, 11(4), 481-484.

Prensky, M. (2001). *Digital game-based learning*. New York: McGraw-Hill.

Romero, M., Usart, M., Almirall, E. (2011). Serious games in a finance course promoting the knowledge group awareness. *EDULEARN11 Proceedings*, pp. 3490-3492.

Romero, M. (2011). Supporting Collaborative Game Based Learning knowledge construction through the use of Knowledge Group Awareness. *NoE Games and Learning Alliance. Lecture at the GaLa 1st Alignment School*. 20 June, Edinburgh.

Romero, M., Usart, M., Popescu, M., and Boyle, E. (2012). Interdisciplinary an international adaption and personalization of the MetaVals Serious Games. *The Third International Conference on Serious Games Development and Applications SGDA 2012*, 26-29 Sep, University of Bremen, Germany.

Roschelle, J. and Teasley, S.D. (1995). Construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), *Computer-supported collaborative learning*. New York: Springer-Verlag.

Sherif, M., and Sherif, C.W. (1953). *Groups in harmony and tension: An integration of studies on intergroup relations*. New York: Harper.

Smith, K., Carroll, S., and Ashford, S., (1995). Intra- and interorganizational cooperation: Toward a research agenda. *The Academy of Management Journal*, 38(1), 7-23.

Soller, A. L., and Lesgold, A., Linton, F., Goodman, B. (1999). What makes peer interaction effective? Modeling effective communication in an intelligent CSCL. In *Proceedings of the 1999 AAAI Fall Symposium: Psychological Models of Communication in Collaborative Systems* (pp. 116–123). Cape-Cod, MA.

Usart, M., Romero, M. and Almirall, E. (2011). Impact of the Feeling of Knowledge explicitation in the learners' participation and performance in a collaborative Game Based Learning activity. *Proceedings of the International Conference on Serious Games Development and Applications*. Springer LNCS.

Van den Bossche, P., Gijselaers, W., Segers, M., and Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments: Team learning beliefs and behaviors. *Small Group Research*, 37, 490-521.

von Neumann, J., and Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton University Press, Princeton NJ.

Voida, A., Carpendale, S., and Greenberg, S. (2010). The Individual and the Group in Console Gaming. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work - ACM CSCW'2010*. ACM Press, 371-380.

Vorderer, P., Klimmt, C., and Ritterfield., U. (2004). Enjoyment: at the heart of media entertainment. *Communication Theory*, 14(4), 388-408.

Whittemore, I.C. (1925). The competitive consciousness. *Journal of Abnormal and Social Psychology*, 20, 17-33.

Wilczenski, F. L., Bontrager, T., Ventrone, P., and Correia, M. (2001). Observing collaborative problem-solving processes and outcomes. *Psychology in the Schools*, 38, 269-281.

Warmerdam, J., Knepflé, M., Bidarra, R., Bekebrede, G., and Mayer I. (2006). SimPort: a multiplayer management game framework. In Proceedings *of 9th International Conference on Computer Games - CGAMES'06*, 22-24 November, Dublin, Ireland.

Zagal, J.P., Rick, J. and Hsi, I. (2006). Collaborative games: Lessons learned from board games. *Simulation and Gaming*, 37(1), 24–40.

Zapusek, M., Cerar, S., and Rugelj, J. (2011). Serious computer games as instructional technology. MIPRO, 2011, *Proceedings of the 34th International Convention*, 1056-1058.

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Chapter 8

GAME CHANGING: DEVELOPING MEET THE EARTHWORKS BUILDERS

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ABSTRACT

The big idea for Meet the Earthworks Builders: a Flash-based video game is that the player will take away a sense of empathy and understanding for another culture, (perhaps multiple cultures, since several American Indian Nations claim to have descended from the Earthworks and Mound Builder culture).

Experiencing empathy may help students to transfer that empathy to others cultures as well. The largest challenge is that there are no written records.

Also, it is a challenge to change stereotypes. Introducing alternative images may do little to get at who the Earthworks and Mound builders were. To that end, this game environment offers no human representation and no words, since words also denote culture. This chapter explores the challenges, solutions, and methodology used to create a game that represents the Earthworks builders, ancestors of Native Americans, as sophisticated and complex.

INTRODUCTION

Role-playing, through games, simulations, and in person, has been used to teach empathy and understanding in areas of history, sociology, religion, and social work (Porter, 2008; Manny, 2008; Cunningham, 2009; Gerdes, et al. 2011; Aylett, et al. 2009; Dorn, 1989). For example, in *Darfur is Dying* (examining the refugees in Darfur) empathetic concern leading to cultural awareness is developed as the player must keep a family alive as they encounter various hardships. *Meet the Earthworks Builders* is a Flash-based video game prototype about an UNESCO World-Heritage nominated site: the Newark Earthworks in Newark, Ohio, and the people who built them. Funded by a grant from National Endowment for the Humanities (NEH) and through The Ohio State University, a small group of educators are developing the

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game to promote cultural awareness that focuses on attitudinal or behavioral change in the player. In designing a prototype for *Meet the Earthworks Builders*, the intention is for the player to take away a sense of empathy and understanding for another culture that extends the in-game experience to cultures worldwide.

The Earthworks encompass a wide variety of concepts, topics, and disciplines (archeology, anthropology, cartography, geophysics, astronomy, art history, art education, history, geography, geology, etc.). The civilizations that built the Earthworks were large and lived in ancient cities similar to those of the Mayans. In the book *The Native American* (1993), Thomas et al. explain that the archaeological history of the Native peoples of the Americas goes back more than 30,000 years, and that by the time Columbus landed in the "New" World, it was an old world that had already seen civilizations rise and fall. They claim that the continents were populated by some 75,000,000 people who spoke 2,000 distinct languages and had developed a rich diversity of separate cultures, all linked by a network of trade.

From many archaeological digs, the Ohio Historical Society (the quasi-governmental agency that is in charge of the site) staff state that the Earthwork builders were also known for their magnificent works of art that they crafted from materials gleaned from the ends of their world: copper from the upper Great Lakes, mica from the Carolinas, shells from the Gulf of Mexico, and obsidian, a black volcanic glass, from the Rocky Mountains.

In the early 1980s Ray Hively, a physicist, and Robert Horn, a philosopher, analyzed the aesthetically ideal geometry of the Octagon (actually a conjoined octagon and circle) of the Newark Earthworks for astronomical alignments. Solar alignments were not found in the structure, but they found—much to their surprise—several lunar ones. Hively and Horn (1982) determined that the major rising and setting points of the moon, encompassing an 18.6-year cycle, are incorporated into the architecture of the Newark Earthworks. They speculate that this astronomical information is not just symbolically encoded into the site plan, but that the substantial earthen walls, with their long sight lines and a height that corresponds, more or less, to eye level, are massive (and therefore long-lived and tamper proof) fixed instruments for making astronomical observations. Geographically, the Octagon is positioned in an area that needed little clearing for sightlines.

The builders of these Earthworks captured the rhythm of the day and night sky and brought its magic to earth in the form of monumental, geometric architecture. There are also relationships between the Newark Earthworks and other earthworks in Ohio, which has been made evident in the ratio of arc distance to longitude difference, inferring precise understanding of both the mathematical ratio of latitude to longitude and astronomic constants and the scale of the earth. The redundancy of expression of the same relationships makes it very difficult to discount the relationships as coincidental. Oral histories of many Nations/tribes, including the Cherokee, Shawnee, and Choctaw, state that mounds served multiple purposes, including social, spiritual, and bartering. Although the story of the Octagon Earthworks began over 2,000 years ago, it is important to know that many different tribes are still creating earthworks—the desire to connect to the earth has not changed. We took on the challenge of connecting students to the Newark Earthworks through virtual experiences that included the science and the cultural components.

GAME DESIGNING FOR EMPATHY

Huang and Tettegah (2010) explain that serious games provide "information about current issues and topics such as health, environment, and human rights," and "have also become a major medium to train and teach skills such as social etiquette and prosocial behavior" (p. 138). They suggest that game designers consider a player's cognitive load in relationship to their ability to experience empathy during game play; if the player lacks prior understanding of a particular situation, and must therefore develop empathy while simultaneously acquiring an understanding of the situation, they will likely experience cognitive overload "due to the dual-tasking if the game environment, characters, and activities lacks empirical ground" (p. 145). They explain that while some research has explored the relationship between learning, emotions, and empathy, "cognitive load and empathy in serious games has not been systematically investigated" (p. 145).

Gerdes et al. (2011) outline a social work framework that identifies education components that comprise the options for increasing empathy: affective, cognitive, and decision-making. Game play should involve aspects of affective response (mirroring, mimicry, conditioning) to promote formation of healthy neurological pathways and cognitive processing (some of which would likely include self/other awareness, role-taking, judgment, and perspective-taking) developed through role-playing. Cognitive decision-making may result from game play, as the player may be moved to empathetic action demonstrated by helping or advocacy or some other social action.

Playing pro-social games has been shown to increase empathy (Greitemeyer, 2010). In a 2008 study, "Teens, Video Games, and Civics," researchers found that 52% of teens are playing games in which they think about moral and ethical issues and 40% are playing games that focus on social issues. Those having civic gaming experiences are more likely to engage in real-world civic activities, to get information about current events, to "persuade others how to vote in an election, to say they are committed to civic participation, and to raise money for charity" (Greitemeyer, 2010, p. 2). The study also revealed that 76% of players report helping others while gaming and 44% report playing games in which they learn about a societal problem.

David Brookes (Sept. 2011) states that empathy is a feel-good idea that goes nowhere significant, meaning that feeling good doesn't necessarily translate into doing good. Brookes writes, " In a culture that is inarticulate about moral categories and touchy about giving offense, teaching empathy is a safe way for schools and other institutions to seem virtuous without risking controversy or hurting anybody's feelings" (September 2011). He explains that it is a sense of obligation to a "religious, military, social or philosophic code" that motivates what we do and is the source of our identity. "Empathy is a sideshow."

He asserts that to make the world a better place people must "debate, understand, reform, revere, and enact their codes." This supports George Lakoff's view that people develop "frames" through which they understand the world. Lakoff's (2008) explanation of frames leads us to understand that we make moral choices based upon the narrative that we've constructed about what we believe to be true. These narratives, he argues, are embodied within our culture. One such narrative is the Rescue Narrative with the characters of hero, villain, victim, and helper. The evidence for culturally embodied narratives is explained through neural binding. Although the theory behind it is unclear, it is what allows us to

understand a blue square as a single object as opposed to something that is both blue and a colored square. Culturally embodied narratives can be evoked by images. These images can become symbols and a deep part of our visual culture.

For example, the "S" from Superman's costume evokes the Rescue Narrative. Lakoff (2008) equates progressive political policy with the moral value of empathy, "together with the responsibility and strength to act on that empathy" (p. 47). What this means is that creating a game to help people see things like history, reality, and justice from other perspectives means that the game will engender a political perspective even if that is not the intended purpose.

The work of Iacoboni (2008, as cited in Gerdes, 2011 and Manney, 2008) indicates empathy may be naturally occurring, which is evidenced by the fact that mirror neurons that allow us to feel empathy, expressed through our facial expressions, have a circuitry and associated pathways. Lakoff (2008) explains,

> There are also "super-mirror neurons" that fire when you perform an action, but shut down when the same action is observed in others. They appear in the anterior cingulate (hypothesized to detect conflicts), in the orbitofrontal cortex (active in planning that involved reward and punishment), and the pre-supplementary motor area (active in organizing simpler actions into more complex ones). In short, they appear to modulate or control the mirroring function of mirror neurons, and perhaps control empathy in situations of emotional conflict and in planning behavior with social consequences. This suggests that empathy is the natural state, but has to be monitored, modulated, enhanced, and sometimes, shut off (p. 203).

All this is to say the super mirror neurons are activated when people play games: games that involve conflict, rewards and punishments, and organizing actions or developing a strategy. Even though humans are biologically wired to feel empathy, some are more able to be empathetic. Those who are less empathetic can be reached by appealing to the cognitive domain to clearly relate to another person's point of view. The tricky part is in creating the proper frame that will result in the player questioning assumptions about what is true and provokes a willingness to see things from another perspective, whether it is through cognitive processing or through appealing to a person's ability to empathize.[1]

BACKGROUND AND CONTENTION

The subject of Native Americans and their roles, influences, and cultures in United States' schools has traditionally been written about from a colonial perspective while ignoring the Native perspective. Several persistent stereotypes have been perpetuated through visual images, movies, and textbooks, including noble savages, Indian princesses, wise medicine men, etc. (Kilpatrick, 1999). Visual images and stereotypes, often used effectively in storytelling, trigger ways of interpreting and understanding. Language and how it has been used to describe others also indicates cultural assumptions and who is making them

[1] The oxytocin receptor is involved with empathy and is affected by one's genetics. (http://www.sciencefriday.com/program/archives/201111183, Rodrigues, et al. 2009). Genetics and one's life experiences, environment, culture, and upbringing all influence one's empathy. Generating oxytocin occurs naturally through cuddling, massage, and social contact.

(Merryfield, 2002). Representation and language used within the game environment is an important concern. Joe Mcneilly (2008, November) identified seven common stereotypes of Native Americans found in video games: token Indian, the hunter, the sex object, the warrior, the half-breed, the scout, and the shaman. Additionally, movies and video games often conflate Indian Nations (Lameman, as cited in Sharp, 2011 August). Many video games make use of stereotypes to evoke our frames of "other" as is seen in war games where the opponent has a "Middle Eastern" look as opposed to a light skin tone or vice versa, depending upon whether the game is made by those in the U.S. or an Arab Nation. *Under Siege* is a Palestinian-created game that depicts Israelis' as the bad guys. "The dominant mode of representation of Arab and Muslim cultures in European and American media generally exploits stereotypical generalizations and clichés" (Sisler, 2008, p. 204). The us vs. them mentality reduces twenty-two countries to a single Arab world (Wingfield and Karaman, 2002: 132, as cited in Sisler, 2008).

Much of the educational material about the earthworks builders and the Woodland period is full of misunderstanding and errors. This makes it difficult for teachers to find suitable teaching materials. The coverage of these people in social studies textbooks is limited to two or three brief paragraphs. Archeological naming conventions can be confusing. For example, archeologists who found artifacts on the property of Mordecai Hopewell in 1891 used the term *Hopewell culture*. When similar objects were found, they were grouped with the Hopewell artifacts. Consequently, that term is used to refer to the people who built the Newark Earthworks as well.

United States history has been interpreted predominately by white Americans of European descent. The Native voice in the history of North America is largely absent. The National Museum of the American Indian (NMAI), which opened in 2004, provides a strong Native perspective. Paul Chaatsmith, Associate Curator of NMAI, said that the purpose of the museum was conceived through introspection about how to shift modern ideas about what and who Indians are and about how to decode the hierarchy of oppression. (personal communication, July 2009) Visitors can see an interpretation of American history that honors and puts forward the Native American perspective as told by Native people. Exhibits were designed by gathering ideas through dialogues and meetings with Native communities that "expressed the desire to bring native stories forward through the representation and interpretation of Indian cultures as living phenomena throughout the hemisphere" (anonymous, n.d., NMAI website). Even the structure of the building incorporates Native sensibilities throughout. For example, the building's design makes "specific celestial references, such as an east-facing main entrance and a dome that opens to the sky" (anonymous, n.d., NMAI website).

It is in the spirit of creating a channel for a Native voice to emerge that this video game and curriculum materials are being developed. In determining the content, the game designers consulted with scientists and educators, some of whom are American Indians. It was essential that this project represented Native voices as opposed to a "white" perspective and interpretation of Native American history.

Contemporary American Indians view the mounds as sacred spaces that are relevant to their lives. Over 26 tribes claim to have descended from the mound and Earthworks builder culture (staff, 2009). American Indian concepts do not fit into the traditional western way of understanding these things. Native concepts and topics include cyclical or parallel time,

naming conventions, land ownership and use, borders, the four directions, cosmology, and cultural constructs.

Our educational system, being dominated by a western view, limits the ability of students and teachers to grasp these concepts. Some archeologists and historians view the Earthworks as evidence from a past people that have little to do with contemporary American Indians. They endeavor to establish scientific methods of inquiry and exploration in discovering the evidence of how people lived, what they did, and how the Earthworks were constructed, why they were constructed, and how they may have been used to interact with the heavens.

Artifacts that have been found buried within the Earthworks give further evidence of movement patterns; use of resources such as mica, flint, marine shells, copper, stone, and pipestone; and provide clues about what might have been important to these people. Archeological digs and skeletal remains have yielded findings about building construction, diet, social structure, and spiritual practices.

Studying skeletal remains for information is a controversial topic, which resulted in the passage of the Native American Graves Protection and Repatriation Act (NAGPRA) in 1990 and designing elaborate systems of reburying excavated remains so that they can be accessed for future research. This tension between those who want to rebury the remains and those who want to study them remains largely unresolved. This situation provides a conflict that could engender player empathy by creating a situation in which the player identifies with a Native character, experiences something, and develops feelings similar to contemporary American Indians regarding the Earthworks.

In this case, the Newark Earthworks are owned by others and cannot be accessed as they once were, causing feelings of loss and displacement. American Indians have been displaced not just in physical space, but as ancestors' bones have been dug up and examined by archeologists in order to find out more about the culture that created the Earthworks. "NAGPRA provides a process for museums and Federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, or objects of cultural patrimony—to lineal descendants, and culturally affiliated Indian tribes and Native Hawaiian organizations" (anonymous, n.d., National NAGPRA). This has not occurred in Ohio.

Museums and researchers are reluctant to give up their artifacts and human remains. Native people believe that their ancestors will not be at rest until they are reburied. This has led to some unusual situations. For example, Sunwatch in Dayton, Ohio, has developed a process whereby the remains of deceased ancestors have been buried in a crypt that is locked with two keys. To open it, the American Indian Advisory Committee to the Dayton Society of Natural History (DSNH) and the archeologists must agree. Each group has a key and cannot open it without the other. This method has also been used in other places.

DETERMINING CONTENT FOR THE GAME

Meet the Earthworks Builders will be situated within a website that will provide curricular materials, a forum for player discussions, a wiki, and links to other sites. Further funding for our group, which includes our non-profit partner Digital Watershed, from the 4th Digital Media and Learning Competition, held in conjunction with the Mozilla Foundation

and supported by the MacArthur Foundation and administered by the HASTAC Initiative (Humanities, Arts, Science, and Technology Advanced Collaboratory), has allowed for the development of an interactive badge system that expands the content topics that can be explored by learners outside the game environment. The concept for our approach is taken from James Gee (2008), who put forward the idea of big "G" and little "g." "The 'game' is the software in the box and all the elements of in-game design. The 'Game' is the social setting into which the game is placed, all the interactions that go on around the game" (p. 24). Within this "Game" framework, we are developing a game prototype and supporting materials and examining how user-generated content and learners as producers can be incorporated and encouraged.

We wanted our design process to serve as one role model in how the arts can embrace collaborative practices and create coalitions. We applied a consulting collaborative approach by interviewing and researching multiple viewpoints/people and carried that method throughout the game design. Smith (2005) states that this process encourages reflective thinking and practice. Consulting collaborative approaches include critical forms of reflective experiences, cultural studies, and research experiences that can challenge established ways of thinking and acting by encouraging a reexamination of one's own values and practices. This process can build learning communities, which will support communities' lifelong successes and achievements through practices that question social problems, policies, and ethical dilemmas.

The content team is comprised of American Indians, including the Chief of the Eastern Shawnee, and specialists in the areas of Native American Studies, earthworks, anthropology and archeology, architectural history, history, art education, astronomy, and science education. The team members discussed the most meaningful topics through the lens of their subject matter and gave advice about how to understand these issues, while the game designers looked for common themes. During the content planning meeting, Peter Gerstmann (personal communication, November, 2011) identified themes and design intentions to consider during the game design process: gifting, ownership, displacement, and creating in the player a sense of awe and mystery, curiosity, a desire to inquire, and an avenue to understand these people—to personally "meet" them and make a connection with them. As Bill Schmitt, science educator, said, the best way to get to know someone is have a conversation with him or her, as opposed to being told about them (personal communication, content team meeting, 2011).

The game was designed to engage players in ways that allow them to enter into the mental and emotional states of the characters and take on emotional concern. Through a discovery approach, the players can identify with the environment from their perspective, as there is no visual representation of the American Indians. Discussion regarding how to represent the earthwork builders led us to believe that it could not be done without stereotyping. Therefore, players do not see "themselves" or others in the game space because tying to pick a period avatar risks losing the option to create a modern day Native understanding. The music used in the game is limited, and sounds are primarily nature sounds and sound effects created using Native American instruments such as drums, shakers, and rattles. Finally, almost no words are used within the game environment in order to avoid any reference to a particular culture through language.

Game genre and player actions position a player to make specific assumptions and reflect a political and social understanding, whether intentional or not. For example, choosing a

"God game" genre similar to that of Civilization would employ a game mechanic that is representative of colonialism (i.e., the player would control large groups of people, directing them, etc.).

In designing games, educational game designer Dan Norton (personal communication, 2011, October) explains that strategies have to be employed to transform our identified learning goals and objectives in gameplay mechanics. To simplify something that is really very complicated, he breaks it down into three essential gameplay components:

Identity- who the player is, what they value, and how are they empowered;
Verbs- what the player does, in terms of both capabilities and constraints;
System- how the rules of the game itself are modeled.

In creating a player identity and tasks for the player to do, the player enters a game world with the knowledge that there are rules that govern what she can and cannot do. These rules are what force the player to develop a strategy, solve problems, and make choices about what to do. As the player plays, the system of how the game works is revealed and her ability to master that game play indicates a mastery of the system being represented. It is through understanding the created system and figuring out how to navigate and advance within it that the player buys in and connects with the role she has taken on, develops empathy with that character, and, one hopes, "sees" her world and actions from the perspective of that character.

To evoke a resonance with the character, the game designer can choose to use symbols and narrative to create a role that the player can easily slip into (Freeman, 2004). On the other hand, to shift someone's perspective, the role must shift at some point in a way that causes the player to become reflective and contemplative. Similarly, when one sees a good movie, one thinks back through the plot, the characters, and actions to make sense of it, perhaps even shifting perspective. Contextualizing information and creating immersive environments in which the player takes on a role contributes to a deeper involvement with the topic and leads people to go deeper on their own (Gee, 2007). In making *Meet the Earthworks Builders*, the questions are: Can a video game create a feeling of empathy in the player that extends to real people and other cultures? If so, how do we quantify this, given that empathy is a complex emotion?

Our intention is for the player to recognize that (1) different disciplines have different perspectives about a given subject, and (2) within a discipline, different people have different perspectives. Rather than attempt to resolve differences among those with differing perspectives, our goal is simply to represent those differences as they are reflected in various academic disciplines and cultural perspectives. The game design team determined the game rules, core mechanics, and goals. They also considered the interface design, use of space and components, and how these elements best embody the content. They figured out the best way to structure the learning activities and the role-playing and decided to scaffold learning. They discussed the interface design, determined the game mechanics (actions that a player can perform like collecting, jumping, avoiding), rules, goals, and environmental components. By incorporating all of these elements, the game design emerged. Consideration was given to the following: balancing challenges with ways for the player to succeed, providing an experience that illustrates the appropriate facts and exposes players to the appropriate concepts, and creating meaningful progress metrics so that both players and teachers know how well they are doing (Gerstmann, personal communication, Jan. 2011). Through this design, success in

the game indicates mastery of the subject. Embedded assessment mechanisms provide player data that can be used to assess a player's skills and knowledge and to provide player feedback. Learning is incremental and cumulative, with the game providing information as its needed, creating flow through progressive challenges. As players progress, the game tracks data indicating whether or not they are using critical thinking and problem solving skills. This data is compiled for teachers and researchers. Similar mechanisms give the player feedback during game play, allowing them to progress forward or try something different. Through player choices we expect to create a sense of inquiry. We want game players to ask questions and evaluate what they think they know about another culture, such as "Is it a good idea to excavate these sites and artifacts?" And "Is what we learn from the bones worth being apparently disrespectful of the culture that put them there?" Through this questioning process they will reconsider their previous way of understanding, questioning previously held images and stereotypes of American Indians. They will "take away" a sense of these early American Indians as complex, sophisticated people. This will be achieved by creating an emotionally complex situation. Switching roles can help the player to understand what one loses and what one gains. In other words, the player will begin to view the Earthworks from multiple perspectives and discover their complexity. We want the player to feel displacement and loss, mystery and awe, and respect. We want the player to understand science not as final authority, but as a process of using methods and tools whereby we can understand the world and people around us.

MAKING THE GAME

At the time of publication, *Meet the Earthworks Builders* is in development, and the discussion above relates to how we have approached our project. Through this process, we considered several ways to communicate the educational information while capitalizing on how games can best be used educationally. What games do best is allow for a player to explore an environment, becoming immersed in that environment, which in turn provides a context within which the player may relate their learning and experiences. The context leads the player to seek information that is needed in that moment (Gee, 2007). A game is not the best place to learn facts or demonstrate learning by responding to multiple-choice questions. Rather, games allow for critical and analytical thinking, problem solving, systems thinking, and evidence-based reasoning. Games are ideal for helping people to see things differently because they create an experience for players that gives them choices that require them to think about what they do. Games also allow players to fail and try again, seeking ways to improve. These are ways of engaging with ideas in larger, big-picture ways that will, ideally, spur the player to do research and respond outside of the game environment.

In our situation, the educational materials that don't readily translate into a game environment will be provided through the website in the form of suggested activities, simulations, or short interactives, all of which will be supported by the badging system. Big "G" game elements grow spontaneously in response to games such as Civilization, Skyrim, and many others. Our challenge is to grow a big "G" learning community without having a "blockbuster" game.

The website devoted to the badges will include ways for students to go deeper through reading, research, and creating their own response that demonstrates their learning in a creative way, such as creating artwork, formal writing or a journal, video, or podcasting. There will be forum topics and a wiki as well as links to learner blogs or websites that contain the learners' creative responses and badges earned. Earning badges will be crowd-sourced among the community that we are endeavoring to build. Thus, this system will not only allow learners to be producers, but encourage them to become mentors. We have identified the following learning objectives for the current iteration of this game:

Learning Objectives

Primary Learning Objectives

- "Look up", noticing the stars, moon, and spatial relationships with the Earthworks.
- Experience through simulation that the Earthworks are a ruin of a lunar observatory and the Octagon precisely tracks the northern-most moonrise.
- Gain a sense of the scale of the Earthworks (the great circle =~ 1,054 feet in diameter).

Secondary Learning Objectives

- Challenge and grow knowledge of Native American accomplishments.
- Reconsider stereotypes about Native Americans.

Working Assumptions

- The mounds were built by an indigenous population whose descendants are living today.
- Players will understand Native Americans as sophisticated people who were able to construct a complex, accurate, large-scale lunar observatory.

GAME PLAY

The player may navigate among a series of panoramic vistas in a style similar to Myst by clicking on hotspots. (We chose Flash over 3D engines such as Unity because the Flash Player is so widely used and, at present, will be more accessible and not require a special player. In retrospect, Unity would have been a better choice, as it now offers the option to output in several ways including Flash Player and iOS devices. The game is still in development and will be rebuilt using Unity.) Palestinian Palestinian) The actual Newark Earthworks is several miles wide.

We are using an accurate 3D model provided by CERHAS (Center for the Electronic Reconstruction of Historical and Archaeological Sites) and John Hancock, who is a content advisor on this project (Figure 1).

By immersing the player in this sort of environment, we hope he or she will experience awe and the size of the Earthworks. To this end, we scaled up the height of the mounds. In this game environment, the focus is on the sky and the cycle of the moon. The user interface gives the player information about the moon for day, month, and year. The Newark Earthworks is structured to observe the northernmost lunar standstill that occurs every 18.6 years. Observing this is the win state, and to attain it the player must stand on the observatory mound, facing the right direction on the right year of the cycle.

Hence, players must manipulate time, position, and orientation in order to advance. To reach this goal, the player will unlock a series of moon positions by collecting markers that correspond to the monthly and yearly cyclical movements of the moon traversing minor to major standstills. Cycles lend themselves to discovering patterns, which makes for great game mechanics. The primary objective of the game is for the player to predict where the moon will rise and, thus, building upon a natural pattern of movement, players will "catch the moon," which will result in players receiving environmental enhancements such as added sounds like bird calls, frogs, wind, and water.

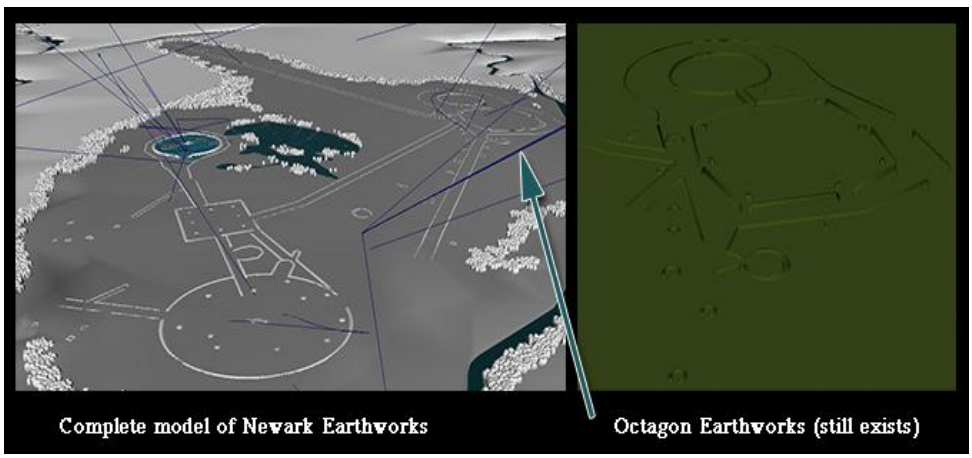

Figure 1. Accurate 3D model provided by CERHAS (left), and the section that represents the game space (right).

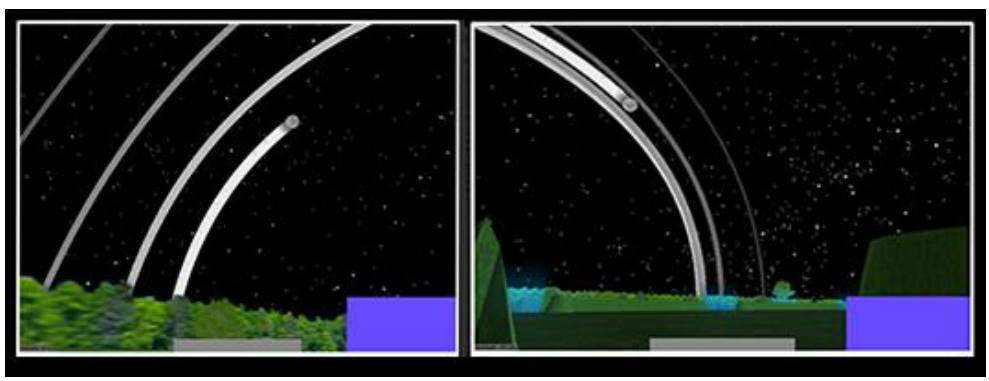

Figure 2. To help the player understand the moon's trajectory, a procedurally animated trail shows where the moon has been and remains for several rotations.

Players will identify moments where time, position, and orientation intersect to reveal lunar events.

In the next iteration of this game, we expect to add a way for the player to choose a role. Before entering the game environment, the player will choose a constellation to make. The pieces of the constellation will be part of the reward structure and by the end of the game will result in "building" one's chosen constellation.

Options will be known Native American tribal constellations, Greek/European constellations, or creating one's own. Outside the game environment, learners can research oral storytelling, explore the stories connected with their chosen constellation and opt to write their own, or make a podcast.

FUTURE RESEARCH

At the time of publication, we are struggling with designing a study that will help us to find out if the learner changes his/her perspective on Native Americans as a result of playing this game. That is, does the player gain greater empathy for and understanding of Native Americans? Enough to explore the website and research further, enough to demonstrate their learning with a creative response? It is difficult to conclusively determine a player's ability to understand a culture different from one's own prior to playing the game or exploring our website. It may be that in designing the badge system and website this sort of evidence may emerge.

In terms of the game itself, what we can do is evaluate if the player can understand that the moon moves in a monthly and yearly cycle and that the Native American culture that built the Newark Earthworks over 2,000 years ago understood that cycle. Their observations are of a similar quality to that of Tycho Brahe, who about 500 years ago made observations that led Kepler to his three laws of orbital motion. Finally, and most importantly, we want the learner to consider why was it important to Native American people to build a structure that allowed them to observe this event that occurred every 18.6 years; and why and how these structures are still relevant to Native American people today.

CONCLUSION

Use of video games in the classroom incorporates and connects to many 21st century skills, helping students understand visual culture using something with which they are already familiar—video games. Integrating games into the classroom curriculum applies current research to teaching and leaning. Technology, in general, can allow a teacher to move into the role of facilitator (Morrison, Lowther, and DeMeulle, 1999), partner (Prensky, 2010), and coach and advisor (Squire, 2011). Teachers can guide students in thoughtful and researched sharing of ideas, recognizing that they themselves do not know all of the answers. The role of the student can also be transformed from passive receiver of knowledge to active producer (Jenkins, 2006; Gee and Hayes, 2010; Prensky, 2010; Squire, 2011). Video games provide powerful and complex learning tools and environments through their inherent ability to combine such multimedia as video, sound, text (including narrative), visual information

(images, tables, graphs), and simulations, including pulling information from databases in real time.

All cultures, including Native cultures, are always in a transitional process. Political and social constructs and the negotiation of traditions, needs, and contemporary issues create cultural transformation in relation to personal interpretations. Most importantly, we can learn to ask questions, listen, and observe. For our students to learn multiple ways of knowing and doing, we must introduce them to sites like the Octagon Earthwork. These sites represent integrated ideologies and imagination. We might never know the extent of how these Earthworks were built and utilized but we can imagine.

NOTES

Development Blog: http://meet-the-earthworks-builders.posterous.com/. We intend to continue to refine this prototype through playtesting and take it into classrooms. We intend to seek additional funding to expand and refine the game as playtesting continues. This Flash game is free and available online at: http://earthworksbuilder.github.com/.

REFERENCES

Anonymous (September 2008) Major new study shatters stereotypes about teens and video games. Press Release, Pew Internet: (retrieved Nov. 20, 2011) http://www.pewinternet.org/Press-Releases/2008/Major-new-study-shatters-stereotypes-about-teens-and-video-games.aspx.

Anonymous (n.d.) National Museum of the American Indian website. (retrieved July 17, 2012) http://nmai.si.edu/visit/washington/architecture-landscape/.

Anonymous (n.d.) Frequently Asked Questions, National NAGPRA. (retrieved July 17, 2012) http://www.nps.gov/nagpra/FAQ/INDEX.HTM.

Atalay, S. (2006). Indigenous archaeology as decolonizing practice. *American Indian Quarterly*, 30(3), p. 25-33.

Aylett, R., Vannini, N., Andre, E., Paiva, A., Enz, S., and Hall, L. (2009). But that was in another country: agents and intercultural empathy. In *Proceedings of The 8th International Conference on Autonomous Agents and Multiagent Systems - Volume 1* (AAMAS '09), Vol. 1. International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 329-336.

Brookes, D. (2011, September 30). The limits of empathy. *New York Times*. (retrived July 20, 2012) http://www.nytimes.com/2011/09/30/opinion/ brooks-the-limits-of-empathy.html.

Cunningham, D. L. (2009). An empirical framework for understanding how teachers conceptualize and cultivate historical empathy in students. *Journal of Curriculum Studies*, 41(5), 679-709.

Deloria, V. (1969). Custer died for your sins; an Indian manifesto. New York: Macmillan.

Dorn, D.S. (1989). Simulation games: One more tool on the pedagogical shelf *Teaching Sociology*, 17(1) 1-18.

Freeman, D. (2004). Creating emotion in games. *Computers in Entertainment (CIE)*, *2*(3), 15-15.

Gee, J.P. (2008) Learning and games. In Salen, Katie (Ed.) *The Ecology of Games: Connecting Youth, Games, and Learning*. (p. 21-40) The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press.

Gee, J. P. (2007). *What video games have to teach us about learning and literacy* (1st ed.). New York: Palgrave Macmillan.

Gerdes, K. E., Segal, E. A., Jackson, K. F., and Mullins, J. L. (2011). Teaching empathy: a framework rooted in social cognitive neuroscience and social justice. *Journal of Social Work Education*, 47(1), 109-131.

Greitemeyer, T., and Osswald, S. (2009). Prosocial video games reduce aggressive cognitions. *Journal of Experimental Social Psychology*, *45*(4), 896-900.

Greitemeyer, T., and Osswald, S. (2010). Effects of prosocial video games on prosocial behavior. *Journal of Personality and Social Psychology*, *98*(2), 211-221. doi:10.1037/a0016997.

Hively, R. and Horn, R. (1982). Geometry and astronomy in prehistoric Ohio. *Archaeo-astronomy (Supplement to Vol. 13, Journal for the History of Astronomy)* 4(S1-S20).

Huang, W.D and Tettegah, S. (2010). Chapter 6: Cognitive load and empathy in serious games : A conceptual framework. In R. Van Eck (Ed.) *Gaming and Cognition: Theories and Practice from the Learning Sciences.* (p. 22-54) Hershey, PA: Information Science Reference, IGI Global.

Kilpatrick, J. (1999). Celluloid Indians. Lincoln, NE: University of Nebraska.

Lakoff, G. (2008). *The Political Mind: Why you can't understand 21st-century American politics with a 18th-century brain*. New York: Viking, Penguin Books.

Manney, P. J. (2008). Empathy in the time of technology: How storytelling is the key to empathy. *Journal of Evolution and Technology*, 19(1), 1-11.

Mcneilly, J. (2008, November 24). The top 7 Native American stereotypes. Retrieved November 20, 2011: http://www.gamesradar.com/the-top-7-native-american-stereotypes/.

Merryfield, M.M. (2002). The difference a global educator can make. *The World in the Classroom*, 60(2), 18-21.

Porter, A. L. (2008). Role-Playing and religion: Using games to educate millennials. *Teaching Theology and Religion*, 11(4), 230-235.

Rodrigues, S.M., Saslow, L.R., Garcia, N., John, O.P., Keltner D., (2009) *Oxytocin receptor genetic variation relates to empathy and stress reactivity in humans. Proceedings of the National Academy of Sciences* In Proceedings of the National Academy of Sciences, 106(50). (15 December 2009), pp. 21437-21441.

Rodrigues, S., (2011, November 18). Strangers Can Spot genetic disposition for empathy. Science Friday, hosted by Ira Flatow. Broadcast on NPR. Retrieved November 20, 2011: http://www.sciencefriday.com/program/ archives/201111183.

Sisler, Vit. (2008). Digital Arabs: Representation in video games. *European Journal of Cultural Studies*. 11(2) SAGE Publications, 203-220.

Sharp, G. (2011, August 9). Stereotypes of Native Americans in video games. *Sociological Images*. Retrieved November 20, 2011: http://thesociety pages.org/socimages/2011/08/09/stereotypes-of-native-americans-in-video-games/.

Smith Tuhiwai, L. (2005). *Decolonizing Methodologies: Research and Indigenous peoples*. London: Zed Books, Ltd.

Staff (fall 2009). Teacher's Guide, Native American Heritage Month, *Mound Builders*. American Indian cultural Center and Museum, Oklahoma. Retrieved from http://www.aiccm.org/past-tribal-outreach.

Thomas, D. H., Miller, J., White, R., Nabokow, P.,and Deloria, P.(1993). *The Native American*. Atlanta, GA: Turner Publishing, Inc.

INDEX

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y