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Effects of Emotional Stimuli on Controlled Processes and Gender

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40 undergraduate students from the University of Western Ontario were randomly selected and participated in a Stroop test following a 5 minute slide show presentation. Each presentation consisted of happy or sad pictures and music, meant to induce an emotional reaction. Participants were split up evenly into 4 groups based on gender and emotional condition. An emotional effect on gender was measured using a 2x2 analysis of variance. It was found that emotion did have an effect on time for both genders \((F(1,32)=3.44, p<.05)\) however there was no effect on performance \((F(1,32)=.40, p>.05)\).

Previous research conducted in the area of emotion has focused on differences in emotional reactions between genders. More specifically attention has been directed towards physical and neurological reactions to emotional stimuli in the form of pictures and music. It has been demonstrated (Bradley, Codispoti, Sanatinelli, Lang, 2001) that highly arousing picture content such as threat and mutilation made both males and females respond with the greatest affective responses, however women tended to respond with a greater reactivity to aversive pictures regardless of the content. Unfortunately, the area of research regarding emotion and its effects on cognition between the genders is relatively young. However it has been demonstrated in a previous
study (Koch, Pauly, Kellerman, Seiferth, Reske, Backes, Stöcker, Shah, Amunts, Kircher, Schneider, Habel, 2007) that there is different neuronal activation in males and females during presentation of emotional stimuli. These differences in perceptual and neuronal activation has lead the current study to investigate whether emotional stimuli effects genders differently in terms of controlled processes and more specifically selective attention.

Subsequent research has been conducted to see if men and women differ in their emotional reaction to varying stimuli. Bradley et al (2001) instructed males and females to make ratings of pleasure, arousal, and dominance on a Self Assessment Manikin scale (SAM; Lang, 1980) following the presentation of pictures. These pictures consisted of pleasant (e.g. sports, erotic couples, families), neutral (e.g. household objects), and unpleasant (e.g. pollution, illness, attacking humans) stimuli. Data was also collected through EMG recordings, skin conductance, and heart rate monitors. Females demonstrated that they found unpleasant stimuli more unpleasant and more arousing than pleasant stimuli. It was also discovered that women often showed more EMG activity, and higher skin conductivity while viewing unpleasant stimuli, although the EMG did not prove to be significant. In a second experiment in the same study, participants were exposed to a 6 second clip of a picture and then had to circle a listed emotion that they may had felt during the presentation. Here it was discovered that men were more likely to show higher arousal to erotic stimuli, while women were more likely to feel afraid while watching threatening images. These results demonstrate gender differences in response to emotional stimuli, but the question arises on whether these are
socially learned responses, or if there is a neurological reason for these affective reactions.

Following this train of thought, Koch et al (2007) conducted an FMRI study which looked precisely at whether cognitive differences occurred in the presence of emotional stimuli between the genders. Single black letters were presented for 500 ms on a white background in a fake-randomized order. Participants had to do attention, and attention and working memory tasks where they had to press a button to a predefined target letter, or respond to a letter that matched the second last letter seen. During these procedures participants were exposed to either a rotten yeast smell or neutral ambient air with the intention of inducing an emotional reaction. Following this, subjects were asked to rate the odour they had just been exposed to using the SAM, as well as a emotional self rating (ESR) scale so they were able to designate the experienced emotion. Results showed that females have significantly stronger brain activation in the insula which is believed to be highly involved in the processing of negative emotion. Furthermore they found that the signal from the left inferior parietal cortex was significantly stronger in male participants. This area is believed to be involved in attention and working memory processes. Women on the other hand were found to have superior activity in their amygdala and orbitofrontal cortex during working memory and negative emotion trials. Both of these have been known to be in charge of the processing of negative emotions, which would explain previous research (Bradley et al, 2001) findings that women receive greater arousal from unpleasant stimuli. These findings give further merit to the idea that, there is a cognitive difference in the processing of emotional stimuli.
As mentioned earlier, it is not just pictures that have been shown to create emotional affect; songs have also been proven to induce emotion as well. Hunter, Schellenburg, and Shimmack (2010) have demonstrated that music can, in theory, soothe the savage beast. Participants in this study were put into a sound booth and listened to a variety of classical music. Four different excerpts for each piece were listened to; a fast-major, fast-minor, slow-major, and slow-minor. After every excerpt participants were asked to answer 6 questions that appeared sequentially on a touch screen asking questions about how the music made them feel, if the music sounded sad or happy, and if they liked or disliked the music. Results showed that if the participants perceived the music to be happy, it made them happy, and if the music was perceived as sad it made them sad. Also, there was significant data showing that happiness ratings were increased after listening to a fast tempo song in a major scale, and feelings of sadness were increased after listening to a slow tempo song in a minor scale.

The current study elaborates on previous concepts of emotional stimulation and the different cognitive effects it has on gender. The emotionally eliciting stimuli will consist of both pictures and songs to ensure a strong emotional reaction in participants. Building off Bradley et al (2001) subjects will be exposed to an attention task, however the current study focuses more on selective attention and whether emotion affects accuracy and time differently between genders. By presenting emotional stimuli prior to using the Stroop task, it should make it harder for the subjects to strengthen attended to stimuli, and weaken others. By having no erotic stimuli in this study, women should differ from men more drastically in their scores and times, and more specifically should be particularly effected by negative stimulus.
Method

Participants

40 undergraduate students from the University of Western Ontario were tested in classrooms around campus. However because of instruction error some scores were not included (N=36). Participants consisted of 20 males and 20 females ranging in ages from 18 and 24. 10 males and females were put into each of the two conditions. These participants were selected from the student body and randomly assigned to one of two groups, and consent was given prior to participation.

Materials

Experiments were conducted in classrooms around campus. A point was made to conduct each experiment in a classroom with no windows as an attempt to limit the amount of external stimuli. Data was collected through the use of charts which allowed for right and wrong responses to be recorded as well as time. A stop watch was used to keep track of time. Participants viewed slide show and listened to music through a HP Pavilion dv7 laptop. The happy slide show consisted of 49 pictures of funny situations, babies, and people (see appendix A for example) and was accompanied by Bach’s “Allegro” from Brandenburg concerto 3 in an E major. The sad slide show consisted of 50 pictures of tragic incidences such as the terrorist attacks on the world trade centers in 2001 (see appendix B for example). These pictures were accompanied by Alexander Nevsky’s, “Russian under the Mongolian Yoke” in a C minor slowed down to half speed. This has been used in a previous study (Wood, Saltzberg, Goldsamt, 1990) to induce feelings of sadness. Each slideshow was 5 minutes in duration. Stimuli used for the Stroop task was written on standard printer paper, with Crayola markers. Cards were
also backed with white construction paper to ensure visibility of the stimuli and stability of the paper.

Procedure

Participants were randomly assigned to a happy or sad where each participant was tested individually. Participants were instructed to watch a 5 minute slide show consisting of music and pictures that were either meant to induce a feeling of sadness or happiness. Participants were not made aware of which condition they were being put in. Upon completion of the slide show participants were instructed to perform a Stroop task. Two cards were presented sequentially approximately 3-4 feet in front each participant on a stand. Each card consisted of 12 words, with 6 words on the left and 6 words on the right. Participants were instructed to read the left column first then move over to the right column. Participants were told to read the words as fast as they could but that no time limit was assigned, although time was being recorded. Responses would be marked incorrect if they answered incorrectly, stuttered or took too long. Once the task had been completed participants were given a disclosure and thanked for their participation.

Results

Out of the 40 participants, only 36 were used for data analyses. A random sample of 18 girls and 18 boys were used for testing. Using a 2 (sex) x 2 (emotion) analysis of variance (ANOVA) with an alpha level of .05 significant differences in participant scores was not achieved ($F(1,32) = 0.40, p > .05$), although there was a small interaction (figure 1). Individual differences between sex ($F(1,32) = 0.11, p > .05$) and emotion ($F(1,32) = 1.97, p > .05$) failed to reach statistical significance. Further analysis was done
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with participant times using the same alpha level .05, which did not show a statistical significant interaction ($F(1,32) = .02, p > .05$) (figure 2). Individual differences between the sex ($F(1,32) = 2.57, p > .05$) did not show statistical significance. However while females seemed to perform at a relatively steady rate across both conditions males varied, doing better in the sad condition than in the happy. Emotion, did seem to have a small effect on response time ($F(1,32) = 3.44, p < .05$). The participants in the happy condition took on average 2.95 seconds longer than the participants in the sad condition (figure 2). The effect of emotion accounts for 9% of the total variance in participant times. A final analysis was conducted in which times and scores of participants were combined. Each incorrect response by a participant added 10 seconds onto the time it took the participant to complete the task. Results did not reach statistical significance ($F(1,32) = .22, p > .05$). Individual differences between sex ($F(1,32) = .03, p > .05$) and emotion ($F(1,32) = 2.09, p > .05$) did not reach statistical significance although females did have a better overall score.

Discussion

The data presented in this study shows that gender is not affected differently by emotion in controlled processing tasks, however emotion has a small effect on completion time for both genders. Surprisingly though, the outcome suggests that sad conditions facilitate quicker response times while the happy condition slightly inhibits them. Interaction was not significant in any of the analyses which were consistent with the hypothesis that men and women would differ in test scores.

The results showing an increase in performance during sad conditions has several possible implications. From an evolutionary standpoint it makes sense that when an
individual is exposed to negative/threatening stimuli they respond quickly and accurately to survive. While in the happy condition participants may not have been properly stimulated to act quickly and effectively. Also the fact that erotic stimuli were not involved could have influenced the results of male performance. As previously noted by Bradley (2001); males experience greater arousal when presented with erotic stimuli. On the other participants were exposed to unpleasant stimulus, which Bradley (2001) proved to increase arousal in female participants more so than males.

Studies have shown (Pinel, 2009) that medial portions of the prefrontal lobes such as the orbitofrontal cortex has been known to demonstrate emotion-cognition interaction. This is also the general area where executive functioning skills such as attention are believed to be located (pinel,2009). Following the notion of spreading activation in neurons, when an individual is exposed to sufficient arousing stimulus, spreading activation could facilitate improved executive functioning abilities in certain areas. As discovered by Koch (2007) women seem to have more pronounced activation in the amygdala and orbitofrontal area when exposed to negative stimuli. This activation could there for stimulate executive functioning processes which would explain why women’s cumulative test scores are slightly better.

Although this may explain why women scored well on the cumulative test scores, it does not explain for their poorer performance on correct word responses or time. As noted in an article by Quirk and beer (2006), “studies have found activation in the orbitofrontal and/or inferior frontal cortex in association with suppressing or reappraising negative emotional stimuli”. Processes like these clearly take a degree of cognitive control, and the more control a cognitive process requires, the less energy left
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for other task. Because women have been shown to have greater activation in this area (Koch, 2007), it could be that there is some level of suppression of reappraisal, which could create competition in cognitive abilities, and explain poorer performance on time's and correct responses.

Precautions taken in previous studies were ignored in the current and because of that, there is a possibility that emotional induction was not strong enough. In Hunter et al (2010) sounds were listened to in a listening booth to ensure that external stimulus did not pollute the sound. Also, through use of a computer program they were able to artificially alter the tempo of all their songs while in the current study it was only able to be done with one of them. At the end of both Hunter et al (2010) and Koch et al (2007) surveys were filled out to note the feelings of the participants and the effectiveness of the emotional stimuli. By incorporating these into their studies they were able to tell not only that there was emotional induction, but also to what degree the subject believed it affected them. By incorporating this into future experiments, researchers would be able to learn more about performance under different emotional states.

An idea for future research would be to direct attention towards if the arousal in males from erotic stimuli produced the same affect as arousal in females from negative stimuli it terms of its affects on cognitive abilities. This could answer the question whether or not this increased neuronal activation in the prefrontal lobe does in fact facilitate a sort of spreading activation to areas of the executive function. As noted by Koch (2007) males also showed stronger activation in the inferior parietal region, so if spreading activation was in charge, the closer this pronounced activation occurred, the quicker performance would be. This study also did not incorporate pictures of
threatening situations or mutilation which could also account for the lack of effect. As noted in Bradley et al (2001) men and women showed the greatest affective response in the presence of these stimuli. The addition of this in future experiments could sufficient arousal in participants.

In conclusion this experiment failed to show an effect of emotion on gender, but did show a main effect of emotion on time. Future research should pay closer attention to sound quality, computer manipulation of songs, scales to gage participant’s emotional and perceptual states. Through presentation of more arousing stimuli in future studies, there should be a more pronounced difference between test scores.
References


Appendix A
Appendix B
Appendix C

Analysis of variance for scores

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Analysis of variance for scores + time (10 second penalty added on for each error)

Critical value

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