Caitlin Sikora
Prof. Dana Karwas and Katherine Bennett
Pre-thesis Paper: Next Iteration
4/19/16

Fluid Conceptions of Ability and Assistance:
Designing for Adults with ASD

Abstract

The strategies that we develop to manage a particular "disability" reflect our understanding of ideal, able bodies. With a rigid view of the able body, we create rigid assistive technology that provides a solid structure upon which to lean, but restricts the body to the limitations of an assigned ideal. On the contrary, if we view ability more fluidly, acknowledging the capacity of different bodies to give and receive form, we create fluid systems of support that alternately provide solid structure and flexibility as needed. The case of high-functioning Autism Spectrum Disorders (ASD) is unique in that sensory processing and communication difficulties often eclipse intellectual aptitude, attentive work ethic, and a desire for acceptance. Inhibited motor and verbal functioning of the body undermine empathy and respect for the individual. Since Autism has no isolated cause or cure, but there is potential for progress and increased quality of life, it is important to adopt a fluid view of ability in the context of ASD, giving credence to Autistic individuals as contributing members of society. Assistive technologies for high functioning adults on the Autistic Spectrum should be adaptive, responsive, and fluid, enhancing an individual's strengths by empowering the body and improving communication to foster a sense of the able, Autistic person.

Keywords

Autism Spectrum Disorder
Sensory Processing Disorder
Sensory Integration Therapy
Neuro-typical/neuro-diverse
Strength-Based Approach
Ability/Disability
Assistive Technology

"For 15 years the only way I had to express my anger or humiliation was through behaviors. I did not have the ability to express the words that were in my head, so I acted out my anger and humiliation. This was not necessarily the best option, but it was the only one I had. When I began to use rapid prompting and then typing, I was able to much more easily express my emotions, but I still to this day have a hard time during confrontational and emotionally charged situations." (Kotler)

In a blog post from September 10, 2014, non-verbal Autism self-advocate–an Autistic individual who advocates for the interests of the broader Autistic population– Paul Kotler describes his efforts to manage his needs and behaviors to fit into a neuro-typical higher education setting. Paul covers frustrations with environmental factors, such as "very little noise absorption and fluorescent lighting that buzzes and flashes," along with the effort to control his responses to these sensory inputs, needing to "make some noises… [or] odd actions" or take breaks. Most heartbreakingly, Paul describes the humiliation and embarrassment of "[being] observed by administrators from the office of disability to determine whether or not [he] could 'behave' appropriately in a class... and [having] individuals question [his] communication assistants as to whether or not [he] was really doing [his] own work…" (Kotler).

Of the many challenges he describes in this and other posts on his blog, Paul articulates most profoundly the frustration of being misunderstood, mislabeled, and dismissed. Autism is unique in that the abilities of people with Autism are directly masked by their Autistic tendencies. Uninformed neuro-typical individuals assume that Autistic people are unintelligent and incapable of contributing to society because they cannot communicate their ideas. The pathway to empowering and improving quality of life for people with Autism is through increased communication and empathy on both the neuro-typical and Autistic sides, redefining ideals about ability and assistance for both Autistic and neuro-typical people.

At a panel discussion on Autism Spectrum Disorders on April 1, 2016, another Autism self-advocate urged the importance of patience when working with people with ASD. He likened therapy for people with Autism to the treatment of an injury, emphasizing the need for tolerance of setbacks and non-linear progress. In both cases, stubborn perseverance and adaptation to limitations are necessary, but finding a balance between the two proves challenging as people adhere to rigid definitions of able bodies.

The way that we understand an ideal, able body influences the way we care for it. In a rigid view of ability, we require each body to fit exactly into an ideal mold with four limbs, ten fingers, ten toes, and five fully functioning senses in order to attain a complete, satisfactory identity. Anything that does not fit this mold is seen as less than ideal and, as a result, unhappy. In this mindset, we are likely to create assistive technology that is rigidly supportive, which is necessary at times.

The crutch, for example, is an assistive technology that supports the weight and forward motion of a body with limited functioning in one or more limbs. In the early stages of recovery from an injury, this rigid structure is beneficial for walking, though the crutch may place a burden on an individual engaged in non-ambulatory activities as he/she is now tasked with looking after the crutch. At some point, the healing body's capabilities surpass those of the crutch, which becomes restrictive. A different approach to managing a disabled limb that reflects rigid ideals is to cease all locomotive activities, remaining stationary until the injury is healed. In this approach, an individual detaches completely from challenge areas, ignoring weaknesses in functionality and the potential for improvement. Likewise, an individual with a rigid conception

of his or her body could simply persevere through "normal" functioning, insisting on walking with no crutch at the detriment of his/her healing injury. I suggest that if we need some combination of all of these.

If we view ability more fluidly, acknowledging the abilities of bodies and minds that do not fit the molds, we can find fluid balances between perseverance and acknowledging limitations so that we can accept support. This approach leads to the development of systems that alternately provide the appropriate support, whether solid structures to push against or freedom of movement.

In September 2014, Autism self-advocate Paul Kotler titled a blog post "Teamwork and Independence: We all need supports," in an effort to remind neuro-typical people that every person needs assistance some of the time. He means to establish a connection between people with Autism and people without it so that the limitations of people with ASD do not lead to a complete disregard for their capabilities. He intends to challenge assumptions that people with ASD are "disabled," incapable of contributing to society. He also highlights the fluctuation of needs: we all need supports, and none of us needs assistance all the time with everything. At times, well-meaning attempts to support can be overbearing and restrictive, so how do we define support? What does assistance look like?

In a talk at Eyeo Festival in 2015, artist and designer Sara Hendren investigates assistive technology, providing a useful framework for understanding systems of support. She distinguishes between forms of assistance that reflect a logic of cure/therapy (engineering/science) and those that reflect a logic of accommodation of difference (art). I suggest that these two logics echo respectively rigid and fluid understandings of the body as it influences and defines identity.

Hendren illustrates these approaches with the example of prosthetic limbs. Often, the term prosthesis conjures images of a powerful woman running on prosthetic feet or of a robot arm that visually and functionally replicates a human arm down to the wedding ring on the finger. Hendren highlights in these examples the desire to restore identity and self-satisfaction with technology through connotative athletic activities and wearable signifiers. Hendren provides a contrasting image of a man named Chris who was born with one arm and can accomplish all of his daily tasks without assistance. It may be tempting for us to create the arm that Chris never had so that he will fit better into our understanding of happy, healthy human beings, but he finds that prostheses are restrictive more than assistive. For Chris, the robot arm would be an imposition on his natural, able form. That said, Chris would like to be able to rock-climb, so he worked with a team of designers on a removable prosthetic attachment that he can snap on and snap off that much better suits his needs.

Our understanding of assistance reflects our approach to the body. A body that needs help is considered to be weak, malleable, in need of support. Moreover, a body that does not fit into our idealized preconceptions of able must be in need of support. This way of thinking about ability indicates an outdated understanding of the body as a physical tool for expressing and executing the intentions of the mind. A happy person communicates emotional state to the outside world through a smile according to the control of the happy mind, which dictates the contraction of facial muscles to produce the appropriate expression. But can a smiling, happy body lead to a happy mind?

Supporting a movement toward more holistic approaches to understanding people and their bodies, cognitive and neural science research provides substantial evidence of a link between non-verbal sensations and emotional state. In a study published in 2010, Casasanto and

Dijkstra examined the relationship between simple, meaningless motor tasks and emotions. They found that when subjects were asked to move marbles downward from a higher bin to a lower bin, they were able to recall memories with negative emotions faster than those with positive emotions. When given emotionally neutral prompts for memories, they were significantly more likely to recall emotionally negative memories (Casasanto). In mainstream media, Amy Cuddy's research on power-posing indicates that spending two minutes in a powerful position raises testosterone levels and lowers cortisol in the brain, enhancing confident functioning in social situations. She has found that the converse is also true (Cuddy).

The study suggests a link between arbitrary motor action and human emotion, supporting conjecture that the physical state of a body affects an individual's mental and emotional states. In this new paradigm, the state of the physical body is now as relevant in determining the state of a person as the state of the mind. The view of the human body as a multidirectional medium for communication and influence empowers bodies. If the body is no longer viewed as a mere signifier of capability, the outward appearance of capacity becomes less important than the real actions and efforts of the body. In this new paradigm, a man with one arm who accomplishes all of his daily tasks successfully is no longer disabled simply because he is "missing" a second arm. Likewise, a person who reaches all of his or her destinations as desired is no longer disabled because he/she has used a wheelchair. In both cases, the individual has accomplished a specific goal and therefore has the ability to accomplish that goal.

The idea of evolving our understanding of the able body is simple as applied to "disabilities" that present themselves in physically observable ways, such as an incapacitated limb. The investigation of differences in the mind is more complex. In these cases, the body itself is not the signifier of the disability. Rather, the actions of the body as understood according to assumptions about the actions of able bodies are the signifier. In the case of Autism Spectrum Disorders (ASD), repetitive or jerky movements, difficulty engaging in speech, a static tone of voice, and expression of obsessive thoughts could be signifiers. Here, it is assumed that an intelligent person who wishes to connect with others is capable of expressing those thoughts and engaging socially with ease. Conversely, a person who cannot express intelligent thoughts or engage with others socially must not have those thoughts or that desire for connection. In the case of ASD, the disability, differences in communication, motor functioning, and sensory processing, is the direct masking of the ability, the capacity to contribute to society through insight, strong work ethic, and compassion. It is clear that assistance for this "disability" should involve augmenting the communication between people with ASD and neuro-typical society from both sides to resolve centuries worth of misunderstanding and dehumanization.

Autism was lumped into the broad category of mental illness until the 20th century. Accounts prior, such as an ill boy described by Protestant Reformation leader Martin Luther as "possessed by the devil and [having] no soul" (Wing 2), reveal attitudes and treatment towards individuals with ASD prior to the 20th century: they were considered mentally and emotionally deficient and often sent to live in asylums. It was only in the1940s that Hans Asperger and Leo Kanner began to study ASD as we understand it today: characterized by social "inappropriateness," "poor intonation and body language," "poor motor coordination," "[absorption] in circumscribed interests," "autistic aloneness" and "insistence on sameness." At this early stage of research, scientists believed that autism had an emotional cause: rigid, perfectionist, cold parents, who became known as "refrigerator mothers" (Wing 5).

In the 1960's and 1970's, it became clear that autism is a lifelong disorder of brain development with no isolatable cure, independent of parenting and separate from childhood

schizophrenia, reduced intelligence and language disorders (Fombonne 1). Children with autism make progress in social interactions, learning, and managing behaviors with structured environments designed to "capitalize on their strengths and compensate their deficits…" (Fombonne 2). Improved understanding of sensory processing, the mind-body interface with the outside world, has led to wide adoption of Sensory Integration (SI) therapies.

According to SI creator Ayers, the sensory processing of a person's environment can be used to "explain why individuals behave in particular ways, plan intervention to ameliorate particular difficulties, and predict how behavior will change as a result of intervention" (Ayers 5). Typical SI therapies "use planned, controlled sensory input in accordance with the needs of the child and are characterized by an emphasis on sensory stimulation and active participation of the client and involve client-directed activities… The goals of treatment are to improve sensory modulation related to behavior and attention and to increase abilities for social interactions, academic skills, and independence through better sensory integration" (Pfeiffer 1).

Ayers' Sensory Integration theory uses a holistic view of the empowered and influential body to address the communication and emotional issues of people with ASD. If a person experiences the external world in a different way, it is expected that he/she will interact with it differently. As Ayers explains,

> "Sensory Integration is the organization of sensations for use. Our senses give us information about the physical conditions of our body and the environment around us...The brain must organize all of our sensations if a person is to move, learn and behave in a productive manner" (Ayers 5).

Sensory processing issues are assessed by occupational therapists according to outward behaviors. Therapists observe sensory modulation issues, including both hypo-responsiveness and hyper-responsiveness to stimuli, as gauged by outward reactions. Hypo-responsiveness to particular stimuli may result in sensory seeking behaviors, such as non-functional repetitive movements or deep touches. Hyper-responsiveness could present as outward expressions of anxiety and frustration to itchy tags or buzzing lights. Other sensory processing issues that might be recognized are sensory discrimination disorders, marked by difficulty organizing and accurately interpreting sensory information, and sensory-based motor disorders, which can involve difficulty balancing or difficulty planning and executing movements.

Though medical professionals may be able to detect sensory processing issues given an individual's behavior, neural scientist are just now beginning to understand the underlying structural and functional brain differences that cause individuals on the autism spectrum to react to stimuli differently. While neural scientists are in the early stages of learning about differences in sensory processing, the effects of these differences on communication and social interaction appear to be significant and pervasive. Evidence suggests that, "Over 96% of children with ASD report hyper and hypo-sensitivities in multiple domains… and while sensory hyper- and hypo-responsiveness are not unique to ASD, they appear to be more prevalent in this population than in other developmental disabilities" (Marco 1). Current research is geared toward understanding the nature of brain differences and how they affect "normal" human interactions like conversation. So far, differences in the processing of auditory and visual inputs suggest that a person with ASD may have difficulty assessing the larger meaning of words, sentences, or facial expressions because their brains are over-processing the details of each input. Furthermore, an

Autistic person is less likely than a neuro-typical person to connect multi-modal sensory inputs to construct an understanding of a single external event.

Beyond the processing of individual sensory inputs and the connections between different sensory modalities, an individual must quickly and non-consciously determine which sensory information must be attended in order to maintain a conversation. Marco and colleagues "suggest that this multidirectional flow of information is impaired for individuals with ASD and that this disruption in cortical communication underlies the individual's inability to attend to their environment in a flexible, productive, and meaningful way" (Marco 5). With a wealth of information coming from the environment at any given time, we must focus on only certain information, suppressing or ignoring the other information in order to functionally engage with our surroundings. Autistic people have been shown to "rely more heavily on already overloaded attention and working-memory based networks, such that when the stimuli reach and exceed capacity, the processing system fails" (Marco 6). It is straightforward to deduce how these sensory processing issues impact a person's ability to engage socially. If one experiences difficulty discriminating between sensory inputs, heightened anxiety in response to unpleasant stimuli, trouble prioritizing important sensory information over irrelevant signals, and increased distress over shifting attention, maintaining a conversation with another person is difficult.

Nadel presents an example of how sensory processing issues affect interactions with others in her book on imitation and social development of children with Autism. A group of children, some with ASD diagnoses and some without, are seated one at a time at a table with their hands beneath the table's surface. In front of them, an image of moving hands is projected onto a screen. The projected hands imitate the movements of the child's hands, and researchers observe the child's behavioral responses. Many children, on and off the spectrum, stop moving their hands, which researchers interpret as an indication of recognition that "those are not my hands." Subsequently, many children recognize that their hands are being imitated and test the imitator with complex hand movements. A handful of children with Autism, however, are unable to recognize that they are being imitated and develop a strategy of leaning down to look at their own hands to compare them visually to the hands being projected. This experiment provides evidence that "the intermodal relationship between visual and proprioceptive feedback has not been attained, and because of this, the recognition of imitation cannot be demonstrated" (Nadel 155). This study presents a situation in which the inability to integrate multi-modal sensory information prevents a child from understanding how his/her "actions have an effect on the environment and on other people" (Nadel 154-155). Additionally, individual sensory processing issues present challenges for an autistic person interacting with his or her environment at every step of the process, so what assistance if any would be helpful?

Let's analyze the situation of a person with Autism melting down in response to sensory overload. A neuro-typical response might be to ask what is wrong? It might be to lightly touch the person's shoulder to express compassion. It might be to ask the person how we can help. None of these approaches are likely to be effective in calming the person down. Perhaps they reflect the wrong reasons for wanting to calm the person done. Is this to help the person or to help us feel more comfortable? Other approaches that might be more helpful are both more fluid and more rigid, but reflect a more flexible interpretation of behaviors and needs. A person on the Autistic spectrum is likely to experience discomfort with light touches and unlikely to be able to identify or communicate needs in moments of heightened arousal. Instead, we might darken, quiet, and minimize our presence in the room, removing distracting sensory stimuli and giving the person space to calm down on their own terms. In this approach, we provide assistance by

empowering the individual to care for him/herself. Alternatively, we might provide a strong, grounding sensory input, maybe a firm pressure to help the person's brain organize and prioritize sensory processing. In this instance, we provide assistance in the form of structure to help orient oneself in the murky space of the social world.

These approaches of intervention for Autism Spectrum Disorders reflect the two most fluid schools of thought in education and occupational therapy. The first provides tools to solidify the changing, elusive landscape of social interactions and space for individuals to manage their own needs. The second uses the body to access the mind, and has gained support in cognitive psychology and neuroscience research like Amy Cuddy's work on power posing. Sensory integration therapy and yoga practices are holistic approaches to understanding mind/body/person, and recent research suggests that they are effective in reducing maladaptive behaviors for people on the Autism Spectrum.

In a recent study, Pfeiffer and colleagues present evidence of the efficacy of sensory integration therapies over traditional occupational therapy methods. Autistic children ages 6-12 were randomly assigned a course of either traditional table-top occupational therapy or Sensory Integration therapy. Participants were tested before and after the course of treatment for "social responsiveness, sensory processing, functional motor skills, and social–emotional factors" according to various models of assessment. Significant progress in these areas was observed in both groups, but "more significant changes occurred in the SI group, and a significant decrease in autistic mannerisms occurred in the SI group" (Pfeiffer 2). Though evidence does not yet support increased neurological functioning, the research group highlights a noticeable reduction in maladaptive behaviors such as "stereotypic motor movements, aimless running, aggression, and self-injurious behaviors" (Pfeiffer 4). Furthermore, teachers who had no awareness of the students' group assignments were able to correctly guess which students were in the SI group based on their progress. Though it is a pilot study, the work of Pfeiffer and her team support the effectiveness of Sensory Integration therapeutic techniques for people with ASD, and future studies in the field will continue to identify the most successful practices and guide the design of assistive and therapeutic devices.

Noting cultural shifts toward alternative medicine and meditation in mainstream culture and a concurrent trend in occupational therapy, Koenig and her team composed a 16-week study of daily yoga practice designed specifically for children with ASD. Regarded as a mind-body intervention, yoga requires a student to respond to visual and auditory cues, imitate movements and positions of another person's body, use proprioceptive and vestibular sensory information to find accurate body placement, and maintain breath and focus by managing anxiety, effort, and even pain. Few other activities require quite the same level of sensory integration and mind-body awareness, so it is natural that many education programs for people with ASD have adopted yoga. In Koenig's study, students were randomly assigned to either a group that began each day with an unchanging yoga routine or a group that began each day with typical morning classroom rituals. Koenig found that, "the intervention group showed a reduction in behaviors that were identified as maladaptive by teachers, including irritability, lethargy, social withdrawal, hyperactivity, and noncompliance" (Koenig 6). Though the findings are not adequate to assert that yoga improves sensory integration at a neurological level, it is clear that the regular practice of yoga can have an overall positive effect on the functioning of people with ASD.

In addition to therapies aimed at improving sensory integration and social functioning, teachers and therapists create tools to aid people with autism in managing their behavior. Dunn Buron provides an example of this approach with her 5-point scale, a tool for monitoring mental

and emotional states in response to sensory stimuli. The 5-point scale quantifies levels of stress and provides strategies for both caretakers and individuals themselves to avoid meltdowns. Dunn Buron explains, "Emotional regulation can be defined as the ability to separate your emotional responses to a problem from the thinking you must perform to resolve the problem." (Dunn Buron 1). The 5-point scale helps "to organize a person's thinking when working through difficult moments… [It] can be considered a strength-based approach since most individuals with autism tend to learn most effectively through concrete, predictable systems" (Dunn Buron 2). Quantifying complex emotional systems can help a person with Autism to maintain perspective and control reactions to stimuli. Techniques that digest multifaceted situations serve as valuable tools for learning and practicing social and emotional skills that do not come naturally to people on the spectrum. Though useful in a special needs education environment or at home, efforts should be made to integrate these scales into a contemporary mind-body work flow.

Prior to the 21st century, devices designed to assist people on the spectrum enhanced the visual contrast between autistic and neuro-typical individuals, extending Autism's intrinsic barriers to communication and empathy. Sensory gyms, the setting of most Sensory Integration therapy, are filled with bright, primary colors and large geometric shapes. While the visual stimulation and organization may are appealing and engaging to young children, adolescents who wish to engage in sensory experiences of this sort are left without age-appropriate alternatives. When special needs education facilities cater to this aesthetic, young adult students on the spectrum who are associated with these facilities are viewed as mentally incapable by their neuro-typical peers. Stereotypes involving mental retardation are reinforced. Empathy and communication are undermined. Current personal devices carry a social stigma as well. Weighted vests, sensory stress balls, and other calming sensory stimuli are obvious. They tend to reflect either a child-like aesthetic– bright colors, smiley faces, porcupine tendrils– or a dry medical appearance – sterile lines of black and white with red accents. A recently developed adjustable weighted vest (Vayu Vest) marks progress in the direction of discrete, user-centered solutions, but adjustments require the attachment of a pump, which is difficult in the middle of class or a birthday party. There is a hole in the landscape of available projects where fresh, attractive, grown-up behavioral management adaptive devices should be. Nonetheless, assistive technologies that enhance communication have begun to impact the lives of individuals with ASD.

As we observed in the case of Paul Kotler, the mobility and accessibility of new typing systems have given a voice to a previously non-verbal individual. Picture-based interfaces for communicating feelings and needs make communication for nonverbal individuals, especially children, far simpler. Torii and researchers developed a system called *Lets Talk!* to "help users to communicate by selecting images and sounds from the program. They tested the system's efficacy with the help of an Autistic 9-year-old boy, whose "bad behavior improved as he learned to express his thoughts and interests appropriately with the application" (Aresti-Bartolome 2). This report is consistent with reflections of Kotler in his blog, where he shares that typing has made it possible for him to express feelings of frustration or displeasure that he could previously only express by "acting out" (Kotler). Not only has typing technology given Kotler a medium for clear, productive expression in daily situations, the internet has given Paul a platform for reaching neuro-typical populations with his perspective. For the first time, Paul is able to communicate his experiences of reality to people who cannot otherwise understand.

In the vein of therapeutic interventions that view the body holistically, social robots are an exciting innovation in the care of people with ASD. Various models of robots that are capable

of gestures, facial expressions, and even verbal communication have been used to encourage social engagement and learning in adolescents with Autism Spectrum Disorders. Advanced models of the robots use cameras and computer vision algorithms to read and respond dynamically to the physical expressions, particularly head movements, of users. In a study by Goodrich and collaborators, "researchers analyzed children's behavior with the robot, including language, gestures, eye contact, imitation and demonstrations of affection... [to find] that the children were very motivated to interact with the robot" and more likely to interact with clinicians after than before the treatment (Aresti-Bartolome 5). In a movement and imitation focused study, Srinivasan and researchers worked with 15 neuro-typical children and children with ASD/ADHD for 8 practice and 8 test sessions, in which they evaluated the children's ability to imitate a robot doing karate and dance movements. They determined that the "participants made fewer errors during the test than during the practice session, thus improving imitation-specific tasks" (Aresti-Bartolome 5). This research suggests that the use of social robots is a promising therapeutic avenue for children with Autism Spectrum Disorders to practice social skills and imitating peers, which can improve motor functioning and communication.

Another therapeutic approach that uses the body and physical expression in combination with technology is that of virtual reality and Kinect games, which are used to provide consequence-free environments for practicing social interactions and movements. Virtual reality technology "makes it possible to create avatars or more real looking characters to enable participants with autism to work on facial expressions and emotions and recognize them while also creating controlled environments to make them feel safe" (Aresti-Bartolome 3). Mitchell and scientists used this technology to create a virtual coffee shop. They showed 6 adolescents with ASD "3 sets of videos of real situations taking place in coffee shops and cafés followed by the virtual environment" (Aresti-Bartolome 3). Participants reported where they chose to sit in the environment and why to 10 evaluators. Participants interacted with the virtual environment for different amounts of time, though they all saw the same videos. Researchers noted "significant improvement, directly related to the time spent in the virtual world when deciding and explaining where they chose to sit" (Aresti-Bartolome 3).

In a study of virtual reality in combination with Kinect, Herrera's research group "developed a set of educational games in which children did exercise (using their bodies as the control mechanism) and which also made them more aware of their own bodies" (Arest-Bartolome 3). With increased knowledge of the physical self, people are more able to embody thoughts and feelings to interact with their environments in more effective, meaningful ways. Recall Nadel's study, in which ASD participants were not able to recognize their own hand gestures when they could not see their hands. Improved proprioceptive awareness could lead to more integrated, fluent communications. These virtual reality and Kinect interventions are geared to help adolescents with ASD develop fluency in languages of physical expression. They enable users to practice interpreting and enacting facial and gestural cues in complex social landscapes, preparing users to communicate more successfully in everyday life.

Technological solutions that aim to solidify slippery social concepts and support the use of verbal language in communication are also emerging. In 2008, Grynszpan developed 3 games using "subtitled dialogues that expressed irony, sarcasm and metaphors, in addition to faces showing emotions" to work on communication and interpretation of language in ASD populations. 10 participants with ASD and 10 without were required to correctly interpret and appropriately respond to the visual/verbal prompts over the course of 13 weeks. The researchers found that "the adolescents with ASD performed poorly on rich multimedia interfaces because

they lacked initiative when organizing the information given in the multimodal sources" (Aresti-Bartolome 4). Perhaps, future efforts could involve a progression from unimodal media to multimodal media in an effort to train social engagement. Another application that aims to teach social and emotional skills called LOLA App is in the early stages of development. At this point, LOLA uses humorous gifs to reinforce successful completion of daily tasks. A feature article on the App explains, "the user sets a certain number of challenges per week, and receives a push notification at a specified time—if the child completes the task they receive a virtual gold star, and if they don't they see a gif of a crying face with the phrase 'LOLA is sad'" (Bonazzo 3). Efficacy of this type of app has yet to be studied, but developers hope that it will help users by holding them accountable for daily tasks that create the interface through which they interact with the external world.

While each of these applications of technology to working with ASD populations is promising, they still tend to address the individual from a rigid perspective of ideal humans, providing therapies to help ASD populations "improve" functioning and behave "better" in neurotypical settings. Solutions that take a more adaptive approach also tend to require significant efforts in order to make adjustments in real time. Efforts should be made to create highly responsive solutions that gauge and provide the assistance that an individual needs at each moment. I suggest we reduce the stigma of "Disability" associated with assistive technologies by creating age-appropriate solutions in consultation with affected populations that can be smoothly and easily adjusted according to changing needs.

As a creator with a background in both art and science, I have found myself torn between a project that falls into the realms of art or engineering, but this rigid adherence to academic structure may be limiting. In the lineage of Lygia Clark, Sara Hendren points out the potential for assistive technology to live somewhere in between between disciplines, affecting change both locally and globally. I am interested in emulating Hendren's interdisciplinary approach in my project, and I will look to dance forms for inspiration in empowering the able, Autistic body. I believe that contact improvisation, for example, can serve as a model of the responsive nature of the technologies I am proposing. It relies on the masterful balance of weight between two bodies to create stability and communication as the balance shifts in different directions to create fluid movement. It requires both rigidity and flexibility in the physical body for successful negotiation of needs, intention, and space. Following my investigation of empowered, able bodies, assistive technologies and the sensory processing issues that impact communication and quality of life for people with ASD, I have prototyped two potential projects that blur the boundaries between art and assistive technology:

The first idea is a wearable device that will transform a user's movement impulses into fluid movements by responding with proportional forces. The placement of the device is designed to make contact with the body in a way that feels supportive rather than restrictive as guided by my experiences with contact improvisation. Magnetic forces will be created with electric currents when a user's movements become rigid. If a user moves with greater force, it will respond with greater force with a system of magnets and memory wire. The purpose of this device is to provide a fluid movement experience to the user, help the user to develop awareness and reflexes for conversing with external forces, and help the user find a different way of engaging his/her muscles. At the same time, the device is designed to be a statement on ability and assistive technology. It questions ideals about able bodies and their movements. What is wrong with jerky movements? Why can't people move how they want to move? Assistive

technology is often designed with the intention of helping people fit into societal ideals more easily, but is this the best approach?

The second idea is a game involving a discrete handheld controller that the user moves around freely to express emotions. In the prototype, there are 6 different controllers in a configuration that looks like a cool sculpture on a desk. The user can unlock the sculpture to release the pieces, which can be arranged in different ways like a puzzle or can be held and moved around as desired. In this version, the handheld pieces control graphics on a computer that provide a score for fluid or aggressive movements. Alternatively, the game could analyze the user's movements to guess how he/she is feeling. The purpose of this game is to provide a break from the constant effort of social interactions in neuro-typical work and school settings. It provides a platform for free expression through movement and helps the user connect that expression to the outside world. It also helps the user develop the ability to move through the world with intention.

Through the process of user testing with people with ASD, parents of children with ASD, and occupational therapists who work with the ASD community, it has become clear that the wearable art idea, commenting on assistive technology through assistive technology, does not read to an audience. Each user saw it as a therapeutic device or an automatic "stimming" device. It may be possible to create a wearable device that serves the purpose of art in the amount of time that I have, but to create something intended for therapy would require more functionality to be effective. The game idea seems more exciting to the users. Feedback on this idea supported the sensory controller that is both flexible and rigid in different areas. Visual representations of the experience were encouraged and cited by occupational therapist Kristie Koenig as strengths for people with ASD.

I am shifting my proposal to an immersive, 3-dimensional movement visualization that can be interacted with through Kinect. The world is created by the user's movements, helping the user to visualize and understand the quality of his/her movements in space. I have drawn inspiration in this visualization from the theme of fluid and rigid structures to visualize jerky and fluid movements differently. This could provide a medium for movement-based expression to a person with ASD that is completely immersive, providing a break from the effort of behaving in a neuro-typical environment. Simultaneously, the user could be developing his or her sense of expressive movement. I imagine a user immersed in a world of sculptures created by his or her movements in real time. I see the user being able to interact with the world intentionally, moving spheres with their extremities and navigating the space with physical body movements. To bring the idea full circle, I would like to use haptic feedback created by a wearable device similar to the wearable prototype described. If the user presses against an edge in the 3D environment, the wearable device on his or her arms could become more rigid to resist the movement against the edges of this imaginary world.

By collaborating with high-functioning adults with Autism Spectrum Disorders and members of the ASD community, I will refine these ideas to create an aesthetically grown-up, responsive assistive technology that enhances communication by empowering the body to build empathy and respect across a neuro-diverse population. Perhaps this research will help to increase awareness and understanding of ASD in neuro-typical populations, or prompt an investigation of ideals concerning able bodies and assistance.

Bibliography

Aresti-Bartolome, Nuria, and Begonya Garcia-Zapirain. "Technologies as Support Tools for Persons with Autistic Spectrum Disorder: A Systematic Review." *International Journal of Environmental Research and Public Health*11.8 (2014): 7767–7802. *PMC*. Web. 6 Apr. 2016.

Ayres, A. Jean., and Jeff Robbins. *Sensory Integration and the Child: Understanding Hidden Sensory Challenges*. Los Angeles, CA: WPS, 2008. Print.

Bloch H., and B.I. Bertenthal. *Sensory Motor Organizations and Development in Infancy and Early Childhood*. Boston: Kluwer Academic Publishers, 1990. Print.

Bonazzo, John. "Prize-Winning App LOLA Uses Humor to Help Kids With Special Needs." *Observer: Business and Tech*. 3 Aug. 2015. Web. 4 Apr. 2016.

Buron, Kari Dunn. "The 5-point Scale and Emotional Regulation." Web. 8 Mar. 2016.

Casasanto, D. and K. Dijkstra. "Motor action and emotional memory." *Cognition* 115 (2010): 179-185. Online.

Cuddy, Amy. "Your body language shapes who you are." TED. October 2012.

Ferrari, M, and S L Harris. "The Limits and Motivating Potential of Sensory Stimuli as Reinforcers for Autistic Children." *Journal of Applied Behavior Analysis* 14.3 (1981): 339–343. *PMC*. Web. 23 Mar. 2016.

Fombonne, E. "Modern Views of Autism." *Canadian Journal of Psychiatry* 48 (2003): 503–505. Web. 14 Mar. 2016.

Golarai, Golijeh, Kalanit Grill-Spector, and Allan L. Reiss. "Autism and the Development of Face Processing." *Clinical neuroscience research* 6.3 (2006): 145–160. *PMC*. Web. 23 Mar. 2016.

Hardy, Michelle W., and A. Blythe LaGasse. "Rhythm, Movement, and Autism: Using Rhythmic Rehabilitation Research as a Model for Autism." *Frontiers in Integrative Neuroscience* 7 (2013): 19. *PMC*. Web. 23 Mar. 2016.

Hendren, Sara. *Eyeo Talk*. Eyeo Festival 2015. Web. 25 Mar. 2016.

Koenig, Kristie Patten, Anne Buckley-Reen & Satvika Garg. "Efficacy of the Get Ready to Learn Yoga Program Among Children With Autism Spectrum Disorders: A Pretest–Posttest Control Group Design."*American Journal of Occupational Therapy* Vol. 66 (Sept. 2012): 538-546. Web. 2 Mar. 2016.

Kotler, Paul. "Teamwork and Independence: We All Need Supports." *The Diverse Appearance of Autism*. 10 Sept. 2014. Web. 2 Mar. 2016.

Kuhn, R. "Eugen Bleuler's Concepts of Psychopathology." *History of Psychiatry* 15 (2004): 361-366. Web. 14 Mar. 2016.

Lyons, V. and M. Fitzgerald. "Asperger (1906–1980) and Kanner (1894–1981), the Two Pioneers of Autism." *Journal of Autism Developmental Disord*ers 37 (2007): 2022–2023. Web. 14 Mar. 2016.

Marco, Elysa Jill et. al. "Sensory Processing in Autism: A Review of Neurophysiologic Findings." *Pediatric Research* 69.5 Pt. 2 (2011): 48R–54R. *PMC*. Web. 1 Mar. 2016.

Mullen, Brian. Vayuvest.com. Web. 26 Mar. 2016.

Nadel, Jacqueline, and Eleanor Corbett. *How Imitation Boosts Development: In Infancy and Autism Spectrum Disorder*. Oxford: Oxford UP, 2014. Print.

Parron, C. et. al. "Recognition of biological motion in children with autistic spectrum disorders." *Autism* 12.3 (2008): 261-74. Web. 16 Mar. 2016.

Pfeiffer, Beth A., Kristie Koenig, Moya Kinnealey, Megan Sheppard & Lorrie Henderson. "Effectiveness of Sensory Integration Interventions in Children With Autism Spectrum Disorders: A Pilot Study." *American Journal of Occupational Therapy* Vol. 65 (Jan. 2011): 76-85. Web. 2 Mar. 2016.

"Social Emotional Learning." *ASD Support,* Rhode Island Technical Assistance Project. 2015. Web. 8 Mar. 2016.

Wing, L. "The History of Ideas on Autism: Legends, Myths, and Reality." *The International Journal of Research and Practice: Autism* 1 (Jul. 1997): 13-23. Web. 14 Mar. 2016.