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Influence of aversive visual stimulation on attention, working memory, and anxiety in university students

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Abstract
The present study investigated the influence of aversive visual stimulation on anxiety, working memory, and selective attention. The study was conducted with 366 participants of both sexes, divided into three groups: (i) no visual stimuli (n = 128), (ii) neutral visual stimuli (n = 114), and (iii) aversive visual stimuli (n = 124). Two DVD films, one containing aversive stimuli and one containing neutral stimuli, were used for the respective groups. Each visual stimulation had a duration of 1 minute and 22 seconds. After viewing the DVD, anxiety, working memory, and attention were assessed. Concomitant with the increase in anxiety were deficits in working memory and deficits in selective attention in the group that was exposed to the aversive scenes. No gender differences were observed. These results suggest that aversive visual stimuli increase anxiety and decrease attention and working memory performance in university students. Keywords: gender, mood induction, emotion, cognition.

Introduction
Studies on violence have been increasing, but not in the same proportion as the actual rise in violence, which has afflicted society and caused cognitive damage (McAlister, 2000; Rangel, 2004a).

Progress in the means of communication, the greater speed and quantity of information acquired, and the relationship between human perception and behavioral support underscore the importance of studying the fields of communication, cognition, and social relationships to better understand basic processes (Aronson, 1995; Rangel, 2004a).

Visual exposure to violence on television and its effects on aggressive behavior in children and adults have been increasingly explored since the 1980s, when the strong correlation between this type of stimulus and the rise in aggressive behavior was established (Centerwall, 1989; Gerbner, 1988). This fact was noted in the report of the Surgeon General’s Scientific Advisory Committee on Television and Social Behavior (1972) and the National Commission on the Causes and Prevention of Violence (Gerbner, 1988), which concluded that the increase in violence is directly associated with the increase in violence in the media, which was subsequently confirmed by the National Institute of Mental Health (Rangel, 2004b). According to some studies (Aluja-Fabregat & Torrubia-Beltri, 1998; Comstock & Strasburger, 1990; Freedman, 1984), this visually witnessed violence, especially on television, stimulates aggressive behavior. The concern raised by these authors is based on the fact that this observed violence covers all violent acts witnessed by the individual. Even if the individual is not directly involved in the action, the person could be subject to suffering only by viewing it. The consequences of this type of visual stimulation are not yet fully known. Normally these types of stimuli, either active or passive, affect the spectator (Browne & Hamilton-Giachritsis, 2005). This stimulation has been termed “life events” to emphasize that they are common in our daily lives and in most cases are not noticed. The stressful stimulation was also classified as either dependent (i.e., with action and participation of the individual) or independent (i.e., without the individual being a participant or directly affecting the event; Margis, Picon, Cosner, & Silveira, 2003).

The influence of daily stressful stimuli on child behavior was verified by Gerbner (1988), which showed that children suffer the most or endure the most cognitive changes from this exposure (Anderson,
Participants

This study included a total of 366 participants of both sexes, aged 18 and 52 years, averaging 24 years and 4 months (SD = 4.96). Subjects were divided into
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Table 1. Description of the groups and percentage (%) of females and males in each group and total number (n) of participants.

<table>
<thead>
<tr>
<th>Group</th>
<th>Female n</th>
<th>Female %</th>
<th>Male n</th>
<th>Male %</th>
<th>Total n</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>68</td>
<td>54%</td>
<td>60</td>
<td>46%</td>
<td>128</td>
<td>35%</td>
</tr>
<tr>
<td>Neutral Stimuli</td>
<td>60</td>
<td>52%</td>
<td>54</td>
<td>48%</td>
<td>114</td>
<td>31%</td>
</tr>
<tr>
<td>Aversive Stimuli</td>
<td>71</td>
<td>57%</td>
<td>53</td>
<td>43%</td>
<td>124</td>
<td>34%</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>54%</td>
<td>167</td>
<td>46%</td>
<td>128</td>
<td>35%</td>
</tr>
</tbody>
</table>

Three groups: (i) no visual stimulation (n = 128), (ii) neutral visual stimulation (n = 114), and (iii) adverse visual stimulation (n = 124) (Table 1).

In Group 1 (no visual stimuli [no movie]), 54% of 128 participants were female (n = 68) and 46% were male (n = 60). An average of 25 students per session (i.e., one class) completed the questionnaire. In Group 2 (neutral visual stimulation), 52% of 114 participants were female (n = 60) and 48% were male (n = 54). In Group 3 (adverse stimulation), 57% of 124 participants were female (n = 71) and 43% were male (n = 53).

The highest family income of the sample consisted of 38.25% (n = 140) with an income between R$3,000.00 and R$1,001.00. Most of the sample was between the second and fourth semester (79.23%) of their courses. The average time spent at university was 3.2 semesters (SD = .70). A questionnaire was used that included a total of five direct questions about visual stimulation through movies, in addition to demographic identification and a self-assessment test regarding emotional valence experienced by movies. Two DVD movies, one including the contents of a hit-and-run accident (adverse) and another including neutral content (a person running continuously without his face being shown), were used for the respective groups. Each visual stimulation had duration of 1 minute and 22 seconds.

**Instruments**

The three selected tests to compose the battery of this study were the following:

State-Trait Anxiety Inventory (STAXI): This instrument was created by Spielberger, Gorsuch and Lushene (1970), translated, and adapted to Brazil by Biaggio and Natalício (1979/2004). The STAXI presents anxiety scales divided into state-trait, rendering the class of anxiety identifiable (i.e., situational [provoked or momentary] or trait [more permanent]). The STAXI also presents standards for these two factors, as well as for the entire scale (single factor with 20 items; Cronbach $\alpha = .79$), and allows for distinctions between males and females.

Concentrated Attention (CA): This instrument was produced by Cambraia (1967) to identify the level of attention and it has reliability (Cronbach $\alpha = .73$).

Personal Selection Testing subtest for memory (PST-M): This instrument was created by King (2004). The PST-M is composed of 11 subtests, presenting scores for attention, perception, thought, dexterity, memory, dimension, parts, precision, fluency, objects, and judgment among others. The memory test was employed in this research to account for visual exercise performed in daily life. The PST-M scores the ability to retain and mention names, traits, and details.

A pilot study was carried out with 23 students of both sexes to examine the structure of the questionnaire and emotional valence of the content of visual stimulation (movies). The content of the movies was suitable for what was proposed, considering that the movie with adverse content (visual stimulation with unpleasant emotions) was identified as adverse and unpleasant by 100% of the participants, and the neutral movie was identified as “normal” by 75% of the participants (with classifications of “pleasant” and “curious” by the other 25%).

The study began by recruiting participants from classes of each department of a private university in the metropolitan area of Porto Alegre. Subsequently, recruitment from classes that would represent each department was carried out (Departments of Exact, Human, Law, Social Communication and Economic Sciences and Department of Health) so that each department contributed three classes. Each class was assigned to a specific group (Group 1, 2, or 3). The first class comprised Group 1 (control group), the second class comprised Group 2 (neutral visual stimulation), and the third class comprised Group 3 (adverse visual stimulation [unpleasant emotions]). After the purpose of the study was explained, the three groups completed the consent form.

**Procedure**

The procedures of the three groups were identical, with the only difference that after the consent form was
collected, testing of Group 1 began without playing the short movie. Group 1 (no visual stimuli [no film]) was composed of 133 students, with an average of 25 students participating at one time (one class) to answer the questionnaire. For Group 2 (neutral visual stimulation), the initial procedure was identical to Group 1, but after completing the consent form, the movie with repetitive visual stimuli was shown. The movie duration was 1 minute and 22 seconds, in which a person appeared on the screen with the back turned to the audience (i.e., the face was never shown), running along a deserted road. After the movie, participants answered a questionnaire, and tests (anxiety, attention, and memory) were administered. The order of the tests was changed to avoid the same order of instrument application. In Group 3 (adverse visual stimuli), the same procedure as Group 2 was used, but the film showed scenes of a hit-and-run accident. The total time of visual exposure to the film was 1 minute and 22 seconds. Films were previously edited to have the same duration. The STAXI lasted 10 minutes. The AC test lasted 5 minutes, and the PST-M lasted 30 minutes. The total time for application of all tests was 45 minutes.

Data were analyzed using SPSS software for Windows version 17.0. Analysis of variance (ANOVA) was used to analyze the variables of the three groups. Student’s t-test was used to analyze gender differences, and the Bonferroni post hoc test was used to analyze the relationships between variables. Values of \( p < .05 \) were considered statistically significant (Table 2).

**Results**

The results showed that the groups subjected to adverse stimulation had changes in working memory (PST-M) and attention (AC), with significantly reduced performance and elevated anxiety scores (STAXI). A significant increase in the level of anxiety in the group with adverse stimulation was also found when compared with the control and neutral groups. The questionnaire also showed the grading of the movie watched by the participants. In Group 2, 87% of the sample classified the movie as neutral. In Group 3, 88.7% of the sample classified the movie as adverse. When asked about the frequency of unpleasant events in daily life, 54.64% (\( n = 200 \)) of the participants responded that such unpleasant events occur a few times per month. Subsequently, participants were asked to define what would be adverse and what each participant would avoid witnessing or watching. More than 80% of the entire sample indicated dramatic events such as fire, assault, and death. Only 12.29% would avoid an adverse movie. Finally, the last part of the questionnaire investigated how participants judged their memory, and more than 60% of the total sample was satisfied with their memory, believing it as good or great. Comparisons of the anxiety variable of the three groups indicated a significant difference between Group 3 (adverse stimulation) and the other groups. Group 1 (control) had \( M = 42.41 \) and \( SD = 7.8. \) Group 2 (neutral) had \( M = 42.71 \) and \( SD = 7.53. \) Group 3 (adverse visual stimulation) had \( M = 52.72 \) and \( SD = 10.08 \) (Figure 1). The attention variable was also different between Group 3 (adverse stimulation) and the other groups. Group 1 (control) had \( M = 93.76 \) and \( SD = 17.05. \) Group 2 (neutral visual stimulation) had \( M = 91.15 \) and \( SD = 14.96. \) Group 3 (adverse visual stimulation) had \( M = 74.25 \) and \( SD = 11.43 \) (Figure 2). With regard to the working memory variable, a significant difference was found between Group 3 (adverse stimulation) and the other two groups. Group 1 (control) had \( M = 38.27 \) and \( SD = 4.76. \) Group 2 (neutral visual stimulation) had \( M = 37.43 \) and \( SD = 6.87. \) Group 3 (adverse visual stimulation) had \( M = 28.22 \) and \( SD = 7.18 \) (Figure 3).

**Discussion**

Students presented high levels of anxiety when subjected to aversive visual stimulation (aversive film) and a decline in their working memory and concentrated attention compared with the participants of the other

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**Table 2. Anxiety, working memory, and attention scores from each group (mean [M] and standard deviation [SD]).**

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th></th>
<th>Group</th>
<th></th>
<th>Group</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( M )</td>
<td></td>
<td>( M )</td>
<td></td>
<td>( M )</td>
<td></td>
<td>( F (df) )</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>G1</td>
<td>42.41</td>
<td></td>
<td>42.71</td>
<td></td>
<td>52.71</td>
<td></td>
<td>10.08</td>
<td>59.09 (2)***</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>42.71</td>
<td></td>
<td>7.53</td>
<td></td>
<td>28.22</td>
<td></td>
<td>7.18</td>
<td>74.40 (2)***</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>93.76</td>
<td></td>
<td>14.96</td>
<td></td>
<td>74.25</td>
<td></td>
<td>11.43</td>
<td>51.52 (2)***</td>
</tr>
</tbody>
</table>

\*\( p < .05 \), **\( p < .01 \), ***\( p < .001 \)

*** significantly different from control and neutral groups

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No significant differences in outcome were observed between males and females in both questionnaire responses and tests. Cognitive function analyzed after aversive stimulation suffered similarly in males and females. Previous studies have demonstrated differences in brain activation, under the same conditions, of a sample of women compared with men, but generally, the functions of working memory and concentrated attention show the same performance (Sarlani & Greenspan, 2002; Schneider, 2000; Shields, 2003; Zald & Kim, 1998). Other authors have shown that men and women tend to present differences when judgment, logic, and verbal expression are analyzed (Gorsky & Willis, 2003; Gur, Gunning-Dixon, Bilker, & Gur, 2002). Differences may exist between performance in both sexes, depending on the combination of stimulation and the function analyzed. Working memory and concentrated attention performance declined when participants were subjected to a state of anxiety caused by aversive stimulation, while the performance of the other groups remained unchanged. These data indicate a relationship between anxiety and performance in concentrated attention and short-term memory.

Anxiety is known to play an important role in the functions of memory, learning, decision-making, and creativity (Compton, 2003; Damasio, 1999; Davis & Whalen, 2001; Dolan, 2002; Loewenstein & Lerner, 2003). Mental function performance is directly linked to the different levels of anxiety experienced and the strategies adopted by each individual to deal with this function (Gable, Reis, & Elliot, 2000; Leen-Feldner et al., 2007; Sloan & Kornstein, 2003; Updegraff, Gable, & Taylor, 2004). Aversive stimulation in the induction of humor (Gilet 2008) can be generated by visual material, such as a movie containing scenes of urban violence. This effect, obtained in handling humor, was obtained using visual materials by Gilet (2008), in which the methods of humor induction can be made according to culture and necessity to thus achieve its goal with greater precision. The tests tend to easily reach their objectives of humor induction, but the more adapted to a particular population, the better the outcome and effect (Slyker & McNally, 1991). In Brazil and the other countries where this research was carried out, a need was noted for an adaptation of humor-inducing tests (Gilet 2008). The few edited tests cannot guarantee the same effectiveness in various cultures, but because of the scarcity of such tests, they are still widely used (Bower & Forgas, 2000).

Unlike induction, data collection has been very reliable over time, with appropriate and adapted tests for each culture. Although the same tools are used, the tests are updated and can be used along with other verification methods, such as positron emission tomography (Davidson, Chapman, Chapman, & Henriques, 1990). The tests used in the present survey have proven to be effective at reporting and measuring the clear influence of stimulation on concentrated attention and memory. Although not used in this work, other tests are also effective, and other functions can be investigated (e.g., changes in mood and judgment capacity; Thayer, 1996).

In addition to deficits reported in these functions, other studies have shown interesting results by researching the positive effects of stimulation, such as with verbal and logical fluency. However, difficulties have been commonly reported in mapping brain activity (Bartolic, Figure 1. Anxiety level scores from the three groups. G1, Group 1 (control); G2, Group 2 (neutral visual stimulation); G3, Group 3 (adverse visual stimulation). ***p < .001. *** significantly different from control and neutral groups

Figure 2. Attention scores from the three groups. G1, Group 1 (control); G2, Group 2 (neutral visual stimulation); G3, Group 3 (adverse visual stimulation). ***p < .001. *** significantly different from control and neutral groups

Figure 3. Working memory scores from the three groups. G1, Group 1 (control); G2, Group 2 (neutral visual stimulation); G3, Group 3 (adverse visual stimulation). ***p < .001. *** significantly different from control and neutral groups...
Basso, Schefft, Glauser, & Titanic-Schefft, 1999; Sen, 1997, 1998). Reiman et al. (1997) and Lane, Chua and Dolan (1997) also mentioned the difficulty of establishing analyses and mapping of emotions in the brain in regions such as the hypothalamus, prefrontal cortex, thalamus, and median cerebral cortex, which are activated in very similar ways by both adverse and pleasurable stimulation. A prior definition of how much and how certain adverse visual stimulation will interfere with the behavior of an individual is very difficult, but the present findings indicate the clear effects of stimuli and feelings on cognitive performance. The present results suggest that changes in cognitive function, including short-term memory and concentrated attention, occurred with adverse visual stimulation. Elevated anxiety negatively altered short-term memory and concentrated attention. Future studies should be conducted with a longer period of adverse visual stimulation exposure to evaluate how long these cognitive changes endure and to more precisely determine their effects on cognition and emotion.

References


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Pan American Health Organization.