DOUBLE PLAY: ATHLETES' USE OF SPORT VIDEO GAMES TO ENHANCE ATHLETIC PERFORMANCE

By

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Submitted to the Department of Comparative Media Studies in partial fulfillment of the requirements for the degree of Master of Science in Comparative Media Studies at the Massachusetts Institute of Technology

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ABSTRACT

A design feature of contemporary sport video games allows elite athletes to play as themselves in life-like representations of actual sporting events. The relation between playing sport video games and actual physical performance has not yet been established. Drawing on data from interviews and observations of elite athletes playing sport video games, this thesis explores why elite athletes are playing these video games as their virtual selves, and establishes a framework for understanding how this play may enhance learning opportunities. Building on theories based in the disciplines of psychoanalysis, education, and neuroscience, this thesis argues that virtual play by athletes playing as themselves in sport video games has the potential to support and encourage physical performance.

Thesis Supervisor: William Uricchio
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Chapter I. INTRODUCTION

Through visualization, experimentation, and the creativity involved in game playing (Betz, 1995-1996), so-called video or computer games can enhance learning and even lead to improvement in complex real-world motor skills such as driving on highways or flying airplanes (Colcombe & Kramer, 1995). Several studies have demonstrated that training using video games has transfer effects to real-life activities.

One such study involved testing of a computer game as a tool to train cadets at an Israeli Air Force flight school. In the study, cadets playing Space Fortress II were tasked with controlling a moving spaceship in a hostile environment, with a maximum score achieved by destroying the threatening space fortress and all mines while avoiding being hit by any of them. When transfer effects from game training to actual flying were tested during eight flights (45-60 min each) in the transition stage to the high-performance jet trainer, the game group performed significantly better than the no-game group in the subsequent test flights (Gopher, Weil, & Bareket, 1994). Athletes commonly use sport video games as a source of entertainment, but research shows that sport video games are beginning to be used by some elite athletes to improve on-field performance.

This thesis explores the potential of sport video games to stimulate learning and how these games can be used most effectively to improve real-life athletic performance. Analysis of the educational potential of sport video games is presented through the learning frameworks of psychosocial moratorium, mirror neuron theory, meta-cognition, and cognitive apprenticeship.

Sport titles, that is, those video games that mimic professional, collegiate or Olympic athletic sports, represent 15.3% of the market share of all video games sold in the United States and Canada (ESA 2009). Some 53% of American adults age 18 and older play video games on their televisions through their video game consoles or on their computers, and about one in five American adults (21%) play every day or almost every day (Pew Internet and American Life Project, 2008).

The interface between physical action and computer technology has recently captured the public's attention with the emergence of the Nintendo Wii system and its progeny.
In 2006, Nintendo released Wii Sports in which players had to physically move their Wii Remote to create simulated movements of avatars in various sports. More physically reactive sports based video games soon followed, such as *Mario & Sonic at the Olympic Games* in which players used the Wii Remote to simulate running, jumping and other Olympic sports. The popularity of this category of games further expanded with the 2008 release of Wii Fit, in which players move through simulated aerobic and fitness exercises using the Wii Balance Board, and the release that same year of *Mario Kart Wii*, a racing game in which players use their remote with a Wii Wheel acting as a steering wheel. The gestural and haptic dimension of these games compels future study of their relevance to improving skills in related physical activities.

Some of the most exciting applications of so-called “exergames” are the use of the Wii in nursing homes and the incorporation of *Dance Dance Revolution* into school physical education programs. The image of seniors participating in virtual bowling leagues or of students stepping to music in front of their video game consoles counters a major criticism leveled against video games: that their use contributes to sedentary lifestyles and expanded waistlines. While “exergames” are important uses of video games they are beyond the scope of this thesis.

Another related category of sport video games outside this thesis topic is the genre of sports management games. The world of fantasy sports leagues, which are available through many websites such as Yahoo, falls within this category of game. The premise of fantasy league games is to put together a fictional team from among real athletes and using the real-life statistics of the players, to make appropriate trades to enhance the virtual team’s standing. These games have found a sizeable fan base: the Fantasy Sports Trade Association reported in 2007 that 29.9 million people from the United States and Canada actively participated in fantasy sports. Unlike the commercial sport video games discussed in this thesis, players are not simulating on-field play using real-life sport moves, positions, or statistics. Rather, sports management games put players in the role of team managers handling strategic, tactical, and financial decisions.

This thesis focuses on the Commercial-Off-The-Shelf (COTS) genre of sport video games that simulate actual on-field athletic sports. These games emphasize actually playing the sport, whilst others beyond the scope of the thesis emphasize strategy and organization (such as *NHL Eastside Hockey Manger or Championship Manager)*. The genre of COTS sports video games focuses on competition, just like real-world sports. Many series of COTS sport video games feature player and team names that reflect the real team. COTS sport video games have been popular throughout the history of video games.

One of the most popular of such games, Entertainment Art's (EA) *Madden NFL Football*, was first introduced in 1989 and was an instant hit. It ran on Apple II computers. Since then, EA has made *Madden NFL Football* available on numerous other gaming platforms, including various Apple computers and PCs, the Commodore 64, Amiga, 3DO Multiplayer, Sega Genesis, Super Nintendo, PlayStation, Sega Saturn, Nintendo 64, Playstation, Playstations 2 and 3, Xbox, Nintendo GameCube, Game Boy and the Wii. The market saturation of *Madden NFL Football* on various consoles for the past twenty years makes it likely that any professional or collegiate player playing today has some familiarity with this game.

By the time I started studying sport video games in 2003, there were about twenty of these commercial sport video games on the market, for sports ranging from tennis, hockey, football, basketball, baseball, soccer, and golf to surfing, skateboarding, snowboarding, volleyball, fishing and rugby. There were some additional games packaged as Olympic sport video games, highlighting Olympic sports not otherwise produced in single title games, such as archery, discus, shot-put, biathlon, riflery, and swimming. Some of these games, such as the ones based on rugby, surfing, and volleyball, never gained traction and have since been discontinued, but others have lasted and are still re-issued annually in updated formats.

The sports game genre is currently dominated by EA Sports and 2K Sports, which hold licenses to produce games based on official leagues. EA's franchises include the FIFA series, the NBA Live series, the Madden Football series, the NASCAR series and Tiger Woods series. The seven sport video games studied for this thesis have stood the test of time, and current versions of these games allow elite athletes to play as avatars that mimic their own real-life accuracy, acceleration, strength, speed, and so on. They are:

EA *Sports Madden NFL Football* (released 1989);

*EA Sports NCAA Football (*released 1998)*;*

*NBA Live Basketball (*released 1995) formally released as the *NBA Playoff* series*;*

EA Sports NCAA Basketball (released 2009) formerly released as *NCAA March Madness;*

FIFA Soccer (released 1995)*;*

World Soccer Winning Eleven International (released 1995); and

*MLB Baseball The Show (*released *2007)*, formerly released as *Homerun* on the Atari in 1978). See Appendix 1 for a more detailed listing of sport games currently available on the market. These games are continually rated among the best selling (ESA 2008) and most realistic versions of physical sports available in the sport video game industry[1]. These are also the sport video games most frequently played by the

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[1] *Madden NFL 08* has received honors including the Game Critics Award as "Best Sports Game" presented at the 2007 E3 Media and Business Summit; "Best Team Sports Game" from Spike TV Video Games Awards; "Best Sports Game of the Year" at the

professional and collegiate athletes interviewed (Silberman, 2005). These seven games are team sports. They are not only played by consumers of all ages but also played by the athletes the games are designed to mimic with their real life teammates. All require a high level of skill and strategy.

These commercial sport video games do not offer much in the way of directions on how players should approach and play these games, nor do the games suggest to athletes how the concepts seen in the game relate to their physical sport. Similarly, these games do not explain how players may use the embedded knowledge in the virtual game to extend their interest in the sport. Although the games are successful at their core, that is, for encouraging many types of play and entertainment, standing alone, their design is ineffective at directing a player to access all the learning that can be gained from the game. It is left to others to uncover the educational potential of these games.

The very notion of video games as educational may seem counterintuitive. This is partly because the public discourse on video games is more often characterized by the arguments surrounding the impact of video games on incidents of teen violence, than on how they can be used for training. This public perception of video games suffers from the problem that society has confronted since the dawn of the Industrial Age whenever a new

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GameTrailers' 2007 Game of the Year Awards; GameSpot's "Best Sports Game" Reader's Choice Award; and the "Best Sports Games" of 2007 by MSNBC. Over the past 20 years, the Madden NFL franchise has sold over 70 million copies and is firmly established as one of the most revered sports video games in the industry. Since 2002, Madden NFL has been the number one selling sports game each year in North America (Gamestop: http://www.gamestop.com/Catalog/ProductDetails.aspx?product_id=70844). *NBA Live* (PC Version) was the runner up in the 2000 Game Critics Awards.

technology has emerged. When the technology is introduced, voices are raised warning of its disastrous effects on our way of life. In time, some fears may come to pass, but the public generally also becomes much more aware of the new opportunities the technology offers. The repeated lesson is not that a technology is intrinsically good or evil, but that it may be used to such effects. The impact of video games on our society will also be determined by how they are used. See The Impact of Gaming[2] for an extended discussion of this topic.

Video games are a relatively recent technology and their potential uses for education are just beginning to be explored. We may be aware of those few games that have direct application to educational purposes such as *Sid Meier's Civilization III*[3] or some might have read about the study at Beth Israel Medical Center that showed doctors make fewer mistakes by playing video games[4], but we are more likely to be familiar with those games styled as "mere" entertainment or play. Of course, we now know that there is hardly a clear line between entertainment and education, or between play and learning. We accept that children learn through fantasy role play, that playing games like bridge or chess can help seniors maintain cognitive functioning, and that PBS's *Sesame Street* taught an entire generation not only their ABC's, but that learning can be fun. The same lessons may be applied to video games once we alter our preconceived notions about their purpose.

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[2] Jenkins, H. PBS: The Impact of Gaming: http://www.pbs.org/kcts/videogamerevolution/impact/myths.html
[3] Squire, K. Dissertation: Replaying History: Learning World History through playing Civilization III: http://website.education.wisc.edu/kdsquire/dissertation.html
[4] *Surgeons may err less by playing video games*: http://www.msnbc.msn.com/id/4685909/

Leading educators have explained this paradigm shift: “The first step towards understanding how video games can [and I argue, will] transform education is changing the widely shared perspective that games are ‘mere entertainment.’ More than a multi-billion dollar industry, more than a compelling toy for both children and adults, more than a route to computer literacy, “video games are important because they let people participate in new worlds” (Shaffer, Squire, Halverson, and Gee 2005, p. 106).

Recent studies indicate that the intellectual activities that constitute successful game play are nontrivial; they include the construction of new identities (Gee 2003), systemic thinking (Squire 2003), collaborative problem solving (Squire 2005; Steinkuehler 2006; Nasir 2005), literacy practices (Steinkeuhler 2007, 2008) and, as one might expect, computer literacy (Hayes and Games in press).

The last few years have witnessed a marked rise in interest within academic circles in leveraging game technologies toward educational ends. Serious study of these issues is underway at the Woodrow Wilson Foundation’s Serious Game Initiative; the Games, Learning and Society program at the University of Wisconsin-Madison; the Education Arcade project at MIT; and Stanford University’s Media X “Gaming To Learn” Workshop, to name just a few (Duncan and Steinkuehler). This academic interest in video games is a very important step towards understanding the educational uses of video games. It is my hope that this investigation of the potential use of sport video games to enhance performance adds in some small measure to this important undertaking.

Concentrating on the sport video games played by collegiate and professional athletes is an important first step in understanding the potential for using sport video games to enhance athletic performance for a number of reasons. It is not just that these players have more opportunities than most other video game players for athletic performance to which they might apply any learning. It is also that these games have been specifically designed to mimic the actual settings, players, strategic play and other conditions these athletes encounter on the real field. While alignment between the representation and reality is not the only factor affecting the potential learning experience, a close nexus between the virtual and physical sport may provide some important opportunities for learning. One particular aspect of this design feature for understanding the learning potential of video games is the opportunity for these elite athletes to play the video game as their virtual selves.

Video games attempt to simulate the elite athlete's physical characteristics by uploading the player's moves and attributes into the game each season with motion-capture tracking. All of the athletes I interviewed have played sport video games as the avatar that represents them at least once and 93% regularly choose to play as their virtual self (using the avatar that represents them) when given the option. While athletes can choose to play as other athletes in these games, elite athletes who choose to play as their own photorealistic avatar may be getting benefits that go beyond virtual game play. It may be that such a choice actually enhances the effectiveness of their virtual play for improving physical athletic performance.

The questions I set out to answer were as follows: Do athletes seek ever more realistic versions of real life sports and play as their virtual selves in sports video games, and if so, why? Might their video game play impact their athletic performance and if so, how might this work? To answer these questions, I looked to elite athletes playing as themselves on leading sport video game titles. Evidence is gleaned from educational theory, review of the literature on video games, observations, surveys, and interviews of elite athletes and managers.

Methods

1. Participant observation

During an all day session held in the video game lab in the University of Wisconsin (UW)- Madison School of Education, I led a team of members from the university's Games, Learning, Society Program in observation of athletes from the UW Madison Men's Soccer team as they played COTS soccer video games. Since we were conducting a pilot study and not seeking to confirm any particular extant theory, we attempted to optimize our chances of obtaining interesting data by utilizing two primary methods for data collection: observations and interviews of the participants.

The twenty athletes were seated in front of five different television sets playing *FIFA Soccer* and *Winning Soccer11* (*Winning 8 Eleven International*). Due to structural constraints, only four athletes were able to play the game at the same time. Allowing the athletes to determine their rotational schedule for the video games provided some observation of their established relationships. The five observers sat separately at different angles to observe the players.

2. Interview

When the players finished the video games, the observers conducted individual interviews of the players. The focus of the questions posed were the players' sport video gaming habits and their views on what, if anything, they had learned from playing the games. While we utilized a small set of previously generated questions, a significant portion of the interview was devoted to unpacking events that had occurred during game play. We also had them each fill out a survey to collect further data on their video game playing habits.

This thesis conceptualizes how this play might impact the performance of athletes in real life with reference to contemporary theory in the learning sciences. The lessons uncovered shine a light on the potential use of sport video games generally for training purposes.

Theoretical Framework

Before I begin, I want to say something about the theoretical underpinnings of the approach I take here, so that readers can situate it within the larger body of literature relevant to the socio-cultural nature of games and learning. Within the past few years, there has been a profound shift in the sort of attention video games have been getting within academia. Prior to the mid 1990s, the vast majority of research surrounding video games focused on their physiological effects. This work was done under the hypothesis that games and learning don't mix (Emes, 1997) and that games make children violent. The work presented here builds off of a new generation of games and learning work that has focused on the actual use of games for use in instruction (Squire & Barab, 2004; Shaffer, 2006).

Video games are particularly good sites for studying the potentials of digital technologies because they are, as University of Michigan Professor of Education Jay Lemke describes, "the most advanced form of multi-sensory, multimodal media with which students and the wider public have experience and which we know to be successfully designed and successfully used by a large population" (Lemke, n.d.). Another consideration is current findings on how one learns. Current cognitive theory supports the notion that the mind works by storing records of actual experiences and constructing intricate connections among them (Clark, 1989; Gee 1992). From this perspective, human understanding consists of how people imagine or simulate an experience in a way that prepares them for the actions they need and want to take in order to accomplish their goals (Barsalou, 1999; Clark 1997; Glenberg and Roberson, 1999). This notion of understanding is implicit in the use of mental-skills training in athletics, which engages athletes in creating mental images of successful performance (Voight, 2005). By engaging players in goal-directed actions within compelling virtual environments, video gaming may help players develop these mental models, or simulations of experience, in a more concrete and embodied sense than through mental imagery alone.

The nature of video gaming allows players to experience immediate and often unpredictable consequences from their actions. Findings demonstrate that because video games can portray a diverse range of potential situations, they allow players to develop a much wider set of mental models of what to do (Magill, 1993), enabling them to make better and faster decisions during actual physical activities (Chamberlin and Coelho, 1993; Starkes and Lindley, 1994). The practical risks of experimentation during actual sport games limit their usefulness as learning opportunities for professional or collegiate athletes. Practice sessions are safer places for athletes to learn through trial and error, but they are dependent on the availability of coaches and other team members and often on physical conditions, which the individual athlete cannot independently control. With older forms of media, athletes have had to wait until they are off the field to view their performance or listen to expert broadcast game analysis. The emergence of video game technology may enable us to provide learning environments for athletes to enhance athletic performance that have not been previously possible or practical.

While analysis of the learning underlying video game play has mostly developed within a discourse around game theory, this thesis builds off more general learning theories, specifically theories of psychosocial moratorium, mirror neuron learning, meta-cognition, and cognitive apprenticeship. Game theory has more typically drawn from psychosocial moratorium, meta-cognition, and cognitive apprenticeship theories, (Carroll, 1987) but discussions of mirror neuron theory and learning are more typically grounded in neuroscience (Ramachandran, 2004). It is my view that mirror neuron theory may help us understand what is happening when athletes play as their own virtual selves, and that bridging the interdisciplinary fields of psychology, neuroscience, game theory, and learning can help us situate and reveal the learning affordances of sport video games.

Throughout this study there were reported and observed learning benefits for athletes from experimentation in game play. Since the benefits of the psychosocial moratorium in the development of adolescent identity formation derive from the opportunity for relatively risk free experimentation, Chapter II explores how experimentation in sport video game may enable learning by reference to an understanding of psychosocial theory.

The athletes in this study overwhelmingly chose to play as their own avatars. Since recent discoveries in neuroscience have expanded our understanding of authentic experience, Chapter III examines discoveries on mirror neurons may explain how athletes may mentally experience sport video games as on-field performance and training.

The reported discussion in and around periods of game play in this study reflected the metacognitive process at work. Therefore, the focus of Chapter IV is on how sport video games may facilitate the process of helping players become aware of necessary adaptations in their play and more capable of analyzing, monitoring and improving their own performance.

The heightened realism of the virtual environment in contemporary sport video games may increasingly enable athletes to derive some of the learning benefits traditionally gained only through real life activity. Chapter V explains how sport video games may provide an opportunity for athletes to derive the learning benefits of a cognitive apprenticeship.

Chapter II: PSYCHOSOCIAL MORATORIUM

The "psychosocial moratorium" is a central element in Erik Erikson's thinking on identity development in adolescence. The adolescent's major psychological task is to seek his distinctive identity, consisting of a conscious sense of personal uniqueness, an unconscious striving for continuity of experience, and a solidarity with group ideals (Erickson, p.156-7). The moratorium is a socially approved time delay of adult commitments permitting exploration and experimentation, which, if truncated, can prematurely foreclose successful resolution of this crisis (Lipsitz, p.4).

Although the term "moratorium" implies a "time out," what Erikson had in mind was not withdrawal. On the contrary, the adolescent moratorium is a time of intense interaction with people and ideas, of passionate friendships and experimentation. The moratorium is not on significant experiences, but on their consequences. It is a time during which one's actions are not "counted." Freed from consequence, experimentation becomes the norm, rather than a brave departure. Consequence-free experimentation facilitates the development of a "core self," in which there is a personal sense of what gives life meaning, and what Erikson called "identity" (Davis, p.3).

As Professor James Paul Gee first noted, video games create what Erickson has called a *psychosocial moratorium*-that is, a learning space in which the learner can take risks where real-world consequences are lowered (Gee, 2003). Sport video games can afford their players an opportunity to experiment in a world in which there are less significant consequences for any missteps than in the real world. As Gee (2003) has explained, games allow for a player to make poor choices without any detrimental effect of game engagement. The mitigated consequences of video game experimentation provide a psychosocial moratorium or sandbox, where the player can try and try again, increasingly informed by knowledge successfully acquired through previous attempts.

The stakes for athletes to try out risky new moves or strategies during a professional or collegiate game are exceedingly high. Their opportunities and perspectives are also constrained by their assigned positions on the field. Even practice sessions carry risks for elite athletes whose performance is constantly being evaluated by their coaches and managers to determine whether a player will be used in an upcoming game or traded away. Moreover, practice sessions are dependent on factors outside the individual athlete's control, such as the attendance of others and weather and field conditions, and even then, the focus of the practice is not all on the individual player. Even when athletes get to try out new moves during a practice session or game, they are not able to observe themselves as they play. At best, they are able to watch themselves on tape once they are off the field, but by then it is too late to apply what they learn until the next time out. Like sandboxes, the video games afford the benefits of experimentation in spaces where real world consequences are lowered in a number of significant ways. In sport video games, the players have opportunities that are denied them when they are stuck in their own bodies.

Specifically, my research shows that sport video games provide opportunities to try out new roles, identities, or selves that are not available in a real game. Whereas in real games and even practice sessions, athletes are mostly consigned to certain positions in the game, in sport video games they can place themselves anywhere on the field, playing in various relations to a changing roster of team members. Brian Calhoun, a University of Wisconsin-Madison football player, described his play this way: “Sometimes I play as myself in *NCAA Football* but usually I play as players on other teams. I can keep up with Colorado players (my old team) by playing them in the videogame. I also like to play as USC because they have a lot of great players to use when I play my friends” (Interview, April 14, 2006).

When I stopped video game users during their video game play and asked them to turn to me and tell me what was happening, the athletes would tell me, “I just passed the ball to my teammate,” or they would tell me about their own individual role, such as, “I’m the striker.” But if we kept talking, they would inevitably point out where they were in the game, give me the score, tell me where the ball was on the field, where the referee was standing, or how the offense or defense was shifting in response to what was happening. They were aware of the entire field. This whole system awareness is further enhanced by the ability of the player to use the game to adopt different perspectives.

These games also provide opportunities for the players to adopt different perspectives on the game that would be denied a player in a real game. The player can only see the field from his place in the game. Jason Chappell ("J.Cheezy"), a basketball player from the University of Wisconsin demonstrated this feature to me while playing *NCAA Basketball* on the Xbox console. He explained how the game enabled him to be both coach and player:

> J.Cheezy: *What the game does well is allowing you to make decisions. In the video game, you are the coach play-calling. You're the one who is making decisions for the team. I like that I can control the tempo like Bo Ryan [the UW Men's basketball coach] does.*
>
> LS: Can you elaborate?
>
> J.Cheezy: *Well, the game does a great job of replaying the game from various angles and you can try out a bunch of plays and do tricks that you might not do on the court in a conference game. There is an option for action [on court] view and an aerial view.*

In video games, the athletes are afforded an opportunity to step outside of themselves, becoming not just actor or spectator, but actor and spectator at the same time. This allows them to adopt a critical stance and to incorporate what they learn into their very next move. In real life, athletes cannot watch themselves play during the game, and they cannot immediately try out what they learn from watching their games on tape. They may get a chance to try out new moves during a practice session, but they cannot observe themselves in the moment of trying out the new moves.

The video game play also allows athletes an opportunity to anticipate strategies and tactics that might work in advance. The video game player gets to watch himself play, doing both simultaneously. As J. Cheezy explains:

> J.Cheezy: *It's cool. I can just try dunking against the other team over and over again. I can even alley-oop* [offensive play] *if I want to. It is fun to see myself doing that for a little while but I usually just focus on fundamentals.*
>
> LS: *What fundamentals?*
>
> J.Cheezy: *I try to focus on sticking to my j* [jump shot] *and defending. Just like I do on the court.*
>
> LS: *Right…*
>
> J.Cheezy: *Pick up those sticks or should we take it outside?*
>
> LS: *For now, let's talk about tactics. How can the game help you anticipate strategies for upcoming games?*
>
> J.Cheezy: *Well, I can see how an alley-oop might work against another team I'm playing against, like Michigan State next week. Check it out. I can decide to play them at the beginning of the game and then when we play I can try this move in the video game. Of course, I'm better at this in the video game than on the court but it's neat to try.*

It is clear from these comments that J.Cheezy understands and appreciates how the game can help him prepare for the upcoming game even as he recognizes that his improved game play does not equate to improved on-field performance.

Moreover, it was noteworthy that overall the athletes interviewed described the use of video game play similarly, as giving them a moratorium on risk, a chance to act in unexpected ways, and in so doing to develop an understanding of their capacities. They may learn not just about the athlete they have been in past games, but also the athlete they might be in future games. This idea resounded with Bob Tewksbury ("Tewks"), the Red Sox sport psychologist, and a former Major League baseball pitcher himself. He suggested I speak to T.J. Large ("TJ"), a relief pitcher for the Boston Red Sox, about how he plays video games. TJ had experienced a slump on the field when he stopped playing the video game, and had spoken to Tewks about it.

In our interview, TJ reported that he used the video game *Major League Baseball: The Show* to create an avatar that pitches like he does, with the ability to throw an 88 or 89 m.p.h. fastball or a decent curveball. He liked seeing how his pitches would work against right- and left-handed hitters he would be playing against in upcoming games. He also reported that playing virtual baseball kept his mind on the game while he was not physically playing. TJ liked to go into the game and update not only his own statistics, but also those of his friends who were called up to the major leagues. He was relieved to learn he was hardly the only professional athlete to connect video game play with improved on-field performance.

TJ was free to try out various techniques and strategies in the video game because it was a safe environment in which real world consequences were mitigated. His use of the video game exemplifies James Paul Gee and Erik Erickson's notion of a psychosocial moratorium. In this video game environment, he was able to find what was likely to work against real players with similar attributes, such as left-handedness, without risk, to gain confidence visualizing himself in successful experiences on the field, and to keep up "playing baseball" even when he did not have the opportunity to be called onto the field.

In this chapter, we see how sport video games provide the players opportunities that are denied them when they are confined in their own bodies. As explained in the next chapter, an elite athlete playing through an avatar designed with his real statistics may have an additional advantage of being able to more easily extrapolate from his virtual experience to the real world. It is almost as if he is watching himself, albeit a virtual self, in the moment of action. To paraphrase J.Cheezy, even if the athletes are somewhat better in the video game than on the field, the video games allow athletes to see how their play might work out against the team they'll encounter on the field, and it's neat to try.

Chapter III: MIRROR NEURON LEARNING

One of the prime discoveries in recent neuroscience was made possible by the invention and use of MRI brain technologies that allow us to see which neurons fire when people are exposed to different stimuli. Scientists uncovered the existence of "mirror neurons" in key parts of our brain, which fire not only as we perform a certain action, but even when we watch someone else perform that action (Rizzolatti, 2005). Further research on this mechanism in humans has further uncovered the fact that when people listen to sentences describing actions, the same mirror neurons fire as would have fired had they performed the actions described or witnessed the actions being performed (Iacoboni, Gallese, Rizzolatti, 2005).

Mirror neuron theory suggests that when we observe others attempting to perform an action, we might actually feel the associated emotions or states of mind that they feel. If this theory holds, mirror neurons may explain our capacity to empathize with others, gauge other people's intentions, and learn through imitation or mimicry. (Ramachandran 2004).

Our unfolding understanding of mirror neurons suggests that everything we watch someone else do, we also do but on a mental scale. "At its most basic, this means we mentally rehearse or imitate every action we observe, whether a somersault or a subtle smile. It explains much about how we learn to smile, walk, talk, or play tennis. At a deeper scale, it suggests a common neurobiological dynamic for our understanding of others, the complex exchange of ideas we call culture, and psychosocial dysfunctions ranging from lack of empathy to autism. It makes sense of why yawns are contagious — to why, watching Olivier fall to his knees, we feel Hamlet's grief for Ophelia" (Dobbs 2006).

The potential function of mirror neurons in training athletes may be explained by reference to a study in London led by Dr. Daniel Glaser. The subjects were Royal Ballet ballerinas and experts of capoeira, a Brazilian martial art with dance moves. All of these expert dancers underwent brain scanning while watching videos of ballet and capoeira movements being performed, while as a control, non-professional volunteers also underwent brain scanning while viewing these videos. The scientists discovered that when the dancers viewed moves standard in their own art form, they experienced greater activity in their pre-motor cortex than when they viewed a dance form in which they were not skilled. By contrast, the non-expert brains did not experience heightened activity in either case; rather, the non-expert brains exhibited steady neuron activity regardless of the type of dance viewed (Cheng, 2005).

Glaser and colleagues reasoned that the mirror neurons located in the pre-motor cortex form a "mirror system" that is specially modified to resonate with the movements and physical skills particular to each person. Importantly, the mirror system constructs a framework through which the brain can interpret information in the world. In the case of the dancers, their brains responded most to movements they themselves could perform and, thus, for which they had developed neuron pathways.

These results imply that dancers and other athletes can "practice" their respective skill even while not physically performing. “Because actual movement is not required to simulate the skill in the pre-motor cortex, mentally imagining and practicing the physical movement in one's mind can build neuron pathways that will enhance physical performance" (Cheng, 2005).

In other words, there may be more going on than modeling best moves when coaches have athletes watch the performances of other athletes. It may be that having developed neuron pathways for athletic skills may enable athletes to perform moves they are watching in their mind, as if they were on the field.

In a naturalistic observation at the University of Wisconsin on March 3rd, 2005, Erasmus James ("Razz"), a former defensive end for the University of Wisconsin Badgers and current Washington Redskins NFL player, explained how he played *NCAA Football* on the PlayStation2, just as the real football season was starting:

> Razz: *What I usually do is go into the game (NCAA Football). I choose my team, the Wisconsin Badgers. During the season, I play against the team I'll be physically playing in our upcoming games. This helps me prepare. I learn things about the other teams members. It's also neat to get to play myself.*

As I observed him play, he continued:

> *"See, look, I messed up that hit. So all I did was go into the practice area of the game."*

When I asked him why, he explained as follows:

> *"Well, you see that guy on screen, he is really like me and he can't mess up. I just practiced what I screwed up because I want to get it right. I need confidence when I play this video game you know. I can't mess up against the other guys!"*

(Razz went on to beat North Carolina State in the virtual game, as he did on the field that season.)

It may be that mirror neurons help explain why athletes like Razz enjoyed playing as themselves. In the games I selected for this study, such as *Madden NFL Football, NCAA Football, FIFA Soccer,* and *NBA Live Basketball*, avatars have been designed to represent elite athletes. In each new version of the games, these avatars have been getting closer and closer to representing the actual players. The avatar not only looks like the athlete, wears the athlete's uniform number, and plays out the athlete's real statistics in the video game. The avatar also reflects the athlete's physical attributes, such as right or left-handedness, height, weight, moves, handicaps, physical tendencies, strengths, and specialties. Moreover, the avatar plays the athlete's typical role on the team, playing in relation to the skills of the real team members, whose avatars themselves reflect their real physical attributes and skills, individually and in relation to each other. Further, the athletes playing as their avatars can play so as to reflect their real play not only in relation to each other, but also in relation to the real attributes of the opposing team members reflected in those avatars.

By including variables that define a character's height, weight, handicaps, strength and special abilities modeled on their real-life performance, contemporary sport games are becoming more and more like simulations or models of real sporting events. One interesting aspect of simulations or models is that they can be purposefully designed to draw the players' attention to particular aspects of the complex system modeled. The designers can recode variables to represent each professional or collegiate athlete's characteristics, and in turn, these variables constrain and afford the interactional dynamics between different characters.

As a consequence, simply by spending time in the game world interacting with different characters, players seem to become sensitized to the various ways their character's traits position them in relation to other team members and may become sensitized to the distinctive skill sets of other players modeled. In turn, this might lead to a more intuitive understanding of the most effective strategies or counter strategies to use in the forthcoming game. In my interview with Erasmus he says, "I figure things about the other team members." Such data lends weight to this theory, suggesting that the athletes are learning. Significantly, the athletes themselves appear to attach a great deal of credibility to the lessons learned. Such learning is not limited to team sports like football or soccer played on a field.

NASCAR drivers describe knowing that before they go up against a particular team in real life, they will play a video game against a team with statistics equal to those they will oppose, racing alongside statistical replicas of their real team members, on courses with weather conditions that replicate those in which the real-life race will be run. NASCAR driver Elliott Sadler describes his use of video games this way: "I use them for the road courses big time. It helps with braking points and elevation changes. When I get to the track, I feel like I have half of the track already figured out. Driver Kevin Harvick adds: "The track you notice it the most is at Talladega. You can see where the asphalt is worn out, almost crack for crack. You can practically see where they put the sealer in." Most drivers say the games helped them the most when they were first starting out at the Busch Series or Nextel Cup level. It gave them a good introduction to tracks they had never raced on before. Neither reviewing past videotaped games nor racing practice sessions afford athletes the opportunity to adjust and readjust their play and variables in the environment over and over, learning the effects of these changes. Thus, when an elite athlete today chooses himself as his avatar, as NASCAR driver Harvick explains, "I always play games as myself. I've got to be myself, because I don't want to get beat by myself," he is coming close to watching himself play in real time while being able to control conditions that closely simulate the conditions he will face on the field (Rosewater 2004). Athletes training for real-life sports events, whether on the racetrack or the soccer field, all have as the focus of practices the challenges they anticipate they are likely to encounter.

In actual practices, coaches will encourage players to try using their non-dominant hand or foot, or to put on extra weights while trying to hit the ball. The coach wants the player to experience the difference in feeling when exerting different strengths. While TJ Large was playing *MLB The Show,* he was not changing his real pitching hand, but he was creating a simulation in which his avatar tried out a different pitching arm with a resulting change in outcome. When playing the *Madden* and *NCAA Football* titles, video game players did what Erasmus described, that is, they selected an option that sent their avatars to virtual practice areas to work on specific skills as they saw weaknesses in their games. The option allowed for self-directed coaching where the players design the practice based on what they want to work on, such as throwing with their non-dominant hand, or changing the speed, direction or angle of the pitch or swing, or trying out particular offensive or defensive plays[5]. The athletes observed seemed to be testing out how their "virtual twin" handled a variety of changes in the game.

My observations examined what players are learning, to try to understand why they play themselves and how this might help them reflect or learn about their own performance. The data shows that they are taking advantage of the opportunity afforded by video games to step outside of themselves and adopt the perspective of a coach from which they can not only critique, but also modify, their own simulated performance. Traditionally, athletes have had to rely on physical practice sessions in which they might try to experiment with different techniques. Athletes have also commonly relied on videotapes of their past games to observe themselves and the opposing team in action. Coaches similarly watch tapes of their players and of competing teams to create a game plan based on the strengths and weaknesses in what they observe. Team practice sessions are routinely used to overcome weaknesses and try out plays, and during these sessions, players may be asked to role-play opposing team members. In comparison to videogame play, the strength of reviewing these videotapes of play of actual games for learning to improve performance is that the athlete is reviewing his real performance. However, when playing a sport video game, the athlete isn't limited to viewing only what actually happened. The strength of the video games is variability: the athlete can modify his performance. Video games provide the significant added value of enabling the athlete to

[5] These games do not yet allow for changing the weight of the bat.

continually try out new ways to learn to improve his performance, to see what works, and to adjust once again, until he learns what works best.

Theoretically, practice sessions allow for such variability, but practice sessions are dependent on the availability of coaches and other team members and often on physical conditions, none of which the individual athlete can independently control. Video games afford athletes the opportunity to play independently, see themselves virtually in real time, and manipulate or control variables in the environment.

Of course, an athlete's performance in the game world is unlikely to simulate their real world performance with complete accuracy. Nevertheless, there may be other factors at work that make this experience so compelling, just as there may be more going on than merely heightened self-awareness when athletes watch themselves on tape. Certainly, it is difficult to have an accurate sense of one's own kinesthetic form, a problem ballet studios address with mirror-lined walls. However, the significance of mirrored reflection goes far deeper. In his Mirror Stage Theory, Lacan identifies the key moment when an infant first recognizes his or her reflection in the mirror as engendering the formation of ego, a moment when the child no longer perceives himself as fractured but as a member of the symbolic order (Lacan, Écrits, 93-94).

Lacan's Mirror Phase theory debunks the notion of an essential self and draws our attention to the fact that our sense of self is a social construct that depends upon representations that are reflected back to us. According to Lacan, the child has no coherent sense of self prior to the mirror phase. The image helps the child recognize himself as a distinct entity apart from the world and his mother's body – as an individual. In later life, the versions of self reflected back by others with whom we interact (friends, parents, siblings) might also start to reinforce our sense of self. As Jerome Butler has noted, "self making is effected not only by the interpretations we offer of our selves, but by the interpretations others offer of our versions". In his essay, "Self Making, World Making," he highlights the way people tell stories about themselves, effectively performing a particular identity for a specific audience. Moreover, our capacity to tell stories about ourselves depends on the cultural resources available to us (Butler, pp. 67-78). As a consequence, we often construct ourselves (and others) through analogy, with reference to narratives, characters and figures from film, literature and drama, as well as real life. Of course, the versions of ourselves that others project onto us are not always desirable. This might lead to ego depletion or in extreme cases, the loss of a sense of core self or identity.

It is extremely important for sports players to maintain a strong ego and positive self-image. However, this can be damaged by a particularly bad game or a string of bad performances. From this perspective, it seems sports video games could help players develop a positive self-image free of the faults and defects that are evident in real life. In this respect, we might start to see role playing a virtual self as a kind of identity project in which players are building up their own self-esteem, self-confidence, and ego in preparation for the real game. Careful analysis of the data seems to provide some anecdotal support for this notion. As an example, when Erasmus says, *"I need confidence when I play this video game, you know"* he supports this hypothesis.

Athletes can and do watch themselves on videotape playing physical games, but they cannot play on an athletic field and watch themselves at the same time; the very act of watching themselves on camera takes them out of an active and involved experience. On the other hand, when an elite athlete is playing a video game as himself, he is simultaneously playing and watching his virtual self play, and in that sense can be both observer and observed, watching the impact of his actions as he performs them. This provides a built-in opportunity for identification, because the avatar is not just an anthropomorphic image on the screen, but a reflected image of the athlete and one that he controls. The avatar[6] is not quite self, but it is more than other. It is somewhat like looking into the mirror while trying out different expressions. When playing video games, TJ explains his feeling that he is playing the real game; at the mirror neuron level, he may actually be experiencing the game as if he were on the field:

> *The virtual game does a great job of having me think about holding runners and who to force out when they're standing on base… I like working my count against right and lefty hitters. The game helps me visualize and understand the hitters I'll be physically playing in upcoming games…I think this is a good exercise on working subliminal thinking.*

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[6] See an extended discussion on avatars in Appendix 1.

How then might mirror neuron theory help explain why top athletes want to play as themselves in ever more realistic sport games? My hypothesis is that more life-like representations are more likely to trigger mirror neurons in the mind of the actor-spectator (player-observer). If this occurs, the mind has effectively been tricked into misrecognising the virtual person for a real person. This might also help to create a more immersive experience that approximates the intensity of the real game with all its emotional highs and lows, and allows players to empathize (or feel the emotions) of virtual characters. This would explain why players want to play increasingly realistic games. Further, if mirror neurons are firing away, the brain might also start to form conjectures about the motivations and intentions of other virtual players and become more sensitized to their actions.

Mirror neuron theory might lead one to conjecture that the experience of playing one's virtual (or second self) affords players new opportunities to understand (and possibly self-regulate) their action, emotions, and behavior in the game. In a sense, this might facilitate the development of a metacognition or self-regulation (from the outside), which athletes and their coaches have traditionally enhanced by watching and discussing video footage of the game, discussed further in the chapter on metacognition. It may be that the experience of playing a virtual second self may set up a kind of recursive loop in which players learn, reflect and modify simulated actions in practice. It seems the self-awareness and self-control gained by the athletes through virtual play might then transfer and enhance their performance in the real game. If so, athletes may be training themselves by playing from the position of actor-spectator as their second-selves.

This chapter has examined how recent discoveries in neuroscience on mirror neurons may explain why athletes playing realistic sport video games as their own avatars may be performing and training mentally as if they were on the field. The discussion in the following two chapters turns to how sport video games can be used to provide athletes with rich cognitive learning environments.

Chapter IV: METACOGNITION

Metacognition is defined as knowledge and awareness of one's own cognitive processes (Mayer, 2003, 100) and refers to higher order thinking that involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature. Specific to its application within the motor domain, metacognitive knowledge about action has been defined as "knowing about knowing how to move" (Wall et al., 1985, p. 31). This chapter discusses the opportunity sport video game play can afford athletes for metagcognitive learning.

Immediate feedback about performance and an opportunity to make necessary corrections can help athletes think about how to enhance performance. However, there are limited opportunities during a real-life athletic competition for athletes to receive individual feedback and redirection. The coaches and athletes have multiple and competing draws on their attention during the game and athletes cannot hear the analysis of player performance by professional sportscasters being streamed to fans. Although feedback after the game may lead the athlete to more focused practice and performance when the next opportunity arises, this delay from on-field performance to feedback, to analysis and self-awareness, to redirected practice and back to on-field performance can limit the opportunity athletes have to think about what they need to learn to enhance performance. Video games may help athletes solve this problem of feedback delay.

The sport video game often uses the same announcers as the television broadcasts, in voiceover snapshot, to react to the players' actions based on their play. For example, the voice and image of broadcaster and retired NFL football player John Madden provides ongoing commentary and reaction after each play in the eponymous Madden NFL Football series. These virtual game announcers offer training reinforcement through analysis of the game. If a player makes a failed fourth down conversion when it made no sense to attempt it, the commentators often says something like, "I really have no idea what the coach was thinking on that play." Unlike radio and television commentary, however, the video game simulated feedback can be heard by the player while on the (virtual) field, enabling the player to gain more immediate self-awareness of what skills he needs to work on, and to use his understanding in his very next play decision. It is as if the on-field athlete had an earpiece streaming live analysis.

Sport video games often also include other features intended to support post-game or even mid-game analysis of moves and strategies. These features are valuable educational tools because they get players in the habit of thinking critically about game play. For example, *Tiger Woods PGA Tour* offers a “mouse-motion swing” in which the tempo and pace of the player’s entire backward and forward movement affects the final result. The point at which the player stops the mouse, the length of the movement, and the amount of side-to-side deviation affect the result as well. After the shot, the game delivers a painstaking analysis of each factor of the swing, thereby allowing the player to work on perfecting the speed of backswing, general tempo, or side-to-side variances. In *Tony Hawk Underground2*, there is even a “focus/slow-motion” control option that allows players to see their moves displayed in slow motion while they are executing them. Many games allow the replay of game segments for post-game analysis.

During this observation the research team actively encouraged athletes to reflect upon and articulate their own learning strategies to facilitate a form of metacognitive reflection. This built upon earlier studies that have shown that metacognitive skills can be potentially increased as a result of playing computer games, along with learning various kinds of thinking skills. For example, Bruning et al. (1999) and Pillay, Brownlee, and Wilss (1999) in their qualitative studies found that game playing allowed players a chance to use metacognitive skills, and that game players perceptively monitored their moves, made inferences, and generated and validated hypotheses. The studies concluded that the constant monitoring of their thinking by game players is evidence of a metacognitive approach.

In the end, it seemed the conversations that took place in and around the game among the players were a fundamental part of the learning process. Recorded conversations of the players during my observation of the UW-Men's soccer team captured the learning that is happening between the players, and the ways they became aware of their thinking as they performed a specific task and then used this awareness to control what they were doing.

After University Wisconsin-Madison soccer team members Matt Arcangeli and Max Wilson played each other on *FIFA Soccer* on the Playstation3, Arcangeli explained that he hadn't really understand the concept of the 'imaginary ball' when it was discussed on the field until he heard Wilson talking about it as he played the video game. Arcangeli described the moment when he finally understood the concept this way:

> Arcangeli: *We were just playing and Wilson was talking about how most of soccer is about open spaces and seeing the next opportunity. When you're a beginner player you only look at the ball and everybody crowds around it. When you're more advanced you know to see the 'imaginary ball' to look to where you are going next. Wilson described how in FIFA you can see those spaces really well.*
>
> Wilson: *Yeah, I think the game makes it easy to see those spaces where our coaches were always yelling at us to see the imaginary ball. It sounds weird but it makes sense when you think about it.*
>
> Arcangeli: *On the field I was thinking about where the ball was going be from my angle, but now I'm seeing that you have to think about where it is coming earlier, where it is going to be coming off of my teammates' feet looking over the whole field.*

Wilson: *The game [video] definitely helps you understand how the whole team has to work together.*

Arcangeli: *I didn't fully get what the coaches were saying about this until we just talked about it. It made me understand what the coaches had been trying to say to me and why it could work more smoothly if I thought about it just a little differently.*

Such collaboration in sport video game play is not unusual, and may increase its effectiveness for metacognitive learning. Almost 83% of the soccer team observed played sport video games with other athletes, either as multi players or as single players giving one another advice. As Professor Henry Jenkins has noted, it is a common misperception that video game play is socially isolating; most are played socially. Collaborative learning environments are increasingly being recognized as highly conducive to developing metacognition. Collaborative settings facilitate overt reasoning and the emergence of a variety of thinking models (Brown and Palincsar, 1989, cited in Brown and Campione, p. 125). Collaboration is central to Vygotsky's (1978) model of socially constructed learning: …". Functions are first formed in the collective in the form of relations among children and then become mental functions for the individual…Research shows that reflection is spawned from argument….Vygotsky, 1978, p.86, cited in Slavin, 1993, p. 284.

In explaining human intelligent activity, cognitive theory has recognized the socially distributed (or shared) nature of cognition (cf., Hutchings, 1991; 1995; Pea, 1993). Distributed cognition refers to a process in which cognitive resources are shared socially in order to extend individual cognitive resources or to accomplish something that an individual agent could not achieve alone. The cognitive significance of distributed cognition is based on the fact that human beings have only limited cognitive resources such as time, memory, or computational power (Cherniak, 1986). Norman (1993, p.43) argued that human cognitive resources are highly overestimated; without external aids humans have only a limited memory and reasoning capacity. Higher cognitive accomplishments presuppose that an agent uses the external world and his or her fellow inquirers as sources of knowledge, organizers of activity, and in general as extensions of his or her cognition.

In sport video games, the in-game commentary and access to the analysis tools seem to stimulate this process of discussion and analysis. But further study is required to show that these features actually prompt players to start discussing and articulating their own strategies and tactics. It may be that the players start to internalize these commentaries, which in turn equip them with a vocabulary to articulate and reflect upon their own performance.

It was evident in video game play observations that elite athletes felt they had gained a great deal of knowledge simply from playing the game. However, there seemed to be a danger that much of this knowledge might remain tacit.

This discussion with University of Wisconsin Men's soccer players Ryan Vint and Austin Spohn while they played *FIFA* on the PlayStation3 was typical of the ways in which the observation team encouraged the players to think about what they were doing and elicit what they were learning. Vint starts off explaining what he learned about getting better at the video game.

Ryan: *When passing to a marked player, you have to aim the ball at the foot of your teammate that's on the opposite side of his marker. It's a little hard to clearly see this in the game while it's happening but I still try to make that happen.*

Austin: *I know Ryan is thinking of getting it to my foot like so. He is usually really accurate.*

Ryan: *When we're playing the real game, and you're making a supporting run and you initiate eye contact with the ball carrier or call out his name, that helps your chance of getting the ball. When you're in the videogame and we play together it's cool that we don't have to yell like we do on the field but moving the player as if to make "eye" contact still helps. It's also neat if we're playing the videogame together to talk next to one another as we play another virtual team.*

LS: *I think it's interesting that you're thinking about where to pass the ball and communicating to one another as you would on the field. How else might you be able to improve your passes as you play the videogame?*

Austin: *Well, our live coaches always want us to think about distributing the ball to open spaces.*

Ryan: *Or, chipping over the defense if we can.*

Austin: *Yeah, see there's usually a lot of "open space" behind the opposite defenders, (he points to the screen and shows me the space). If you can play the ball to open space you'll have a great advantage because it's usually hard for the defense to recover. You can usually use a chip or a wall pass. I should do that more.*

Ryan: *Me too. There's also a good way to create this space on the outside angles by making an overlapping run.*

Austin: *Definitely.*

By encouraging Ryan and Austin to reflect on what they were doing become more aware of what they were learning but it also helped them start draw bigger lessons for real play. The key challenge was to encourage them to consciously reflect upon and articulate their experience of game play in meaningful ways. This may relate to a wider issue with games based learning. Apparently, it is not only the features of the applied technology but the form of implementation of the technology, which support collaboration.

Since collaborative game based learning appear to engage students to participate in in-depth inquiry over substantial periods of time and to provide socially distributed cognitive resources for comprehension monitoring and other metacognitive activities, it had seemed plausible to assume that imitation of good cognitive practices can be elicited by simply creating learning environments that mediate the processes of inquiry. This, in turn, would allow students to become aware of their conceptual advancement, as well as of changes in their practices of inquiry. Many researchers have shown how different technical applications can be used to facilitate distributed teaching and learning (Lehtinen, Hakkarainen, Lipponen, Rahikainen, Muukkonen pg.3).

Metacognition leads to greater self-control because learners become more aware and thus more capable of monitoring their own learning strategies. Metacognitive reflection empowers learners to analyze or monitor their own practice and then make necessary changes or adaptations when necessary to optimize their performance on a task. Because metacognition plays a critical role in successful learning, it is important to determine how learners can be taught to better apply their cognitive resources through metacognitive control (Livingston, 1997).

The attributes of the games that facilitate discussion of strategies and tactics may help athletes make necessary adaptations in their on-field play and that athletes can use sport video games to become more capable of analyzing, monitoring and improving their own performance. In this way, the recorded conversations the athletes were having in and around periods of video game play became an interesting data source for evidence of metacognitive process at work.

Chapter V: COGNITIVE APPRENTICESHIP

It has been noted that video games, as compared to other media, have many features that can be strong advantages in designing cognitive apprenticeship-based learning: they provide realistic virtual worlds, are effective in visualizing and modeling processes and strategies, allow for high levels of interaction, and are effective in giving feedback and opportunities for practice, and that applied properly, these features can make cognitive-apprenticeship-based environments more engaging for both students and teachers (Um and deHann). For these reasons, researchers have suggested that video games could be used to create a cognitive apprenticeship-based learning environment (Jenkins, 2002; Prensky, 2001; Squire, 2004) and that video game technology can assist in the implementation of designing such learning environments. (CTGV, 1993). It is therefore helpful to situate the discussion of the learning achievable in sport video games in the framework of cognitive apprenticeship (Collins, Brown, & Newman, 1989) that embeds learning in activity and makes deliberate use of the social and physical context of learning.

Cognitive apprenticeship is an instructional design model originally presented as a way of deploying the critical elements of traditional apprenticeship to learning in the classroom. The theory of cognitive apprenticeship derives from traditional apprenticeships, in which the apprentice learns a trade by working under a master teacher. Based on perceived limitations of classroom teaching, Collins and his colleagues (1989) proposed cognitive apprenticeship as an alternative method of instruction that would synthesize formal schooling and traditional apprenticeship. The goal of cognitive apprenticeship is to make the thinking process of a learning activity visible to both the students and the teacher. The teacher employs the methods of traditional apprenticeship (modeling, coaching, scaffolding, and fading) to effectively guide student learning.

Cognitive apprenticeship also addressed the perception that traditional apprenticeships often failed to take into account the implicit processes involved in carrying out the complex skills they are modeling. The master may not be aware of all the steps he is taking to get his results or be able to explain them to the apprentice, and the apprentice may not be able to understand what he needs to do and therefore get stuck repeating errors until he stumbles on a better result. To combat these tendencies, cognitive apprenticeships incorporate elements of schooling by bringing "these tacit processes into the open, where students can observe, enact, and practice them with help from the teacher…" (Collins, Brown, & Newman 1989, p. 453). In cognitive apprenticeship, the process can be stopped at various stages to discuss what happened, and bring out why various choices were made, and how students can change course to get a different result.

By listening to the master explain exactly what she is doing and thinking as she models the skill, the apprentice can identify relevant behaviors and develop a conceptual model of the processes involved. The apprentice then attempts to imitate those behaviors with the master observing and providing coaching. The coaching process includes additional modeling as necessary, corrective feedback, and reminders, all intended to bring the apprentice's performance closer to that of the master. This teaching method is familiar to athletes, who routinely play under the guidance of a sports coach who helps the athlete modify his actions to reach his performance potential.

It is understood that if someone wants to learn how to play a sport, they need get out and engage in the activity. While it might be helpful to read about how to play the game, at some point they will need to engage in the activity itself in order to learn it. It is evident that it is only through engagement in the authentic activity that learners will be able to gain access to the perspectives of the players to understand how to act meaningfully and purposefully. We also recognize that it is activity that will develop their skills. Finally, we know that playing the sport will provide experience they will need for subsequent action (Collins, Brown, & Newman, 1989). Educational theorists have attempted to explain why.

Educational theory underlying cognitive apprenticeship attempts to explain why learners need to engage in authentic activity, based on an understanding of the products of that activity. Under this theory, different activities produce specific representations and perceptions in the minds of the people engaging in them that are central to learning. Since the environment of the activity contributes importantly to the representations formed, learning is situated. Moreover, knowledge is situated as well. When knowledge comes in it is connected to the activity and environment in which it is developed, some of which is in the mind and some in the actual world. Thus, it is not just useful that learning methods be embedded in authentic situations; it is essential Collins, Brown, and Newman (1989, pp. 32-42).

Cognitive apprenticeship is situated within the social constructivist paradigm (Brown et al., 1989; Resnick, 1989). Every human thought is adapted to the environment (Clancey, 1997), and what people perceive, think, and do develops in a fundamentally social context (Driscoll, 2000). The cultural context, the co-constitutive nature of individual-action-environment, and multiple knowledge communities are elements of situated cognition theory, are the basic premises of this theory. They were summarized by Wenger (1998) as: (1) We are social beings, which is a central aspect of learning; (2) Knowledge is a matter of competence with respect to valued enterprises, such as playing a sport; (3) Knowing is a matter of participating in the pursuit of such enterprises, that is, active engagement in the world.

Collins, Brown, and Newman (1989) and Collins (1991) identified four aspects of cognitive apprenticeship-based learning: content, instructional methods, sequencing of instruction, and sociology. Content refers to the different types of knowledge required for expertise and includes domain knowledge of concepts, facts, and procedures and strategic knowledge of an expert's ability to make use of concepts, facts, and procedures to solve problems. Instructional methods are the learning activities used during instruction to help students construct, use, manage, and acquire new knowledge. Sequencing involves the staging of learning whereby tasks are presented in increasing complexity and diversity so that students develop a broad understanding of the domain of expertise. Sociology deals with the authenticity of the learning environment. Technological, social, time, and motivational characteristics of real-world situations are designed into the learning environment so that students will learn when, where, and how the knowledge applies to other situations (Collins, Brown, & Newman, 1989). They recommended seven instructional methods: "modeling," "coaching," "scaffolding," "fading," "articulating," "reflecting" and "exploring."

These basic methods of cognitive apprenticeship have been successfully applied to teaching in the domains of reading, writing, and mathematics (Palincsar & Brown, 1984; Scardamalia & Bereiter, 1985; Schoenfeld, 1985). Their approach was designed to give students a grasp of the complex activities involved in expertise by explicating modeling of expert processes, gradually reducing support or scaffolding for students attempting to engage in the processes, and providing opportunities for students to reflect on their own and others' efforts.

More recently, cognitive apprenticeship has been applied to instructional design in computer and on-line settings. Lesgold and his colleagues (2001) designed 'Sherlock,' a computer-coached practice environment, to train Air Force electronics technicians in troubleshooting. The system demonstrates expert understanding to the trainees through a schematic based on cognitive apprenticeship theory of modeling, scaffolding and coaching. Jarvela (1995) and Snyder et al. (2000) used discussion databases, e-mail and multimedia in an instructional design approach to teaching technical skills on-line, with cognitive apprenticeship techniques of expert modeling, coaching, scaffolds, articulation, reflection, and exploration.

As with other video games, sport game technology seems to offer potential for affording learning opportunities according to the principles of Collins-Brown's (1989) model of cognitive apprenticeship. I will discuss these in turn briefly below:

1. Content:

The four kinds of knowledge described by Collins, et al. (1989) are domain knowledge, heuristic strategies, control strategies and learning strategies. Domain knowledge is the conceptual and procedural knowledge typically found in instructional materials such as textbooks. Heuristic strategies are ‘tricks of the trade’ or ‘rules of thumb’ which people use to solve problems. Control strategies are what students employ to monitor and regulate their problem-solving activity. Learning strategies are strategies for learning; they may be domain, heuristic, or control strategies, aimed at learning.

The environment of sport video games has the potential to provide these different types of knowledge or strategies. In sport video games, domain knowledge is often presented via a tutorial or presentation using multi media such as text, narration, graphics, video and animation. Heuristic, control and learning strategies are demonstrated through repeated problem-solving practice (Squire, 2004). In the virtual environment of sport video games, learners can repeat actions without the anxiety of failure. Also, by taking part in virtual sport play, the learners easily observe the natural uses of domain knowledge and later apply it in an authentic context.

Sport video games present domain knowledge in context and require players to apply this knowledge in problem-solving activities in order to succeed in the game. By solving problems in the play and achieving incremental goals, game players also learn other strategies. Players are able to experiment with more advanced strategies, ultimately learning complex and advanced strategies and skills.

2. Situated Learning:

Instruction based on the cognitive apprenticeship model is placed within 'authentic' contexts that mirror real-life problem solving situations. The learning environment should reproduce the technological, social, temporal and motivational characteristics of real-world situations where what is being learned will be used (Collins, Brown & Newman, 1989).

Sport Games support this principle by providing a representational environment in which learners can practice and apply newly acquired knowledge and problem solving abilities. The game play takes place in a true-to-life environment, down to the roar of the ground and voices of real game announcers. Playing the sport as one's own avatar or other professional or collegiate player using real life statistics in this environment gives learners the experience of contextualized learning, in which interaction and collaboration are integral success strategies.

3. Modeling and explaining:

In a video game, the modeling of processes and the demonstration of expert performances can be easily visualized. Squire (2004) sets forth the reasons that computerized simulations or 'edutainment' video games can be powerful tools for learning: (1) learners can manipulate otherwise unalterable variables, (2) students can view phenomena from new perspectives, (3) learners can observe a system's behavior over time and (4) students can visualize a system in three dimensions.

This learning potential is demonstrated in sport video games. They contain features that model and explain using visual feedback and analysis, allowing a player to observe a process and understand its underlying factors. Control and perspective over the entire field allows the player to gain an understanding of various strategies.

4. Coaching:

Gee (2003) described how good video games deal with overt information and guidance on one hand and immersion in practice on the other. Sport video games provide immediate, ongoing feedback and expert analysis from virtual sport announcers throughout the game. Additional coaching can be added to aid the player during the virtual game. This is demonstrated in an interchange in which I provided a constructive suggestion to Wisconsin men's soccer player Brandon Miller during his play. As he played, he explained how he was virtually tied with another teammate in *FIFA* and how he always comes up with the big play in the clutch.

> LS: *Brandon, can you describe what are you doing right now?*
>
> BM: *Well, if I tell you my virtual teammate will know my strategy but here is an example. Right now I'm dribbling up the sides of the field moving the ball up by weaving in and out of players-like so. Then I'm planning to distribute the ball to the middle and quickly pass it back to the outside. Then I'll be at the top right corner of the field. I'll come up with a big cross to the middle and my other players will be in position to head or one touch it in.*
>
> LS: *That sounds like a great play. Have you thought about dribbling up the middle of the field and trying to get a penalty?*

BM: *Actually, that works really well too. Sometimes even better because you can't always guarantee that your other players will be ready for the cross. I'll still be able to get past him. You know, thanks for talking about that strategy with me even though Dix (teammate Kenny Dix) will know what I'm doing.*

Kenny Dix: *He can think all he wants; I'm still going to win!*

This also suggests the potential of sport video games to help players analyze their play and improve their performance by prompting reflection.

5. Articulation and Reflection:

Cognitive apprenticeship encourages the development of self-correction and monitoring skills, by noting differences between novice and expert performance and by using techniques such as abstracted replay (Collins & Brown, 1998).

In video games, the instant replay and analysis provides a feedback loop that can facilitate articulation and reflection. Malone (1981) referred to multiple goal structures for feedback on their progress, which sport video games provide based on scoring and analysis. One example of how video games prompt reflection is through the slow motion replaying and reviewing of learners' actions and scoring. More advanced methods of prompting reflection is evidenced in '*ESPN NFL 2K5*,' in which the computer can analyze every aspect of a player's play style, save it to a memory card, and allow that person or a friend to practice against her play style and learn her strengths and weaknesses. This also supports prediction, hypothesizing and experimentation, which focus a student's attention directly on her own thought processes (Herrington & Oliver, 1996).

Sport video games can be played collaboratively with others, fostering a player's frequent articulation of his knowledge when negotiating with other players about which strategies to take and how to execute them. A player may have to not only suggest a course of action to the group, but also have to give several reasons why and how it should take place, or why it should happen one way and not another in order to be persuasive.

6. Exploration:

In the real world of professional and collegiate sporting events exploration can carry risks. In virtual environments, learners can apply as many different strategies and hypotheses as they want. In this regard, Gee (2003) suggested a multiple routes principle: there are multiple ways to make progress or move ahead. The learning afforded by video games allow learners to make choices, by allowing them to rely on their own strengths and styles of learning and problem solving while exploring alternative styles (p.108).

In sport video games, students can choose from among numerous different plays and strategies to win points or oppose others, and can adjust strategies in order to become a more effective team member or player. Importantly, players can learn different perspectives by observing the effect of various strategies.

7. Sequence:

Sequencing involves the staging of learning where tasks are presented in increasing complexity and diversity in order to help students develop a broad understanding of the domain of expertise. One of the common characteristic features of sport video games is their increasing complexity and level of difficulty that adjusts as the player progresses. (Malone, 1981). In addition, it is possible to reduce the amount of help from virtual guidance or coaches as the levels increase. Thus, sport video games offer an effective implementation of cognitive apprenticeship theory.

The design of sport video games using current technology has evolved to the point where the games closely reflect the environment of an on-field athletic sport event. It is my hypothesis that these virtual games have become so realistic that playing them may allow players the mental representations needed to learn to play the real-life sport. Support for this hypothesis comes from the athlete testimonials. The athletes often spoke about the positive impact on their on-field performance from playing sport video game. Here is Eric Conkin, forward on the University of Wisconsin-Madison men's soccer team, recounting his experience playing virtual soccer using *FIFA*: "Look when I'm going in for a header off a corner kick I'm imagining that's me out on the real field. It helps me plan where my body should be in position to the ball, the defender, and goal. I know I use what I'm thinking about when I play the game on the real-field."

The realism of the game graphics of the game seems to help the athlete imagine himself in the real game. It may be that such realism also enables an athlete to learn because when he plays the video game, he gets some of the same mental representations he gets from playing on the field. Eric Conklin described how he plays FIFA as a member of one of his favorite teams, imagining himself on the field as if he were one of the professional athletes he is virtually controlling. He told me that playing this way helps him better understand the perspectives of the real life players, and to think more about strategy in his real play.

The cognitive apprenticeship model also offers an interesting way to start thinking about virtual coaching, especially in the introductory training phase of the game. In the *Tiger Woods Golf* tutorial, Tiger or Tiger's coach (depending on the version) teaches players the basics and special shots, giving them a virtual master instructor to model the behavior. The Tiger Woods virtual coach personalizes his instruction to the virtual player's ability level and stops the action to demonstrate and provide feedback. This allows for individualized, in-the-moment analysis. But there are also important differences. For example, at present a virtual coach cannot gauge an athlete's level of understanding skill nor can the rookie ask the master a question. Nevertheless, features exist that compensate. For example, players can often choose a difficult level and thereby choose an environment that positions them in a zone of proximal development.

Sport video games have the potential to provide a cognitive apprenticeship learning environment for athletes. The heightened realism of the virtual environment in contemporary games may enable athletes to derive some of the learning benefits traditionally gained only through authentic activity. To the extent game play creates an environment in which it produces mental representations of the real-life game sufficient for learning, it is authentic for learning purposes. If playing a soccer video game produces the similar "indexicalized" representations idiosyncratic to real-life soccer, it may be like actually playing the sport at the level of cognition, with some of the benefits of real coaching.

VI: CONCLUSION

As video games have advanced both technologically and in popularity, there has been a movement to study the cognitive potential of games and how human interaction and the design of learning environments can be supported through game study (Squire, 2004). Bowman (1982) suggests that educators could use video games as a model for improving learning environments by providing clear goals, challenging students, allowing for collaboration, using criterion-based assessments, giving students more control over the learning process and incorporating novelty into the environment. Educators see video games as powerfully motivating digital environments and study them in order to determine how motivational components of popular video games might be integrated into instructional design (Bowman, 1982; Driskell & Dwyer, 1984; Bracey, 1992).

The "Games to Teach" Project (Jenkins, 2002), a collaborative effort between Microsoft and MIT's Comparative Media Studies Program, conducted a series of elaborate "thought experiments," and developed several conceptual prototypes exploring different models for how games might enrich the instruction of science, engineering and math at the advanced placement high school and early college levels. Their studies suggest that games do offer teachers enormous resources they can use to make their subject matter come alive for their students, motivate learning, offer rich and compelling problems, model the scientific process and engineering contexts, and enable more sophisticated assessment mechanisms.

If we were unlikely to think about what video games could teach us about learning, we are even more unlikely to have thought about sport video games in an educational context. It would probably come as little surprise that professional and collegiate athletes would gravitate to playing virtual sports games that feature themselves. Athletes are expected to be interested in anything having to do with sports and they are known to have strong egos. For those reasons, it may seem unremarkable that they would enjoy spending a large part of their down time off the field relaxing with a video game version of their sport, and only natural that they would like the experience to mimic as much as possible the real sporting event, with themselves as the star player. But athletes and some coaches increasingly seem to be taking their play very seriously, crediting video games for enhanced performance and achievement. My initial observation and discussion with athletes and their coaches suggested to me that something much more significant and consequential was involved.

My research posed the question: why are these athletes choosing to play videogames in increasingly life-like representations of themselves and their environments? My findings from interviews with these athletes and observations of their play support the theory that there is real learning going on when elite athletes play as themselves in these realistic environments. To understand how and why this could be happening, my analysis built on established educational theories on learning and theoretical frameworks grounded in psychoanalysis and neuroscience.

Some of these approaches showed more promise than others. While there are opportunities for more risk taking in sport video games and avoidance of some of the practical problems associated with practice sessions, there may be some redundancy with existing coaching methods, assuming opportunities to try out new moves, positions, and strategies in a supportive practice environment.

Moreover, there are sports-related skills that cannot be taught with current videogame technology. As just one example, our movements with the mouse do not yet directly correlate to eye-hand coordination when pitching or throwing a pass. Further, an interesting development beyond the scope of this thesis is the rapidly changing interface technology. It may be that recent haptic, gesture-based interfaces following the Wii will offer affordances that older technological interfaces lack, opening new dimensions and possibilities for sports games and learning.

Finally, while the discussion has stressed a literal correlation between the avatar and the player in terms of characteristics such as height, weight, and statistics, this does not mean that learning is only effective if a game is directly modeled on the player. That being said, these findings suggest that opportunities for learning may increase with a movement towards more customizable games in the future. It is now up to video game developers and educators to help realize the full potential of this technology. In this ever-changing landscape, the opportunities will go to those who keep one eye on the bottom line, and the other firmly fixed on the horizon.

My analysis of the educational potential of sport video games builds on the learning frameworks of psychosocial moratorium, mirror neuron theory, meta-cognition, and cognitive apprenticeship. My findings about elite athletes playing sport video games expands on the broader notions of video games in the work of Gee and Squire describing videogames as offering "designed experiences" for conceptual learning. Beyond that, this thesis suggests a re-thinking of the relation between the virtual and the physical.

In this thesis, I set forth my hypothesis of a type of "double-play," in which playing sport videogames as one's own avatar makes it more likely that mirror neurons are triggered, enabling the athlete to shift back and forth from actor to observer. While these mirror neurons are firing, the athlete is actually experiencing the virtual game as if he was playing the actual game. Moreover, he is able to play the sport situated in an environment in which he has more control over variables than in real life, increasing his chances of experiences that strengthen his sense of self more than actual games may afford him, and providing him with more opportunities than he would otherwise have to self-observe, reflect, and modify his actions. We may all find ourselves benefiting one day from experiences through our virtual selves that are more positive than real life can afford, and those experiences may in fact become a part of our new reality.

APPENDIX

Appendix A.

Selective List of Commercial Sport Video Games

Nearly all of these games release new editions every year. They are usually updated with new players and features. Typically, the newest games will be the best games to use for elite training purposes. The games listed here are appropriate for most age levels. They play on consoles, such as Sony PlayStation, Microsoft Xbox, Nintendo Wii, or Nintendo Game Cube, that link to a television. Many of these games are available for PCs. They range in price from $10 to $60; consoles cost from $90 to $400.

Baseball

Backyard Baseball, Backyard Sports, MLB Power Pros, MLB The Show, Baseball MVP NCAA Baseball, Wii Sports-Baseball

Basketball

ESPN NBA 2k5, NBA 2K, NBA Live, NBA Street

Football

All-Pro Football Backyard Football, NCAA Football, Madden NFL Football

Golf

Hot Shots Golf Fore!, Tiger Woods PGA Tour

Hockey

Gretzky NHL NHL Hockey

Soccer

FIFA Soccer World Soccer, Winning 8 Eleven International World Tour Soccer

Tennis

Grand Slam Tennis, Mario Power Tennis, Sega Superstars Tennis, Ultimate Tennis, Virtual Tennis, Wii Sports-Tennis WTA Tour Tennis

Other

Athens 2004, Dance Dance Revolution, Mario and Sonic at the Olympic Games, Rapala Pro Fishing, Rugby 2005, SSX Summer Heat Beach Volleyball, Tony Hawk Underground Series

Appendix B.

Avatars

Avatars represent the player physically in the game's world. As Rune Klevjar (Klevjer) describes the avatar in his dissertation, *What is the Avatar? Fiction and Embodiment in Avatar-Based Single player Computer Game*:

The avatar is an instrument or mechanism that defines for the participant a fictional body and mediates fictional agency; it is an embodied incarnation of the acting subject. It is dependent on the principle of the model, and acts as a dynamically reflexive prop in relation to its environment. Its capabilities and restrictions are based on the objective properties of the model, and these capabilities and restrictions define the possibility-space of the player's fictional agency within the game. The avatar therefore defines the boundaries of the make-believe…The only requirement for vicarious embodiment to be unified and coherent, is that the avatars are comparable in certain respects; that they can be perceived as belonging to the same, temporary universe (87-88).

Choosing an avatar that resembles one's own physical self appears to heighten the identification between the player and avatar, according to the elite athlete interviews I conducted. As an identical twin, this finding was not surprising. I have experienced for myself the benefits of being able to see someone just like me struggle with the same physical activities I am trying to learn. As enthusiastic amateur athletes, my twin sister and I have continually watched, mimicked, and spurred one another on. While it is likely that our on-field success was enhanced by the communication between us, seeing my identical twin with my own physical characteristics and attributes perform an athletic move enabled me to easily visualize myself doing the same. This experience is not uncommon for twins, even from an early age. Even as babies, identical twins have been known to benefit from seeing their likeness perform the same task. As a pediatrician explains, "When it comes time to crawl, for example, each one notices how the other goes about the task. (You may think that young babies are completely unaware of other children around them, but this is not the case. Even though they do not play cooperatively with each other, babies pay close attention to siblings who are near in age.) They can learn from each other's success and mistakes, as well as sharpen their social skills--learning, for instance, how far they can assert their own will before their sibling fights back. Because they have a ready point of comparison, twins also may develop somewhat precocious self-awareness” (Needleman). There are many examples of athletic twins, from the Bryan (tennis) and Barber (football) twins to the Ferraro (hockey) and Hamm (gymnastics) twins. Some credit to their success to their ability to read each closely on the field and to have a partner of like skills with whom to practice. “From birth (perhaps even in utero), twins learn from each other. Even as babies, when cooperative play is several years off, twins watch and mimic each other. Having a twin helps at each developmental stage. It motivates the children, gently pushing each one to keep up with the other. Carefully watching each other, they spur each other on.” (Borden, p. 93). Cameron and Tyler Winklevoss, the twin entrepreneurs from the University of Connecticut, (see Figure 1) are also rowers who recently competed for a spot on the US Olympic rowing team. As their coach describes it, their athletic partnership began 12 years ago outside an old railroad shed on the water in Westport, Conn. When James Mangan saw two “skinny little fellas” trampling toward him, he automatically smiled. The Irish-born rowing club coach was a twin himself, and he knew that siblings had a built-in advantage in rowing, where timing and intuition were crucial to success. He also noticed that the brothers were about 5-foot-11 and still growing.

Appendix C.

Relationship between television and video games

The relationship between television and video games ESPN sport video games and highlight reels rely on video game technology to imagine game scenarios. In turn, sport video games are a type of replay of what was on ESPN. There are even simulated ESPN television commentators appearing in the video games, reporting on plays as they occur ESPN expropriated from the video game the behind-the-quarterback perspective; it did the same with multiple camera angles, and now uses them in its television broadcast. In the ongoing cycle, these television broadcasts are then referenced once again in the video game's simulated ESPN broadcast. Examining how the relationship between television and video games has evolved through the years helps to contextualize the object of the game itself, and to explore the "new" way we watch sports and virtually play them today. What was originally created as a form of entertainment, the sport video game is now helping us to watch and enjoy the original medium. ESPN and other sport program reels are racing to replicate the next generation graphics and new angles that sport video games are creating. The Wii camera mode in Wii Sports Tennis is now in an older ESPN mode, with the camera situated in the side-line for certain aspects of the game, while also giving players the evolved aerial and action shots. On ESPN sidelines, players can see and hear commentators "talking" directly from the game sidelines. The transfer was first from the video game angle to the ESPN angle. Replay and highlight features are adopted from TV into video games. Replay features are now options at any point in the play of many sport video games. A player can choose when he wants a replay and of what play, and can view the replay from multiple camera angles. to the ESPN angle. Now we have the video game mimicking things that the ESPN highlight reels used to distinguish themselves, such as branded microphones. Some of the symbiotic features of how sport video games and televised sports reporting have historically evolved are as follows:

1. Physical sports played on field

2. Radio broadcast of sport with commentators

3. TV broadcast of sport with commentators

4. Simulation of the sport in the video game

5. TV commentator first seen in video games –John Madden

6. TV incorporates video game camera features (e.g. quarterback camera angle) and video game animations to present real game highlights and replays

7. ESPN and EA team up to offer live sport statistics while playing video games online.

8. In-game fantasy statistics can now be seen scrolling at the bottom of TV screens during games. Live television statistics can also be seen on tickers at the bottom of fantasy sport sites. Some fantasy sports consumers often have one eye on their TV and one eye on the computer screen, monitoring the progress of their teams or players while live games are on.

Appendix D.

Methodology of Data Collection

Data compiled through surveys of the University of Wisconsin-Madison Men's Soccer Team Survey indicated that a significant percentage thought video games had some positive correlation with their on-field performance. Overwhelmingly, they thought being a soccer player gave them an advantage in playing video soccer games, but they also thought that playing video games furthered their understanding of certain aspects of soccer, various styles of play and helped to familiarize them with professional teams and statistics, leading to discussions with their teammates as to why those players were successful.

Based on results of these initial survey findings and observations, more in-depth analysis with elite athletes and managers from a variety of sports was conducted.

Fieldwork findings: Using the NCAA basketball video game, players were directed to use the game so as to account for the player's athletic attributes and the situation in which he will be playing on the field. In these circumstances, surveys confirmed improved learning experiences.

Trustworthiness

The observers sat at different angles while observing the athletes playing the game. We watched, listened, and wrote field notes individually. We also collected and analyzed our findings separately.

As collegiate Division I soccer athletes, these players were very familiar with the terminology, rules, skills, maneuvers, and strategies used in the sport of soccer and this knowledge was reflected during the observation. For example, when they yelled out "…slide tackle! Use slide tackle!" it was clear that they not only knew what a slide tackle maneuver was, but that it would be helpful to use that maneuver at that particular moment in the game.

From the outset, we were aware that these were members of the same collegiate sports team with prior relationships, used to working together collaboratively towards a common goal. This was attractive to us as it enabled us to evaluate the impact of working towards new individualized goals on these already formed relationships.

75.9% play teammates in soccer video games

72.4% believe soccer video games may help to familiarize them with professional soccer team leagues or statistics

62.1% think soccer video games may help them have a better understanding of various styles of play

79.3% think being a soccer player gives them an advantage over non-soccer players when playing soccer video games

37.9% have played sport video games online

51.7% believe soccer video games provide a good starting point to discuss with teammates professional league game players and what makes those players successful

75.8% say video games help them understand certain aspects of soccer

27.6% Somewhat Agree that playing sport video games helps stimulate their interest in sports

24.1% Agree that playing sport video games helps stimulate their interest in sports

10.3% Definitely Agree that playing sport video games helps stimulate their interest in sports

Appendix E.

Thoughts on The Future of the Game Industry

My years as an MIT graduate student, research scholar, game developer, and new media consultant to industry in the United States and abroad coincided with the years of major innovation and growth in the video game industry. These experiences have afforded me unique insight into the business and creative future of the game industry. There are exciting, expressive, connective avenues being opened on the business and creative sides of the industry. The future of the industry will lie with those who can design structural arrangements that best take advantage of those opportunities. The structural model for the commercial game industry structure has been undergoing change. Traditionally, the industry has followed the model of large companies pursuing vertical integration utilizing long-term contracts. Such companies tend to give the green light to big budget games with an established track record or sequels of proven hits, hence the proliferation of EA sport games and *Halo*. These big game publishers have been purchasing smaller competing game companies, leaving little room for mid-budget game companies in the three to ten million-dollar ranges to compete. Independent game companies have had trouble competing with the traditional structure due to the inefficiencies of scale, but that barrier is now breaking down. The game industry is starting to follow the innovation that favors independent production. New models of distribution will enable aspiring independent game designers to have their games played by a wider audience. Innovative models of distribution on the web like Etsy and In Rainbows are pointing the way. In addition, the gaming industry is experimenting with the new distribution channels birthed by the advent of web platforms such as Facebook and Metaplace/Areae; these will continue to be more widely used even as new channels emerge. This expansion will allow games to proliferate from a wider variety of creators.

The digital distribution of games will change how consumers receive and play games. There will be more competitive price structures to the games including innovative pay as you play models. We will see both larger development budgets for commercial games at one end of the spectrum and more niche games at the other. We will continue to see more people playing Augmented Reality and mobile games. A greater number of distribution channels will also encourage experimentation in the types of games developed, improving the chances of finding truly creative approaches to game play. Some of the changes already underway are improved simplicity in user interface, more physical movement in game play, and an increase in learning focused games. On the creative side, games will become increasingly personalized. Innovations in technology are enabling enhanced participation of the player in the game, such as through the Sony's

Eyetoy or through virtual avatar construction. Similarly, there will be more opportunities for input from fans in the development stages. Fans will be contributing to the story narrative across video game, cell phone, and web platforms. There will also be more transmedia properties. An example of this trend is the video game *Enter The Matrix*, which expands the storyline of the movie *Matrix Reloaded*. In the coming years, consumers will experience more innovative uses of video game hardware and software. One place we are currently seeing an example of this trend is at Seattle Mariner's Safeco Field, where fans can play trivia and word search games against other fans in the stadium, while software allows them to check out player stats from MLB.com, watch the commentators on the live TV broadcast of the game, and even order and track food to their seats. While some games provide amazing solo experiences, single player games will become more rare. With on-line capability, games are becoming a more social experience. Not only are gamers playing against others on-line, they are playing with other people in the same room. Already, 59% of gamers play games with others in-person, a rise from 56% in 2007 and 51% in 2006 (ESA 2008). The video game industry is highly dynamic and undergoing subtle and sometimes profound transformations on an almost daily basis. It is therefore impossible to say exactly what the future of video games will be. What we know is that we all need to be life-long learners in an increasingly fast-paced, connected, and competitive world and that technology can help us get there.

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