

Improving Autism with Augmented Reality

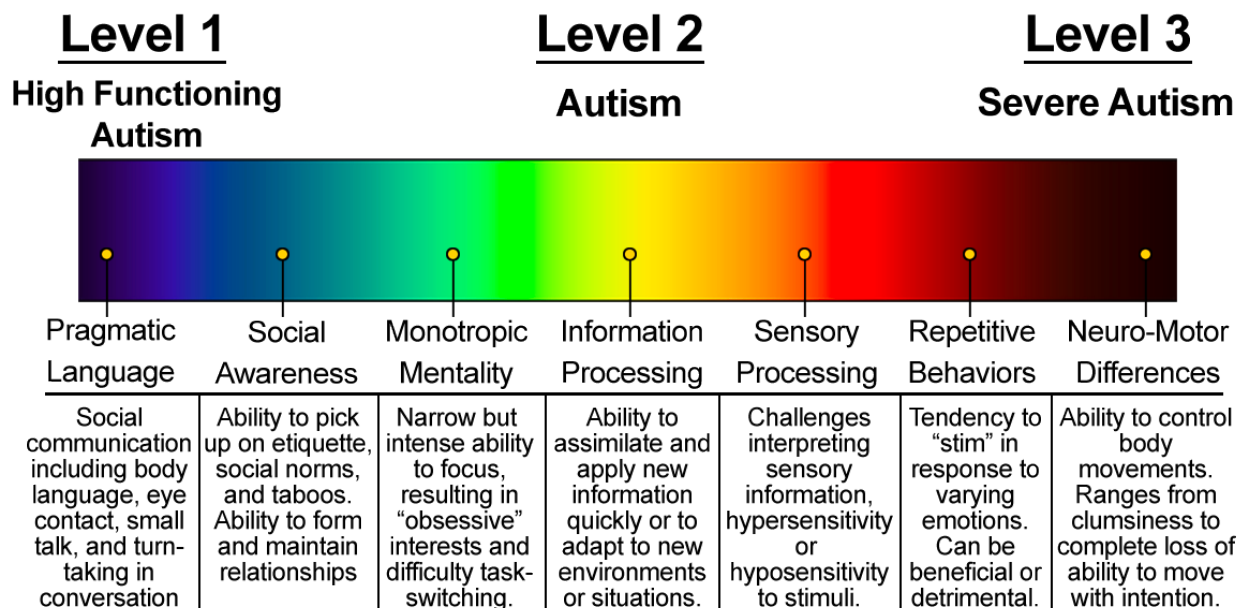


Unlocking Mysteries for Cognitive Well-Being

By Chad Jordan March 11th 2017

What is Autism?

To aid autism, we must first understand it by observing both facts and myths about it. Autism does not carry one defining level of severity but rather falls under a scale that can require some attention, moderate, and more severe cases. For this research, we look to the Autism Spectrum Disorder (ASD) scale. According to autismspeaks.org refers to a broad range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication. Like most areas of behavioral science, autism carries much complexity because it isn't a *one size fits all* scenario. Many people in computer science/mathematics/engineering (*and other scientific fields*) have it on some varying level, even if it isn't that extreme. Since I came from the computer science and engineering field, I can personally speak to other colleagues that I've worked with who have it on both minor, and more extreme levels.



An important factor to point out is that many people in our society are swift to dismiss autism as *"only a burden"* or a *"problem to be swept under the rug"* and this is simply not true, nor is it a healthy viewpoint for people to practice. The Oxford Dictionary defines this as **Ableism**: *"Discrimination against people who are not able-bodied or of a sound mind. An assumption that it is necessary to cater only for people of normal abilities."* At its core, ableism is rooted in the assumption that disabled people require *'fixing'* and defines people by their disability. Like racism and sexism, ableism classifies entire groups of people as *'less than,'* and includes harmful stereotypes, misconceptions, and generalizations of people with disabilities. This disturbing mentality, unfortunately, runs very high in our society. Rather than taking the time to learn about autistic tendencies like working with people who have Aspergers, many people take on a discriminatory mindset because it's easier for them to dismiss it as *"others who have the problems, and not them."* If you're on social media long enough to witness someone display an angry or overly-aggressive act, you'll notice large numbers of people commenting what has become a common, social response: ***"Looks like someone forgot to take their meds!"*** To those

individuals, this toxic behavior of belittling others with social disorders or emotional problems subconsciously validates their actions because it removes any responsibility from their end, and thus able to feel “normal” and not the antagonist. However, this method of behavior abandons rational thinking and empathy for others. If more people practiced better patience and compassion for those with Asperger’s syndrome, there would be better strides towards more humanity for our fellow man. These efforts would allow us to see the beauty in how it allows each of us to learn about the diversity of unique creations.

Myths & Facts of Autism

There are several myths regarding autism that are frequently misconceived by societal views and are in need of correction.

1) Myth: Autism is a mental health disorder.

Fact: Autism is a neurological disorder and yes there is a difference. Studies of people with autism have revealed abnormalities in brain structure and neurotransmitter levels. What is commonly overlooked is that individuals with developmental disabilities are twice as likely to have a co-occurring mental health disorder that also needs treatment or, at times, may render them in need of acute mental health stabilization, while also taking into consideration the developmental disability.

2) Myth: All people with autism have disabilities.

Fact: Individuals on the autism spectrum are unique, with a wide range of intellectual abilities. Individuals with autism can be harder to test so IQ and abilities can be under- or overestimated unless testing is done by an expert in IDD and autism. Tests designed to include language and interpersonal analyses may misrepresent the intelligence of people with autism, who struggle with social skills. Many individuals on the autism spectrum have earned college and graduate degrees and work in a variety of professions.

3) Myth: Individuals with autism are violent.

Fact: While the media will push stories in the news relating autism to violence, aggressive acts from autistic individuals usually arise from sensory overload or emotional distress, and it is typically unheard of for individuals with autism to act violently out of malice or pose any danger to society. Many autistic individuals actually prefer to limit their exposure and interactions with other people because social situations can feel confusing and anxiety-provoking.

4) Myth: Individuals with autism do not feel love, and are unable or unwilling to form meaningful social relationships.

Fact: Though many individuals with autism have difficulty with social interaction, many of them have close social relationships, fall in love and even raise children. Some people may express their loving feelings in less obvious ways, but that does not mean they are incapable of experiencing or expressing love.

5) **Myth: People with autism are cold and lack empathetic feelings.**

Fact: Individuals with autism feel as much, if not more, empathy as others, but they may express it in ways that are harder to recognize. Some individuals with autism may seem “cold or uncaring” if they are very anxious or if they are expected to show care or empathy in a more “typical” manner.

6) **Myth: People with autism have no sense of humor.**

Fact: First of all, a statement like this is widely lacking any empirical evidence mainly due to the fact that humor is already a subjective term in nature. While it may be true for some people with autism, it is more likely that the individual expresses or shares humor in unique or less obvious ways. Many parents report that their family member may tease, tell jokes, or mimic comedy actions or comedy lines appropriately, anticipating others will be entertained.

7) **Myth: All autistic people have savvy skills.**

Fact: While some people with Autism may have a savant skill, like having a photographic memory, or the ability to compute complex mathematical equations quickly and Autism may be linked in some way, others may not. The best way to learn about someone’s strengths is by getting to know who they are as a person and what they love.

8) **Myth: Autism can be outgrown.**

Fact: Since autism is a neurological condition, people with autism will always have autism. But they can learn skills, tools, and techniques to help them function in a world that’s not always made for them. They still have autism, but it’s not as easy for outsiders to spot the issue. People tend to get **BPD** (*Borderline Personality Disorder*) confused with autism, but unlike autism, BPD can actually be outgrown by many people.

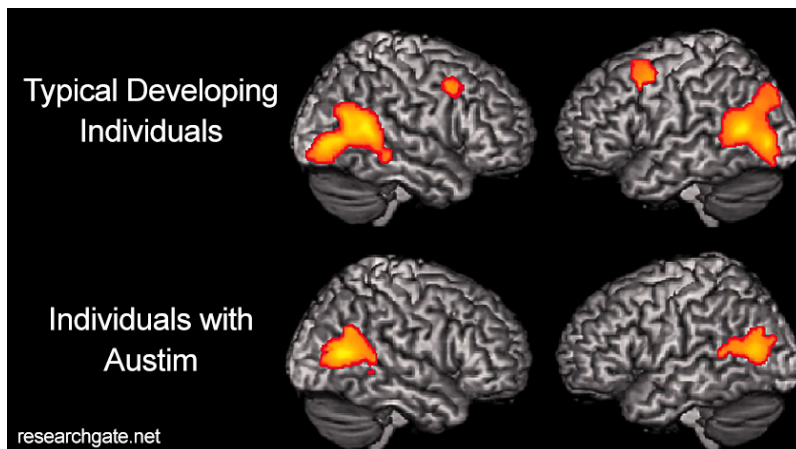
A Deeper Dive into ASD

Autistic Disorder and Asperger's Disorder are also classified as forms of Pervasive Developmental Disorder (PDD)—a group of heterogeneous developmental disorders characterized by delays in the development of multiple basic functions including socialization, verbal/nonverbal communication, posture & movement, eating/drinking, sleeping patterns, and responses to sensory input. This group of disorders include Autistic Disorder, Asperger’s Disorder, Rett’s Disorder, and Childhood Disintegrative Disorder. Children and adults with ASD likely have severe sensitivity to sounds, textures, tastes, and smells. Cognitive deficits are often associated with impaired communication skills. Repetitive stereotyped behaviors, perseveration, and obsession, common in ASD, are associated with executive deficits. Executive dysfunction in inhibitory control and set-shifting have been attributed to ASD but are also seen in ADHD.

ASD may be comorbid with sensory integration difficulties, mental retardation or seizure disorders. Seizure disorders occur in approximately one in four children with ASD; frequently beginning in early childhood or adolescence. There is also a significant symptom overlap

between ASD and ADHD since both groups reveal executive dysfunction in inhibitory control, set-shifting, and mediating front striatal neural pathways in the brain. Many of the difficulties in functioning seen in ASD can be viewed from a neuropsychological systems perspective as involving dysfunction within arousal, attentional, sensory integration, and executive functions of brain systems.

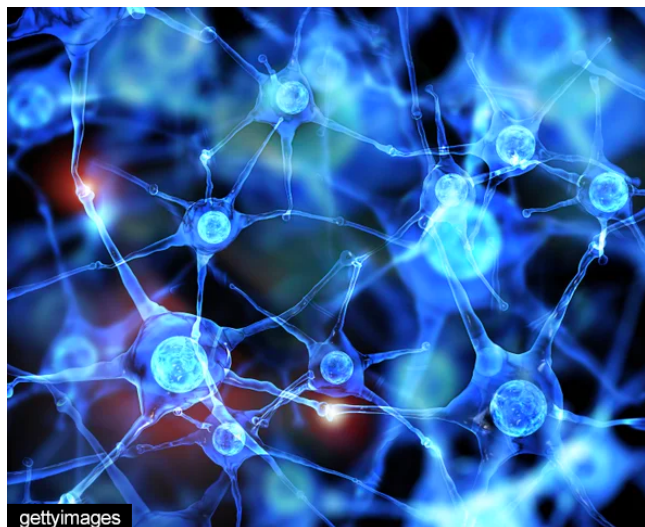
Current research suggests that ASD may be associated with a functional disconnect between brain regions. There is evidence of anomalies in the functional connectivity of the medial temporal lobe. Abnormalities have been found specifically in the functional integration of the amygdala and Parahippocampal gyrus. Such abnormalities in brain function point to the need for therapeutic interventions that address ASD as a neurodevelopmental and brain disorder.



These images of the brain are from the right and left superior temporal areas, demonstrating activity during the task of watching computer-generated line-drawn animations. This activity was recorded during what is known as the **Temporoparietal Junction (TPJ)**. This is an area of the brain where the temporal and parietal lobes meet, at the posterior end of the lateral sulcus

(*Sylvian fissure*). The TPJ incorporates information from the thalamus and the limbic system as well as from the visual, auditory, and somatosensory systems. Behavioral and social-educational treatments have been the traditional options for treatment. Dietary modification and food elimination interventions are becoming more common and appear to have positive impact in a minority of cases. Prescription medication and OTC supplementation treatments have proven only marginally effective. As yet, there is no treatment that can “cure” ASD. Current therapies focus on symptom reduction, behavioral and social skills training, and quality of life enhancements.

More recently EEG neurofeedback has shown itself to be a promising alternative treatment for the milder forms of autism and Asperger's. EEG neurofeedback is a non-invasive therapeutic intervention that has been shown to enhance neuroregulation and metabolic function in the brain. In contrast to behavior therapy,



positive treatment outcomes as a result of neurofeedback training may be achieved over the course of several months as opposed to a year or more of intensive behavioral training.

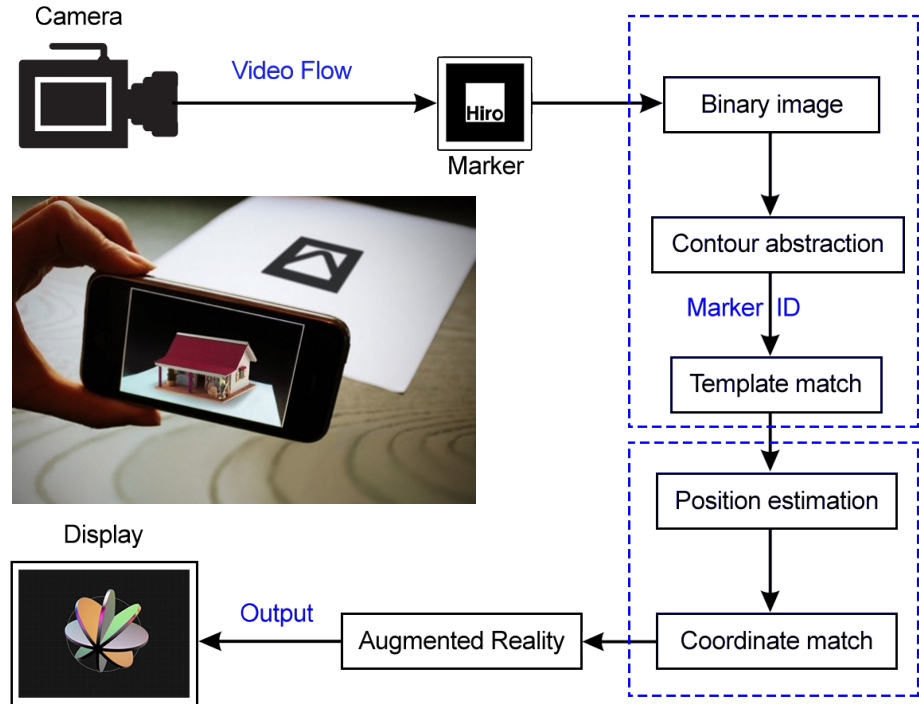
Final Consensus on Autism

We know that there is not one form of autism but many subtypes, most influenced by a combination of genetic and environmental factors. Because autism is a spectrum disorder, each person with autism has a distinct set of strengths and challenges. The ways in which people with autism learn, think, and problem-solve can range from highly skilled to severely challenged. Some people with ASD may require significant support in their daily lives, while others may need considerably less support and, in some cases, live entirely independently. In regards to people being treated less on account of autism, as a society, people love to jump to the easiest conclusions so they can *“have the truth that they want”* without putting in the effort to learn what is real and what is commonly misconceived. Even when it comes to science people will manipulate situations to serve their own belief system as long as it doesn't make them look or feel bad. Reaffirming false beliefs helps others feel better about themselves, but this is a very destructive mindset for them to live by. Autism, along with other disabilities is not as black and white as most people like to make it. It's a far more complicated topic that many would benefit from if they were simply willing to put in the time to learn about the subject and the people who live with it. Through the research performed on this subject, we see a disconnect between regions of the brain during tasks for motor skills. Creating positive interventions to help stimulate and focus on the temporoparietal junction. We know these areas can be improved upon regardless of no cure for autism. The focal point should be having empathy for others with autism and stimulating the areas that can be improved upon. The study of EEG-Neurofeedback as a tool to modulate cognition and behavior is another important focal point. Neurofeedback is attracting renewed interest as a method to self-regulate one's own brain activity to directly alter the underlying neural mechanisms of cognition and behavior. It not only guarantees new avenues as a method for cognitive enhancement in healthy subjects, but also as a therapeutic tool. EEG-based neurofeedback represents a non-invasive, economical, and potentially mobile technique for the modulation of brain activity. Psychological approaches can help people with ASD cope with anxiety, depression, and other mental health issues. **Cognitive-Behavior Therapy (CBT)** is one psychological approach that focuses on learning the connections between thoughts, feelings, and behaviors. During CBT, a therapist and the individual work together to identify goals and then change how the person thinks about a situation to change how they react to the situation. Additionally, there is **Pivotal Response Training (PRT)** which is a form of naturalistic **Applied Behavioral Analysis (ABA)** aimed at increasing a child's motivation to learn, monitor their own behavior, and initiate communication with others by focusing on behaviors that are seen as key to learning other skills, such as language, play and social skills. PRT works to generalize skills across many settings with different people.

What is Augmented Reality?

AR is a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view. The process starts with a device with a built-in camera, such as a webcam, a smartphone, or a tablet. This device will augment physical environments on the screen by overlaying them with digital content.

When it comes to the difference between virtual and augmented reality, these are completely different technologies. Unlike VR, AR is based on a footprint of real surroundings and it only adds additional computer-generated data like animation or three-dimensional objects to it instead of replacing the virtual one.



With the growth in the number of smart mobile devices and the continuous improvement of their capabilities, augmented reality has penetrated a number of aspects of human life. This has become an interactive concept that affects how we buy or study.



To superimpose digital information, AR applications can use different methods like connecting computer-generated content to 'markers' or determining the point where to add data with GPS. Furthermore, the immersive technology implies overlaying additional content in real-time and within the context of the surrounding.

How Can AR Help Autism?

We've established the definitions between autism and AR. Now, how do we combine the technology to aid this disorder? First, we consider what we are needing to specifically address in autism, and next, how we accomplish the endeavor. Let us reference the earlier **ASD** scale. This focal point is really the more severe areas where the Autism Spectrum has significantly impacted the person badly enough that their speech is impaired, and their motor functions require almost full assistance in order to get from point **A** to point **B**, or even prepare a meal for the person in question. I refer to this process as *Stimulating Cognitive Neurotherapy*. This practice of cognitive awareness between virtual dynamics and real-world objects with Hiro markers can help to stimulate neurotherapy. Even severely impaired minds, while having issues performing motor functions, may still be able to process other areas of the brain entirely.

Additionally, AR has been known to help in the following areas:

1) AR Can Increase Attention and Positive Emotions

Robert Malenka, professor of psychiatry and behavioral sciences at Stanford University says, *"Through immersive interventions, serotonin is released in the nucleus accumbens, this really plays an important role in enhancing sociability in autistic people. Serotonin can help block reabsorption into neurons as a means to improve autism."* AR overlays, like 3D videos, figures, and information, can be added to anything and multiple studies have shown that these AR experiences result in increased engagement, enjoyment, motivation, and attention.

2) Improving Social Interaction

AR can help children with ASD practice social skills like eye contact, initiating interaction, asking questions, and sharing interests with their peers. Social exchange depends on the ability to empathize with others to be aware of emotional and interpersonal cues, and respond appropriately. This requires joint attention and nonverbal social skills. Fortunately, evidence-based research shows that AR attracts the attention of children with ASD and allows them to focus on social cues.

3) AR Can Improve Motor Skills

AR can apply virtual messages to learning objects so that 3-dimensional models can be superimposed into textbooks, which allows learners to read books while operating 3D character models. This process helps to verify the effects of learning outcomes, motor skills, and learning motivation with AR-assisted instruction.

4) AR Can Teach Vocabulary

Sets of scientific vocabulary words were created with AR content to help teach students with ASD and intellectual disabilities. The content included video, audio of definitions, labeled pictures and figures, and 3D simulations. The study was found to be highly effective for all participants, and the particular student with ASD learned all the words in a relatively short time frame with immediate improvement.

Final Consensus on AR with ASD

AR allows for interaction with virtual objects in the real world which makes it easier to generalize real-life situations through digital content. The immersive, visual purpose of AR capitalizes on a strength largely held by people with ASD and produces more curiosity and engagement. Introducing new technology can also be highly motivating, creating a more in-depth learning experience. In addition, AR can be easily adapted to supplement evidence-based practices, such as picture prompting and video modeling, that are currently being used by clinicians.

With AR technology being relatively new, but also online long enough to have an array of advanced features, increasing content and uses, we see this as an invaluable time to explore further research. Its usage within healthcare, and particularly the realm of ASD, while still preliminary, is continuing to yield positive improvements. Studies show that the simple addition of an AR element to current therapies can increase motivation, attention, and focus. These highlighted outcomes just scrape the surface of the potential of AR-based interventions, and the outlook is promising for future clinical use.