Studying the contextual cues associated with fear of crime through eye tracking techniques

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Abstract. Fear of crime is a hot topic of criminological field and a problem in its own right. Researchers have been studied the individual and contextual variables of fear of crime. This project applies eye tracking techniques to deep explore the features of environment that have an impact on fear of crime. In addition, it intends to analyze the selective attention to emotional pictures in comparison with neutral ones. Using an eye tracker a set of measures were collected: probability of first fixation, total fixations number, total duration of fixations and number of dwells in each region. Contrary to the literature, individuals mostly focus their time in neutral images when comparing to emotional ones. Also, negative image captured more attention comparing to a positive picture. The prospect of environment was important to subjects as well as features such as graffiti and window bars. The results and limitations of research will be discussed.

Keywords: fear of crime; emotions; contextual variables; eye tracking.

1. Theoretical background

1.1. Definition and determinants of fear of crime

The focus of this project is to explore the emotional component of fear of crime and the contextual aspects of the environment associated with it. Fear of crime has been defined as a negative reaction to crime or symbols associated with it [1]. Fear of crime (as the crime itself) has an unequal spatial and temporal distribution [2]. The *hot spots of crime* and hot spots of fear of crime do not always overlap [3]. Several authors point out the incivilities - *social and physical conditions that are viewed as troublesome and potentially threatening* such as graffiti, litter and vandalism – as having a negative impact on fear of crime [4, 5]. Blocked viewpoints where potential offenders can hide and/or areas with blocked escape are associated with fear of crime [6]. Also, the lack of lighting is one of the greatest cue associated with increased fear. Painter [7] argues that darkness increases feelings of vulnerability due to the reduction of area vision field. Guedes et al., [8] found that in night and non-rehabilitated conditions people reported higher levels of insecurity and negative emotions. The spatial cues associated with these feelings of insecurity were lack of luminosity, the state of conservation of buildings and the presence of corners and alleys.

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1.2. Previous eye tracking studies

To our best knowledge, fear of crime has not been addressed with eye tracking techniques. Davoudian & Raynham [9] using an eye tracker found that subjects spend less time looking to footpath at night comparing to daylight since night condition made people spend longer time evaluating their environment. Much is known about the selective attention to emotional pictures through eye tracking. Wadlinger & Isaacowitz [10] attempted to analyze the effects of valence in selective attention. They found that subjects presented a heightened attentional breadth in emotional positive images comparing negative images. Also Nummenmaa et al., [11] found that individuals first looked to emotional pictures and the fixated more the emotional pictures. Moreover, individuals looked more to emotional pictures with negative and positive content comparing to neutral pictures. Quigley et al., [12] in order to compare the effects of trait and state anxiety on selective visual attention to emotional pictures found that state anxiety (but not the trait anxiety) was related to increased attention to threatening images. They conclude that individuals first looked at emotional pictures comparing to neutral ones.

2. Goals

The present study aims understanding the impact of environment on fear of crime. The research questions are: a) what are the physical features of urban images that are more observed by individuals during an eye tracking task; b) what is the first environmental feature that individuals first look? Additionally, c) individuals focus more their attention to emotional or neutral images; lastly, d) controlling for arousal, individuals look more to images with high or lower valence?

3. Methods

3.1. Subjects

The results presented in this study are from 10 voluntary students (5 were female) of University of in which all the data were available. All the participants signed the informed consent.

3.2. Stimuli

Stimuli were 19 pictures selected from a set of 50 images previously rated to valence (1-9 points), arousal (1-9 points), fear of crime (1-5 points) and victimization risk perception (1-5 points). The selection of pictures was made in order to meet the criteria for this research: compare neutral with emotional pictures, low with high valence pictures and lastly images with low and high fear of crime levels.

3.3. Apparatus

Stimuli were presented on a 19-in (48.3 cm) HP monitor (1440 by 900 pixels of resolution) with a Dell Intel® Core ™ i5 computer. Participant's eye movements were recorded with a Mirametrix Tracker S2®. The sample frequency of eye tracker was 60 Hz. The presentation of stimuli was held by PsychoPy v1.80, an open-source package for running experiments. Programming for stimuli presentation and data analysis was done in collaboration with a physics researcher. To draw and select the areas of interest (AoI) of pictures Paint.net was used. The size of each individual picture was 1720 x 720 pixels. Pictures were randomized in the experimental protocol.

3.4. Stimulus displays and procedure

Volunteers were tested individually. After signing the consent form, they were seated 85 cm apart from the screen. A computer mouse was handed to them for responding to the questions. The calibration was made and accepted if estimated error was lesser than 40. Then, the experiment started. Before each trial a fixation point appeared on the center of the screen during 3000ms. After the fixation point, either a pair of pictures appeared during 4000ms or an individual picture during 6000ms. In total, there was 14 trials (6 individuals and 8 pairs). Each stimulus display consisted in one of these two situations: a) a pair of two pictures varying in levels of arousal and valence or b) an individual picture representing an urban context varying in fear of crime. The pictures were either presented in two opposing corners of the computer screen (if pair) or in the center of it (if individual). Following each trial individuals were asked to assess if levels of valence were equal (in pairs) and if the place was insecure (in individual images). After the eye tracking experience, the participant answered to a questionnaire of personal characterization.

3.5. Measures

The measures were different according to the category of photos (pair of individual). To analyze the selective attention in pair pictures, the measures were: a) probability of first fixation after stimulus onset, b) duration of first fixation (ms), c) number of total fixations in each image, c) total duration in each image (ms). For the individual pictures, the measures were: a) probability of first fixation in an AoI, b) number of total fixations each AoI and c) dwell total time in each AoI (ms), that is, the duration in each AoI from the entry to the exit.

4. Results

Emotional and neutral pictures

In order to test if individuals would look more to emotional pictures regardless the stimuli content (positive or negative) in comparison with neutral pictures four pairs were presented to subjects. In two of the four pairs of images, individuals looked firstly to the emotional picture. However, in pairs 1 and 7 individuals looked first to the neutral image. Results of total fixation and dwells number were analyzed. Non parametric tests were carried out to observe the existence of statistically significant differences between emotional and neutral pictures. Although there were no differences in total fixations number and in the total dwells number ($p>.05$), in pairs 1 ($p=.019$) and 2 ($p=.037$) individuals fixated more the neutral pictures. On contrary, in pair 4 ($p=.047$) individuals fixated more the emotional picture.

Low and high valence

To address the goal of analyzing the differences of selective attention to pictures differing in low and high valence, two pairs were presented to subjects. Results show that although individuals firstly looked to image with positive valence in pair 3, the same did not occur in pair 6. Regarding the other variables it is possible to observe a difference in pair 6 for the total fixations number ($p=.07$) and for the total duration of fixations ($p=.01$).

Individual pictures heatmaps

Pictures 1, 2, 3 and 4 represent the heat maps (see attachment 1 to see picture 1 and 2), that is, the locations of images which had a higher gaze direction. The image 1 shows that individuals mainly focus a) building under construction, b) window bars, c) the shadows and the corner of the

left size of image. Regarding picture 2, which is a place with a high prospect and large streets, it is possible to observe that individuals mostly focus the bottom of the road giving the idea that they are measuring the length of it. They also focus people passing by and the buildings. In picture 3 it is clear that subjects mainly focus the black tunnel and also the graffiti (signs of incivility). Lastly, in picture 4, similar to picture 2, individuals mostly focus the end of the street.

5. Discussion

This ongoing study has the main goal of analyzing the selective attention to emotional pictures which depict urban spaces. Concretely, we intend to explore, in one hand, what are the features of urban spaces previously rated for insecurity level that capture the attention of individuals and, in other hand, the differences of attention for emotional and neutral pictures. To address these goals, an experience using eye tracker was planned. A set of trials were presented to a sample of 10 individuals and a few measures were collected. Regarding the comparison between neutral and emotional images, the results were mixed. The first fixation was consistently directed to the left images regardless the content (emotional or neutral). This fact shows a tendency for individuals to look firstly to the left side which is related to a limitation of our work (position of pictures presented). In future work, images should be positioned in different parts of the screen to overcome this limitation. Contrary to the literature, individuals mostly fixated longer time the neutral pictures (excluding one pair). One explanation for this result could be that these are naturalistic pictures that depicted urban spaces in which external variables (complexity and luminosity) are difficult to control. So that, in future research it would be important to control these variables and to compare pictures with a higher difference for valence levels. Regarding the comparison between low and high levels of valence, it is possible to observe the same tendency of looking firstly to the left side. Moreover, in one of the pairs, negative image (which represents a narrow street with graffiti at night) captured more attention than positive image. This result could be explained by the fact that, at night, individuals take more time adapting and evaluating the environment. However, to study these hypothesis, it would be important to overcome another limitation of this work: the size of the sample and the low amount of trials. Since this is an ongoing study, when more data are collected it will be possible to obtain better internal and external validity. Lastly, the analysis of heat maps revealed the importance of prospect of urban spaces since the bottom of the streets was the feature that captured more attention to subjects. So that, when walking in an urban environment they make an evaluation of (in) security through how much they can see of that space. This result was already obtained through surveys by authors such Nasar and colleagues [2]. Others aspects of the environment previously rated as insecure were the window bars, graffiti and buildings under construction at night. The window bars could transmit to individuals that the space is not secure and needs extra precaution. Moreover, elements such graffiti are, according to literature, signs of disordered places that no one takes care [3, 5]. In future work would be important to use interviews in order to deep explore the meanings attributed by individuals to these environmental features.

In conclusion, to our best knowledge eye tracker has not been applied to fear of crime studies. Although with a few limitations mentioned above that will be soon overcome, this ongoing research contributes to the literature of fear of crime since it points out important elements of environment associated with it. In order to have a more complete understanding of this phenomenon, qualitative work should be complemented with eye tracking techniques.

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Attachment 1

Picture 1 **Picture 2**