Proposal to Develop a Game-Based Intervention for Mentalization in ASDs
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Introduction

Autism Spectrum Disorders (ASD) are estimated to affect 1 in 110 children in the United States, numbering approximately 730,000 individuals age 0-21 (CDC, 2010). This social, communication, and behavioral disorder ranges from mild to severe, effect 4-5 times more boys than girls (CDC, 2010). As part of their social deficits, individuals with ASDs have “selective difficulties attributing mental states to others”, including a person's thoughts, desires and intentions, a skill called mentalization or mentalizing (David et al, 2010; Kuusikko et al, 2009). Children and young adults display lower reaction times and lower accuracy when using the skill of mentalization than typical children and young adults (David et al, 2010).

In typical development, children reach the adult level of mentalizing by 10-11 years, (Kuusikko et al, 2009). However, individuals with ASDs are impaired in their ability to interpret “nonverbal and non-propositional socially salient information from face, gesture, and body positions.” (David et al, 2009; Kuusikko et al, 2009). In ASD, the impairment is permanent (Kuusikko et al, 2009). There are particular difficulties with emotional recognition in eyes and a tendency to misinterpret neutral emotions as negative emotions (Kuusikko et al, 2009). This causes atypical responses in social situations leading to social rejection, social anxiety, and social isolation (Kuusikko et al, 2009). This is a major problem, as social anxiety and depression are comorbidities of many with ASDs.

A Digital Game as a Method of Intervention for Mentalization

A game is an ideal place to begin a novel intervention for children and adolescents with ASDs. As a game takes place separate from the real world, there would be no chance for social rejection as a person with ASD would practice mentalization. With the development of new technologies, such as the iPad, a game could be a portable practice tool. This allows the potential to mitigate difficulties in Central Coherence and generalization through specially designed augmented reality levels, that ask the individual to use their game acquired skills in the real world after learning
them in the safe environment of the game. Finally, children and adolescents with ASDs demonstrate higher levels of engagement with interactive media rather than traditional media forms (Mineo et al, 2009). Therefore, creating intervention in this type of environment would harness this attention for intervention purposes.

**Target Audience**

This game will be designed for intervention and practice of mentalization in older children and adolescents with Asperger Syndrome (AS), Pervasive Developmental Disorder Otherwise Not Specified (PDD-NOS), and High Functioning Autism (HFA) with verbal language/cognitive skills assessed at age 5 or higher. The focus on this audience is due to this age group's higher verbal communication skills, but social deficits. Also during the ages of 9-14, typical peers are becoming increasingly social. In addition, because typical peers are achieving adult levels of mentalizing skills during this period, it is important to improve this skill in individuals with ASDs (Kuusikko et al, 2009). Otherwise, children with the disorder become noticeably deficient in social skills to their peer group.

**Targeted Outcomes**

The overarching aim of this game is to improve basic mentalization, a skill necessary for social competence in 9-15 year olds with ASDs. In addition to this objective, it is the goal that players will be able to generalize mentalizing skills in contexts outside of the game environment. In order to accomplish this, the game has measurable enabling objectives. By the end of the game, 1) players will improve facial expression recognition and body language recognition through interactions as an avatar with an Non Playable Character (NPC) they guard, and interactions with other NPCs, Shadows, that affect the emotional well-being of their charge. 2) Players will also be able to mentalize using knowledge of facial expressions, body language, and an expression dictionary resource as they interact with in game characters.

Supporting 1 and 2, players will engage in 3) perspective-taking by taking on the role of the
avatar and becoming responsible for the well-being of an NPC. 4) They will also use prerequisite skills of joint-attention and gaze discrimination while interacting with NPC charge to recognize important events within the game. 3 and 4 are considered prerequisite skills they will not be a part of outcome measurement (Mundy & Newell, 2007; David, 2010).

Current Intervention

There are several intervention protocols available to individuals with ASDs for help with social skills including mentalization. The majority of these interventions fall under the broad category of Cognitive Behavioral Interventions (CBI), which integrates social cognitive processes with social behaviors, and as a group have a higher incidence of generalizing skills from the intervention to everyday social situations (Stitcher et al, 2010). Under this type of intervention are Cognitive-Behavioral Ecological (CB-E) Intervention and Social Competence Intervention (SCI), both of which consider the natural environment a key indicator of an individual's social-emotional characteristics. Therefore each include practice in natural social situations as part of scaffolding (Bauminger, 2007; Stitcher, 2010). CB-E indicated maintenance of improvement longitudinally, and it is likely further studies of SBI will reveal similar patterns, making both valuable intervention methods.

Additional interventions include Social Skills Group, which is a peer mediated intervention (Loudon, 2010). Theory of Mind Training and Social Skills Training, have been suggested as sequential interventions to integrate skills necessary for social competence (Feng et al, 2009). Finally, there is the Hierarchical Face Processing Model, in which Domain III, Interpreting Social Cues, directly addresses cognitive processes related to mentalization (Tanaka et al, 2003). While this final is not an explicit intervention, it is a model on which useful interventions can be based.

Computer Assisted Intervention

Computer assisted interventions use any combination of the above intervention methods in a computer-delivered format. Wainer and Ingersoll provided a comprehensive literature review on these
interventions and their effectiveness. Some target social skills generally, such as Teachtown a subscription based online intervention, and Junior Detective. Four interventions specifically target emotion recognition, Emotion Trainer, Let’s Face It, Mind Reading the Interactive Guide, and My FriendSpace. Of these, only two, Let’s Face It and Mindreading, show evidence of generalization outside of the computer training, and this evidence is limited (Tanaka et al, 2010; Wainer & Ingersoll, 2010). Only one allows the individual to practice decoding faces in context, MyFriendQuest, and it is also the only digital game (Ahmad, 2010).

As a result, a new type of computer based intervention is necessary to promote mentalizing skills. Because children and adolescents with ASD suffer also from impairment in Central Coherence, “the natural propensity for processing information in context,” generalization is difficult (Pellicano, 2010). This is a problem across all types of interventions. However, with new accessible mobile interfaces such as Smart-phones and iPads, there are novel ways to scaffold between an intervention environment and the real world as exemplified in PDA and mobile based visual support systems (Hirano et al, 2010; Hayes et al, 2010). With careful planning of objectives, use of appropriate empirically proven intervention models, and use of said portable technologies, it could be possible to overcome this limitation. In this case, a game would need levels that encourage the individual with ASD to test out skills learned in the game in everyday life. It is an exciting time to develop game-based interventions for individuals with autism.

**Game Design**

**Methodology**

As social competence interventions (SCI) has been shown to be highly effective in increasing the social skills of individuals with ASDs, the structure of this intervention has been taken into account with design decisions (Stichter et al, 2010). This intervention was developed from the Cognitive Behavioral Intervention (CBI) and integrates social cognitive processes with social behaviors (Stichter
Several key features of this methodology include a) reviewing previous skills and introducing new skills, b) skill modeling (“I do, you do”), c) opportunities to practice skill in “structured and naturalistic activities,” and d) closing or review of skills (Stichter et al, 2010). This methodology is desirable because it takes into account both scaffolding and generalization concerns related to Central Coherence. Figure 1 demonstrates how this intervention will be applied in the structure of Keeper.

Also, many facets of these procedure are already embedded in quality entertainment games, though described in games research with such terms as “situated learning” and “well-ordered problems” (Gee, 2007). It is simply a matter of conveying content relevant to an autism intervention in a way that is accessible to target members of the autism community. It is important to note the SCI curriculum is not being applied, as the curriculum is outside of the scope for this serious game study.
However, lessons on facial expressions are the first within this intervention curriculum and method.

**Interface**

The interface for this game is designed to be a touch screen. In this way, the game can be designed as an app for the iPad. This interface would be simple for children with varying degrees of fine motor control, rather than relying on a mouse and keyboard, controller, or joystick that requires sophisticated hand eye coordination skills. In addition, the iPad is portable and already has the support of a number of apps designed with the specific purpose of supporting individuals with developmental disabilities lead more independent lives.

**Story and player objectives**

The child/adolescent plays a new guardian angel. This angel does not understand human emotions yet. In order to learn be a good guardian angel and grow large, beautiful wings, they must learn to interpret the emotions of the human in their charge keeping them happy and safe. This story is culturally appropriate for an American audience, providing a reason why the player needs to decode faces in order to win the game.

**Features**

**Avatars and Personalization**

The angel can be personalized through an avatar system. The use of an avatar encourages a children or adolescent with ASD to adopt another visuospatial viewpoint. New research indicates that because this is a primary representation, individuals with ASDs have this ability (David et al, 2009). However, it is argued that this is also a skill that individuals with ASD must receive support using this skill (Stichter et al, 2010). Ideally, individuals with ASD should be encouraged to use visuospatial perspective taking as it has long been argued related to mentalization, a secondary and meta representation (David et al, 2009).

**Contextualizing Gaze and Facial Expressions**
For an individual with ASD, contextualizing facial expressions is also a challenge, and they have difficulty explaining why another person is displaying an emotion (Stichter et al., 2010). Contextualization of expressions is also an important component of Domain III of the Hierarchical Face Processing Model (Tanaka et al., 2003). This is an area where current computer based interventions has barely explored.

Throughout the game, the player is responsible for another character. This NPC is the player's peer, a faucet of Social Skills Groups (Loudon, 2010). As an angel, they are becoming their guardian and friend. The player watches the face of the NPC for cues as to their emotional state, as well as reactions to the environment. The narrative rationale is that for the angel to help this other character they must pay attention to emotions and the context of these emotions. The player watches for things the person likes, doesn’t like, danger, etc. This NPC should be modeled through a program such a Poser 4.0, so that the accuracy of facial expressions can be controlled by a program designed for sculpting human figures.

The primary challenge in the game is facing Shadows. In Keeper, the player must watch the NPC’s emotions to decide whether a Shadow is dangerous or not. The Shadow is why the NPC is experiencing a specific emotion. If they are dangerous, the player makes them disappear. If they are not dangerous and they player makes them disappear, then their charge gets upset and loses Friendship Points, which the player uses to grow stronger wings. The shadows evolve through the game levels. Eventually, they will also see their features and have to read their faces as well as their charge to decide whether to make them disappear, as in the real world, one deals often must read the nonverbal signals of more than one person. Ultimately, the player accumulates enough Friendship Points to receive a reward and progress to the next level.

**Wings: Challenge and Reward**

As the player progresses through levels they gain stronger wings and more beautiful wings.
This is an extrinsic reward, but it is also scaffolding. As the wings grow, challenge is increased since when exploring the player can fly farther from their charge. This makes the facial expressions harder to read and it also adds body language to the nonverbal cues that must be decoded. This scaffolding ideally transitions a player between levels, the equivalent to SCI lessons (Stichter et al, 2010). These wings are earned by keeping the NPC happy and accumulating Friendship Points for them by successful reacting to the world and their emotions based on their facial expressions and body language. This provides positive reinforcement for passing the previous lesson in mentalization.

Saving Progress and Resuming Play

Due to the often limited time for interventions in a school or home setting, it is necessary to incorporate a Save feature in this game. When the player returns to the game, it reverts to the previous level in a mini-form. This way, they can review skills they have already succeeded at before returning to the main game. This mini-level must also be completed between levels before moving on to new material. This is standard practice in autism intervention, and an important step in SCI (Stichter et al, 2010).

Facial Expression Codex

Because the mentalizing impairment is permanent in individuals with ASDs, it is important to provide resources that can be used to cue accurate interpretations of facial expressions (Kuusikko et al, 2009). The angel has access to an Expression Codex to refer to in game play. They can draw the face they see on their charge, and it will reference similar faces so they can find out what emotion they are displaying. They also have the option to choose from simple icons and browse these faces. As autism is heterogeneous, it is important to offer different ways for individuals to access helpful information. This Codex would also be available for download to a home computer or other mobile device, allowing the individual to use the Codex as a tool for socializing in everyday life. The individual will be taught to generalize using this tool through a generalization extension of the game. Yale and Carnegie Mellon
are just two institutions that offer face databases for research and non-profit projects.

The Generalizing Level: Game Meets Real Life

Because children and adolescents with ASD suffer from impairment in Central Coherence, generalization is difficult (Pellicano, 2010). Therefore, this game provides a level that pushed game learning out into the natural environment of everyday socialization. This is also an integral part of both CB-E and SCI (Bauminger, 2007; Stichter et al, 2010). In this game, the player can take their avatar home with them, in the form of the iPad. Their angel can be activated play with them in social situations, such as a playground or after lunch. The angel can prompt them to interact and interpret emotions, using the codex. The player must input a sketch of the face just like in the game. Then, the best possible choices are given. The player then can attempt to decode faces in everyday situations using the same strategies from the game. For each time the individual uses to Codex to identify a face, they receive additional points for the game and continue to help their angel grow.

Evaluation

Participants

Participants must have a clinical diagnosis of ASD, be 9-14, language skills must be assessed at age five or higher, and they have access to neurotypical peers during their day (Stichter et al, 2009). Participants will be recruited through the Michigan State University Autism Research Center or the Licking County Education Service Center Multiple Disabilities program, My Place to Be, and Central Ohio ASD programs with an interest in novel, classroom sized interventions. The introduction of these other participants pools would depend on the number of participants recruited local to Michigan State University.

Baseline assessment

Because ASD is a heterogeneous disorder, it is necessary to complete a thorough baseline screening in order to create a well randomized trial. A research assistant will administer or collect the
results of the Autism Diagnostic Observation Schedule or Autism Diagnostic Interview-Revised. 
(Stichter et al, 2010). Additionally, parents and child will complete a questionnaire participants with 
parents, to determine prior experience with computers and video games to establish non-autism related 
moderating factors (Ennemoser, 2009).

Additionally, the following pretests will be completed: The “Reading the Mind in the Eyes 
Test”, the Social Responsiveness Scale, and the Diagnostic Analysis of Nonverbal Accuracy-2 Child 
Facial Expressions (DANVA-CF). Qualitative pre-test data will also be collected through a parent 
questionnaire about social behaviors of their child and a child questionnaire about how they feel about 
understanding others emotions. This is to collect further data on moderating factors as well as provide 
valuable insight into how quantitative data translates to observable behaviors and emotions.

Method

The evaluation method will be a randomized clinical trial of intervention consisting of a 
treatment group and a control group. Both groups will consist of mixed ASD 9-14 years olds with 
language abilities at age five or higher.

The control group will receive an iPad game app for entertainment, Angry Birds. The 
participants will play in a clinical environment for 1 hour each day and 3 days each week to mimic a 
therapy schedule in a school or home environment. They may take the game home with them and play 
when interested, logging their play time. This will last four weeks.

The intervention group will received Keeper on an iPad. The participants will play in a clinical 
environment for 1 hour each day and 3 days each week to mimic a therapy schedule in a school or 
home environment. Participants can use the Generalization Game Extension at home, as this is a key 
feature of the game that requires interaction with peers and family. This extension level will log play 
time data. This will last four weeks.

Data Collection and Analysis:
Following the four week intervention protocol, the following tests will be readministered: The “Reading the Mind in the Eyes Test”, the Social Responsiveness Scale, and the DANVA-CF. The pre and post-test data will be compared using ANOVA.

In addition, qualitative post-test data will also be collected through a second parent questionnaire about social behaviors of their child and a second child questionnaire about how they feel about understanding others emotions. This secondary information, again, illuminated potential moderating factors for groups of participants.

Budget

The budget for the project is $234,194. Personnel costs have been lowered through the use of a student development team. *Table 1* is the complete budget, including potential travel expenses.

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The other major expense worthy of explanation is the cost of iPads. In order to have a sufficient participant pool, at least forty iPads must be available for the study. These can be purchased at an institution rate.

Timeline
Due to the urgency of research in treatments for ASDs, the timeframe for game development and the pilot study, is one year. This will provide relevant evidence for further development of this novel intervention. See Figure 2 for a complete timeline.

### Figure 2

**Project Timeline**

- Month 1: IRB Approval
- Month 3: First Prototype/Playtest
- Month 5: Second Prototype/Playtest
- Month 7: Late Prototype/QA Testing
- Month 8-9: Final Game for Study
- Month 9, Week 1: Baseline Assessment
- Month 9 Week 2: Randomized Assignment
- Month 9 Week 2: Begin Intervention Protocol
- Month 9 Week 4: Intervention Midpoint Assessment
- Month 10 Week 2: Intervention Post Assessment
- Month 10, Week 3: Post Mortem
- One Year: Published Results

### Conclusion

It is an exciting time to develop games for autism intervention. New accessible and portable technologies allow new opportunities to support generalization for individuals with ASDs. Also, increasingly realistic graphics mimic the real world, providing additional support. Furthermore, many intervention formats exist that lend themselves to games. Beyond the scope of mentalization, the development of data driven, game-based interventions will lead to more opportunities to improve the social and cognitive lives of individuals with ASDs.

### References


Running Head: Proposal to develop a game-based intervention for mentalization in ASDs


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