

Computerized Health Games to Promote Social Perceptual Learning in Autism

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Many individuals with autism spectrum disorders (ASD) struggle to read nonverbal social cues, such as facial expressions, and often have difficulty recognizing a person's identity from their face. New computerized video games being developed by the Center for Autism Research (CAR) at The Children's Hospital of Philadelphia are being tested for their effectiveness for improving face perception skills in children with ASD.

Recognizing facial information and understanding it are essential skills for competent social functioning, like grasping what another person is thinking and feeling. Functional brain imaging studies have shown that regions of the brain specialized for reading faces are less active among individuals with ASD compared to typically developing peers, indicating that these skill deficits have a discrete basis in the brain. Using infrared eye tracking, research shows that individuals with ASD look less at faces, especially the eye region. New research is studying whether this is because social interactions are less pleasurable for individuals with ASD, such that focusing their gaze on faces is less "rewarding." The first functional im-



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aging studies of reward processes, in fact, do suggest that persons with ASD get less pleasure from observing social images. Using this framework, researchers are now beginning to design computer-based interventions to teach social perceptual skills and to enhance pleasure from social activities.

Computerized video health games are an especially promising intervention tool because they are naturally engaging and

allow the child to learn skills in the context of an activity that is intrinsically rewarding and self-motivating. These games demand increasingly fine perceptual discriminations, gradually teaching advanced skills. Anecdotal evidence and empirical data have shown that many children with ASD have circumscribed interests in technology such as computers, and prefer computer gaming over other activities. Furthermore, several re-

cent studies have reported that persons with an ASD can in certain regards derive more therapeutic benefits from computer-based approaches than direct teacher or therapist instruction. Hence, there is a natural fit for using computerized games as a therapy in ASD.

The Center for Autism Research (CAR) at The Children's Hospital of Philadelphia recently developed a set of therapeutic computer games called *FaceStation* to improve face perception skills among children with ASD, and to boost the reward value of faces. The *FaceStation* game suite builds on an earlier game platform called *Let's Face It!* (LFI), developed by CAR's Director, Robert Schultz, PhD, and James Tanaka, PhD (at the University of Victoria). In a study published last year, LFI was shown to significantly enhance perceptual skills for face recognition in children with ASD.

Following this initial success with LFI, *FaceStation* takes this approach even further. It was designed by a team of psychologists, clinicians and computer programmers to fulfill two key components of successful health games: (a) to be therapeutically effective and (b) to be intrinsically engaging so to perpetuate game play and hence learning without any teacher or therapist oversight. Unlike conventional teaching and training methods, the *FaceStation* games aim to tap "reward" circuits

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Lessons from Autism

By Kim Wilson Owens, LCSW
Parent

About 16 years ago an unwelcome guest came to live in our home. Our beautiful daughter Khery was diagnosed with autism. It (autism) has been her constant companion. Unwanted and merely tolerated by all of us in our family and our home. In the beginning, I had high hopes that this unwelcome visitor would leave our family and let us get on with our lives. But it has not gone away.

As I look back over the years of joy and sorrow since Khery was diagnosed, I have come to a number of realizations. These ideas are based upon my own experiences and those of our immediately family members (I present them in no special order of importance):

- The grief that has been experienced as a result of this diagnosis has been ongoing. It is intermittent and is felt anew each time a milestone is not reached. This feeling of grief is not of the same intensity or duration each time but it is recognizable as grief nonetheless. Several years ago Khery, had she been a neurotypically developing young woman, would have been graduating from high school and applying to college. That was not to be. Even though I have known intellectually for quite



Kim Owens with her daughter Khery

some time that college was not in her future, I did not experience grief related to this loss until her 18 birthday. At that time I felt the pain of this loss very directly. It seemed as we attended graduations and had the opportunity to visit colleges that I experienced a deep sadness directly related to the fact that Khery would never be a college student.

- Parents of children with developmental disabilities make excellent friends and have a wealth of information. They have been by far our best resource.

- Many well-meaning persons who make suggestions have no idea what they are talking about. Some of these people are very insistent. Perhaps Khery appears to them as a “spoiled” or poorly disciplined child. Learn to agree to disagree. Nod, say thank you and move away. This can be tricky if it is a family member.
- Do not expect everyone to understand your atypical child and his/her special needs. Do not be put off by this. Continue to advocate for your child regardless of the feelings of others

- Trust your instincts. They are often right even if you have less book knowledge and clinical experience than the _____ (doctor, teacher, lawyer, and therapist). Fill in the blank.
- Learn to multi-task at least some things. It may be the only way those tasks get done.
- Do not assume that no one understands or cares. Many people want to understand and wish to be helpful.
- You must learn your child’s particular language. (This includes nonverbal grunts, yelps and maybe screams and everything in between.) You are the chief interpreter to the outside world. It is important that other family members are also versed in this special language. Our 23 year old son is often better at this interpretation than my husband and I, although we are pretty good. We are fortunate to have several teachers who are pretty good as well. If you have a caregiver working with your loved one he or she too needs to understand this language.
- One day at a time. I borrowed this idea from the 12 step folks. Often the day has to be broken into smaller units like one morning at a time.

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in the brain by challenging players to perform a wide range of tasks that promote social perceptual skill development.

There are several elements that are central to good game design: clear level goals, adequate positive and negative feedback and reinforcement, proper game controls, interface design, sound effects, supporting music elements, story lines and graphical themes. In designing the game suite, the *FaceStation* team took into account the complex environment of a sophisticated video game, and took precautions to ensure that the games did not cross over the line from educational and enjoyable to over-stimulating. Other player-related factors taken into consideration were age, motor skills, cognitive abilities, and prior gaming experiences. Game structure (not overly complex, but not too simple) and game content (thematically appealing and therapeutically meaningful) were constructed to foster learning in the target population. These elements, which are responsible for grabbing the attention and maintaining the interest of a game player, are often overlooked by educational game developers who primarily follow the repetitive approach of practice-makes-perfect at the expense of fun.

The *FaceStation* platform consists of seven different, stand-alone computer games. The suite has been developed over a period of several years and was extensively pre-tested in a group of children with ASD using behavioral observations, questionnaires and eye-tracking technology. The main design goals for

each game were as follows: (1) to ensure a large amount of repeated face identity and face expression matching, (2) to use autism-specific motivational hooks and clear reward contingencies for correct perceptual matching, (3) to have graduated game levels with increasing complexity, (4) to emphasize positive social behaviors rather than violent themes, and (5) to ensure self-directed game play rather than intensive case management. Additionally, a *FaceStation* internet homepage was created to host the games, the gamers’ profiles, and leader boards for each game and for the game suite overall, so that game players are able to compare their own gaming progress and achievements to that of other players. The homepage also enables *FaceStation* researchers to automatically collect online gaming data and skill improvement for each player over the course of the intervention.

Research on the effectiveness of using health games to improve social skills is still in its infancy. CAR is currently using *FaceStation* in a randomized clinical trial with children and adolescents with ASD that is funded by a grant from the Robert Wood Johnson Foundation. By using a controlled design with randomization to either active treatment or a waitlist group (which provides basic experimental control), CAR can rigorously evaluate potential changes in social perceptual skills attributable to the gaming “therapy”.

CAR researchers are assessing a broad array of outcomes, including enhanced face recognition and memory tests. CAR is also using functional magnetic reso-

nance imaging (fMRI) to measure changes in neural activity and organization that should accompany skill-based learning. This project aims to obtain fundamental insights into reward processes that motivate and promote social learning. In doing so, CAR will begin to be able to measure the malleability of the brain during game-based learning and skill development. Given recent findings on the genetics and neurobiology of ASD, which spotlight basic mechanisms at the level of cell to cell communication in the brain and the “plasticity” of neuronal connections as important to the cause of ASD, a focus on skill-based learning research with neuroimaging should greatly enrich researchers’ understanding of how, why and when rehabilitation games are most effective. As new medicinal therapies are developed in the future, it seems clear that they will be effective only when paired with rigorous teaching regimes. A modern view of the neurobiology of ASD suggests that ASD results from biological “blockades” which impeded typical skill acquisition during development. There is hope that new medicines (e.g., oxytocin) can assist by reducing these biological blockades, thereby allowing for enhanced skill acquisition, but only in the context of appropriately structured learning experiences. Self-motivating game-based approaches to enhance social skills could have a very important role to play in this new science of autism intervention. *FaceStation* can serve an important heuristic function, as a model of how to achieve these gains, and when successful, this approach can be adapted to other domains of learning (e.g., communication and language).

CAR is currently enrolling children ages 8-18 into the intervention study to measure the efficacy of *FaceStation*. Children participating in this research will be asked to play a series of computerized games at home over a 12-week period. Participants will receive noninvasive brain imaging before and after the gaming intervention to measure changes in the brain due to enhanced social perceptual skills. Additionally, participating children will receive diagnostic, social, behavioral, intelligence (IQ) and other developmental testing. Parents will be asked to answer questionnaires over the phone, in person, and on paper. Individuals who take part will receive a comprehensive evaluation and report. There is no cost to participate. Families will be paid for their time and reimbursed for their travel costs.

Many other studies are also underway at CAR with the aim to better understand the causal mechanisms of autism spectrum disorders, and to determine which treatments are most effective for which children (based, for instance, on their genetic, neural, and behavioral profiles).

For more information about the *FaceStation* project and other research programs at CAR, contact 1-866-570-6524 or autism@email.chop.edu.

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