5-2020

Effect of Spatial Surround and Sound on Individuals

Taylor Noem

Effect of Spatial Surround and Sound on Individuals

A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Science in Psychology Department from
The College of William and Mary

by

Taylor N. Noem

Accepted for _____Honors_____
(Honors, High Honors, Highest Honors)

___Jennifer___Stevens_____
Jennifer A. Stevens, Director

____Chris Ball _____
Chris Ball

___Evie N. Burnet_____
Evie Burnet

Williamsburg, VA
May 5, 2020

Effect of Spatial Surround and Sound on Individuals

Taylor N. Noem

College of William & Mary

Author Note

I would like to thank the Charles Center for offering me a grant to conduct my research over the summer. Next, I would like to thank Riley Smith for her help with conducting the first experiment in this present study. Finally, I would also like to thank my committee for helping and supporting me through this project.

Table of Contents

Abstract

The purpose of this study was to evaluate methods to reduce stress for individuals on the Autism Spectrum (AS) using space and sound. There were two experiments comparing individuals across a range of scores on the spectrum, evaluated using the Autism Spectrum Quotient (ASQ): the first experiment compared the length of stay in a small space versus a large space, and the second experiment compared the length of stay in a small space versus wearing a weighted blanket. In each condition, participants listened to three sounds: rain, fire, and white noise. We predicted that individuals with higher ASQ scores would stay in the small space longer in the first experiment and would wear the weighted blanket longer in the second experiment. While some trends appeared in the data for both experiments, the results are relatively inconclusive.

Keywords: Autism Spectrum, space, weighted blanket

Effect of Spatial Surround and Sound on Individuals

The purpose of this present study was to examine stress and stress reduction for people on the Autism Spectrum Disorder (ASD) in everyday environments. ASD individuals often find school and work environments to be overwhelming due to their senses being over responsive. For an ASD person, having too much noise in one place or standing too close to someone can make it hard for them to focus and feel comfortable. There have been previous research findings regarding ASD individuals using weighted blankets to help reduce stress that have shown positive results (Mullen, Champagne, Krishnamurty, Dickson, and Gao, 2008).There have also been studies researching the preferred amount of interpersonal space for ASD individuals, but the results have been inconclusive (Miron, 2008). However, there has been a lack of studies that compare to the two against one another. This present study aims to compare the difference of effects between enclosed spaces and a weighted blanket.

Autism Spectrum Disorder

An individual on the Autism Spectrum Disorder (ASD) can be described as someone within an array of diagnoses that can include Autism, Asperger's Disorder, and Pervasive Developmental Disorder (Beuker, Schjølberg, Kveim Lie, Donders, Lappenschaar, Swinkels, & Buitelaar, 2013). A diagnosis of any of these disorders also means the individual has a developmental disability. The search for a cause is partly inconclusive, but a few risk factors have been found. According to the Center for Disease Control ("What is Autism Spectrum Disorder," 2020) a person's genes can be a key risk factor for developing ASD, and children who have siblings with ASD are also at a higher risk for landing on the spectrum. The CDC also states that taking prescription drugs such as valproic acid and thalidomide during pregnancy may

increase the risk of developing ASD, along with having the chromosomal condition fragile X or tuberous sclerosis ("What is Autism Spectrum Disorder," 2020). There tends to be a higher prevalence of males being on the ASD with 1 in 37 boys diagnosed while 1 in 151 girls are diagnosed (Autism Speaks, "Autism Statistics and Facts"). It is important to note that Autism is a spectrum disorder, which presumes that each individual's signs will vary and typically appear before the age of two (NIH, "Autism Spectrum Disorder").

Diagnosis of ASD is based on the presentation of common signs that correlate with the spectrum (NIH, "Autism Spectrum Disorder"). Generally, children have regular check ups to see if they have developmental delays at nine, eighteen, twenty-four, and thirty months. If developmental delays such as cognitive, language, and age-appropriate skill delays or behavioral issues are evident at these check ups, a doctor may begin to wonder about a diagnosis and have the child referred for a second stage of evaluation. Second stage evaluations include examining cognitive skills, language abilities, or age-appropriate skills; assessment is often completed by a child psychologist or neuropsychologist.

Adolescents or young adults who have been diagnosed typically demonstrate difficulty with: back and forth social interaction, maintaining eye contact in conversation, and repetitive behaviors (NIH, "Autism Spectrum Disorder"). Additionally, the CDC reports other signs including having trouble relating to others and their interests, understanding other people's feelings, and expressing specific words or emotions ("What is Autism Spectrum Disorder", 2020). Because of these outward, social interactive signs, family or peers are often the first to notice that an individual has these challenges with social interactions (NIH, "Autism Spectrum Disorder").

Sensory over-responsivity in ASD individuals

While it is common for most individuals to experience certain levels of anxiety or stress, individuals with ASD typically experience elevated levels (Amos, Byrne, Chouinard, & Godber, 2018). It is commonly thought that social interaction can play a large part in creating stress for individuals with ASD, but sensory over-responsivity (SOR) is another significant source for heightened stress. SOR is a disruption in processing within any of the five senses due to a hypersensitivity to the stimuli (Amos, Byrne, Chouinard, & Godber, 2018). One study examined competing models of anxiety and stress in order to determine if SOR created anxiety or if anxiety leads to SOR (Amos, Byrne, Chouinard, & Godber, 2018). The results supported a one-way effect, with SOR causing an increase in anxiety in ASD individuals, while anxiety itself was not found to result in the development of SOR. This means that the anxiety experienced by ASD individuals is not causing the sensory overload issue; it is an issue that arises when the environment is too difficult to process. This effect serves as a primary background study for the second experiment, designed to examine methods to reduce stress for an individual with ASD while they are in stressful situations, including social and environmental.

There are a number of physiological markers for stress. One of the most common measures is heart rate. When someone is stressed, their sympathetic nervous system is activated, causing their heart and respiration rate to increase, an associated increase in body temperature, and individuals may become hyperaware (AHA, “Stress Heart and Health”). Not only does heart rate and skin conductance measure stress levels, cortisol can also help indicate the amount of stress a person is experiencing. Researchers Blythe, Mendoza, Abdullah, and Wegelin (2006) conducted a study measuring cortisol levels in children with Autism before and after putting them into a mock MRI scanner. A mock scanner is a closed in surrounding that

often includes loud banging noises. Cortisol levels were measured in both ASD and neurotypical participants, but only the ASD participants displayed increased cortisol levels. It is likely that the mock scanner provided a sensory overload for the ASD individuals. These results are significant because they help to identify the role that environment can play in the stress response in ASD, often the result of what is termed sensory over-responsivity (SOR).

The effect of interpersonal space on ASD individuals

Several studies have researched the distance with which ASD individuals find to be the most appropriate between them and another person. However, throughout these findings, there does not seem to be a conclusive theory. There are studies such as Miron's (2008) where she measured the comfort level of high-functioning individuals with ASD by two processes. The first process was by calculating the distance between the participant and an interviewer. The second process included having the participants indicate on photographs what they would have considered to be a comfortable amount of space between two people. Miron's results were inconclusive because of the fact that each participant had a high variability due to each person's own comfort level; there was not the same baseline for each participant. The only conclusion she came to was that each level of interpersonal distance preference varies between each ASD individual and cannot be generalized to a group of people.

On the other hand, Candini, Giuberti, Manattini, Grittani, di Pellegrino, and Frassinetti (2016) also examined the amount of interpersonal distance designated as comfortable for individuals on the spectrum. They compared typically developing, low spectrum ASD and high spectrum ASD individuals in a task that measured space between individuals. Participants that were highest on the spectrum preferred the largest amount of space between them and an adult

they did not know, and the typically developing participants preferred the lowest amount of distance between them and an adult. These findings suggest that the normal parameters of personal space for neurotypical individuals are different for ASD individuals, which can could stress for an ASD individual if a neurotypical individual were to get too close. Compared to Miron's (2008) study, Candini and colleagues (2016) study has more variety in their participants with them being on different levels of the spectrum. Candini and colleagues (2016) study supports the theory that autistic individuals higher on the spectrum prefer a larger amount of interpersonal distance.

The effect of a weighted blanket on ASD individuals

One tool that has shown positive results with reducing stress in neurotypical and autistic individuals is a weighted blanket. Since SOR can result in a stress response in autistic individuals, a sensory-based intervention may be useful in trying to reduce SOR. A weighted blanket is believed to help calm one's senses by reducing the individual's heart rate due to the pressure of the blanket on their body. By reducing the heart rate, a person's parasympathetic nervous system is activated, allowing the body to rest and become more grounded, allowing the individual to only focus on one thing ("More than Just a Fad…", 2019).

Use of a weighted blanket to apply pressure to the body falls under a form of therapy called deep pressure stimulation (DPS), and, some studies have shown that individuals with Autism actually prefer this form of therapy (Edelson, Edelson, Kerr, & Grandin, 1998). DPS is often applied by using the sense of touch and applying pressure to a person's body through holding, swaddling, or a feeling similar to a hug (Mullen, Champagne, Krishnamurty, Dickson, and Gao, 2008). A pilot study conducted in 1998 by Edelson, Edelson, Kerr, and Grandin

researched how effective DPS is by using an instrument named Grandin's hug machine. The machine was a device that was made to apply pressure to the individual inside of the cylinder-shaped machine after a lever was pulled. The participants were individuals diagnosed with Autism and had moderate levels of anxiety, and a control group that did not receive the pressure from Grandin's hug machine. The results were promising for the pilot study and demonstrated a significant decrease in the experimental participant's tension and general anxiety. Moreover, the researchers also found that the machine was more effective for persons with an over aroused sensory system, or sensory over-responsivity. This suggests that the machine would only be needed for individuals who already have a high level of anxiety due to stimuli from their environment, which happens to be individuals on the ASD.

In the present study, a weighted blanket was chosen because it offers an accessible and economical way to examine the effects found with the hug machine technology. Moreover, Mullen and colleagues (2008) reported that a weighted blanket is effective in reducing anxiety in individuals. In their study, a 30-pound weighted blanket was given to adult participants to use for five minutes, similar to Grandin's hug machine. The researchers then measured the participant's blood pressure, pulse rate, pulse oximetry, and the effectiveness by electrodermal activity to see if they would decline with the use of the weighted blanket. Overall, the results of Mullen et al.'s (2008) study concluded that using the weighted blanket was safe and effective and that 63% of the participants rated having lower anxiety after using the blanket.

Overview of experimental studies

It is important to note that when beginning this study, there were a few challenges that changed the route of the work. Before the start of collecting data in the fall semester, there were

a set of questions that were supposed to be put in the Introductory Psychology course mass testing to help identify which participants to invite to the study. These specific questions were not put in the original mass testing until later in the semester. Because of this oversight, data collecting was delayed and participants were asked to take the Autism Spectrum Quotient (ASQ) (see Appendix A) questionnaire before performing the first experiment. Furthermore, due to the status of campus and all classes being moved online in the middle of the spring semester, data collection for the second experiment was abruptly suspended. This resulted in an uneven number of ASD participants and neurotypical participants. Because of this, the study moved to analyze the ASQ results as a correlation to length of stay and a predictive variability by using new criteria for grouping low and high ASQ individuals.

Experiment 1

There have been inconclusive findings on the topic of interpersonal space and ASD individuals. Some results support that ASD individuals want a large amount of space between them and others, giving the ASD individuals their own space. Other results support the theory that ASD individuals do not know an appropriate amount of interpersonal space and can be too close to others. The purpose of this experiment is to see if ASD individuals prefer to stay in a smaller, more confined space longer than a larger, more open one. We hypothesized that participants who scored higher on the ASQ would stay in the smaller space longer because there would not be room for any object or person to get close to them, which leads to them feeling more comfortable in their own space.

Method

Participants

There were 36 participants in this study recruited from the Introduction to Psychology courses (PSYC 201 and 202). Participants earned courses credit for their participation. In order to recruit individuals on the Autism Spectrum, students who yielded a score of 15 or higher on the ASQ on the mass testing survey were sent an email invitation to sign up for the study through William & Mary's SONA system. The range of scores was eight to thirty-six across all participants.

Apparatus

The experiment took place in the CogNeuro Lab in the Integrated Science Center, room 1162. The CogNeuro Lab contains the makeshift room, computer, and wireless headphones, to perform the experiment. The makeshift room (see *Figures 1 and 2*) was made out of wood and rolled on wheels to make a 2'x2' small space and expanded to make a 6'x6' large space. Researchers used the computer's audio connected to the wireless headphones that participants wore to play the three sounds, white noise, a crackling fire, and rain falling, found from the website https://mynoise.net. The headphones were cleaned after every participant who used them.

Procedure

Before beginning the experiment, participants signed the consent form and were asked to fill out a claustrophobia questionnaire (CLQ) (see Appendix B) because the experiment required participants to be put in an enclosed space that could potentially create anxiety. After researchers reviewed the participant's CLQ score to ensure the majority of answers were in the low to zero

range, the experimental method was explained to them. Participants were then given the option to deny participation while still obtaining course credit. All participants felt comfortable performing the experiment and completed it without incident. After filling out the CLQ, participants used the computer to fill out the ASQ survey online and were told not to press the button that gives them their score. Researchers checked participant's ASQ scores after they entered the small or large space.

Eighteen participants were randomly assigned to stay in the small space, and another eighteen were randomly assigned to the large space. Participants were asked to stand with their eyes open in their assigned space for as long as they felt comfortable while wearing the wireless headphones for three trials. Participants were told that they could leave the room whenever they wanted by saying, "I want to leave the room." Before entering either space, participants were asked to place the headphones over their ears to make sure they could hear the sound and were told to adjust the volume if needed. Participants were asked to listen to three different sound conditions in both spaces, and each participant listened to the three sounds in a random order. The sounds were not of primary interest to the study but provided an added variable for analysis. There was no explicit hypothesis associated with the sounds, for they were used to provide the participants with unique experiences across the different trials. Participants indicated their desire to move onto the next trial by knocking on the wall. In situations when participants reached the maximum time of six minutes, the experimenter indicated that the trial was over and moved onto the next trial or let the participant out if it was the last trial.

Researchers recorded how long each participant stayed in the small or large space for each sound trial with a stopwatch application on their iPhone. Participants were not informed on how long they stayed in the space or that the maximum amount of time they could stay in either

space was six minutes. After the participants completed the three sound trials, they were debriefed on the purpose of the experiment, given credit, and released.

Results

Participants were considered low if they scored a 19 or below on the ASQ; individuals scoring 20 or above were grouped as high. Analysis was completed to examine the effect of this grouping variable on length of stay in the small and large spaces. We ran a multivariate ANOVA test to if the hypothesis that higher scoring ASQ participants would stay in the small space longer than the large space. The results demonstrated that higher scoring ASQ participants stayed in the small space longer (M=314.00 seconds, SD=91.57) as compared to the large space (M=293.43 seconds, SD=102.94). Lower scoring ASQ participants did not stay in the small space much longer (M=240.99 seconds, SD=132.42) than the large space (M=244.87 seconds, SD=101.44). However, there was not a significant difference between the time in the two spaces, $F(1,35) = 0.05$, $p > .05$, and there was not a significant difference between the higher and lower ASQ groups, $F(1,35) = 2.83$, $p > .05$.

The interaction between size of space and ASQ group was also not significant, even though there appears to be a preference for the smaller space in terms of length of stay for high ASQ individuals, $F(1,35) = 0.11$, $p > .05$. Higher scoring ASQ participants stayed in both spaces longer than lower scoring ASQ participants. The average length of stay for higher scoring ASQ participants for both spaces was 305.53 seconds (SD=93.80), and the average length of stay for lower scoring ASQ participants was 243.24 seconds (SD=111.99). As a second level analysis, we ran a Pearson's correlation to determine if there was a relationship between the participant's

ASQ scores and their length of stay overall. The results showed that there was not a significant correlation ($p > .05$) but seems to be approaching one as shown in *Figure 3*.

Lastly, we checked for any effect of sound and did not find a significant main or interaction effect between the spaces and participants ($p > .05$). Even though there was not a significant effect, we did notice a trend between the three sounds and both spaces. Participants (N=18) listened to the rain sound the longest (M=282.43 seconds, SD=111.03), fire the next longest (M=271.67 seconds, SD=112.54), and white noise the shortest (M=263.86 seconds, SD=117.83).

Discussion

There might not have been statistically significant results, but the hypotheses were still supported with the means that were found. Higher scoring ASQ participants stayed in both spaces, small and large, longer than lower scoring ASQ participants. In addition, there was not a significant effect between the sounds, the results still showed a preference for the rain sound. With these findings, it can be inferred that people who score high on the ASQ prefer to be in enclosed spaces and find it comforting. After being debriefed on the purpose of the experiment, several participants claimed that they felt more relaxed being in the space and listening to the sounds. With these implications, we decided to compare the small space to another item that has been shown to reduce stress in ASD individuals.

Experiment 2

There have been several studies that support the use of weighted blankets for ASD individuals because it helps reduce their stress and SOR (Edelson et al.,1998; Mullen et al.,

2008). Using the results from the first experiment, we wanted to see which condition participants favored more: the small space or sitting with a weighted blanket. We hypothesized that participants who scored higher on the ASQ would stay seated with the weighted blanket longer than standing in the small space. The same sound conditions were used as in the first experiment.

Method

Participants

There were 18 participants in this current study who were recruited from an Introduction to Psychology class (PSYC 201 and 202). Participants earned courses credit for their participation. In order to recruit individuals on the Autism Spectrum, students who yielded a score of 15 or higher on the ASQ questions of the mass testing were sent an email invitation to sign up for the study through William & Mary's SONA system. The range of scores was nine to thirty-four across all participants.

Apparatus

The second experiment took place in the same CogNeuro lab as the first experiment. The second experiment used the same makeshift room, computer, and wireless headphones as the first experiment. A weighted blanket (see *Figure 4*) was the only new material introduced to perform this experiment. The weighted blanket was 60''x 80'' and weighed 25 pounds. Researchers used the same computer with the audio connected to the wireless headphones that participants wore to play the same three sounds from the first experiments. The headphones were cleaned after every participant who used them. Researchers used a stopwatch application on their iPhone to record the participant's length of stay in both conditions.

Procedure

Before beginning the experiment, participants signed the consent form and were asked to fill out a CLQ because the experiment required participants to be put in an enclosed space that could potentially create anxiety. After researchers reviewed the participant's CLQ score to ensure the majority of answers were in the low to zero range, the experimental method was explained to them. Participants were then given the option to deny participation while still obtaining course credit. All participants felt comfortable performing the experiment and completed it without incident. Participants used the computer to fill out the ASQ survey online and were told not to press the button that gives them their score. Researchers checked participant's ASQ score after they went into the small space or put on the weighted blanket looking away from the computer.

Nine participants were randomly assigned to stand in the small space for as long as they felt comfortable while listening to the same three sound conditions with the wireless headphones from the previous experiment. These nine participants followed the same procedure from the first experiment with regards to the small space. Researchers recorded how long each participant stayed in the small space for each sound trial with the stopwatch application on their iPhone. Participants were not informed how long they stayed in the space or that the maximum amount of time they could stay in the space was ten minutes.

The other nine participants were asked to sit with a weighted blanket over their shoulders while wearing the wireless headphones and listening to the same three sound conditions. Participants were asked to place the headphones over their ears to make sure they could hear the sound and were told to adjust the volume if needed. Once participants placed the headphones on, they were asked to sit in a chair facing a blank, white wall, while the researcher placed the

weighted blanket on top of them. The weighted blanket covered the entire front half of the participant's body from their feet all the way up to their shoulders. Each participant was asked if they felt comfortable and were told to inform the instructor if at any time they wanted the blanket to be taken off. Once participants stated they were comfortable, they were asked to inform the researcher when they were ready to move onto the next sound trial by saying out loud, "I'm ready to move on to the next trial." Researchers began the experiment and then recorded how long each participant sat with the blanket on during each sound trial. In situations when participants reached the maximum time of ten minutes, the experimenter indicated that the trial was over and moved onto the next trial or let the participant out if it was the last trial. Participants were not informed on their length of stay for each trial or that the maximum amount of time they could stay in each trial was ten minutes. After the participants completed the three sound trials, they were debriefed on the purpose of the experiment, given credit, and released.

Results

Participants were considered low if they scored a 19 or below on the ASQ; individuals scoring 20 or above were grouped as high. Analysis was completed to examine the effect of this grouping variable on length of stay in the small and large spaces. We ran a multivariate ANOVA test to test the hypothesis that higher scoring ASQ participants would stay in the weighted blanket condition longer than the smaller space. The results did not support the hypothesis and actually support the opposite. Lower scoring ASQ participants stayed in the small space longer (M=403.05 seconds, SD=200.04) than the weighted blanket condition (M=312.34 seconds, SD=245.61). Higher scoring ASQ participants also stayed in the small space longer (M=228.28 seconds, SD=249.49) than the weighted blanket condition (M=153.01 seconds, SD=170.62).

Overall, the average length of stay for lower scoring ASQ participants for both conditions was longer *(M*=357.69 seconds, SD=216.00) than the average length of stay for higher scoring ASQ participants (*M*=190.64 seconds, SD= 201.91). However, there was not a significant difference between the two spaces, $F(1,17) = 0.63$, $p > .05$. There was also not a significant difference between the higher and lower scoring ASQ groups, $F(1,17) = 2.57$, $p > .05$, but it does seem to be approaching significance. Lastly, there was not a significant interaction between the two conditions or groups, $F(1,17) = 0.01$, $p > .05$. These results do not support our hypotheses that higher scoring ASQ participants would wear the weighted blanket longer or that participants would wear the weighted blanket longer than staying in the small space. As a second level analysis, we ran a Pearson's correlation to determine if there was a relationship between the participant's ASQ scores and their length of stay overall in the two conditions. The results showed that there was not a significant correlation ($p > .05$).

Finally, we checked for any effect of sound and found a significant main effect between the sounds, $F(1,17) = 4.29$, $p < .05$. Participants listened to the rain sound the longest (*M*=318.66 seconds, SD=249.08), fire the next longest (*M*=301.87 seconds, SD=240.99), and white noise the shortest (*M*=229.82 seconds, SD=208.33). As a second level analysis, we ran a paired t-test to compare the three sounds. There was a significant difference between white noise and fire, $t(-2.16)$, $p < .05$, and white noise and rain, $t(-2.72)$, $p < .05$. There was not a significant difference ($p > .05$) between fire and rain. Overall, there was a common trend (see *Figure 5*) in both experiments where participants listened to rain the longest, fire the next longest, and white noise the shortest (see Table 1).

Discussion

Our results showed a complete contrast from the first experiment with low scoring ASQ participants staying in the smaller space longer than the weighted blanket condition. Low scoring ASQ participants also stayed in the small space longer than higher scoring ASQ participants. Both of these results do not support our initial hypothesis that higher scoring ASQ participants will stay in the weighted blanket condition longer than the small space. These results do not support previous studies that suggest ASD individuals find weighted blankets to be comforting because higher scoring ASQ participants preferred the small space over the weighted blanket. This could potentially provide support for the first experiment that suggested higher scoring ASQ participants would prefer the small space over the large space. Finally, there was a significant difference between the three sounds with participants staying in the spaces the longest while listening to the rain condition. These findings follow the same trend that was found in the first experiment (see *Figure 5*). This supports the idea that low and high scoring ASQ people like the sound of rain falling.

General Discussion

Overall, both experiments demonstrated differing results on how to reduce stress in individuals with higher ASQ scores. In the first experiment, the small space represents an individual's personal space, and the large space represents an area where other people and objects can disrupt this private space. The first experiment did not have enough statistical significance to support that high scoring ASQ individuals would prefer the small space over the large space, but the numbers did show that they stayed in the small space longer. In addition, there was an approaching significance between the correlation of participant’s ASQ scores and overall length

of stay. There might not be statistical support, but the correlation does suggest that higher scoring ASQ participants prefer their own space because higher scoring ASQ participants had higher scoring length of stays compared to lower scoring ASQ participants. This idea that higher scoring ASD participants prefer their own personal space supports Candini and colleagues' (2016) study where researchers found that higher scoring ASD individuals preferred a larger amount of distance between them and another person compared to lower scoring individuals. While these results might not have a significant effect, they still support the importance of ASD individuals having their own space so they do not get too overwhelmed with sensory over-responsivity.

The second experiment also did not show any significant effects between the two conditions and ASQ groups. Even though there was no statistical support, the numbers demonstrated an opposite effect from the first experiment with lower scoring ASQ participants staying in both conditions (small space and weighted blanket) longer than higher scoring ASD participants. We were surprised to see such a contrast from the first experiment, especially because the first experiment had double the participants than the second experiment. Based on both experiment's findings on the small space, the results seem to be inconclusive just as Miron (2008) found in her study. Miron's (2008) study suggested that each person has their own comfort level, making it difficult to come to one specific conclusion for how to reduce stress in everyone.

Furthermore, lower and higher scoring ASQ participants stayed in the small space longer than the weighted blanket condition in the second experiment. This finding was also shocking because of past research that has suggested weighted blankets work well to reduce stress in ASD individuals (Edelson, Edelson, Kerr, & Grandin, 1998). It could be possible that people do prefer

weighted blankets over smaller spaces, but the lab setting might have been too controlled for participants to feel comfortable. People were also sitting while wearing the weighted blanket instead of laying down, which could be another reason why participants preferred the small space.

With regards to the sound conditions, the second experiment showed a significant main effect, and the first experiment did not. Even though the first experiment did not show a significant effect, the numbers and trends were similar to those in the second experiment. In both experiments, the trends for both spaces included: listening to rain the longest, listening to fire the second longest, and listening to white noise the shortest. The weighted blanket condition in the second experiment showed a slightly different trend with participants listening to fire the longest, rain the second longest, and white noise the shortest. We are not sure why the trend changed for the weighted blanket, but one possible explanation could be because people think of sitting by the fire with a blanket. Overall, the majority of the results show that people preferred listening to the rain sound the longest, suggesting that people enjoy and feel relaxed listening to the sound of rain falling.

Limitations

It is important to note that both experiments have several limitations. The first and main limitation was that there was not an even amount of high and low ASQ participants. There was an attempt to have an even split of ASD and neurotypical participants, but several students with higher scores on the ASQ did not sign up to participate after receiving an invitation through email. This was why we decided to have each participant take the ASQ test so we could then run a correlation between the participant's scores and length of stay in both experiments. But,

without an even split of ASD and neurotypical participants, it was hard to fully compare the results between two different participant groups.

The second limitation was that there were not enough participants in both studies to have a high power. Without a large participant pool, it is hard to find significant effects within the results to support the hypotheses. There was also a particularly low number of participants for the second experiment because data collection had to end early due to classes being moved online. Because of the low number of participants and limited time, I would recommend conducting a future study with more participants, an even amount of ASD and neurotypical individuals, and including a task that induces mental stress on the participants to compare which method works better.

Conclusion

To conclude, the current study reports inconclusive findings on ways to reduce stress in ASD individuals. Both experiments did not have significant main or interaction effects, except for an approaching significance in the first experiment's correlation of ASQ scores and lengths of stay. A huge limitation in this study was not having enough participants. Future research should continue to focus on finding ways to reduce stress in ASD individuals to help them in their day-to-day lives.

References

Amos, G. A., Byrne, G., Chouinard, P. A., & Godber, T. (2018). Autism Traits, Sensory Over-Responsivity, Anxiety, and Stress: A Test of Explanatory Models. *Journal of Autism Developmental Disorders, 49*(1), 98-112. http://dx.doi.org/10.1007/s10803-018-3695-6

Autism Speaks. (n.d.). Autism Statistics and Facts. Retrieved June 3, 2019, from https://www.autismspeaks.org/autism-facts-and-figures

Autism Spectrum Disorder. (n.d.). Retrieved June 3, 2019, from https://www.nimh.nih.gov/health/topics/autism-spectrum-disorders-asd/index.shtml

Beuker, K. T., Schjølberg, S., Kveim Lie, K., Donders, R., Lappenschaar, M., Swinkels, S. H., & Buitelaar, J. K. (2013). The structure of autism spectrum disorder symptoms in the general population at 18 months. *Journal of autism and developmental disorders*, *43*(1), 45–56. https://doi.org/10.1007/s10803-012-1546-4

Blythe, C. A., Mendoza, S., Abdullah, M., Wegelin, J. A., & Levine, S. (2006). Cortisol circadian rhythms and response to stress in children with autism. *Psychoneuroendocrinology 31*(1), 59-68. doi.org/10.1016/j.psyneuen.2005.05.011

Candini, M., Giuberti, V., Manattini, A., Grittani, S., di Pellegrino, G., & Frassinetti, F. (2016). Personal space regulation in childhood autism: Effects of social interaction and person's

perspective. *Autism Research, 10*(1), 144-154. http://dx.doi.org/10.1002/aur.1637

Edelson, S. M., Edelson, M. G., Kerr, D., & Grandin, T. (1998). Behavioral and Physiological Effects of Deep Pressure on Children with Autism: A Pilot Study Evaluating the Efficacy of Grandin's Hug Machine. *The American Journal of Occupational Therapy 53*, 145-152. doi:10.5014/ajot.53.2.145

Miron, P. (2008). Use of interpersonal distance by children and adolescents with high-functioning autism or Asperger's syndrome. *ProQuest Dissertations and Theses,* 131. Retrieved from https://proxy.wm.edu/login?url=https://search-proquest-com.proxy.wm.edu/docview/304821975?accountid=15053

More Than Just a Fad: 4 Ways Weighted Blankets Can Actually Help You – Penn Medicine. (2019, February 5). Retrieved June 12, 2019, from https://www.pennmedicine.org/updates/blogs/health-and-wellness/2019/february/weighted-blankets

Mullen, B., Champagne, T., Krishnamurty, S., Dickson, D., & Gao, R. X. (2008). Exploring the Safety and Therapeutic Effects of Deep Pressure Stimulation Using a Weighted Blanket. *Occupational Therapy in Mental Health, 24*(1), 65-89. https://doi.org/10.1300/J004v24n01_05

Stress and Heart Health. American Heart Association. (n.d.). Retrieved July 17, 2019, from https://www.heart.org/en/healthy-living/healthy-lifestyle/stress-management/stress-and-heart-health

What is Autism Spectrum Disorder? (2020, March 25). Retrieved June 3, 2019, from https://www.cdc.gov/ncbddd/autism/facts.html

Tables

Table 1

Length of Stay Means (seconds) for Sound Conditions in both Experiments

	N	White Noise	Fire	Rain
Experiment 1	36	263.86	271.67	282.43
Experiment 2	18	229.82	301.87*	318.67*

Note: * = significant effect when compared to White Noise

Figures

Figure 1

Makeshift Wood Room: Small Space

Figure 2

Makeshift Wood Room: Large Space

Figure 3

Experiment 1 Correlation between: ASQ scores and Average Length of Stay

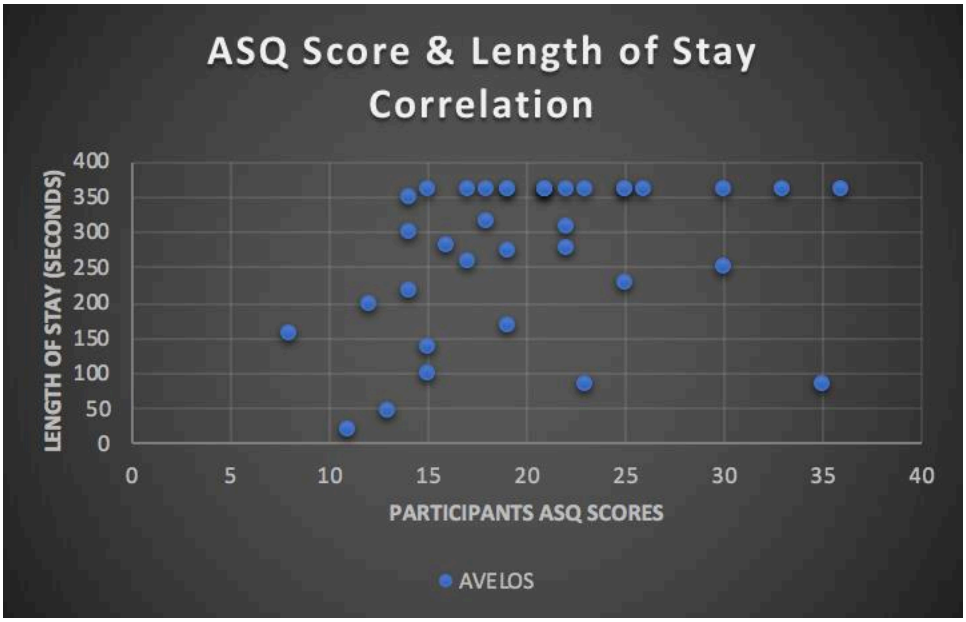
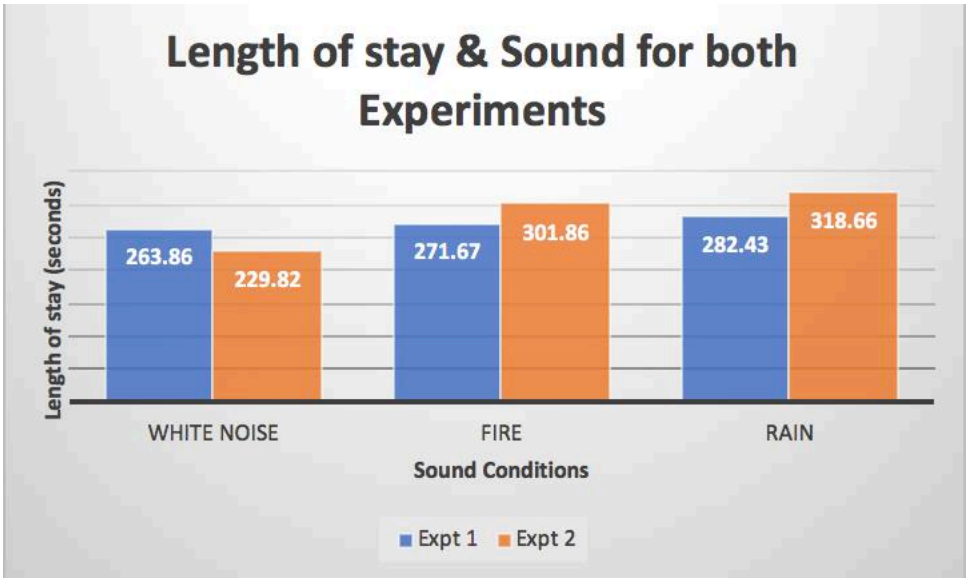


Figure 4

60’’x 80’’ 25-pound weighted blanket used in Experiment 2

Figure 5

Bar Graph Analyzing Length of Stay and Sound for both Experiments



Appendix A

Autism Spectrum Quotient Questionnaire

Autism Spectrum Quotient

Tests | About Us | Get Help

Choose one response that best describes how strongly each item applies to you.

	Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
1. I prefer to do things with others rather than on my own.	○	○	○	○
2. I prefer to do things the same way over and over again.	○	○	○	○
3. If I try to imagine something, I find it very easy to create a picture in my mind.	○	○	○	○
4. I frequently get so strongly absorbed in one thing that I lose sight of other things.	○	○	○	○
5. I often notice small sounds when others do not.	○	○	○	○
6. I usually notice car number plates or similar strings of information.	○	○	○	○
7. Other people frequently tell me that what I've said is impolite, even though I think it is polite.	○	○	○	○
8. When I'm reading a story, I can easily imagine what the characters might look like.	○	○	○	○
9. I am fascinated by dates.	○	○	○	○
10. In a social group, I can easily keep track of several different people's conversations.	○	○	○	○
11. I find social situations easy.	○	○	○	○
12. I tend to notice details that others do not.	○	○	○	○
13. I would rather go to a library than to a party.	○	○	○	○
14. I find making up stories easy.	○	○	○	○
15. I find myself drawn more strongly to people than to things.	○	○	○	○
16. I tend to have very strong interests, which I get upset about if I can't pursue.	○	○	○	○
17. I enjoy social chitchat.	○	○	○	○
18. When I talk, it isn't always easy for others to get a word in edgewise.	○	○	○	○
19. I am fascinated by numbers.	○	○	○	○
20. When I'm reading a story, I find it difficult to work out the characters' intentions.	○	○	○	○
21. I don't particularly enjoy reading fiction.	○	○	○	○
22. I find it hard to make new friends.	○	○	○	○
23. I notice patterns in things all the time.	○	○	○	○
24. I would rather go to the theater than to a museum.	○	○	○	○
25. It does not upset me if my daily routine is disturbed.	○	○	○	○
26. I frequently find that I don't know how to keep a conversation going.	○	○	○	○
27. I find it easy to "read between the lines" when someone is talking to me.	○	○	○	○
28. I usually concentrate more on the whole picture, rather than on the small details.	○	○	○	○
29. I am not very good at remembering phone numbers.	○	○	○	○
30. I don't usually notice small changes in a situation or a person's appearance.	○	○	○	○
31. I know how to tell if someone listening to me is getting bored.	○	○	○	○
32. I find it easy to do more than one thing at once.	○	○	○	○
33. When I talk on the phone, I'm not sure when it's my turn to speak.	○	○	○	○
34. I enjoy doing things spontaneously.	○	○	○	○
35. I am often the last to understand the point of a joke.	○	○	○	○
36. I find it easy to work out what someone is thinking or feeling just by looking at their face.	○	○	○	○
37. If there is an interruption, I can switch back to what I was doing very quickly.	○	○	○	○
38. I am good at social chitchat.	○	○	○	○
39. People often tell me that I keep going on and on about the same thing.	○	○	○	○
40. When I was young, I used to enjoy playing games involving pretending with other children.	○	○	○	○
41. I like to collect information about categories of things (e.g., types of cars, birds, trains, plants).	○	○	○	○
42. I find it difficult to imagine what it would be like to be someone else.	○	○	○	○
43. I like to carefully plan any activities I participate in.	○	○	○	○
44. I enjoy social occasions.	○	○	○	○
45. I find it difficult to work out people's intentions.	○	○	○	○
46. New situations make me anxious.	○	○	○	○
47. I enjoy meeting new people.	○	○	○	○
48. I am a good diplomat.	○	○	○	○
49. I am not very good at remembering people's date of birth.	○	○	○	○
50. I find it very easy to play games with children that involve pretending.	○	○	○	○

Score my Answers

Sources

1. M Woodbury-Smith. Screening Adults for Asperger Syndrome using the AQ: a Preliminary Study of its Diagnostic Validity in Clinical Practice. 35(3): J Autism Dev Disord 331-335. 2005.
2. Simon Baron-Cohen, et al. The Autism-Spectrum Quotient (AQ): Evidence from Asperger Syndrome/High-Functioning Autism, Males and Females, Scientists and Mathematicians. 31: J Autism Dev Disord 5-17. 2001.
3. Dorothy VM Bishop, et al. Using Self-Report to Identify the Broad Phenotype in Parents of Children with Autistic Spectrum Disorders: A Study using the Autism-Spectrum Quotient. 45(8): J Child Psychol Psychiatry 1431-1436. 2004.

Appendix B

Claustrophobia Questionnaire

CLQ

	Not at all anxious	Slightly anxious	Moderately anxious	Very anxious	Extremely anxious
SS					
(1) Swimming while wearing a nose plug	0	1	2	3	4
(2) Working under a sink for 15 min	0	1	2	3	4
(3) Standing in an elevator on the ground floor with the doors closed	0	1	2	3	4
(4) Trying to catch your breath during vigorous exercise	0	1	2	3	4
(5) Having a bad cold and finding it difficult to breathe through your nose	0	1	2	3	4
(6) Snorkeling in a safe practice tank for 15 min	0	1	2	3	4
(7) Using an oxygen mask	0	1	2	3	4
(8) Lying on a bottom bunk bed	0	1	2	3	4
(9) Standing in the middle of the third row at a packed concert realizing that you will be unable to leave until the end	0	1	2	3	4
(10) In the centre of a full row at a cinema	0	1	2	3	4
(11) Working under a car for 15 min	0	1	2	3	4
(12) At the furthest point from an exit on a tour of an underground mine shaft	0	1	2	3	4
(13) Lying in a sauna for 15 min	0	1	2	3	4
(14) Waiting for 15 min in a plane on the ground with the door closed	0	1	2	3	4
RS					
(1) Locked in a small DARK room without windows for 15 min	0	1	2	3	4
(2) Locked in a small WELL-LIT room without windows for 15 min	0	1	2	3	4
(3) Handcuffed for 15 min	0	1	2	3	4
(4) Tied up with hands behind back for 15 min	0	1	2	3	4
(5) Caught in tight clothing and unable to remove it	0	1	2	3	4
(6) Standing for 15 min in a straitjacket	0	1	2	3	4
(7) Lying in a tight sleeping bag enclosing legs and arms, tied at the neck, unable to get out for 15 min	0	1	2	3	4
(8) Head first into a zipped up sleeping bag, able to leave whenever you wish	0	1	2	3	4
(9) Lying in the trunk of a car with air flowing through freely for 15 min	0	1	2	3	4
(10) Having your legs tied to an immovable chair	0	1	2	3	4
(11) In a public washroom and the lock jams	0	1	2	3	4
(12) In a crowded train which stops between stations	0	1	2	3	4

How *anxious* would you feel in these places or situations? Circle the most appropriate number.