MAS 962: Autism Theory and Technology
Final project report
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Abstract

This project report describes a study that aimed to explore the emotional arousal in individuals with Asperger syndrome (AS) and high-functioning autism (HFA). In addition to being conducted as a class project in MAS 962: Autism Theory and Technology, the study was conducted as an extension to an ongoing project: “Wearable Platform to Foster Learning of Natural Facial Expressions and Emotions in High-Functioning Autism and Asperger Syndrome” (Picard et al. 2006). While the ongoing project focuses on evaluating the scientific and clinical significance of using a wearable camera system, Self-Cam (Teeters et al. 2006), to improve recognition of emotions from real-world faces in young adults with AS and HFA, this study introduced a physiological measuring device, a wireless SCR monitor, to measure the autonomic arousal level of the subjects while engaged in the socio-emotional activities included in the Self-Cam study. This report describes and discusses three different sub-studies: First; SCR was measured in 6 young men with high-functioning Autism Spectrum Disorders during conversation. Second; SCR was measured in 6 typically developed men and women at the Media Lab. Third; SCR was measured in a woman with low-functioning autism during conversation in general, as well as during more specific tests. Due to the exploratory structure of the study no conclusions can be made at this stage. However, the study generates several interesting questions that will be addressed in a future study.
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1. Introduction

The main purpose of this study was to explore the relation between the physiological reaction and emotional arousal in individuals with Autism Spectrum Disorder (ASD), in the hope of generating some initial cues regarding the correlation between the two reactions. Several lines of research suggest that the processes of arousal regulation found in normally developing individuals, are disturbed in individuals with ASD. Differences have been found both regarding cognitive and physiological response (Dawson 1991). These results propose that many of the characteristics seen in individuals with ASD, a decrease in social attentiveness and engagement being one, could in fact be traced back to the inability to regulate arousal and stress. However, though the topic has been explored for many years now, the level of inconsistency and uncertainty, both with regard to results and to interpretations, is still fairly high and several questions are yet to be answered (Begeer et al. 2006, Belmonte et al. 2004).

1.1 Autonomic reactivity and emotions in typically developing individuals

Though many diverse theories of the correlation between the emotional state and the physiological reaction in normally developed individuals exist, researchers seem to agree on the fact that there is a correlation. There are those that claim that emotions happen as a result of physiological reactions, rather than being the cause of them\(^1\) (James 1884), whereas others propose that these two reactions occur at the same time\(^2\) (Cannon 1927). According to the Facial-Feedback Hypothesis (Adelmann and Zajonc 1989), facial expressions provide feedback to the brain about expression, which causes and intensifies the emotion. Antonio R. Damasio (1999) has suggested that while the senses of vision, hearing, touch, taste smell function by nerve activation patterns that correspond to events in the external world; emotions are nerve activation patterns that correspond to the state of the internal world. For example, if we experience a state of fear, then our brains will record this body state in nerve cell activation patterns obtained from physiological feedback, and this information may then be used to adapt behavior appropriately. Emotions can therefore be seen as cognitive representations of body states by which the internal physiological state is monitored and controlled, and by which this internal state influences behavior of the whole individual.

Thus, even though we do not fully understand the cause and purpose of emotional response and bodily reactions, it is clear that an intimate relationship between these two reactions exists. In other words, by measuring one of these two reactions, we are likely to be provided with information regarding the other one.

Understanding the mechanisms of emotional and arousal regulation in humans in general and in individuals with ASD in particular, is an intriguing and important research questions since a failing arousal regulation system may well be the root of many of the deficits seen in individuals with ASD (Dawson 1991, Dalton et al. 2005, Joseph et al. 2005). It has been shown that, in typically developing individuals, the capacity to regulate arousal has profound influences on attention and information processing and socioemotional functioning (Berlyne 1960, Greenspan and Lourie 1981, Dawson 1991). Dawson distinguishes between two different classes of psychophysiological response: orienting and aversive. Orienting response, e.g. increased SCR,

\(^1\) James-Lange Theory of Emotion (James 1884)
\(^2\) Cannon-Bard Theory of Emotion (Cannon 1927)
decreased peripheral blood flow, and initial slowing of heart rate, is typically elicited by low-intense and familiar stimuli and helps the individual to attend to the current stimulus. The response normally habituates when the stimuli is presented repeatedly and thus, eventually leads to a return to pre-stimulus baseline levels. Aversive response, e.g. heart rate acceleration, is typically generated by overly-intense stimuli and does not lead to habituation. It is suggested to serve to limit the effects of the stimulus on the individual by causing the individual to withdraw from the stimulus (Dawson 1991). Field (1982) proposed that pre-term infants have a lower threshold for aversion to stimuli than normal infants. According to Field, attention and positive emotional response during socioemotional interactions occur within a range of activation which has an attention threshold as its lower limit and an aversion threshold as its upper limit.

1.2 Autonomic reactivity and emotions in individuals with ASD

In individuals with ASD, the correlation between the physiological and mental state is not as direct (Dawson 1991). Little is known about the ways in which individuals with ASD experience and utilize emotions and arousal. As a matter of fact, not much is known about how these individuals attend to emotion expressions and events in general. A few studies have been carried out to address these open questions. Begeer et al. (2006) conducted a study in which they aimed to assess the attention to facial emotion expressions in children with autism. Twenty-eight high-functioning boys with autism (and a control group) were asked to sort pictures of smiling and frowning faces of adults. The study suggests that children with autism are only less attentive to emotional expression in situations that are socially irrelevant. Thus, the attention of these children to emotional expressions in others is influenced by situational factors. Shalom et al. (2006) conducted a partly similar study where indices of physiological emotions and of the expression of conscious feelings in 10 children with HFA or AS and a control group were measured. Pleasant, unpleasant, and neutral pictures were presented while SCR were measured. In addition, self-report ratings of pleasantness and interestingness were taken between pictures. The study suggests that skin conductance responses did not differ between the two groups, whereas the self report ratings were different, with the children with autism giving more similar answers to the two questions than the comparison children. Thus, the results indicate a deficit in perception and/or expression of conscious feelings, rather than in physiological reactions. The well-known impairments in socio-emotional expression in autism, being: (1) difficulty relating to other peoples' nonverbal cues and mental states (Hobson 1993; Joseph and Tager-Flusberg 1997; Frith 2003); (2) a lack of eye contact (Volkmar and Mayes 1991); (3) atypical eye gaze processing and reduced fixation time on facial features, especially the eyes when shown facial stimuli (Klin, Jones et al. 2002; Pelphrey et al. 2005); (4) difficulty understanding and expressing one’s own feelings (Hill, Berthoz et al. 2004); and (5) a restricted range of emotional expression, may all be related to this perceptional/exceptional deficit (Shalom et al. 2006).

A study conducted by Joseph et al. (2005) generated results that partly contradict those presented by Shalom et al. (2006). In their study, Joseph et al. used SCR as a measure of autonomic arousal for examining the psychophysiological reactivity to faces and face recognition performance in 20 children with autism and 20 normally developing children. The results indicate that children with autism exhibit increased bodily arousal (in this case SCR) to direct gaze, which was strongly and inversely related to their face recognition accuracy. The authors suggest that a strongly increased arousal level play an important role in autistic face processing and social deficits.
Similarly, Goodwin et al. (2006) conducted a study at the Groden Center in which they aimed at assessing arousal responses, based on heart rate variability, to different novel stimuli or social situations in individuals with autism. The results of the study support the findings presented by Joseph et al. (2005) in that they suggest a difference between the physiological response of individuals with ASD and normally developing children. Goodwin et al. claim that on average “the participants with autism showed mean HR [heart rate] responses approximately 20 bpm higher during baseline and nearly every potentially stressful situation. The group with autism also showed approximately half the amount of variance in HR responsivity compared to the typically developing group” (Goodwin et al., 2006).

Dalton et al. (2005) carried out a study in which magnetic resonance imaging (MRI) was used to assess brain activity in individuals with autism when processing faces. The study implies a significant difference in how individuals with autism attend to gaze (eye fixation), as well as scan and process facial images. According to the model presented in the paper, face-processing deficits in autism arise from hyperactivation in the central circuit of emotion (amygdala) that produces an increased sensitivity to socioemotional stimuli. Thus, the main conclusion of the study is that diminished gaze fixation within the autism community may function as a way to reduce negatively valenced overarousal to social stimuli, which in turn results in atypical activation in other parts of the brain, such as fusiform gyrus.

2. Procedure

The studies described above were all more or less conducted in controlled and unnatural settings. This study aims to take a step towards more natural experimental settings. The study was conducted as an exploratory study. This means that apart from the context, i.e. approximately 10 minute long conversations, no specific arrangements or constraints were defined prior to the study sessions. However, it should be pointed out that my goal has been to make the sessions as similar as possible to enable between-subject comparison. Thus, although the topic, mood, and flow of the conversations differed slightly, the main context and time constrains were more or less comparable. During the conversation the subjects were all asked to wear a wireless device called the HandWave sensor (Strauss 2005, Strauss et al. 2005), which is similar to the commercial Galvactivator (Picard and Scheirer 2001, Galvactivator 2007), to measure the skin conductance response (SCR). The HandWave is worn around the arm and uses two electrodes, placed on the subject’s palm, to measure the electrodermal response. The HandWave device measures SCR in units of (micro-)Siemens. In addition, the device contains a Bluetooth module that enables data to be sent directly to a receiving server; in this case to my personal laptop.
During the study sessions, I ran a python-based application that plots the data in real-time on my laptop in order to get immediate feedback.

2.1 Setup: Experimental group, Groden Center study

The Self-Cam study, conducted by Picard et al., involves a group of young adults diagnosed with AS/HFA who are all students at the Groden Center in Providence, Rhode Island (The Groden Network 2006). Two times per week the subjects are asked to wear a Self-Cam while engaged in a conversation with their assistant who is also wearing a Self-cam. The cameras record facial expressions for future studies and training sessions. The additional SCR study, conducted by me, was carried out during two days, involving a total of 6 male subjects of which three were tested twice. One of these duplicate tests (“S (M)”) had to be discarded since the subject touched the electrodes throughout the whole session. Thus, a total of 8 sessions were recorded and analyzed.

2.2 Setup: Control group, Media Laboratory

The control study, conducted at the Media Lab, was carried out in a similar manner. The subjects, 2 female and 4 male graduate students, were asked to wear the Hand Wave device during an approximately 10 minute long casual conversation with me while being recorded by a video camera (not a Self-Cam). The video camera was used in order to synchronize SCR data and events. Although I made an effort to make the experimental and control study as similar as possible, it should be pointed out that whereas the experimental subjects have participated in the Self-Cam study since the beginning of March, the control subjects participated for the first time. One of the sessions (“T (F)”) ended up being incomplete regarding annotations, since the video camera accidentally turned itself off during the conversation.

2.3 Setup: Additional study, Person with low-functioning autism

This study was conducted as a final exploratory study. The subject is a woman (A) with low-functioning autism. Although the study had the form of a casual conversation, 4 tests were carried out during the conversation. The test: (1) resting followed by moving, (2) resting followed by listening to smacking sounds, (3) resting followed by close face-to-face interaction, and (4)
resting followed by reading an “angry” and “hostile” blog, were all initiated by the subject. In addition to these tests, SCR was measured during two unintentional flapping moments: (5) toe flapping and “biting” arm and (6) arm flapping. In total, the study lasted for approximately 90 minutes. No video or audio recordings were made.

2.4 Ethical review

All participants were informed of the nature of the investigation, the types of assessments involved, the potential risks involved in participation, and were asked to sign an informed consent and personal assent prior to the study. For those participants who have legal guardians, the legal guardians received information about the study and were asked to sign the informed consent. Some people who wear the HandWave device might feel it is geeky or clunky, uncomfortable or embarrassing. However, my aim was to minimize these factors by making the devices as invisible as possible and talking about it in a positive manner. The fairly neat design of the device hopefully makes it feel less awkward. The device was put on by me or in some cases by personnel whom the subjects trust, in a (private) environment where the subject seemed to feel comfortable. I also ensured that the sessions occurred in an environment (i.e., The Groden Center or the Media Lab) where social interactions are most likely to be supportive and understanding. I have consent from MIT’s Committee on the Use of Humans as Experimental Subjects Confidentiality (COUHES) as well as from the IRB board at the Groden Center to conduct this study.

3. Results

As pointed out before, the results of this study should be viewed as a possible ground or springboard to future research, rather than as final results. Due to the exploratory layout of the study, in addition to the strictly limited number of subjects and between-group differences, makes it almost impossible to draw any conclusions. In this section I present the collected data as charts with manual annotations. Additional comments regarding observations that I personally find intriguing have been added to each chart.

3 Larger versions of the charts can be viewed at http://web.media.mit.edu/~paulina/main_autism.htm
3.1 Results: Experimental group, the Groden Center

In the chart above, the 8 sessions have been plotted in the same chart. The color is individual and since two subjects were tested twice, two colors occur twice. What I find particularly intriguing in this chart (this makes even more sense when compared to the control group, Figure 3) is the fact that there seem to be two groups of responses: one where the SCR level is rather high and varying (SK, C and to some extent N) and one where the SCR level is very low (P, D and SG). Now, it should be pointed out that we all have individual SCR baselines and patterns. Thus, these results have to be put in a context (external factors, stressors, behavior) before further analysis can be done.

C is a very mellow person. He matches the traditional description of people with ASD in the sense that he usually does not use facial expressions to show emotions. He is also very detail oriented and talks fairly monotonously. However, his SCR shows that he responds rather “normally”. Monopoly, a topic C initiated, seems to excite him the most. In addition, we see a clear spike at the end of the conversation, when C stands up.

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4 Sampling rate ~40 samples/second.
P is probably the most expressive subject. Although, he tends to "freeze" sometimes (he gets a dreamy look in his eyes and does not respond), he normally responds very well to questions, makes jokes and smiles. In P’s case the two charts look rather different. This is interesting since P’s SCR seems to be correlated to his responsiveness. The second day, the assistant had a hard time engaging P in the conversation. P was dreamier and seemed more tired than he did the first day. The relatively low SCR on the second day could be related to this lack of responsiveness. One possibility is that the second day was simply less interesting or exciting since P had done it the day before.
D initially has a rather “normal” curve in the sense that his SCR decreases during the initial rest period. However, his SCR does not increase when the conversation starts and especially the first chart is continuously low and stable. D is a rather mellow person but occasionally gets very involved in the conversation; he makes jokes, laughs, imitates, and uses his whole body to emphasize the current topic. Normally, his SCR does not change during those moments. Neither does the level change when the conversation ends and D stands up.
N gives the impressions of being a rather nervous person and seemed to have a hard time concentrating during the conversation. He turned around quite often to look at me and my computer. He wanted to see the SCR curve being plotted in real-time. In N’s chart the temporary increase after about 12000 (time) samples is interesting. However, I have not been able to find a satisfying explanation for the increase. N was relatively unfocused during that time period and at 15000 samples he does not respond to the assistants questions. After a while he turns around to ask me if he can watch my computer. Thus, the peak may be either the cause or result of this nervous behavior. Like C, N’s SCR increased significantly when he stood up after the end of the conversation.

SG’s SCR pattern reminds me of that of D. We see a clear drop in SCR during the one minute resting period and after that the SCR level stays low. In SG’s case the SCR is even extremely low (~0.5 micro-Siemens). The response seems to be independent of topic and does not change when the conversation ends and SG stands up. As a person, SG is very mellow, although slightly nervous. He does not show emotions, but seemed slightly anxious as he every now and then turned around to look at me. He rocked back and forth quite a lot.
Personally, I think SK’s case is the most interesting of them all. Before the arranged conversations SK is always very excited and talkative. However, as soon as the conversation starts SK sits quiet. He still seems to be emotionally responsive since he laughs a lot when the assistant makes jokes, but he does not use words. SK’s response seems to be correlated to his behavior. As soon as the conversation starts (~500 samples) his SCR increases significantly and when the conversation ends (~25000 samples) the SCR drops. Thus, it seems like something in the situation makes SK so shy or nervous that he is no longer able to fully engage in the conversation.

### 3.2 Results: Control group, the Media Lab

Compared to the experimental group, the control group is more homogeneous. Apart from one subject (C), the subjects all show a decrease in SCR during relaxation, followed by a slow increase throughout the conversation. Thus, there seems to be no habituation effect, i.e. the subjects do not seem to get more comfortable and relax as time passes. There are many possible explanations for these results. It is worth pointing out that although I deliberately chose subjects to whom I talk to on a regular basis in order to minimize nervousness, the control subjects are not as experienced as the experimental group when it comes to this study. Whereas the latter group has participated in the Self-Cam study for approximately 3 months now, the control subjects only
participated once. Thus, the relatively high SCR may simply be a general novelty effects. It is also possible that the chosen topics influenced the SCR patterns.

After the conversation starts R’s SCR increases and stays fairly high. I have not been able to identify what causes the local peaks. It may be related to whether R is speaking or not, since R’s level seems to increase when I talk; particularly at the end of the conversation (~40000 samples). It should be pointed out that in R’s case the topic is quite personal and private; we talk about her husband and marriage. It is possible that this made R nervous and uncomfortable and thus caused the SCR to increase.

T’s annotations are unfortunately incomplete since the video camera stopped recording during the conversation. Nonetheless, T shows a pattern similar to that of R. After relaxing, T seems to get more aroused as the conversation begins. After that the level increases slowly until the end of the conversation.
D’s SCR level is relatively consistent in the sense that it fluctuates along a fairly constant level ~7-8 micro-Siemens. Like all other control subjects, D’s SCR decreases during resting and increases when the conversation begins. Apart from that, I have not found any particularly interesting patterns or details.

M shows a clear increase in SCR throughout the conversation. After the conversation ended, M described the conversation as increasingly “uncomfortable”. He explained that he did not like the fact that we were taking about fairly private topics such as how he met his wife. Thus, he kept thinking: “How much is she going to ask me?” or “I wish we could change the topic.” This supports the idea (described above) that more lightweight topics and variability could change the control subjects’ SCR patterns.
C is the only subject who’s SCR decreases after the conversation begins. It is hard to assess why; it could be a personality trait but it could also reflect the fairly shallow topic. The peaks at around ~10000-15000 samples were generated when C touched the electrodes of the HandWave device.

J’s SCR does not decrease during the relaxation period but increases when the conversation starts. Apart from a couple of peaks (the peak ~22000 samples was caused by moving the electrodes), the level is fairly constant around 10 micro-Siemens. I have not been able to identify the cause of the local peaks.

3.3 Results: Additional study, Person with low-functioning autism

The study involving A, a woman with low-functioning autism, differs quite significantly from the study described above. This study is best described as an ongoing dialogue with improvised tests. All tests were initiated by A and were based on her personal experiences of stress and anxiety. Below are charts of 4 arranged tests and 2 unplanned events. After the session, A pointed out that the study should have been conducted in the afternoon or evening rather than in the morning, since her overall stress level tends to be relatively low in the beginning of the day. More specific comments can be found under each chart.
The first test involved resting for one minute, followed by immediate movement. A wanted to carry out this particular test since she believes that she unlike most people has to make an effort to move her body. A describes this in her blog:

“I have known for a long time that my relationship to voluntary movement is not the same as my relationship to automatic movements, that there is in fact quite a large difference between the two, and that I process automatic movements as “background” but don’t process voluntary movements that way. And that most movements for me are not automatic, but require finding the body part and making it move around for me in a fairly laborious way.” (Baggs 2007)

This test consisted of resting followed by me smacking loudly in A’s ear. A explained that she finds smacking sounds really annoying. However, as you can see in the chart, the smacking did not lead to an increase in A’s SCR. As pointed out before, this could be due to the fact that A was generally relaxed. It could also be that A expected smacking due to the unnatural setup of the test, and thus was prepared for it.
This test involved resting followed by me moving really close to A’s face while staring in her eyes. It is believed that people with ASD in general dislike eye contact. A claims that it causes her a lot of stress. However, similar to the previous test, this test did not generate an increase in SCR.

Lastly, A asked me to capture her SCR while she was reading an entry in the blog “Hating autism” (Hating autism 2007) that discusses A in a negative manner. As expected, her SCR level increased from ~20 micro-Siemens to ~25 micro-Siemens. It should be pointed out that the decrease, followed by a steep increase shown in the chart (~1000-4000 samples) is due to a glitch in the electrodes. The level at ~0 time samples shows A’s “real” SCR level prior to the test.
This data was captured during a period during which A was flapping her toes and sucking on or biting her arms. She was completely unavailable during this time period. Though we can see an increase in SCR I do not have enough data to conclude that there is a correlation between the two events.

This case is similar to the previous one: Amanda starts flapping her arms and is mentally unavailable for approximately one minute. We can see a clear increase and irregularity in A’s SCR but the data collection is interrupted by the fact that the electrodes came off (~4000 samples).

4. Discussion

As pointed out above, I consider this study too exploratory to draw any final conclusions. The study has however pointed out some areas that I would like to explore further in a longer and more controlled study. These areas are discussed below.
4.1 **Conduct controlled studies of SCR in subjects**

As the charts presented in this paper show, there are differences in SCR both within the two groups and between the groups. In order to be able to draw any conclusions I have to define the “typical” SCR pattern of the involved subjects. More specifically, before I can compare the two groups, I have to figure out if the SCR in individuals with ASD and normally developed people are inherently similar. Thus, I should carry out a series of controlled studies where the subjects (in both groups) are exposed to stressors that are known to cause an increase in SCR in normally developed individuals. Examples of such stressors are sudden, unexpected noises or events. These stressors should not only be used for exploring the initial SCR, but also for exploring the subjects’ habituation patterns (the subjects are exposed to the same stressor several times in a row).

4.2 **Make the main study more controlled**

Although the layout of the experimental and the control study were fairly similar the variety within and between the groups is still far too large. The discussion topics and the length of the conversations vary. In addition, as pointed out before, the control subjects have not been exposed to the test as many times as the experimental subjects. Other factors that can influence the results are the context and time. The control subjects were all tested the week before an MIT Media Lab open house event – a week that is known to be one of the most stressful periods for students in the Lab. Thus, additional tests, under circumstances identical to those in the experimental group, should be conducted in the control group.

4.3 **Pinpoint particularly interesting SCR patterns**

As mentioned above there are specific results that I would like to explore further. The subjects SK and SG are two examples. If we get the same results in future tests it is worth looking into if there is any correlation between the SCR patterns and interactions styles (personality traits) of these subjects. Does the highly increases arousal level in SK prevent him from communicating? What causes the increase? Is there anything that causes SG’s low SCR level to increase? If yes, does this show in the way he interacts with and responds to his environment?

4.4 **Compare SCR and HR**

Goodwin et al. (2006) have already conducted studies in order to assess the heart rate (HR) and heart rate variability in all experimental subjects involved in this study. In addition to suggesting that there is larger within-group variability in the ASD community, the study also indicates that there are two different subgroups within the community: one group of individuals with a constant low HR and one of individuals with a relatively high HR. The SCR results above indicate a similar division. Needless to say, it would be interesting to compare the SCR results with the gathered HR results in order to see if there is indeed a correlation.

4.5 **Apply A’s results to the larger test**

The subject A mentions a number of activities that, unlike in normally developed individuals, require a lot of effort; moving being one. The SCR data collected supports that claim since even toe wiggling caused the level to increase:
“Every time I voluntarily moved a body part, the graph started jumping upwards. I am told that most people can wave their arms around really heavily and not have it do that. All I had to do was move a leg a little bit or even wiggle my toes.” (Baggs 2007)

It would be interested to explore the correlation between movement and SCR in both the experimental group and the control group.

5. Summary

This paper described an exploratory study of the SCR in individuals with high-functioning autism. Although the study is not controlled and extensive enough to generate final results, it leads the way to future research within the field. Initial results show that there seem to be a greater diversity and greater extremes within the experimental group (autism group). Future research should aim to assess the “normal” SCR patterns in both groups before exploring these results further.

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6. References


James, W. (1884). What is an emotion? Mind, 9, 188-205


