Investigating the relationship between emotional state and attention and its implications for HCI

Boris Filin

The Australian National University

u7637604@anu.edu.au

Abstract

I participated in two experiments investigating the relationship between a person's emotional state and their visual spacial attention. The first experiment was focused on strong immediate stimuli, whereas the second focused on my long-term emotional state, and both presented me with attention tasks. I concluded that when I am disturbed, I become less attentive and more prone to failing reaction checks. The results match the previous findings of other researchers in the area, and highlight the importance of intuitive design in emergency websites of all sorts.

Introduction

This report describes two similar experiments that investigate the relationship between a person's emotional state and their attentiveness. Both descriptions include a brief synopsis, objective recall of events alongside subjective participation experience, as well as a constructive critique. The two experiments are then compared directly to one another. Finally, the report ends with a discussion of possible relationship between mood and attention and its implications for the Human-Computer Interaction.

Experiment 1

Emotion and Attention Experiment
(Official name: Emotion and Attention Experiment (Warning: contains graphic & emotionally-evocative stimuli))

Background

According to the official description of the experiment on the Sona page, "The project aims to test the relationship between emotion and attention". More specifically, it tests the changes in human attention directly following short emotional stimuli, both positive and negative. The latter elicit sexual excitement and disgust respectively. Because of that, multiple content warnings are presented before the test.

Methodology

The first two parts of the experiment have a cross in the middle of the screen to fix participant's gaze. They are then shown a picture for approximately half a second. Then a letter made out of

smaller letters appears on the screen. If the participant sees a T, they are asked to press the T key on their keyboard. Likewise, they should press H if they see H.
In the first part of the task, H or T are the smaller letter that the bigger ones are made out of. That tests immediate reflexes, as the participant only needs to look at one letter in the middle.

HHHHH
H
HHH
H
H

Figure 1. A recreation of a letter from part 1 of the experiment

In the second part, the smaller letters are insignificant, and the bigger letter is either H or T. That tests global attention, because the participant needs to shift their focus and spend a moment identifying the big letter.

EEEEE
E
E
E
E

Figure 2. A recreation of a letter from part 2 of the experiment

The images shown are not mixed. They begin with neutral images of people's faces and human interaction. Then they suddenly become sexual in nature, mixed with pictures of human achievement – astronauts, parachute acrobats, etc. At the end of each part, the images become disturbing and disgusting. The specific description is avoided for the reader's safety.

The final part of the experiment presents the participant with a number of pleasant images, such as flowers, nature, and cute animals. The participant can look at each one as long as they want before moving on to the next.

Figure 3. One of the images (similar to) from Part 3 of the experiment
Source: https://photos.com/featured/mother-polar-bear-with-cub-lying-on-art-wolfe.html

Personal Experience

Going into this experiment, I was focused, so I only made one or two mistakes with the neutral images. The erotic content was slightly more distracting, but I still managed to get most of the attempts right. But when it came to the unpleasant imagery, I found myself significantly more disturbed, and it was harder to focus on the tasks, especially in Part 2, where more attention was required.
I suspect that Part 3 was put in place to relieve the participants after the gross pictures. It definitely helped me get my mind off the scary parts of the experiment. In fact, my brightest memory from the test is that of a picture of two dolphins playing with a soccer ball from the last part.

Critique

By far the biggest flaw of the experiment was a relatively small amount of pictures for each section. Because of that, each image could be seen up to five times in each part. This directly affected the quality of the data, because after seeing a picture for a couple times, it no longer evoked as strong of a reaction. That was especially noticeable with the disturbing imagery, when without the element of surprise my mind tried to discard the picture, and as a consequence I made less mistakes in attention tasks.

Experiment 2

Mood & Attentional Control Experiment

Background

According to the Sona page of the experiment, “The goal of this project is to understand the relationship between trait anxiety and spatial attentional control”. It goes on to state that correlation between nervousness and decrease of attention is already being investigated, but the inclusion of visual spatial attention remains unexplored.

Methodology

The experiment is comprised of a survey followed by three increasingly difficult attention tests. Apart from general demographic information, the survey enquires about the participant’s mental state at the current time, as well as generally. It also asks how attentive they are in different ways, such as remembering people’s names or forgetting their keys. Then the participant is redirected to a download page for an external application used for the tests. The web page also has a link that should be pressed once the application is installed, that opens the main part of the test.
At the beginning, for a split second the participant is shown an icon of either a car or a truck. Then the image is covered with black-and-white noise, presumably to prevent the appearance of an afterimage. On the next screen the participant has to choose which icon they think they just saw.

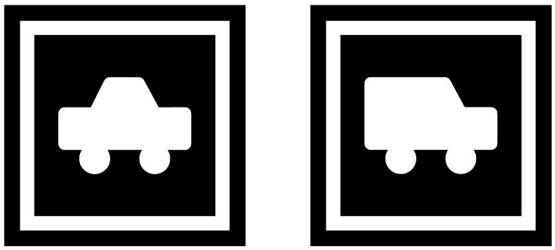

Figure 4. The recreation of icons used in the experiment

Those steps are then repeated a number of times, and each time the image disappears faster. For the second part, the process is the same, except there is a second icon – a car, and it appears in one of the 8 directions – cardinal and diagonal. The participant is then asked not only which icon was in the middle, but also the direction towards the second icon. Finally, in the third and final stage, the same thing happens, but this time all of the circle inside the directions is filled with white triangles in black squares, making the second icon way harder to find.
The test concludes automatically, and the window of the application closes.

Personal Experience

When answering the specific survey questions, I realised that I am generally very attentive except when it comes to human interaction, especially remembering names. Maybe because of that I made relatively few mistakes when completing the first two parts of the attention test, and managed to get even the last, very short, image flash. However, when doing the last part that was filled with triangles, I had to guess almost all of my answers.

Critique

First of all, following the last sentence of the last paragraph, the last section of the experiment was practically impossible. The triangles cluttered my peripheral vision, and the tenth of a second given for each image was not enough to spot the second icon. While that might be the intended behaviour of the test, I presume that the necessity to guess affects the data negatively. Perhaps a “skip” button would be more suitable.
Second, the two icons used in the test were very similar, as can be seen by their approximate recreation in Figure 4. Because of that it was easy to confuse them. Perhaps a more distinct shapes would be more appropriate.
Lastly, and this is the biggest issue, the test results were not saved, even though I did everything exactly according to the instructions. I completed the entire test and the window closed automatically as intended (according to the download page), but a day later the experiment status is still “pending” on Sona.

Experiment Comparison

Both experiments investigate the relationship between the human mood and visual attention. They employ similar means of time-based interactive testing. However, they test different aspects of participant’s emotional state. The first experiment focuses primarily on the instantaneous emotional

response to strong stimuli, whereas the second one looks at the participant's general emotional state, both long-term and short-term. It obtains that information by directly asking the participant.
The first experiment has a very narrow focus, in a sense that it only tests unconscious reactions to stimulating imagery.
On the other hand, the second experiment has a much broader scope – it records a lot of various data about not just the participant's emotional state, but also their general attentiveness. Because of that, the second experiment produces a lot more data, but is also less accurate, because it relies entirely on people's recollections of themselves rather than specific stimuli.

The Implications for the HCI

Even though the tests were not directly related to Human-Computer Interaction, their results are important for a certain part of that field. To clarify – part of the conclusion of the two experiments is that people in a state of distress or shock, as well as long-lasting anxiety, are much less attentive, particularly visually. The results are consistent with the work of Fales et al. (2008), which examined the relationship between anxiety and attention control from a physiological perspective. The study found that "*... the high-anxious group showed significantly reduced sustained activity in cognitive control regions but increased transient activation during task trials*", confirming the theory proposed by Bishop (2007) that "*higher anxiety reduces cognitive efficiency by impairing the ability to recruit working memory regions in what may be an optimal manner*".
When it comes to web development, disturbed people are not usually considered as a large part of a website's audience. However, that does not apply to emotional support sites, domestic abuse help and other emergency websites.
A lot of those sites have to deal with people in the state of despair or confusion, and these experiments clearly show that developers of such websites have to go an extra mile to ensure that the page is as simple and clear as possible, so that people who maybe cannot properly focus after a traumatic episode can still find the information they desperately need. For example, emergency help phone lines or chats have to be the first thing anyone notices when visiting the site.

References

1. (*Experiment 1*) Goodhew, Emotion and Attention Experiment (2023) https://anupsych.sona-systems.com/exp_info_participant.aspx?experiment_id=1039
2. (Experiment 2) Goodhew, Mood & Attentional Control Experiment (2023) https://anupsych.sona-systems.com/exp_info_participant.aspx?experiment_id=1046
3. Fales, C.L., Barch, DEM., Burgess, G.C. et al. Anxiety and cognitive efficiency: Differential modulation of transient and sustained neural activity during a working memory task. Cognitive, Affective, & Behavioral Neuroscience 8, 239–253 (2008). https://doi.org/10.3758/CABN.8.3.239
4. Sonia J. Bishop, Neurocognitive mechanisms of anxiety: an integrative account, Trends in Cognitive Sciences, Volume 11, Issue 7 (2007). https://doi.org/10.1016/j.tics.2007.05.008