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THE DESIGN AND EVALUATION OF A VIDEO GAME TO HELP TRAIN PERSPECTIVE-
TAKING AND EMPATHY IN CHILDREN WITH AUTISM SPECTRUM DISORDER

by

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ABSTRACT

This paper discusses the design, implementation, and evaluation of a serious game intended to reinforce applied behavior analysis (ABA) techniques used with children with autism spectrum disorder (ASD) by providing a low cost and easily accessible supplement to traditional methods. Past and recent research strongly supports the use of computer assisted instruction in the education of individuals with ASD (Moore & Calvert, 2000; Noor, Shahbodin, & Pee, 2012). Computer games have been shown to boost confidence and provide calming mechanisms (Griffiths, 2003) while being a safe environment for social exploration and learning (Moore, Cheng, McGrath, & Powell, 2005). Games increase children's motivation and thus increase the rate of learning in computer mediated environments (Moore & Calvert, 2000). Furthermore, children with ASD are able to understand basic emotions and facial expressions in avatars more easily than in real-world interactions (Moore, Cheng, McGrath, & Powell, 2005).

Perspective-taking (also known as role-taking) has been shown to be a crucial component and antecedent to empathy (Gomez-Becerra, Martin, Chavez-Brown, & Greer, 2007; Peng, Lee, & Heeter, 2010). Though symptoms vary across children with ASD, perspective-taking and empathy are abilities that have been shown to be limited across a wide spectrum of individuals with ASD and Asperger's disorder (Gomez-Becerra, Martin, Chavez-Brown, & Greer, 2007). A game called WUBeeS was developed to aid young children with ASD in perspective taking and empathy by placing the player in the role of a caregiver to a virtual avatar. It is hypothesized that through the playing of this game over a series of trials, children with ASD will show an

increase in the ability to discriminate emotions, provide appropriate responses to basic needs (e.g. feeding the avatar when it is hungry), and be able to communicate more clearly about emotions.

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On a personal note, the author wishes to give special thanks and appreciation to his parents, Charles and Carol Hughes, his children Aiden and Brogan, and his fiancé, Kelly Vandegeer for their undying support and love throughout the course of this journey.

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CHAPTER ONE: INTRODUCTION

Over the past decade, there has been an increase in the number of children diagnosed with an autism spectrum disorder (ASD). According to the 30th Annual Report from the USDOE (2010), nationally, in Fall 2006, 8.9% of the population ages 6 through 21 was served under IDEA, Part B with 1.3% from categories for students with significant disabilities including Autism and Multiple Disabilities. In an effort to evaluate ASDs over time, the Center for Disease Control (CDC) established the Autism and Developmental Disabilities Monitoring (ADDM) network. The first ADDM reports (study years 2000–2002) were released in 2007, indicating an average of 1 in 150 children affected by an ASD (CDC, 2007). March 30, 2012 the CDC released ADDM results (study years 2006-2008) estimating prevalence at an average of 1 in 88 children with 80% of those children receiving special education services.

Table 1 shows increases in numbers of school age children in the U.S. identified with autism from 2007 through 2011 (Data Accountability Center [DAC], 2011a). It is notable that the number of children identified with ASD rose steadily over the five-year period for a total increase of 76%; whereas the number of children identified across all disability categories decreased by 2.5% over the same time period. As a percentage of the total population of children with disabilities, children with ASD almost doubled, increasing from approximately 2.7% in 2007 to 5% in 2011.

Table 1. Number of Children Ages 6-21 Identified with Disabilities from 2007 through 2011

Disability	2007	2008	2009	2010	2011
National All Disabilities	5,912,586	5,884,739	5,877,196	5,818,074	5,785,203
National Autism	257,863	292,638	333,022	369,774	406,957
Florida Autism	10,582	12,532	14,636	16,963	19,365

As seen in Table 1, growth in the autism category in Florida’s ESE program mirrored the national trend, increasing by 80% between 2007 and 2011 (DAC, 2010a). A Revised State Board of Education Rule 6A-6.03023 ESE Eligibility for Students with Autism Spectrum Disorders went into effect July 1, 2007 (FLDOE, 2007). The FLDOE revised terminology from “students who are autistic” to “students with autism spectrum disorders” and broadened eligibility criteria to reflect that features of autism occur across a spectrum in varying degrees. The impact of the revised rule was seen in statistics indicating, for the 2008-2009 school year, there was a 36% increase in Florida students identified with ASD receiving services in just two years following the rule revision (FLDOE, 2009).

While increased access to health care, improved public awareness, methods of detection and treatment, and evolving/expanding definitions certainly account for a portion of the increase in diagnoses, ASD stands out from other disabilities. In a study conducted using data over the

course of a 10 year period, from 1993 to 2003 among individuals between the ages of 6 and 22 in the U.S., the diagnosis of ASD increased 783% while all other disabilities increased by 28%. This discrepancy is cause for great concern and highlights the need for innovative approaches to assisting the caregivers of and the individuals with ASD (Figure 1).

Previous researchers have suggested having a child with a disability such as ASD presents a unique set of challenges that impact the entire family unit and individual family members' health, well-being, and experiences across the lifespan (Patterson, 2005; Turnbull, Turnbull, Erwin, & Soodak, 2006). These stressors include challenges navigating the myriad of educational, medical, and behavioral services; financial hardships related to the cost of care; and emotional aspects of having a child with a disability (Plant & Sanders, 2007).

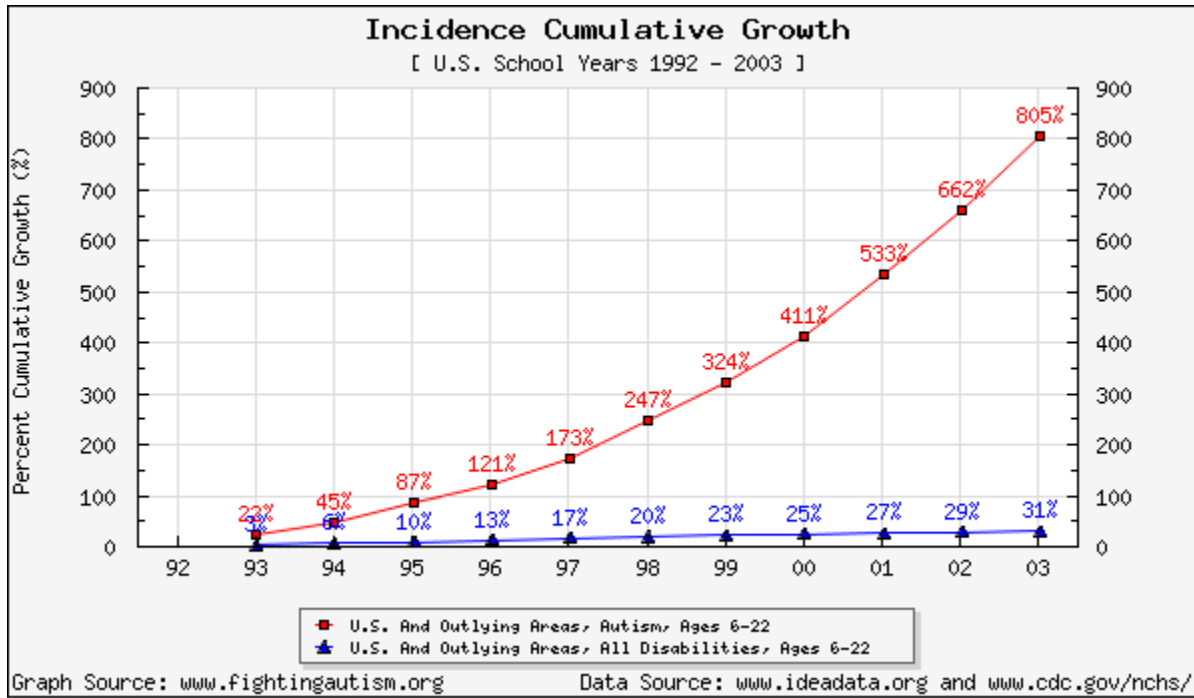


Figure 1. Growth of Autism in the U.S. and Outlying Areas

The behavioral challenges often associated with ASD can leave families feeling isolated (Woodgate, Ateah, & Secco, 2008). In addition, studies have demonstrated that parents of children diagnosed with an ASD experience greater amounts of anxiety, depression, stress, and strained marital relationships than parents of typically developing children or parents of children with other types of developmental delays (Dumas, Wolf, Fisman, & Culligan, 1991; Plant & Sanders, 2007). Clearly the need for early intervention for children and families with ASD are a common recommendation found in the empirical literature.

Perspective-taking, Empathy and ASD

Perspective-taking in common terms is seen as the ability “to walk in another’s shoes” or to “see through another’s eyes.” It has been defined as “the ability of an individual to interpret his/her emotional and mental states and those of others” (Gomez-Becerra, Martin, Chavez-Brown, & Greer, 2007). This crucial antecedent to empathy is typically found in developmentally average children by age four or five (Happe, 1994; Perner, Leekman, & Wimmer, 1987). However, children and adults with ASD have shown significant impairment in this ability and the ability to empathize when compared with their typically functioning counterparts (Baron-Cohen & Wheelwright, 2004; Auyeung, Wheelwright, Allison, Atkinson, Samarawickrema, & Baron-Cohen, 2009). This lack of a critical social skill set can cause problems at home, in school, and later in life with relationships and careers. However, early intervention therapy has been shown to successfully train correct social behaviors in situations where empathetic responses are commonly expected through modeling, prompting, and reinforcement (Schrandt, Townsend, & Poulson, 2009). While prior research has focused on face-to-face strategies using tradition media, at the time of this writing, this author has found no research on the effects of an interactive gaming experience designed with the purpose to help train empathy and perspective taking in autistic children despite the many potential benefits that a virtual gaming environment can provide.

Therefore the purpose of this study is to teach empathy and perspective taking to 5 children with autism. Data will be collected using quantitative analysis of game play utilizing, video and

audio recordings, two observers, and pre-post-tests for emotional discrimination. Game data includes response time to avatar needs, avatar “happiness” over time (a summation of all needs), achievements collected and achievements spent, time spent playing incentive games, individual needs fulfilled/unfulfilled (e.g. how often did they feed the avatar or how often did they take the avatar to the potty), response to changes in emotional or physical expression of the avatar (e.g. does crying or eliminating on the floor elicit a response), response to changes in meters (e.g. does a ‘red’ meter trigger a response), and other yet-to-be-determined game-play behavior. The primary research question for this study is as follows: *Do the children in this study show an increase in game performance over the course of multiple trials and does this correspond to an increase in emotional discrimination, engagement, and observable behavior?*

CHAPTER TWO: PRIOR RESEARCH AND REVIEW

The use of serious games as a medium for children's education was explored previously in two National Science Foundation supported projects. The first project was part of a virtual recreation of the 1964/65 New York World's Fair (NYWF) and involved the design, implementation, and evaluation of a suite of science, technology, engineering, and mathematics (STEM) games aimed at middle school children. The subsection "Interaction Metaphors for Driving STEM Education Game Development," details this project and is excerpted, in part, from previously published articles in the proceedings of Immersive Education (iED) 2012 in Boston, MA, USA and the proceedings of Human Computer Interaction International (HCII) 2013, Las Vegas, NV, USA. The second project used a mixed reality display in a museum context to educate middle school aged children on principles of Newtonian physics through the use of perspective taking and metaphor. The subsection "Mixed Reality Space Travel for Physics Learning," is excerpted, in part, from a previously published article in the proceedings of Human Computer Interaction International (HCII) 2013, Las Vegas, NV, USA.

Interaction Metaphors for Driving STEM Education Game Development

This section presents a set of learning metaphors and their use in an immersive downloadable 3D experience that is set in the backdrop of the New York World's Fair (NYWF). Virtual Fairgoers are transported to a historically faithful recreation of the NYWF site where they can freely explore the environment and its attractions. The experience weaves together individual threads of singular disciplines found within the Fair's many pavilions into a multidisciplinary

tapestry of exploration. Throughout the Fair environment “discovery points” afford opportunities for in-depth interaction with science, technology, engineering, and mathematics (STEM) topics, while empowering visitors to explore the evolution and broader consequences of technological innovations. The core target audience for the environment is adolescents and pre-teens between the ages of 9 and 13.

Since their inception, World’s Fairs have been born from a societal desire to showcase the newest wonders of science and technology. The 1964/65 NYWF, which occurred at the beginnings of the Space Age, can serve as a central portal through which a wide array of STEM content can be explored. Upon entering the virtual NYWF environment, the user is presented with a storyline that encourages navigation of the Fair. This environment is used as a platform to learn about basic building blocks of STEM through discovery and a series of mini-STEM games in addition to the larger games described in this section.

Numerous researchers have pointed to the strong potential of video games for enhancing learning in STEM domains (Barab & Dede, 2007; Barab, Scott, Siyahhan, Goldstone, Suiker, & Warren, 2009; Mayo, 2009; Squire, 2011)[1, 2, 3, 4]. In this section we attempt to explore this potential further by describing several useful interaction metaphors that can be applied to game designs and utilized to promote education in multiple content areas.

STEM Experience Methodology

Educational content is delivered using a wide variety of modalities throughout the NYWF experience in the form of virtual artifacts, souvenirs, pop-ups, voice-over recordings, videos,

talking avatars, and other in-game experiences. In addition to the educational materials found within the virtual Fair, individual STEM “discovery points” and games provide content-appropriate knowledge associated with a particular pavilion. In order to account for a wide range of learning and teaching strategies, the following educational metaphors have been applied as part of the experience design: learning by seeing/hearing, doing, playing, creating, and sharing. Each module makes use of one or more of these metaphors in order to provide a wide range of learning strategies and levy the advantages and disadvantages of any individual approach. Furthermore, this process mimics that of the scientist and the artist, who must study others’ work, create his/her own work, and disseminate this work for peer review.

Learning by seeing/hearing provides a high level of content but a low level of interactivity for the virtual fairgoer. This traditional approach is similar to how an individual learns from a book, overhead presentation or an Internet website. Text, image, video, and sound are the primary means of communication in this example. These modules appear as pop-up windows within the simulation. Users can choose to click links to learn more about a particular topic or close out the window and continue exploring the virtual Fair. This method can be used to provide educational information in a passive and non-committal format, and works best when players are curious and motivated explore further

Learning by doing refers to “hands-on” simulations and is intended to be similar to what a student might experience in a participatory lab. In order for the user to fully engage with the learning content of these modules, active participation and experimentation are required. The

student is presented with a simulation based on scientific models and dynamic data sets that can be manipulated with sliders and buttons. In these modules, the users can make predictions and observe the consequences of their decisions in real-time.

Free-play learning allows for interactive, learner-manipulated experiences that focus on a gaming objective such as scoring points, collecting items, solving puzzles, completing missions, etc. In the context of this project, this typically means 3D immersive experiences that resemble modern video games. The emphasis on free-play allows users to become a part of the discovery and exploration process (i.e., the student is not being taught so much as they are actively pursuing knowledge integral to completing the game or solving the mystery). This method differs from many traditional approaches in education in that the path to knowledge is not predetermined by the designer/instructor but rather the designer/instructor must design the game in such a way that the user is guided implicitly to learn the system.

Learning by creating is a method in which the user generates content within the context provided by the simulation designers. Just as an educator might assign a student to write a short story about a historical event, in this context, the learner might be asked to create a digital interpretation of a particular painting, event, or concept. This method of learning empowers the student to give their own impression of an idea or concept. By giving the user the ability to take control of the content, the subject matter can become more personal and meaningful.

Learning by sharing is akin to digital show-and-tell. This could take the form of an online gallery, a discussion forum, or any other method of shared media. Learning by sharing promotes community involvement, public debate, collaboration, and peer review. This method ultimately becomes the showcase for user-generated content, enabling the students to teach and learn from each other.

Table 2 provides a summary of the educational methodologies, their characteristics, and the implementation platforms.

Table 2. STEM Game Development Methodology

Method	Seeing/Hearing	Doing	Playing	Creating	Sharing
Characteristics	<ul style="list-style-type: none"> • “Textbook” or presentation approach to education. • Image, text, voice narration, video, etc. • High level of content/Low level of interactivity. • Passive and non-committal. 	<ul style="list-style-type: none"> • “Hands-on” simulations. • Requires active participation and experimentation. • Scientific models and dynamic data. • High level of interactivity/complexity. 	<ul style="list-style-type: none"> • “Video game” • Focus on gaming objectives: scoring points, collecting items, solving puzzles, completing missions. • The user becomes part of the discovery process – actively pursuing knowledge in the hope of “beating” the game. • Path to knowledge is determined by the user. 	<ul style="list-style-type: none"> • “Make your own game” • User generated content/Designer generated context. • Empowers students to give their own impression of an idea or concept. • Subject matter becomes more personal and meaningful. 	<ul style="list-style-type: none"> • Digital “show-and-tell.” • Public debate. • Collaboration. • Peer review. • Community learning.
Implementation	<ul style="list-style-type: none"> • Flash and HTML pop-ups. 	<ul style="list-style-type: none"> • Netlogo and Processing simulations. 	<ul style="list-style-type: none"> • FPSCx10, Ogre3D. 	<ul style="list-style-type: none"> • Ogre3D, Kinect, webcam. 	<ul style="list-style-type: none"> • Internet forum, web galleries.

STEM Game Examples

“Follow the Stars” (Figure 2) is a 3D, first-person game that provides insight into many techniques used by Polynesian navigators to traverse vast expanses of the Pacific Ocean

without the aid of a compass or modern sailing techniques. Educational content is transmitted both through gameplay and pop-up videos at pre-determined locations within the experience. The main objective is to follow a path of stars in the sky while visiting neighboring islands and collecting tradable goods. If the user deviates too far from the course, the ship will take damage, thus ensuring some structure and focus while still allowing free-play and exploration. The game is completed when the student successfully navigates to the final destination and the final score is saved locally. “Follow The Stars” uses a combination of learning by playing and learning by seeing/hearing to provide information to the learner.

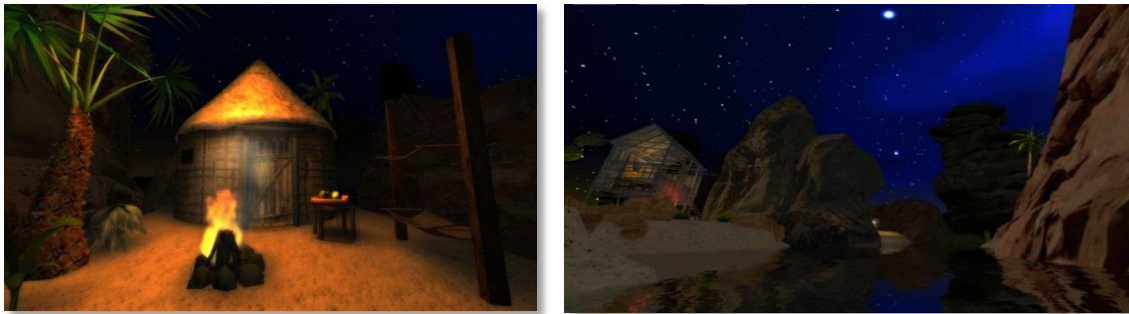


Figure 2. Follow the Stars

“Sea Hunt” (Figure 1Figure 3) is a 3D, first-person “eater” from the view point of an anglerfish on a deep sea mount in the “midnight zone” (3000 – 13,000 feet below sea level). This game teaches students about deep sea ecology, the predator/prey relationships of that ecosystem, bioluminescence, hydrothermal vent ecology, and the historical and engineering accomplishments of the Bathyscaphe Trieste (a submersible that reached the bottom of the Mariana Trench in 1960 – a feat that has never been repeated). In this experience, the user

swims around in the dark waters encountering bioluminescent creatures, some of which they can eat, while others, such as the colossal squid and toothfish, will attack and eat them. The game is completed after the learner has encountered all of the various creatures, eaten enough to maintain its health, and avoided being eaten.



Figure 3. Sea Hunt

“Journey into the Earth” (Figure 4) is a 3D, first-person game that takes the student deep into a West Virginia coal mine. The user learns about geology, engineering, chemistry, ecology, and the potential dangers of mining. As they travel deeper into the mine, the oxygen and methane levels must be monitored. If the user attempts to mine in areas where the methane level is too high, an explosion will occur, resulting in loss of health – possibly requiring the user to re-spawn at a previous check point. Points are accrued by mining for and collecting coal. After a mine

collapse, the student must tap on pipes and employ emergency strategies to obtain rescue from the mine.



Figure 4. Journey into the Earth

“Meteorites” (Figure 5) takes place on an Antarctic icefield. The vast majority of meteorite collection and research is done in Antarctica due to the unique opportunities provided by slow moving ice sheets that reveal, over time, ancient meteorites. In this experience, students must identify legitimate meteorites from common terrestrial rocks. The user is provided with a field guide that they can bring up at any time with a key stroke. Positive identification increases the score, while incorrect identification reduces the score. The game is completed when the learner identifies all of the correct meteorites while keeping their errors to a minimum.

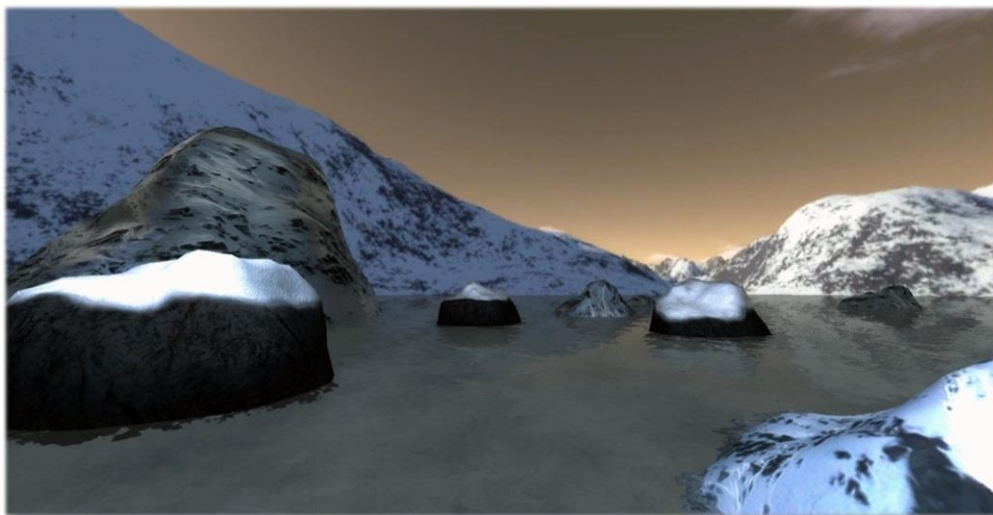


Figure 5. Meteorites

“ChemLab” (Figure 6. ChemLab) is a 3D laboratory experience that allows the user to conduct a set of chemistry experiments while learning about the history and composition of Kevlar by following in the footsteps of chemist Stephanie Kwolek. This simulation does not contain as many traditional game play elements as the other games presented here, rather the student is given the freedom to explore the laboratory, interact with virtual chemists, engage in experiments that interest them, and exit the game at any time. “ChemLab” combines learning by playing and learning by doing methodologies and provides a hands-on learning experience.



Figure 6. ChemLab

“Pythagoras’s Music Challenge” (Figure 7. Pythagoras's Music Challenge) is a 3D game that teaches students about the basics of music theory as attributed to Pythagoras’s concept of intervals. The learner is challenged to mimic patterns that the computer system presents to them, in increasing complexity, while teaching musical intervals such as seconds, thirds, fourths, etc. The users interact with the system by hitting keystrokes on the keyboard’s number pad that correspond to instruments laid out in front of them. Students are not penalized for incorrect answers; rather they lose points as a result of not producing the correct answer in an allotted amount of time. Some experimentation is encouraged in this game with a training period at the start and a free-play mode after completing the challenges – allowing the users to just enjoy the interface and create their own music.



Figure 7. Pythagoras's Music Challenge

Plant Invaders (Figure 8. Plant Invaders) is a game that educates children and teens about freshwater, flora ecology in man-made lakes such as Meadow Lake in Flushing Meadows-Corona Park. This game highlights eight species of plants that are commonly found in freshwater lakes throughout the United States – four of which are native and four that are non-native, invasive plants. The player must correctly identify and remove the invasive plants to return the lake to full health. The game is won by removing all invasive species and lost by removing too many native plants. Additionally, methods of removal are discussed.



Figure 8. Plant Invaders

Formative testing conducted on all twelve of the independent games yielded positive results both in terms of general enjoyment and transference of knowledge. Specific to Sea Hunt, the perspective-taking approach to education was employed wherein the player, takes the “point-of-view” of an angler fish. This metaphor provoked a discussion about what it might be like to play the game through the eyes of several of the other creatures and experience the predator/prey relationships through a variety of modalities. Another player commented that he would like to be able to “see himself” (as in a third-person perspective) suggesting that the player had embraced the metaphor of player-as-fish. Furthermore, several participants commented on the “mysteriousness” of the game and felt this quality made the game more exciting – perhaps indicating an increased sense of immersion.

The children in this study were unanimous in their belief that the game was compelling and enjoyable. When asked if they believed if the game was a good way to learn about deep ocean ecology, all students answered “yes.” Many of the participants communicated that they were unaware of bioluminescence, tube worms, hydrothermal vents, and most of the creatures in the game. They referenced many of the organisms by name in the post surveys indicating that the students took the time to read the pop-ups and were able to actively discuss the various elements of the ecosystem. The participants also commented that they wished there were more levels and they wanted the game to be longer.

In addition to the formative evaluation, both Sea Hunt and Pythagoras’ Music Challenge have been played by large groups of middle school students over the course of the last 12 months within the research laboratory. It has been observed, informally, by both faculty and staff that these and our other independent games foster collaboration among groups of school children wherein the students gather around the computer while one person plays the game. The observers often read-aloud the educational pop-ups offering advice and discussing the content together.

Mixed Reality Space Travel for Physics Learning

Mixed Reality (MR) is used to describe technology environments that mix the real and the virtual. MR merges the physical with the virtual world, either by augmenting real environments with digital elements, or augmenting virtual environments physical elements (Milgram & Colquhoun, 1999). Physically interacting with digital artifacts has benefits for learning (Price &

Rogers, 2004), and several researchers have demonstrated the potential for using MR technologies to promote education across various domains (Birchfield & Megowan-Romanowicz, 2009; Chang, Lee, Wang, & Chen, 2010; Hughes, Stapleton, Hughes, & Smith, 2005; Pan, Cheok, Yang, Zhu, & Shi, 2006). Some have even described design principles for MR environments that facilitate learning (Johnson-Glenberg, Koziupa, Birchfield, & Li, 2011) such as allowing for intuitive mechanisms for controlling digital objects through direct manipulation, and supporting interactions on a “human scale.” In this section we describe an MR environment that was designed to enact these principles by engaging users in a metaphorical interface scheme. By analyzing video of participants using the system, we describe the ways that the interface succeeded in supporting the central metaphor, as well as obstacles that must be addressed in future iterations of the technology.

MEteor is a MR game designed as an informal education simulation to be installed in science centers for middle school-aged children, providing a whole-body experience centered around learning Newton’s laws of motion and Kepler’s laws of planetary motion. Using multiple, calibrated projectors, the experience is displayed on the floor while minimizing shadows that often limit visibility and playability in floor-projected, interactive displays (Hughes, Stapleton, Hughes, & Smith, 2005). In this simulation, the learner is presented with a 30 foot by 10 foot display of a star field. When the learner walks onto the display, a tracking circle is projected around his or her feet – providing immediate feedback to the user that the simulation is interactive. In addition to the floor display, a separate wall display provides guidance in the form of short text instructions, a graphical display that shows the participant’s performance,

and additional gameplay information such as “level” and “score.” In its current testing phase, a human guide is present to answer questions, provide assistance, and regulate the flow of participants.

In order to familiarize the participant with the gameplay mechanics, they first complete a series of training exercises. In these exercises the participant learns to launch their asteroid by jumping off a virtual space platform. The asteroid leaves the platform with the same velocity as the participant. Once launched, the participant must stay with the asteroid as it moves through space. The training exercises teach the participant that their tracking circle will change color (green to red) if their body gets too far from the launched asteroid’s trajectory. They also learn that the graph on the wall display shows their path and how closely they adhered to the asteroid’s path.

Once the practice levels are complete, the learner is taken through a series of physics games wherein they learn how to launch their asteroid past planetary objects with varying amounts of gravitational pull, how to knock a satellite planet out of orbit, and lastly how to place the asteroid into its own successful orbit. Learners are not only scored on their ability to successfully launch the asteroid on the correct trajectory, but also on their ability to follow the asteroid on its path, thus predicting the movement based on the various gravitational forces present at each level.

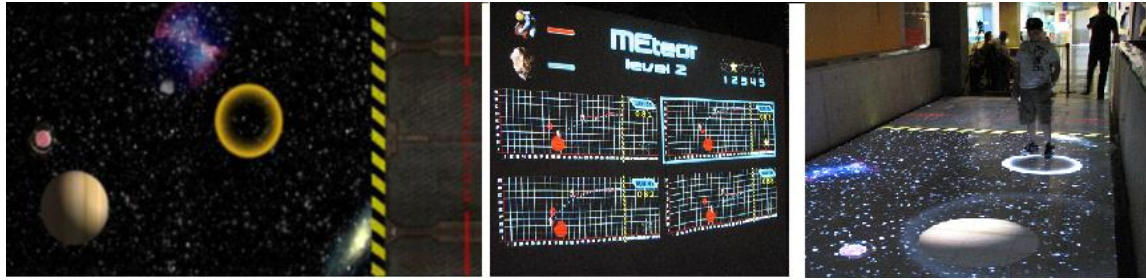


Figure 9. The MEteor MR simulation game. Left: A screen shot of the floor projected imagery. Middle: Graphs and game information displayed on the wall. Right: A participant interacting using MEteor at the museum.

Objectives

A central challenge in teaching physics is the cognitive persistence of the “Aristotelian model.”

In everyday experience, moving objects tend to stop moving unless pushed, and everything falls toward the earth. Space provides an opportunity to observe the motion of objects without the influence of friction and air resistance, but learners are typically unable to experience and observe motion from this controlled perspective. The MEteor project is built around a set of experiments in which we use MR technology to provide a simulated space travel experience to young learners.

This space travel experience, however, does not involve passive ridership in simulated rockets. Learners instead embody the movement of a digital asteroid, making active predictions about how its trajectory will be affected by the presence of planets and other entities in the simulation. Our central hypothesis is that a realistic interactive simulation, experienced through whole-body motion, affords opportunities to directly confront the implicit models that

we all learned from our earliest days, and replace them with new models and intuitions that can be built upon by formal instruction.

MEteor leverages the theories of embodied cognition wherein it is posited that learning is shaped by our physical interactions with the world. This understanding is aided by the use of functional metaphors.

Embodiment researchers and philosophers (Gallagher, 2005; Johnson, 1987) have argued that the body's form and activity provide functional metaphors that constitute the foundation of our language and our understanding. This research provides insight into the ways that computer systems and interfaces can support these body metaphors through immersive simulations and robust systems of feedback. In this simulation, the learner is encouraged to take the perspective of the asteroid and through this virtual embodiment, it is predicted that they will learn concepts in ways that they might not encounter in formal educational interventions.

Design and Methods

In the spring of 2012 we invited approximately 270 middle-school-aged students to use the MEteor simulation, either in our lab or at our installation at a local science center. Participants typically used the simulation for approximately 20 minutes, and while they were guided in their use by a member of the research team, students were given the flexibility to explore the interface and discover the means to achieve the goals of the game. All sessions were videorecorded, giving the research team the opportunity to observe and analyze features of the

system that supported the target metaphorical connection, and those features that appeared to detract from it.

In conducting our analysis, it was useful to conceptualize the interface scheme in terms of a set of control inputs and system responses, with the overall goal being the optimal configuration of these such that learners achieved a better understanding of Newton and Kepler's laws.

Control Inputs

The control inputs in this simulation are all based on the learner's position (tracked by a laser scanner) within a space divided into the "launch deck" and "outer space." While on the launch deck the position of the digital asteroid is determined by the runner (projected right in front of her). When the asteroid crosses the edge of the deck the asteroid follows physical laws (e.g., the pull of a planet's gravity) and the runner must try to stay with the asteroid. Three degrees of freedom are determined by this launching run: (1) the lateral position where the asteroid enters space; (2) the angle of entry, and (3) the speed.

System Responses

How do the learner's actions generate feedback that maximizes learning about science, rather than about the control mechanisms of this particular simulation? Visual and auditory cues indicate the degree to which the participant stays with the asteroid in real time. Additionally, a score and a graphical replay projected on the wall provided feedback about how well they tracked the asteroid in a form of after-action review.

Results and Lessons Learned

Analysis of the video sessions indicated overall mixed success with maintaining the “child as asteroid” metaphor using the control inputs and system responses. In many cases, participants would not stay with the asteroid once they had determined that it was not going to hit its target. Their attention seemed focused on the task of hitting the target rather than that of predicting, following and understanding the asteroid’s motion. However, participants who grasped the interface metaphor early on in their trials had greater success with the simulation. For example, one participant kept hitting the target but failing to get a good score. A member of the research team reminded the participant that, in order to get a good score, he needed to not only hit the target but also stay with the asteroid. In the next try the participant kept his eyes on the asteroid, but at one point fell behind and noticed he had lost contact. He immediately ran after it to catch up again, apparently realizing that he no longer had control over the asteroid after the launch. This “a-ha” moment allowed him to successfully control the asteroid and to more effectively traverse the subsequent levels.

In the following sections we describe a few of the interface interaction patterns that we observed in our review of the video sessions. The first two of these observations, decoupling and competing metaphors, are events that appeared to have detracted from the overall interaction and learning goals of the *MEteor* experience. The second two observations are instances of behaviour and insight that appeared to advance the learning and performance goals of the simulation.

Decoupling

As previously discussed, the participant is asked to perform two tasks: launch the asteroid on the correct trajectory and follow the asteroid's path. In reviewing the video recordings, it was clear that many of the participants would prioritize hitting the target over following the asteroid – despite the cost of a lower score. In many cases, hitting the target presented itself to the participant as the primary goal. This prioritization led the participants to *decouple* themselves from the asteroid, breaking the key interface metaphor.

The current design of the simulation perhaps reinforces this behaviour in a few ways.

Successfully following the asteroid but not hitting the target does not lead to the completion of the level. Achieving a high score then becomes less essential where it might not be viewed as a success. Furthermore, hitting the target generated satisfying sound and visual effects indicating success. Another factor is based on the speed of the asteroid; in some instances the asteroid would move quite quickly and a participant would have to run to keep up with it. As one might expect, the adolescent participants in this study were not always willing to exert the necessary physical activity to meet these objectives.



Figure 10. Decoupling: A participant not following the asteroid. The participant stops moving just after the launch line, allowing the asteroid to get away from him and the tracking circle to go red.

Competing Physical Metaphors

Whole body simulations by their very nature must be built around some pre-existing metaphors of interaction. A common “mistake” made by many of the participants is to try to kick the asteroid, or even drag it with their foot. In the real world, if an object is on the floor and the intent is to move that object, kicking it is often a valid approach – especially in the context of games (e.g. soccer, kickball, etc.). Likewise, some participants thought that the trajectory of the asteroid was based on which leg was forward when it was launched, while others tried jumping off the platform thinking that this was the required action to put the asteroid into space. One participant even attempted stomping the target when the asteroid failed to hit it.

In a traditional computer-mediated game run on a desktop, it is less likely that these kinds of mixed metaphors would occur. Not surprisingly, creating a simulation that occupies real physical space appears to invoke real-life metaphors. There is the potential for these real life metaphors to be leveraged in powerful ways with natural user interfaces. However, these metaphors can also lead to confusion and difficulty when real-life metaphors and virtual representations do not align.



Figure 11. Competing physical metaphors: A participant trying to kick the asteroid

Real-time Visual Cueing

As soon as a participant enters the 30 foot by 10 foot projected game space, a green circle is projected around their feet – providing a visual cue to inform the participant that they are

being tracked. To reinforce the coupling of the participant to the asteroid and to encourage the participant to follow and predict its trajectory, the circle gradually changes to red when they deviate from the asteroids path. This commonly-used metaphor proved to be quite effective in many instances.

In Figure 12, we see a participant trying to catch up to the asteroid after seeing the circle change from green to red. This simple use of color-coding provided immediate and clear feedback to the participant. Not only did this convention keep participants connected to the asteroid, but it compelled them to perform an accurate enactment of how objects move in space, reinforcing important physics principles in physical way.



Figure 12. Real-time visual cueing: A participant trying to catch up to asteroid

Post-action Representation Supports

The primary function of the wall display is to provide a post-action review of the last-completed trial. A graph shows the path of the asteroid and the path of the participant, thus allowing the participant to make modifications or adjustments on their next trial. The display provides an abstraction of the participant's performance in order to invoke increased awareness of the process and principles while also allowing other participants to make comments and observations. In the science center environment this often led to further discussion among groups of participants as they watched a classmate play the game.

In Figure 13(left), a participant ponders his past trial while receiving input from an instructor. In Figure 13 (right), the participant gestures to the place on the graph where he lost track of the asteroid and discusses with the researcher why he believes this event happened.

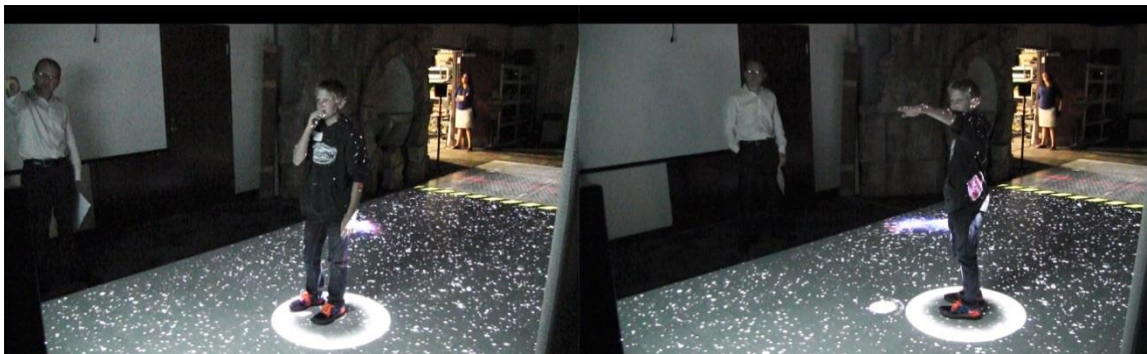


Figure 13. Post-action representational support: A participant studying post-action graph

Conclusions

Whole-body, MR simulations that utilize real physical space in combination with virtual objects can provide unique educational experiences and perspectives not offered by traditional gaming technologies. Designing such a simulation requires an awareness of potential competing metaphors and other usability considerations – wherein real-life experiences with physical objects, individual physical capabilities, and task priorities must be addressed. Visual and audio cueing, consistent and tightly coupled metaphors, and post-action representational supports can be used to improve usability and comprehension.

Games for Social Skill Development

Gaming and simulation for STEM education has received a lot of attention over the past decade with a fair amount of research yielding positive results. The use of virtual environments for social skills development, on the other hand, while benefiting from past research into education and technology, is still a relatively new kind of application (Moore et al., 2005). Technology-based approaches may soon surpass traditional forms of social skills instruction given their cost effective and user-friendly format (Buggey et al., 2011; DiGennaro Reed et al., 2011). However, the propensity that students with ASD show toward technology is perhaps even more promising (Marino, 2010). Given how it may lessen their anxiety with direct face-to-face interactions (Mintz, Branch, March, & Lerman, 2010) and the ongoing need for sameness and routine, technology-based interventions may be most effective.

Technology encompasses computer-based learning (CBL), a growing trend for interventions in school and clinical settings, which may help individuals with ASD overcome cognitive limitations regarding social interactions (Moore, Cheng, McGrath, & Powell, 2005). The benefits of computer-based learning (CBL) are numerous (Golan & Baron-Cohen, 2006), given that they may be designed according to the specific interests of a student; they may also be repeated, routinized, and made financially accessible. Of most value, however, is how much more effective CBL may be compared to traditional models of intervention.

Faja et al. (2008) suggested that computerized, face-specific training programs could improve the facial processing abilities of individuals with ASD. Golan et al. (2010) measured the effectiveness of *The Transporters*, an animated series of 3D vehicles with super-imposed human faces that systematically teaches facial awareness skills. Based upon the concept of *MindReading*, an educational software program and also the name of the intervention, users attune to vocalizations and facial expressions in an engaging multimedia forum. The Cambridge *Mind-Reading (CAM) Face-Voice Battery* was used to assess user-proficiency of a library of over 412 emotions at six different developmental levels ranging from ages four to adulthood (Golan & Baron-Cohen, 2006) and discovered that technology-based applications are inherently rewarding and motivating to individuals with ASD. *FaceSay*, a CBL social skills program, uses avatar assistants to promote eye gaze, facial expressions, and emotions (Hopkins et al., 2011). Students with high-functioning autism (HFA) manifested successful emotional recognition and social interaction skills as a result of this intervention (Hopkins et al., 2011), which begs the

question whether simulated virtual environments (VEs) may actually generate as many results as a CBL model.

Virtual Environments and Individuals with ASD

The use of virtual environments (VEs) for social skills acquisition is an underrepresented methodology (Moore et al., 2005) and further research is needed to realize potential for students with ASD (Mitchell, Parsons, & Leonard, 2007). VEs are simulated platforms that utilize 3D or 2D technology with digital avatars. The user can practice real-life scenarios by interacting with the comfort of a digital environment. It is well-documented that students with ASD prefer simulated environments over traditional role-playing models given the predictable, structured nature of the setting (Bricken, 1991; Cheng, 2005; Cheng & Ye, 2009; Parsons, Leonard, & Mitchell, 2005). Despite increased levels of engagement, students with ASD often do not generalize their learned skill sets well to other domains (Mitchell et al., 2007). However, the benefits of VEs for students with ASD are increasingly noted with each subsequent study (Marino, 2009).

According to Neale et al. (2002) there are two types of virtual environments, the single-user VE (SVE) and the collaborative VE (CVE). The CVE is fashioned to help students with ASD and their Theory of Mind (ToM) deficit (Moore et al., 2005). Cheng and Ye (2009) noted strong reciprocal social engagements with the utilization of a CVE as reported by parents' reports of increased eye contact, emotional recognition, and attention during a social interaction. In post-test reports, students could provide specific examples of how the VE had helped with their social

skills in real-life experiences and even reported the experience as enjoyable (Parsons, Leonard & Mitchell, 2004). VEs can also control for extraneous variables, such as verbal statements from the avatars, which allow participants repeated attempts to practice without harmful consequences. A VE affords a safe environment accounting for physical proximity, level of sound, and body language to provide opportunities for participants to experience social interactions that they would otherwise not achieve (Bricken, 1991; Cromby et al., 1995). Student behavior may also be shaped by responses from the avatar such as expressions on the faces and emotional expressions (Cromby et al., 1995). Ultimately, several researchers note VEs to be of great value in teaching social skills to students with ASD (Bricken, 1991; Cheng et al., 2005; Cromby et al., 1995; Neale, Leonard, & Kerr, 2002). Further validation of existing studies, as well as randomized controlled studies of larger group designs, are needed to expand the literature base and continue to understand the potential benefits of VEs for students with ASD. In the following chapter, the design and development of a game intended to help children with ASD to train specific social-based skills (e.g. emotional discrimination, perspective-taking, and empathy) is discussed.

CHAPTER THREE: GAME AND EXPERIMENT DESIGN AND METHODS

The purpose of this study is to teach empathy and perspective-taking to 10 children with autism. Data will be collected using quantitative analysis of game play utilizing, two observers, and an emotional discrimination probe. Game data includes response time to avatar needs, avatar “happiness” over time (a summation of all needs), achievements collected and achievements spent, time spent playing incentive games, individual needs fulfilled/unfulfilled (e.g. how often did they feed the avatar or how often did they take the avatar to the potty), response to changes in emotional or physical expression of the avatar (e.g. does crying or eliminating on the floor elicit a response), response to changes in meters (e.g. does a ‘red’ meter trigger a response), and other yet-to-be-determined game-play behavior. The primary research question for this study is as follows:

1. To what extent does serious empathetic game play increase the correct emotional discrimination selection as measured by a non-experimental pre/post assessment for children with autism?
2. Given an increase in empathetic responding, to what extent does game play increase engagement and use behavior for children with autism as measured by back end metrics of frequency, and duration of play?
3. What observable changes occur with the children of the course of the interventions and how do they physically and verbally respond to the avatar’s emotional changes and perceived “needs?”

Participants and Settings

Ten similarly functioning elementary children with ASD were selected to participate in this study. Students were selected using the following criteria: 1) prior diagnosis of autism 2) reported by both teachers and parents as not regularly demonstrating empathy towards others and 3) have a prerequisite skill of vocal imitation of three word phrases modeled by the researcher and on auditory recordings. The study took place at Our Children's Academy (OCA) in Lake Wales, Florida, in an office space provided by the school. Students were transported in groups of two from their classrooms by an OCA employee and UCF researcher who assisted in running the studies and was present for all sessions. A third observer, a UCF employee, was also present for more than 50% of the sessions to establish inter-observer agreement. The game was delivered on two, touch-screen, Windows 8 laptops with 15" monitors. The keyboards for the laptops were covered to prevent the participants from becoming distracted and to prevent interactions from occurring other than touch.

Independent Variable

WUBeeS is a game that places the player in the role of a caregiver to a virtual avatar. A WUBee is an ambiguous furry creature that has many of the same basic wants and needs of a typical child in a home setting. The avatar is intentionally ambiguous in both gender and species to avoid any possible gender-bias or past encounters with real-world animals (e.g. a child may have had an unpleasant experience with a dog or cat in the past). Five categories of needs were determined for this project that would be best suited for a home environment: need for

food, need for water, need to eliminate, need to sleep, and need to play. Four environments were selected as locations where the various needs could be fulfilled: a kitchen, a bathroom, a bedroom, and a backyard. Several game play mechanisms were developed to motivate the child to take on the role of the caregiver and fulfill the needs of the avatar.



Figure 14. Screen shot from the WUBeeS game shows the avatar in the kitchen about to be fed

In order to communicate the various needs a meter system was implemented with a simple color-coded interface, ranging in 9 intervals from green to red, with bright red indicated a severe need, yellow a moderate need, and green representing complete fulfillment. These needs are supported by a behavior system built into the avatar. The overall “wellness” of the avatar is determine as a summation of all the various needs and informs the “mood” of the avatar across five variations: happy, content, worried, sad, and crying. Additionally, a further set of behaviors were assigned to the specific needs wherein the avatar will do a “potty dance”

if it needs to go to the bathroom and its eyelids will not open fully if it is tired. If the need to eliminate is not satisfied before the meter turns red, the avatar will eliminate on the floor (or in the bed if sleeping).



Figure 15. Screen shot from the WUBeeS game shows an unhappy avatar that has not had its needs met

To further motivate the player to actively care for the avatar, an achievements system was implemented, allowing for points to be gained and later “spent” on accessories such as shirts, hats, glasses, and necklaces for their avatar, and satisfying certain needs, such as putting the WUBee to bed, unlocks a set of simple games. Five mini games in total are built into the simulation all of which encourage motor skills development.

All interactions are recorded in software, allowing for objective data analysis of player behavior, decision-making, and sequencing. This ability to pull quantifiable data unlike surveys, video

analysis, visual coding, physiological measurement devices, and other measures that may exhibit some manner of bias or subjectivity lends some unique advantages over tradition methods of training and evaluation. However, in the interest in pulling as many data points as possible, these methods are also a part of the experiment design.

Thirty percent of all archived sessions were observed and scored to assess treatment integrity. Additionally, 50% of treatment integrity observations included a second observer to establish inter-observer agreement (IOA) on the Fidelity Checklist System. Two observers viewed and scored the researcher's delivery of the independent variable.

Measures

The primary dependent variable is emotional discrimination. Emotional discrimination is operationally defined as the ability to correctly identify an image of a human or avatar displaying the correct emotion when prompted by the researcher. Participants were given alternating images of three human faces and three avatar faces based on an established and validated emotional discrimination probe (Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I., 2001). Each human and avatar image corresponds to "happy," "sad," and "mad." The participants were asked to select the image corresponding to the prompted emotion and the results were recorded and scored out of a possible six correct per session.

Secondary measures of empathy are the game play data. Game Data includes response time to avatar needs, avatar "happiness" over time (a summation of all needs), achievements collected and achievements spent, time spent playing incentive games, individual needs

fulfilled/unfulfilled (e.g. how often did they feed the avatar or how often did they take the avatar to the potty), response to changes in emotional or physical expression of the avatar (e.g. does crying or eliminating on the floor elicit a response), response to changes in meters (e.g. does a 'red' meter trigger a response), and total number of interactions. For the purposes of this study, achievement score and total number of interactions were analyzed since the achievement score is directly mapped to interactions that involve caring for the avatar.

The third metric is observational data from the two primary observers. This includes overall reaction to the game, the participants' responses to the avatar's emotional states, and the participant's emotional behavior and comments.

Procedures, Experiment Design, and Conditions

The primary research questions, "Do the children in this study show an increase in game performance over the course of multiple trials and does this correspond to an increase in emotional discrimination, engagement, and observable behavior?" are addressed with a multiple baseline across participants design. Intervention sessions were conducted five to seven times across two weeks and lasted approximately 30 minutes. Baseline trials were conducted prior to intervention and an emotional discrimination probe was administered. A baseline trial began when the researcher presented the emotional discrimination probe which consisted of three human images and three avatar images. The prompter, seated next to the participant, alternated the display of the human and avatar images and asked the participant to select the image that best illustrated a particular emotion (e.g. "can you show me sad?"). Participants

moved onto gameplay after a predictable and stable trend was established in baseline conditions.

During intervention, a session also began with the emotional discrimination probe. The participants were then asked to watch a 2 minute training video. After the video completed the participants were given 20 minutes of game play with a “warning” when there were only 5 minutes left.

CHAPTER FOUR: RESULTS

Ten children with ASD between the ages of 7 and 12 were selected for the study and participated, on site, at Our Children’s Academy in Lake Wales for seven school days. The participants were given multiple baseline probes for emotional discrimination prior to the intervention stage of the study. During intervention, each session consisted of an emotional discrimination probe followed by 20 minutes of gameplay with group one receiving 7 interventions, group two receiving 6 interventions, and group three receiving 5 interventions. The game was delivered on two 15” touchscreen computers and quantitative data from the gameplay interventions were recorded to the local drives. Each intervention was observed directly by two researchers.

Emotional Discrimination Probe

Figure 14 illustrates the performance of the 3 groups across baseline and intervention. Though a modest increase in performance can be seen in group three, overall scores did not improve beyond baseline. The participants memorized their responses and effectively “locked in” on a consistent answer. Two of the participants openly expressed that they would “pick the same answer every time.” Other participants indicated that they had memorized their responses by picking up the image and providing a response before the researcher asked the question. Furthermore, some of the younger participants showed a consistent spatial preference by always selected the image based only on placement (e.g. always selecting an image on the far left). Perhaps an emotional discrimination test that uses a larger set of images to define the

emotions would require the participants to reconsider their responses and prevent memorized routines.

Ambiguity in the emotional probe likely caused further confusion wherein the “sad” avatar and the “mad” avatar were often flipped. While the human images showed emotion through their eyes, the avatar’s eyes remained the same through all three emotions. Therefore, discrimination of the avatar’s emotions required the participant to notice the mouth orientation. Detailed analysis of the graphs is presented below.

Median Correctly Identified Emotions

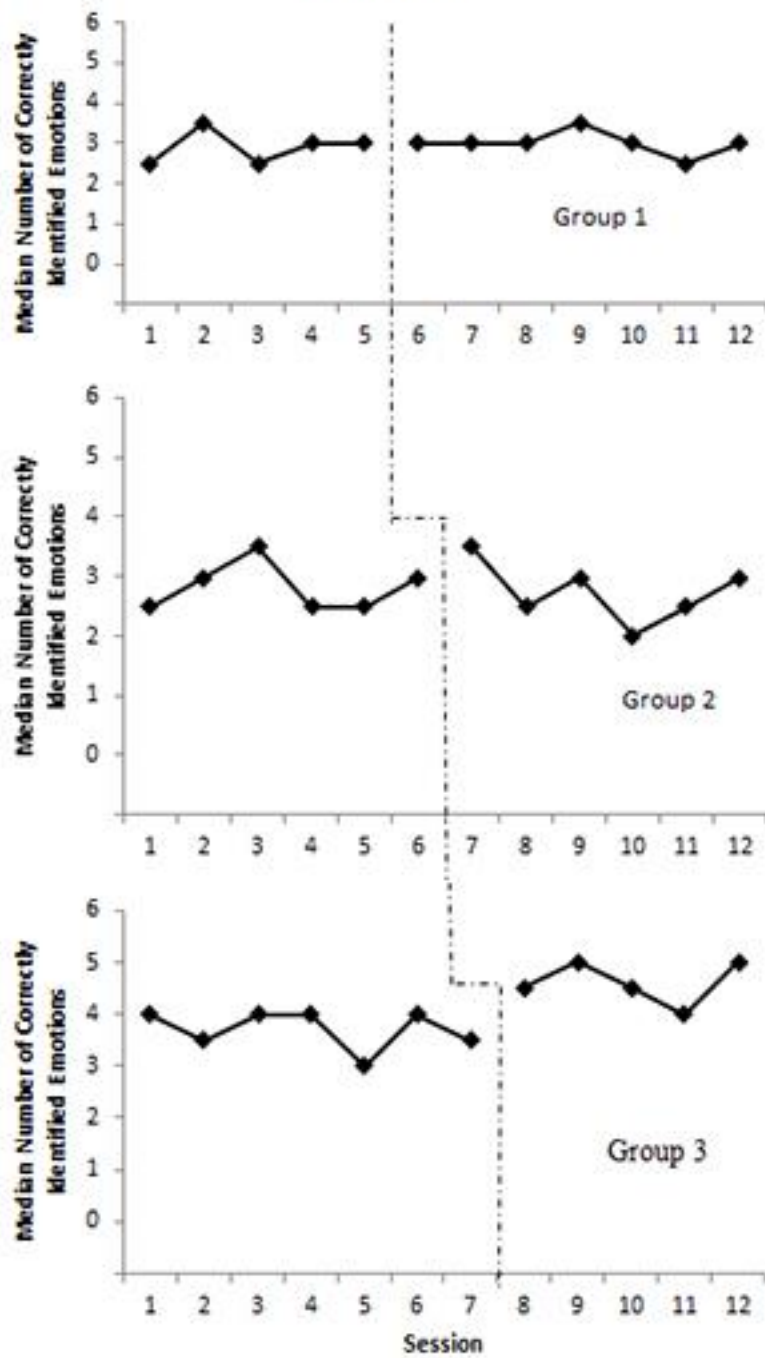


Figure 16. Median number correct for emotional discrimination probe

Group 1 results indicate student performances consistent with baseline levels during the intervention phase. As shown in figure 16, student performance during the baseline phase averaged approximately 50% total proficiency. Student performance during intervention averaged 50% total proficiency, as well. Observational records indicate students interacted with the game during each game session to a much great extent than indicated in their awareness of emotions. To expand further, Group 1 students consistently demonstrated pleasure during the game play session, awareness of the needs of the avatar, and verbally represented their understanding of the game. For example, one participant discussed his awareness of the avatar's needs, but actively chose to attend to other aspects of the game play scenarios. This advanced understanding of the game play and user interface with the game manifested itself in student performance on the emotional discrimination task. Student attention was towards game play, as opposed to the emotional discrimination task.

Group 2 performance on the emotional discrimination task varied extensively across baseline and intervention phases. One participant, when prompted during the task, stated that the researcher "should already know what [he] would say...[his] answers are always going to be the same." This metacognitive approach to the task was consistent with researcher observations of student performance. The participant successfully engaged with the game and attended to the needs of the avatar. Consistent with Group 1 performance, student performance on the game exceeded student performance on the emotional discrimination task. Additionally, student

enjoyment while playing the game, as measured by researcher observations, steadily increased during game play. Again, while these results are inconsistent with student performance on the emotional discrimination task, they are consistent with game play performance.

Group 3 performance on the emotional discrimination task surpassed the performance of the two comparison groups. Student performance averaged around 83% proficiency during intervention. Student interaction with the game increased their awareness of the emotions of avatar and humans alike. Consistent with game play results, students demonstrated an increased awareness of emotions and interpersonal relations.

Gameplay Data

Gameplay data was recorded for every session. Every time a participant interacted with the game (i.e. touched the screen), a report was generated providing a timestamp and variable state information. For this study, two variables were analyzed to determine engagement and improvement across sessions: “achievement points” and “touches.” Every time a participant engaged in an activity that helped “care” for the avatar, they gained twenty achievement points. The total number of achievement points per session provides a quantitative measure for how often the participant actively satisfied the avatar’s needs. The total number of touches per session describes how often the participant touched the screen.

All groups showed a sharp increase in achievement points across the sessions suggesting the participants not only learned the game mechanics but actively sought to satisfy the avatars needs. This is further supported by the decrease in total touches across the sessions. The

participants' interactions become more focused and effective requiring fewer touches. While the increase in score can be partly explained by an increase in understanding of the game mechanics, it also demonstrates an active interest in the participants to care for the avatar where the participants could have focused solely on the mini-games instead.

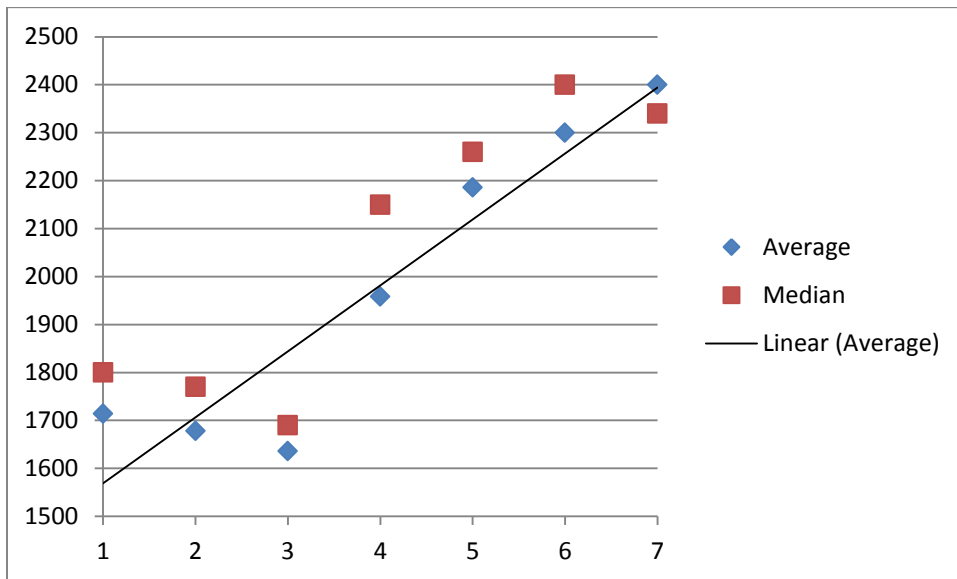


Figure 17. Achievement scores across interventions

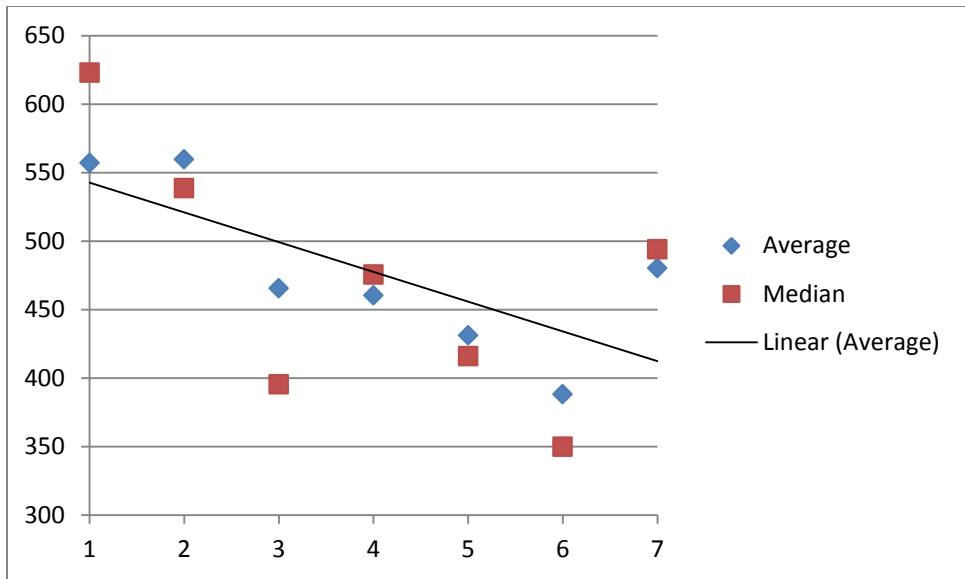


Figure 18. Touches across interventions

Observations

Overall the participants seemed to enjoy the game and had few problems understanding the game mechanics or paying attention to the game. A loss of focus was noticed in some of the participants after about 12 minutes of game play, however, simple verbal reminders (e.g. “keep playing” or “take care of the WUBee”) would reengage the participants and all participants were able to complete all of their 20 minute game sessions.

Some of the younger participants expressed concern about the avatar’s well-being and their inability to help the avatar during the first intervention (e.g. “it’s sad” while pointing at the avatar). These same participants, however, observably, paid closer attention to the training video during their future interventions and by the third intervention all of the participants had a

functional command of the game, the ability to satisfy all of the avatar's needs, unlock the mini games, and use achievement points to customize the avatar.

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

Autism spectrum disorder is a rapidly increasing disability that requires new and innovative approaches for managing and treating the large variety deficiencies associated with it. Empathy, perspective-taking, and emotional discrimination are crucial social skills for interacting with and participating in society. Simulation and gaming can offer safe environments for the practicing of all kinds of social interactions and situations. Games inherently provide the ability to take on another perspective and “see through another set of eyes.” The game designed as a part of this study aims to put children with ASD in the perspective of a caregiver and through that process help encourage empathetic responses while also increasing self-awareness of basic human needs.

While this study did not find positive results with the emotional discrimination probe that was employed, there still exists evidence that progress occurred both in the participants’ understanding of the game mechanics, the avatar’s needs, and the participants’ responses to the avatar’s needs. Several of the participants expressed, without being asked, if they could continue to play the game at home and showed interest in being able to “download” the game to their home computer or smart phone.

Due to several of the participants unexpectedly closing out the game, selecting “new game” when “resume game” should have been selected, or vice versa, a detailed quantitative analysis of full game play data for the existing trials is likely not possible. Revisions to the game infrastructure should reflect these potential challenges for future studies. One participant who

showed quick mastery of the game and became increasingly disinterested over the trials was able to effectively play one of the mini-games and ignore the main purpose of caring for the avatar. While the mini-games functioned as an incentive for most of the participants, the game should be revised to prohibit repeated play for non-essential components. However, it is worth noting that most of the participants were able to figure out this “loop hole” in the game but chose to continue to take care of the avatar, regardless.

While a substantial amount of research has been conducted in the area of educational games, games that aim to teach or enhance social skills remain largely uninvestigated at the time of this writing. Game data and observational results from this study suggest that games may be used to assist in social skill development in children with social deficits.

APPENDIX: APPROVAL OF HUMAN RESEARCH



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1
FWA00000351, IRB00001138**

To: **Darin E. Hughes and Co-PIs: Eleazar Vasquez III, Erika M. Nicsinger**

Date: **February 10, 2014**

Dear Researcher:

On 2/10/2014, the IRB approved the following modifications / human participant research until 2/9/2015 inclusive:

Type of Review: UCF Initial Review Submission Form
Project Title: THE DESIGN AND EVALUATION OF A VIDEO GAME TO HELP TRAIN PERSPECTIVE-TAKING AND EMPATHY IN CHILDREN WITH AUTISM SPECTRUM DISORDER
Investigator: Darin E Hughes
IRB Number: SBE-14-09992
Funding Agency:
Grant Title:
Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 2/9/2015, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

IRB Coordinator

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