Creativity in Autism

Ashley Smith

Professor Elizabeth Madden-Zibman

Abstract: *A widely known belief about autistic children is that they do not have the capability or capacity to be creative or display any type of imagination. Because of this common belief, researchers seek to explore the subject and discover the details concerning the creative and imaginative minds of autistic children. Can autistic children actually be considered creative and how exactly do they display imagination? The answer to this question stems from research in multiple studies, experiments, and different therapies. This research illustrates that high-functioning autistic children tend to perform poorly on creative tasks. However, it also demonstrates that these children have the capacity for creative and imaginative production as well as creative enhancement with the help and aid of educators and therapists. These studies are also concerned with the autistic savant and how his/her creative production is influenced by the condition. Therefore, different degrees of autism have the capability of producing different degrees of creativity.*

Introduction

Autism Spectrum Disorder is a condition not typically associated with creativity, but more with the lack of it. The Autism Speaks organization states that autism affects 1 in every 110 children worldwide. The U.S. National Library of Medicine defines autism as a "developmental disorder that appears in the first 3 years of life, and affects the brain's normal development of social and communication skills" (Autism, PubMed Health). It also states that children with autism typically have difficulties in pretend play, social interactions, communication, thinking abilities and success at school (Autism, PubMed Health). Because of these difficulties, it is a widespread belief that autistic children, even on the higher end of the spectrum, are unable to possess and demonstrate creativity. The link between autism and creativity fluctuates and currently remains undefined. Many believe that individuals with autism are incapable of possessing

creativity or imagination while others believe the opposite. Researchers continue to investigate whether autism has a significant impact on creativity in children and create tests to compare the creativity of an autistic child to the creativity of a non-autistic child. There are a number of questions to be addressed about the creative and imaginative abilities of ASD children. These include questions in the medical realm; about the brain of an autistic individual; as well as questions of enhancing creativity, autistic progression, and expression. Can high-functioning autistic children be considered creative, and if so, how do they display imagination? The autistic creativity and imagination of children can be directly connected to the theories of James C. Kaufman's "4 P's of Creativity" as well as Sternberg's Propulsion Theory. In Kaufman's "Modern Theories of Creativity," he explains the 4 P's of Creativity as the product, process, person, and press/environment of creativity. The Propulsion Theory describes different ways people can make a creative contribution and categorizes these contributions (Kaufman, 26). This research will focus on the creative autistic person, the creative process of autistic children, their creative environment, and the creative products produced by autistic individuals. Although many individuals believe that autistic children are incapable of such creativity, studies and experiments verify that autistic children demonstrate the capability of not only possessing creativity and imagination, but enhancing it through hands-on therapies such as sandplay, art therapy, and robot interaction. Additionally, savants appear to have an enhanced creative ability that can potentially surpass that of the average, non-autistic individual.

Creative-Enhancing Therapies

As highlighted by a number of studies and tests, the creative ability of children with autism is not necessarily at a standstill. Through these experiments, researchers find that creativity is not something that one is merely born with, but instead is something that can be built upon and enhanced. An autistic child's creative progression relies on a number of factors. These can include the encouragement of teachers and parents to promote creativity, as well as the type of approach taken

to make creative enhancement. The use of sandplay, art therapy, and toy robot interaction proved to be successful methods of enhancing creativity. A study conducted by 4 researchers, Lucy Lu, Fiona Petersen, Louise Lacroix, and Cecile Rousseau, evaluated if the use of sandplay in a classroom setting could encourage autistic children to become more creative and imaginative. The researchers explain that, "for several weeks the children would resist attempts to extend and expand on their play, closing circles of communication very quickly. Through close observation of the play and placing a prompt at the right movement, eventually the point of entry would be found and the child's play would move to a deeper level of complexity" (60). The researchers found that in the beginning of the experiment, the autistic children were resistant to enhancing their creativity. However, over a number of weeks, the children began to open up and explore more with the sand and toy props, some even making connections with the toy props and their personal lives (60) (See Figure-1). These improvements demonstrated progress in the children's imaginations and abilities to formulate creative products. Educative specialists including teachers and therapists reinforced and encouraged the children's improvement; it was through these counselors that the autistic children were able to find regulation and a source of communication. The children were able to expand upon their creative-thinking skills as well as enhance communication skills through the outlet of sandplay. The educators supported this improvement by participating in two-way engagement and making emotional connections to the children's experiences. Lu, Petersen, Lacroix, and Roussea state that, "according to developmental theories of play (Greenspan & Weider, 2006; Wolfberg, 1996), a child's ability to engage in higher levels of spontaneous communication, socialization, and symbolic elaboration is based on shared attention and sustaining two-way pre-symbolic communication" (63). The sandplay approach proved to be a medium that was highly effective and influential upon the creativity and imagination of the ASD students. Through the encouragement of the therapists, the children were able to expand their horizons and build upon

their creations.

Two other groups of researchers discovered that the use of toy robots was successful in creative stimulation within autistic children. In these two separately conducted studies, the children were placed in the presence of a toy robot that acted based on the child's actions, measuring things such as eye contact, movement toward or away from the robot, as well as posture, and touch (Giannopulu and Pradel, 309). In Giannopulu and Pradel's experiment, they concluded that, "autistic children used a variety of behavior when playing with the robot in free game play" (309). They also state that, "free, spontaneous game play with robots is possible with autistic children and could better facilitate the transfer of social and learnt abilities to real life" (Giannopulu and Pradel, 309). Through the interaction with the robot, the autistic children showed enhanced attention and response. In acting toward the robot, the children opened their senses and displayed ideas through interaction. Props such as robots have the ability to stimulate a child's mind and encourage him/her to display creative ideas and imagination, just as the educators and parents did within the sandplay experiment. Not only did the robot experiments stimulate the autistic children's minds, but they demonstrated that robot interaction could lead to enhanced social and real life abilities. In a very similar study in which high-functioning autistic children participated in a robotics class, researcher, Joshua Wainer and three other researchers state, "many of the children's parents reported that attending the class helped or would help their children in social situations" (454). The creative stimulation within an autistic child can be the key to opening up and enhancing senses and a variety of abilities in these children that can ultimately improve their condition.

Another approach demonstrated enhancements in ASD creativity is art therapy. Pamela Ullmann, an art therapist who has worked with children with medical and special needs states that, "art making can be a particularly effective therapy for people with autism. Because they tend to have difficulty processing sensory input and are often non-verbal, autistics respond well to visual, concrete, hands-on therapies" (18). This

hands-on approach conducted through art therapy was also illustrated in the sandplay and robot experiments. This demonstrates that autistic children tend to have greater creative progression under a more physical, hands-on method rather than a verbal approach, as autistic individuals are known to have many difficulties with verbal skills. Ullmann explains how art therapy can contribute to enhanced communication skills as well as social skills, individuality, relationships, and sensory integration in autistic children. She explains that communication for an autistic child does not just mean language. Communication for autistic children is, as Ullmann writes, "the expressive aspects of art therapy thus help autistic children communicate by providing an additional method for interpersonal interaction" (18). Communication is typically uncommon in autistic individuals. Through art therapy, communication and social skills can be enhanced in ASD children, therefore increasing creative and imaginative production – just as they were in the sandplay experiment. When autistic children can communicate their ideas more easily, they are then in turn able to communicate their creative ideas more easily.

People may disagree with this view, stating that the autistic child is not creatively progressing through therapy and is instead, being forced to act and perform in a certain way by parents or teachers. However, a number of studies state that the autistic child retains her progression over a period of time with mild encouragement and better displays creative imagination over time without the constant and excessive aid of parents or educators. With the aid of therapists and educators, the autistic children were able to reach their place of "flow". Hungarian psychology professor, Mihaly Csikzentmihalyi, describes his concept of flow as an "optimal experience" that "calls the sensations and feelings that come when an individual is actively engaged in an intense favorite pursuit" (Kaufman, 36). With a positive environment of therapists and educators, the autistic child experienced optimal creative flow in the sandplay study. Because autistic children are fairly unaware and unfazed by those around them, the children's experience of flow could be observed and tested by bystanders that look for things such as eye contact and how much

attention the children pay to the task. Similarly to Csikzentmihalyi's theory, in their Four C Model, Kaufman and creativity teacher, Ronald Beghetto, explain, "in mini-c…an idea or product doesn't need to be new and original, necessarily, just new and original to the subject at the time" (Kaufman, 46). They also explain that mini-c is something that can be encouraged and enhanced through parents, teachers, and mentors, which ultimately leads to greater creativity (Kaufman, 26). When the autistic students were encouraged to enhance "mini-c" by their environment, they were able to get into their state of flow by spending an extended amount of time engaged in therapy and therefore were better able to display creative and imaginative ideas. The implementation of these different types of therapies in autistic children have illustrated over a number of studies to be effective in not only enhancing creative and imaginative production in autistics, but leading to enhanced social and other real-life abilities that autistic individuals usually lack.

Savant Syndrome

Savant Syndrome is a unique and intriguing form of the autism spectrum disorder. The Encyclopedia of Children's Health defines savant syndrome as a condition that "occurs when a person with below normal intelligence displays a special talent or ability in a specific area" (Savant Syndrome, Encyclopedia of Children's Health). Autistic Savant Syndrome is the most common type of savant syndrome. Savants have shown to have this special talent within the specific area of creativity. Studying savants extensively, researchers discovered that differences in the make-up of the brain in autistic savants allow them to have this special talent or ability. There have even been many accounts of savants displaying greater creativity and imagination than a non-autistic individual. Biologically, an autistic savant's brain differs from the brain of a non-autistic person. A study conducted on a savant college professor of animal science at Colorado State University displayed these differences (Damien, n.p). Damien reports that, "scans showed professor Gandin's brain is significantly larger than that of three matched neurotypical control subjects – something seen in some children with

autism but which scientists do not yet understand" (Damien, n.p). Although it is still not completely understood why the professor's brain was significantly larger than the control brains, the findings illustrate that brain size is an important factor in the realm of autism studies. Perhaps the extra brain tissue develops larger or more functional areas for creativity within the savant's brain. Researchers still have yet to make such a discovery. Another medical finding in the study explained the construction of the professor's brain and how it compares to an average brain:

> The researchers also traced white-matter connections in Professor Grandin's brain using diffusion tensor imaging, finding what they dubbed 'enhanced' connections in the left precuneus, a region involved with episodic memory, visuospatial processing, reflections upon self, and aspects of consciousness…She also had enhanced white matter in the left inferior fronto-occipital fasciculus. This region connects the frontal and occipital lobes, which might explain the professor's keen visual acuity, the researchers said (Damien n.p).

This study discovered that the brain of this particular savant had enhanced connections that the average brain does not possess. Professor Grandin's brain also contains enhanced white matter that causes her keen visual acuity. Medically, the differences between a savant and non-savant autistic or a savant and a non-autistic can be drawn through medical tests and examinations.

How a savant's brain functions can be studied from childhood on to understand how these individuals perform creatively and imaginatively. In "Creativity in Savant Artists with Autism," Linda Pring and three other researchers explore savant children who were profoundly artistic. One child they observed was a young girl, Nadia, who was diagnosed with autism at the age of six. Despite having poor language and comprehension skills, Nadia displayed the characteristics of an autistic savant through her profound ability to draw, never making mistakes and drawing images solely from memory. They write, "she

also displayed the use of complex graphic strategies…which are not usually apparent in artistic output until much later in life, all without formal artistic training" (Pring et al., 46). Nadia is just one out of many children who have this type of gift. Even as an autistic young girl, at the age of three and a half she was creatively advanced, probably far beyond those her age. Her heightened memory also enabled her to never make mistakes when drawing, something most average non-autistic adults can't do. Laurent Mottron explains how an autistic savant can learn something new more quickly than typical students, such as how visual tones are more easily picked up by savants than by average students. He writes, "In addition, the initial choice of domain of so-called restricted interest demonstrates the versatility of the autistic brain, in the sense that it represents spontaneous orientation towards, and mastering of, a new domain without external prompts or instruction" (1388). Mottron describes the autistic brain as "versatile" and being capable of learning new things without the aid of external prompts or instruction. Through Nadia's art example, it's clear that one of these domains that Mottron discusses could be the domain of creativity. Nadia is able to draw perfectly and produce creative work without any formal artistic training, something that she is capable of doing since she is a savant. Some readers may disagree with my view that autistic children can be more creative than an average-developing child since many believe that autistic children aren't even creative at all. Indeed, that is understandable because my own argument seems to ignore that the majority of children with autism are not more creatively enhanced than a non-autistic child. However, savants demonstrate that there is always a possibility that an individual with autism can be more creative than the norm. In the realm of Savant Syndrome, the creative person is the center of attention when evaluating creativity. In J.S. Renzulli's creative-production type of giftedness, he calls for a three ring conception of giftedness consisting of high intellectual ability, creativity, and task commitment (Kaufman, 44). It's quite clear that savants, including Professor Grandin and Nadia, possess these three characteristics of creative giftedness that drive their

special gift of creativity.. Savants are also known to be quite committed to the task on hand and aim to complete it, even when a struggle is present. It is because of certain enhanced portions of a savant's brain that autistic savants are able to display creative capabilities that frequently surpass the creative and imaginative abilities within non-autistic individuals and provide insight to a region of autism that is unlike any other in the autism spectrum.

Testing for Creativity

How to test the creativity of individuals is a difficult subject for people to agree upon. Because creativity is so subjective, it becomes difficult to evaluate and perhaps put a "number" or a "score" on. Because of this, testing the creativity of an individual with autism can be a daunting task. However, studies demonstrate that regardless of the different approaches researchers take in measuring the creativity of autistics, the results tend to compare significantly in an overall evaluation. As Craig and Baron-Cohen explain, "although aspects of the imagination and deficit in autism have been investigated…there have been almost no experimental studies of creativity in autism" (319). The lack of these types of studies results in researchers utilizing many similar testing strategies in measuring the creativity of autistic children. In "Creativity and Imagination is Autism and Asperger Syndrome," James Craig and Simon Baron-Cohen explain the types of approaches they employed in discovering the creativity of autistic children, as well as Asperger Syndrome children, MLD children, and normally developing children. In their study, Craig and Baron-Cohen referred to the "Torrance Tests of Creative Thinking (Torrance, 1974)" (320). They state, "the Torrance tests represent, "one of the most popular and frequently used procedures for assessing creative thinking" (Rosenthal, DeMers, Sidwell, Graybeal, & Zins, 1983)" (320). In Craig and Baron-Cohen's study, they used three different experiments to evaluate the creativity of autistic children. In the first experiment, they applied figure completion that "utilized two conditions from the Torrance Tests of Creative Thinking" (Craig and Baron-Cohen, 320). Condition one involved all stimuli

remaining constant with different responses required for each. Condition two involved different stimuli as well as different responses for each. (Craig and Baron-Cohen, 320). In condition one, the children had to complete pictures with straight lines and in condition two they were to complete pictures with squiggle lines.

In a study conducted by Michelle A. Turner, a very similar approach was taken in measuring creativity. In her "Design Fluency Task," the autistic children were given a "free" condition and a "fixed condition" (Turner, 192). Almost identical to condition one of Craig and Baron-Cohen's study, Turner explains, "in the fixed condition, subjects were given 4 minutes in which to produce as many different designs as they could that were comprised of exactly four distinct lines" (192). Both studies utilized distinct lines as a fixed stimulus in the creative tasks. Also, similar to condition two of the Craig and Baron-Cohen study, Turner writes, "in the free condition, subjects were given 5 minutes to produce as many different designs as they could" (192). Both condition two and Turner's "free" condition gave the children more leeway and freedom in illustrating their creative abilities. The use of objects also proved to be an effective approach in both studies. Craig and Baron-Cohen explain that in their experiment, "participants were handed a toy elephant and the experimenter said, "I want you to tell me lots of ways to make this elephant more fun to play with. What could you change about it to make it different? What could it do?"(320). Likewise, Turner used a similar approach as follows, "How could we use a newspaper? Tell me something useful that we could do with it" (192). Later on they were then asked to think of as many uses as they could for six other objects (Turner, 192). These approaches proved to be effective ways of measuring the creativity of autistic children. The results of these experiments illustrated that the individuals with autism performed very similarly in both cases.

Some may object to these types of creativity tests. They may say that creativity is far too subjective of a topic to measure or test, especially in autistic individuals. Nevertheless, the consistency of results across a number of studies and experiments indicates that these

types of testing and measuring strategies for creativity in autistics can be deemed accurate and reliable. The different experiments done by the researchers show characteristics of Sternberg's Propulsion Theory that focuses on creative products (Kaufman, 26). Kaufman writes, "this theory describes eight different ways that someone can make a creative contribution and categorize these contributions based on their relationship to the domain" (26). The experiments involving the creation of creative pictures from straight and squiggle lines are a form of forward incrementation. Kaufman explains that "this type of contribution pushes forward the domain just a little. Maybe the creator-makes a slight change in what already exists" (27). With the lines or squiggles given to them, the children made additions to them, slightly changing or altering what was presented. Another aspect of the Propulsion Theory, redirection, displayed itself in the experiments with the toy elephant and the newspaper. As Kaufman states, "redirection represents an attempt to redirect the domain to head in a new direction" (28). In both the studies with the newspaper and elephant, the children were asked to redirect the use of the objects. The results of Craig and Baron-Cohen's as well as Turner's experiments were used to measure the creativity of autistic children compared to that of other children. As tests and studies such as these are commonly used to evaluate creativity particularly in autistic individuals, there are many other approaches that can be examined and executed by researchers to study autistic creativity.

Study Results

Although a number of conducted studies and experiments have shown the creative giftedness an autistic child can possess, many others have defined the opposite. While autistic children have demonstrated that they have the capacity to be creative and imaginative, many young autistics are simply not at the same level of creativeness as their peers. The studies performed by Craig, Baron-Cohen, and Turner give insight to the imaginative deficit of autistic children. In the experiments discussed earlier, the ASD children tended to perform at a severely lower level than the other children involved. Craig and Baron-Cohen illustrate this deficit

with an example of a study done by Frith in 1972. Frith discovered that autistic children were unable to come up with varied patterns of xylophone notes or colored rubber stamps (Craig and Baron-Cohen, 319). Lewis and Boucher (1991) had similar results when evaluating the drawings of autistic children. Both studies illustrated that there was indeed a lack of creativity within autistic children (Craig and Baron-Cohen, 319). In a discussion of their "Imaginative Fluency" experiment, Craig and Baron-Cohen concluded that the autistic children produced very few responses. They state, "when the types of responses made were examined, significantly fewer of the children with autism or AS produced any animate responses at all" (Craig and Baron-Cohen, 325). They also add, "these results suggest reduced overall fluency as well as reduced imaginative fluency in autism and AS" (Craig and Baron-Cohen, 325). Turner had similar findings when reviewing a study conducted by Boucher. In Boucher's 1998 study, autistic children participated in a word fluency experiment. They were asked to think of as many possible words as they could in sixty seconds (Turner, 191). Turner explains, "the children with autism performed very poorly on this task, generating significantly fewer words than the age and ability matched control subjects" (191). In her own word fluency experiment, Turner found strikingly similar results to the Boucher study. In her study, Turner had four groups of subjects: high-functioning autistics (HFA group), high-functioning control subjects (HFC group), mentally disabled individuals with autism (LDA), and learning disabled control subjects (LDC) (191). The subjects were asked to perform a series of tasks including producing as many words with the same letter as they could (191), thinking of different ways to use a newspaper (192), and constructing different designs from a set of given lines (192). Turner found that overall, individuals with autism performed rather poorly on all tasks. In her word fluency experiment, Turner found, what she describes as, "clear evidence of reduced fluency in the autistic, relative to the control groups at both levels of ability" (197). She also discovered through the objects task that the autistic group produced significantly lower numbers of responses

as well as a small proportion of imaginative responses (Turner, 198). Turner states, "in particular, the performance of the high-functioning autistic group was remarkably poor, being almost indistinguishable from the LDS group, and significantly more impaired than the LDC group" (198). In the last task of the experiment, the Design Fluency Task, the autistic children were found to have produced high rates of repetitive, inappropriate responses, stemming from an impaired capacity to produce imaginative and creative responses (Turner, 198). Through their own studies as well as others Craig, Baron-Cohen, and Turner found remarkable and credible evidence of the creative and imaginative deficits in autistic children. In studies and experiments such as these, the product created by an individual is what is evaluated for creativity. Csikszentmihalyi's Systems Model looks at the creative product through the interaction of the domain, field, and person (Kaufman, 24). Kaufman also explains that, "the success of such a creative product will likely depend on the interaction between the field (the gatekeepers) and the person. If a person creates a product that is uninteresting or offensive, the field will be unlikely to appreciate the product" (24). In this case, the researchers (field) did find the autistic children's products to be uncreative and not up to par. The results of studies like Craig, Baron-Cohen, and Turner's give truer insight to the deficits of autistic children and the areas in which they lack creativity. Compared to other studies such as the sandplay experiment, these studies show that without the help or aid of others, autistic individuals tend to have difficulties on all of the presented tasks. Individuals such as the ones that participated in these experiments define the lack of creativity and imagination that most people believe autistics possess.

Conclusion

As autism and creativity are not something that typically go hand-in-hand, it is a topic of interest that more researchers are beginning to look into. The general assumption that people make is that autistic individuals do not have the capability or tools for creative or imaginative production. Through the evaluation of creativity in autism, research

shows that the creative and imaginative capabilities in children with autism are present, but not commonly displayed, needing encouragement and prompting. In the experiments conducted by Craig, Baron-Cohen, and Turner, the children showed large creative deficits and were pronounced uncreative. However, different therapies as well as hands-on aid, proved to be an effective way in having autistic children display their creative and imaginative ideas. Not only did the sandplay, art therapy, and robot interaction help in the children displaying their creativity, but the therapies also opened up avenues of creative enhancement. Through the help of others, autistic children showed enhanced creativity and imaginative ideas that they could not display in the studies done by Craig, Baron-Cohen, and Turner. Savant autistic children, on the other hand, do not require this type of aid or therapy to display their creative productions. Savants' brains differ from other individuals with autism, which gives them the gift, in this case, of creativity. Therefore, the line between high-functioning autism and savant autism is wide in the context of creativity. While savants display creativity, even beyond that of a non-autistic individual, high-functioning autistic children showed little to no creativity in studies and experiments. The creative theories of Sternberg, Csikszentmihalyi, Renzulli, Kaufman, and Beghetto prove to fit the concept of creativity in autistic children.. The results and findings of these studies are extremely important in the improvement of creativity in autistic children. Through different experiments and close attention, researchers can discover how to progress autistic children not only in the creative realm, but in all aspects of autistic life.

Appendix

Figure 1: Photos of three childrens' sandplay activities during week 1 (left) and week 10 (right)

Works Cited

Autism Speaks. "As CDC Issues New Autism Prevalence Report, Autism Speaks Asks, "What Will It Take?" for Government to Meet the Challenge of this National Health Crisis." Autism Speaks Inc., 18 December 2009. Web. 5 November 2012. http://www.autismspeaks.org/about-us/press-releases/cdc-issues-new-autism-prevalence-report-autism-speaks-asks-what-will-it-take

"Autism." PubMed Health. A.D.A.M, 16 May 2012. Web. 3 November 2012. www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002494/

Craig, J., and S. Baron-Cohen. "Creativity and Imagination in Autism and Asperger Syndrome." *Journal of Autism & Developmental Disorders* 29.4 (1999): 319-. Print.

Gayle, Damien. "The Brain Map that Shows the Differences in the Brains of Autistic People can Explain their Difficulties – and also Shed Light on their Unique Talents." *Mail Online*, sec. Science: 16 October 2012. Print.

Giannopulu, Irini, and Gilbert Pradel. "Multimodal Interactions in Free Game Play of Children with Autism and a Mobil Toy Robot." *NeuroRehabilitation* 27.4 (2010): 305-11. Print.

Kaufman, James C. "Modern Theories of Creativity." *Creativity 101.* New York: Springer, 2009.

Lu, Lucy, et al. "Stimulating Creative Play in Children with Autism through Sandplay." *The Arts in Psychotherapy* 37.1 (2010): 56-64. Print.

Mottron, Laurent. "Enhanced Perception in Savant Syndrome: Patterns, Structure and Creativity." *Philosophical Transactions of the Royal Society B: Biological Sciences* 364.1522 (2009): 1385-91. Print.

Pring, Linda, N. Ryder, L. Crane, B. Hermelin. "Creativity in Savant Artists with Autism." *Autism: The International Journal of Research & Practice* 16.1 (2012): 45-57. Print.

"Savant Syndrome." *Encyclopedia of Children's Health.* 2012. Web. 4 November 2012.

Turner, Michelle A. "Generating Novel Ideas" Fluency Performance in High Functioning and Learning Disabled Individuals with Autism." *Journal of Child Psychology & Allied Disciplines* 40.2 (1999): 189. Print.

Ullmann, Pamela. "Art Therapy and Children with Autism: Gaining Access to Their World through Creativity." *FUSION* April 2011. 3 November 2012 www.arttherapy.org/autismtoolkit/Ullmann.pdf

Wainer, Joshua, et al. "The Effectiveness of using a Robotics Class to Foster Collaboration among Groups of Children with Autism in an Exploratory Study." *Personal & Ubiquitous Computing* 14.5 (2010): 445-55. Print.