Fixation Analysis of Affective Picture Processing in Aggressive Adolescent

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ABSTRACT

Aggressiveness is an emotional state associated with physical or verbal violence or destruction towards others or oneself. Aggressive behaviors in adolescents are a frequent reason for consultation in mental health care services because it generates negative consequences in the life of the person and their environment, in addition, it increases the probability of school dropout, psychiatric disorders, and substance abuse. The study contemplates the presentation of images with positive valence and images with a negative valence of the set IAPS to 60 adolescents who were previously evaluated with the CAPI-A test, divided into 30 adolescents with aggression and 30 without aggression. The results were analyzed through an eye tracker and indicate the existence of bias in the visual attention of aggressive adolescents towards negative stimuli, while non-aggressive adolescents tend to focus on positive stimuli.

Keywords: Aggressiveness, Adolescents, Eye movement, Positive stimuli, Negative stimuli

INTRODUCTION

Aggressiveness refers to any intentional action performed to provoke harm towards others or oneself, aggressive behavior can be verbal or physical, and the aggressor attacks hopping that the victim is harmed in some way (Arsenio, 2004; Li et al., 2010; Ramírez et al., 2020).

Adolescence is a biopsychosocial development phase considered one of the most important stages of life because in this phase of the life cycle occurs physical, psychological, and social change, this transition changes the relationships of adolescents with other people in the family, social and school environment (Glock et al., 2008; Musitu et al., 2012). The environment family passes to second place and adolescents are mostly influenced by the social environment, they behave violently within the group to obtain respect and popularity among themselves, increasing the probability that these aggressive behaviors continue, from this age everyone wants to imitate the most powerful of the group, even if he is a negative leader (López, 2013), it increases the probability of having others violent behaviors in the

future, school dropout, psychiatric disorders and substance abuse (Estévez y Jiménez, 2015).

Aggression is the result of a complex interplay of various neurochemical substances and other factors that may be: environmental, neuroanatomical, hormonal, and genetic, specific structures such as the frontal lobe, hippocampus, amygdala, and thalamus are involved in the regulation and control of decision making, behavior, and aggressive behavior (Rubio, 2009; Calero e Ibañez, 2020; Ortega y Alcazar, 2016). In adolescents, environmental factors induce aggressive behavior, but, mostly the biological factor, such as serotonin, norepinephrine, and dopamine neurotransmitters, influence these aggressive responses (Arias, 2013).

Identifying new modalities for the early detection of aggressive behaviors will help prevent them in the future (Lin et al., 2016). Visual tracking technology known as eye tracking is responsible for obtaining and analyzing the eye movements of a person toward a certain scene or image, also allows us to perform inferences about our attention patterns and cognitive processing, recording what the subject observes, the time interval of his observation, visual trajectory and pupil dilation to presented stimuli (Isaacowitz et al., 2015; Duchowski, 2017).

The eye tracking methodology has identified that aggressive adolescents put more attention to signals of hostility and threat in other people's behavior and that gaze fixation time in hostile signals can predict aggressive behavior (Lin et al., 2016; Lauel et al., 2018). Adolescents with autism spectrum disorder see less to the eyes in emotional images of fear, anger, joy, and neutrals, also, they take significantly more time to fix their gaze, while adolescents with oppositional defiant disorder display faster initial gaze fixation compared to others (Bours et al., 2018). Adolescents with disorder conduct display significant hypo-activation in the right anterior insula during emotional face processing and spend significantly less time in the eye region (Menks et al., 2021), in addition, display deficiencies in emotion recognition and a reduced tendency to fix their gaze in the region face when they see expressions of fear and sadness, males recognize emotions worse than women and display a reduced tendency a fix their eyes (Key et al., 2018; Alvarado-Cando et al., 2019; Andrade-Castro et al., 2020; Gomez-Ochoa et al., 2020; Argudo-Vásconez et al., 2021).

Aggressive tendencies predict violent, suicidal, or self-injurious behaviors, while that eye movement allows for obtaining objective information (Bercea, 2011; Duchowski, 2017). For this reason, this research aimed to identify the presence or absence of a pattern of fixation in adolescents with aggressive behaviors compared with adolescents without aggressive behaviors.

METHODOLOGY

A non-experimental quantitative, comparative, and descriptive study was performed with a sample of n = 60 adolescents (age range = 12-17 years), to whom, the CAPI-A aggressiveness test (Andreau, 2010) was previously applied, dividing them into n = 30 adolescents with aggression and n = 30 adolescents without the aggression of the school "Mario Rizzini" in Cuenca-Ecuador (Table 1).

Table 1. Distribution of the study sample.

	Sample		
	Aggressive	**Non-aggressive**	**Total**
12 years	4	2	6
13 years	3	6	9
14 years	5	7	12
15 years	6	4	10
16 years	3	4	7
17 years	9	7	16
Total	**30**	**30**	**60**

Software Implementation

For data management, the Gazepoint Analysis software was used to obtention eye tracking parameters and digitize stimuli (Gazepoint, 2021).

Procedure

Sixteen images from IAPS set previously validated in Cuenca-Ecuador (Andrade, 2020; Gómez, 2020) were used, divided into 8 images with a positive valence or pleasant and 8 images with a negative valence or unpleasant, images that presented violence and explicit sexuality were omitted. The random digitization of the IAPS set images was performed with the formula =random() to determine the order and location of images, within each slide, a positive and negative image located on the right or left side were placed interspersed, then, each image was uploaded to the Gazepoint Analysis software. To record eye movements GP3 eye tracker was used, it contains a high-resolution infrared camera with an image processing system (Gazepoint, 2021), the same one that was calibrated according to each participant. Between each of the slides was an image called "Fixation Cross", this image serves to focus the gaze after each visual stimulus. The sample time for each slide was 3 seconds and 2 seconds for the fixation cross.
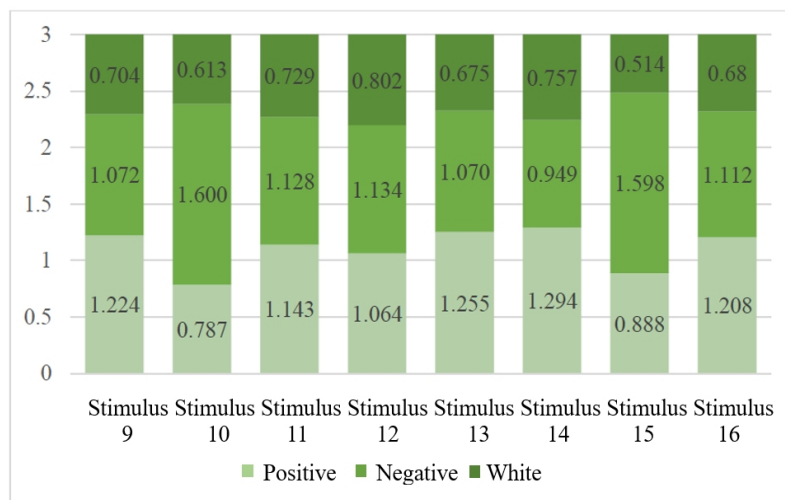
Results

A comparative analysis was performed between the groups of aggressive and non-aggressive adolescents using the box-and-whiskers diagram, it was observed that the group of non-aggressive adolescents have a higher prevalence for positive stimuli than aggressive adolescents, and in comparison, when comparing negative stimuli, aggressive adolescents have a higher prevalence than non-aggressive adolescents (Figure 1).

The measurements of time (Figures 2 and 3) and the number of fixations (Figures 4 and 5) indicate differences in the attention between the two groups. Aggressive adolescents focused faster on images with negative stimuli, and they saw more times and for more time these images, contrasting with non-aggressive adolescents, in whom, attention was more dispersed, they had fewer images with negative stimuli and focused more on images with positive stimuli.
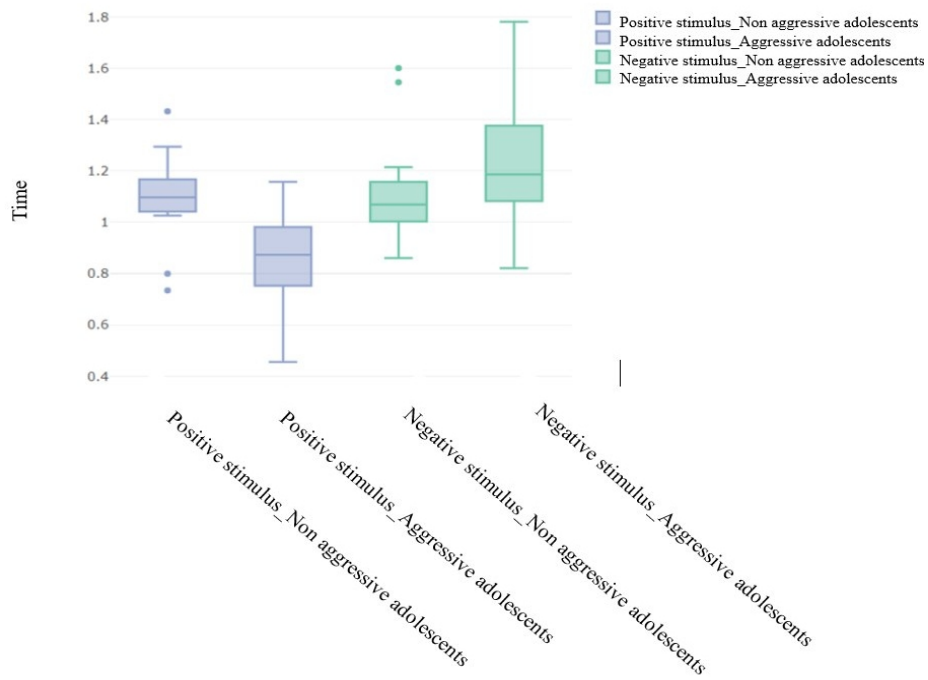
Figure 1: Comparative analysis between aggressive and non-aggressive adolescents.

Figure 2: Results of time of non-aggressive adolescents.

A comparative analysis of time and fixations to positive and negative stimuli was performed between aggressive and non-aggressive women and men through the means and standard deviations of the estimates obtained in the 16 images of the IPAS set.

In the group of non-aggressive adolescents, comparing the time and fixations in positive stimuli, men obtained a higher prevalence than women, and
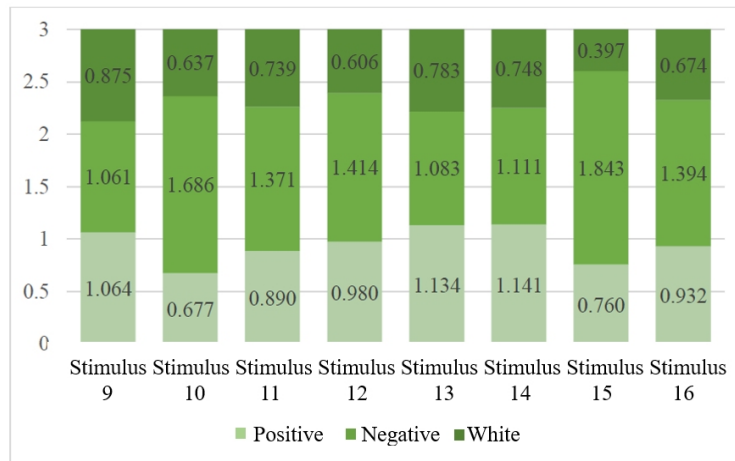
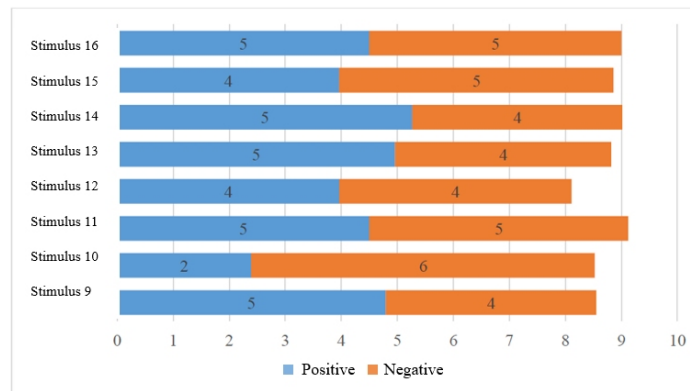**Figure 3**: Results of time of aggressive adolescents.

Figure 4: Number of fixations of non-aggressive adolescents.

about the time in negative and fixations negatives, women obtained a higher prevalence than men (Tables 2 and 3).

In the group of aggressive adolescents, comparing the time and fixations in positive stimuli, men obtained a higher prevalence than women, about the time in negative stimuli, women obtained a higher prevalence than men

Table 2. Comparison of non-aggressive men/women. Variable time and fixations to positive stimuli.

	Positive stimuli, non-aggressive			
	Time		Fixations	
	M	**SD**	**M**	**SD**
Men	0.818	0.190	3.344	0.780
Women	0.815	0.262	3.132	1.003
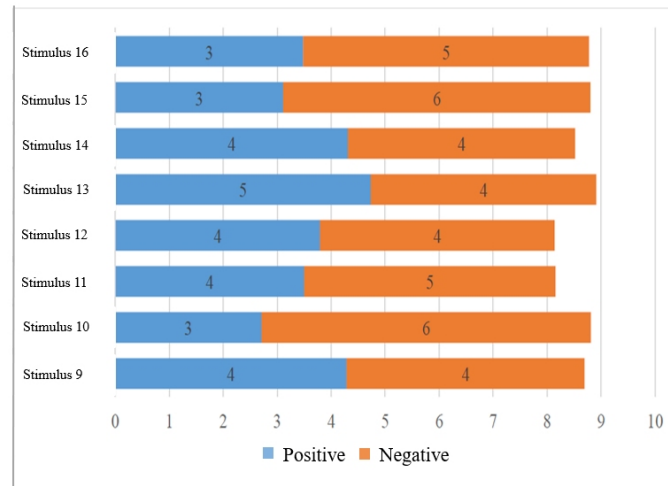
Figure 5: Number of fixations of aggressive adolescents.

and in the fixations in negative stimuli, men obtained higher prevalence that women (Tables 4 and 5).

Table 3. Comparison of non-aggressive men/women. Variable time and fixations to negative stimuli.

	Negative stimuli, non-aggressive			
	Time		Fixations	
	M	SD	M	SD
Men	1.245	0.289	4.521	0.852
Women	1.384	0.327	4.694	0.849

Table 4. Comparison of aggressive men/women. Variable time and fixation to positive stimuli.

	Positive stimuli, aggressive			
	Time		Fixations	
	M	SD	M	SD
Men	1.117	0.196	4.429	1.009
Women	0.992	0.217	3.750	0.862

Table 5. Comparison of aggressive men/women. Variable time and fixation to negative stimuli.

	Negative stimuli of IAPS set_adolescents aggressive			
	Time		Fixations	
	M	SD	M	SD
Men	1.130	0.243	4.402	0.965
Women	1.179	0.309	4.149	1.027

CONCLUSION

The data obtained in this research indicate the existence of a bias in visual attention between non-aggressive and aggressive adolescents. Aggressive adolescents are more sensitive to negative valence stimuli, they focus faster and see more time these stimuli, this result matches with Arias (2013), who indicates that adolescents with aggressive behaviors tend to focus more on negative events due to the environment by which they are influenced, while that the attention of the non-aggressive adolescents are more dispersed, they see fewer images with negative stimuli and focus more on images with positive stimuli.

Women with aggressive behaviors tend to observe more time and obtain a greater number of fixations in negative stimuli in comparison to aggressive men, this result agrees with some studies about emotion processing that refer that men tend to process emotional stimuli in terms of their implications for the required action and are somewhat indifferent to the negative emotions, while that women tend to put more attention to the feelings provoked by stimuli (Wager et al., 2003 Gardener et al., 2013; Kong et al., 2014; Lungu et al., 2015).

The results of this research add to the evidence that selective visual attention when associated with hostile emotions can predict aggressive or violent behaviors.

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