Dean&Francis

ISSN 2959-6149

The Role of Negative Emotions and Emotion Regulation in Aggressive Behavior: Insights from Eye-tracking

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Abstract:

Aggressive behavior and the rising number of violent incidents significantly impact social security. Such behavior is influenced by various factors, including emotions, social environment, and cultural background. Many studies explore aggressive behaviors from sociological and psychological aspects. However, some research on aggression and aggressive emotions has been lacking in empirical data. This study aimed to investigate the link between negative emotions, cognitive emotion regulation, and aggressive behavior. The Positive and Negative Affect Schedule (PANAS) and Cognitive Emotion Regulation Questionnaire (CERQ) are used to assess the participants' levels of negative emotions and their cognitive emotion regulation strategies. Additionally, we indirectly measured their responses by tracking their eye movements as they observed aggressive behaviors with an eye-tracker. The data analysis revealed that individuals with higher levels of negative emotions had a significant attentional bias towards aggressive behavior, indicated by longer total fixation durations and higher fixation counts. Likewise, those with higher scores on the Negative Cognitive Emotion Regulation Questionnaire exhibited a greater aggressive attentional bias. The study's findings highlight the importance of negative emotions and cognitive emotion regulation strategies in shaping attentional biases towards aggressive stimuli. The results show the importance of interventions that target cognitive emotion regulation to reduce aggressive responses and enhance emotional balance. These insights not only fill gaps in the existing social aggression theory but also could assist psychotherapists and behavior modifiers in applying this knowledge to treat aggressive behavior. Future research could consider more diverse samples and examine long-term effects to better understand these relationships and develop more effective strategies for reducing aggression through improved emotion regulation.

Keywords: Negative emotions, Cognitive emotion regulation, Aggressive behavior, PANAS, CERQ, Eye tracking

1.Introduction

In social psychology, aggression is often defined as the behavior or attitude intended to cause harm to another person (Anderson, 2003). It can take various forms, such as physical violence like fighting and beating, verbal aggression including the use of offensive language and threats, or emotional harm through bullying or manipulation. Inappropriate aggression is not only distressing for the individual but can also be detrimental to others and society. Thus, controlling aggression is a crucial part of an individual's social development (Dodge, 2003). Social psychologists believe that negative emotions, social environment, and cultural context significantly influence aggressive behavior (Mesquita, 2002).

Cognitive emotion regulation is the process where individuals use cognitive strategies to affect the experience and expression of emotions. By altering their thinking about emotional events, individuals can regulate the intensity and duration of these emotions. Common strategies include reappraisal, inhibition, and attentional distraction (Gross, 2001). Emotion regulation can control negative emotions by leveraging cognitive reappraisal to transform negative feelings and improving impulse control through expression inhibition. The combination of these two approaches can effectively reduce aggressive behavior. Davidson's (2000) study indicated that highly aggressive behavior, particularly impulsive aggression, often stems from a deficit in emotion regulation. Zhang's (2009) research also found that adolescents' aggressive behavior results from emotional dysregulation, with aggressive adolescents tending to have poor impulse control and deficits in emotional regulation. Neuroscientific studies have found that the neural mechanisms of emotional control in highly aggressive individuals differ significantly from those in the general population (Björk, 2015).

Previous research on aggressive behavior or mood has largely relied on questionnaires and implicit association tests (Troy, 2010; De Houwer, 2012; Pawlowski, 2013; Bolling, 2017). The results from questionnaires are comparatively subjective and a lack of strong empirical support. Therefore, this study employed an eye-tracker to measure subjects' attentional bias when encountering aggressive stimuli. The eye-tracker captures real-time data on participants' visual attention, providing more objective and direct quantitative data instead of relying on subjective self-reports. Moreover, it can detect unconscious shifts in attention as participants process emotional information, which other methods cannot match. The significance of this study lies in its potential to advance psychological theory and its practical applications. Understanding how negative emotions and cognitive regulation affect attention can guide interventions to reduce aggressive actions. Our findings could offer valuable insights for mental health professionals, educators, and policymakers, aiding in the development of strategies that promote healthier emotional responses and reduce societal conflict.

2.Method

2.1 Participants

In the experiment, 30 individuals were randomly recruited from an office building in Shanghai, China, including 9 males and 21 females. Each participant was informed of the experiment's procedures and potential risks, and all subjects provided voluntary consent to participate. Demographic information of the participants was also collected.

2.2 Stimuli

At the start of the experiment, subjects were shown a roughly two-minute video designed to evoke negative moods. The video was compiled from various clips depicting negative social interactions, such as arguments, fights, and quarrels, intended to trigger emotions like anger and disgust in viewers. Following the video, the Positive and Negative Affect Schedule (PANAS) questionnaire was used to assess the subjects' levels of negative emotions. The Cognitive Emotion Regulation Questionnaire (CERQ) was then used to evaluate their emotional regulation capabilities.

In the eye-tracking portion of the experiment, stimuli were selected from the Bodily Expressive Action Stimulus Test (BEAST), consisting of images of five males and five females. Each model posed in two different ways: one with an aggressive posture, such as an attack stance, and the other with a non-aggressive posture, such as a neutral stance. Each page displayed two images side by side, featuring the same character in both aggressive and non-aggressive poses. The images were identical in size, character proportion, and color, with the aggressive pose appearing randomly on either the left or right. To control for extraneous variables, facial features were blurred, and the images were adjusted to black and white. Other visual factors were also controlled, ensuring that the only difference between the two images in each pair was the presence or absence of aggressive movement.

(Citation: BEAST stimulus set, http://www.beatricedegelder.com/beast.html)

2.3 Procedure and Design

This study utilized a within-subjects design. Participants received informed consent before the experiment began. Each participant was initially shown an emotion-eliciting video designed to induce a negative emotional state, as described in section 2.2. After viewing the video, par-

ISSN 2959-6149

ticipants completed the PANAS to measure their current emotional state. Next, participants were seated in front of a screen linked to a laptop and an eye tracker (Tobii 4C). The calibration process was undertaken to ensure accurate capture of the gaze. Participants then viewed 10 sets of images, with each set being displayed for 6 seconds in a randomized sequence. The eye tracker recorded the participants' gaze patterns during the image viewing session. After the eye-tracking task, participants filled out the CERQ to evaluate their personal emotion regulation strategies. Upon finishing all experimental procedures, participants received a gift for their participation. The entire experiment lasted approximately twenty minutes.

Aggressive (attack) and nonaggressive (neutral) postures in each image group were designated as Areas of Interest (AOIs). Once all subjects had completed the trial, eye gaze data were extracted based on the AOI regions. Total fixation duration (TFD) and fixation count (FC) were utilized for the analysis. Scores from two questionnaires were also collected individually.

2.4 Data Analysis:

The questionnaire results were integrated to categorize participants. For the PANAS questionnaire, those in the top 50% for scores were designated as the high subgroup (PANAS-high: PH), and the remaining as the low subgroup (PANAS-low: PL). For the CERQ questionnaire, scores on the positive and negative dimensions were calculated individually. Participants scoring in the top 50% on the positive dimensions were classified as the high group (CERQ-positive-high: CPH), and those in the bottom 50% as the low group (CERQ-positive-low: CPL). Similarly, the negative dimensions were divided into high (CERQ-negative-high: CNH) and low (CERQ-negative-low: CNL) subgroups based on the same criterion.

To investigate the impact of negative mood on aggressive behavior, t-tests were performed comparing TFD and FC on aggressive versus non-aggressive postures between the PL and PH groups. Additionally, to examine the influence of positive and negative emotion regulation on aggressive behavior, t-tests were conducted on TFD and FC for aggressive and non-aggressive postures for both the high (CPH, CNH) and low (CPL, CNL) groups within the positive and negative dimensions, respectively.

3.Result

3.1 T-test for TFD and FC of PH and PL Groups

Table 1 presents the results of independent-samples t-tests examining the effect of PANAS scores on visual attention to aggressive and non-aggressive stimuli, as measured by TFD and FC.

For the high PANAS group (PH), there was a significantly longer ($t = 1.84$, $p < 0.05$) TFD on aggressive postures ($M = 23.75$, $SD = 5.57$) than on non-aggressive postures ($M = 20.22$, $SD = 5.30$). This indicates that individuals with higher PANAS scores paid more attention to aggressive stimuli. However, for the low PANAS group (PL), there was no significant difference ($t = 0.23$, $p > 0.05$) in TFD between aggressive and non-aggressive postures.

Similarly, the PH group displayed a significantly higher ($t = 2.59$, $p < 0.01$) FC on aggressive postures ($M = 93.38$, $SD = 20.76$) compared to non-aggressive postures ($M = 76.94$, $SD = 14.53$). This further supports the observation that individuals with higher PANAS scores exhibited more attention to aggressive stimuli. However, the PL group did not show a significant difference ($t = 0.34$, $p > 0.05$) in FC between aggressive and non-aggressive postures.

3.2 T-test for TFD and FC of CPH and CPL Groups

As shown in Table 1, participants in the CERQ-positive-high group (CPH) displayed no significant difference ($t = 0.98$, $p > 0.05$) in TFD between aggressive ($M = 23.97$, $SD = 5.05$) and non-aggressive postures ($M = 22.21$, $SD = 4.77$). In contrast, the CERQ-positive-low group (CPL) exhibited a significantly lower ($t = -2.00$, $p < 0.05$) TFD on aggressive postures ($M = 20.27$, $SD = 6.44$) compared to non-aggressive postures ($M = 24.58$, $SD = 5.28$). This suggests that individuals with lower positive cognitive emotion regulation (PCER) focused less on aggressive stimuli.

Similarly, the CPH group did not show a significant difference ($t = -2.00$, $p < 0.05$) in FC between aggressive ($M = 86.07$, $SD = 16.59$) and non-aggressive postures ($M = 77.93$, $SD = 19.80$). However, the CPL group demonstrated a significantly lower ($t = -2.41$, $p < 0.05$) FC on aggressive postures ($M = 80.73$, $SD = 15.78$) compared to non-aggressive postures ($M = 95.47$, $SD = 17.59$). This further supports the finding that individuals with lower CERQ-positive allocated less attention to aggressive stimuli.

3.3 T-test for TFD and FC of CNH and CNL Groups

Table 1 shows the outcomes of independent-samples t-tests that evaluated the impact of CERQ scores on attention to aggressive versus non-aggressive stimuli, as indicated by total fixation duration (TFD) and fixation count (FC).

For the CERQ-negative-high group (CNH), there was a significantly longer ($t = 1.92$, $p < 0.05$) TFD on aggressive postures ($M = 24.58$, $SD = 5.28$) than on non-ag-

gressive postures (M = 20.89, SD = 5.27). In contrast, the CERQ-negative-low group (CNL) did not show a significant difference (t = 0.25, p > 0.05) in TFD between aggressive and non-aggressive postures.
The CNH group also had a significantly higher (t = 2.31, p < 0.05) FC on aggressive postures (M = 95.47, SD = 17.59) than on non-aggressive postures (M = 80.33, SD = 18.33). However, the CNL group did not exhibit a significant difference (t = 0.67, p > 0.05) in FC between aggressive and non-aggressive postures.

Tabel 1: TFD and FC for Aggressive and Non-aggressive Postures

		PH	PL	CPH	CPL	CNH	CNL
Aggressive	TFD(s)	23.75	22.90	23.97	20.27	24.58	22.13
	FC(freq)	93.38	84.64	86.07	80.73	95.47	83.13
Non-aggressive	TFD(s)	20.22	22.41	22.21	24.58	20.89	21.60
	FC(freq)	76.94	82.07	77.93	95.47	80.33	78.33

4. Discussion

The Positive and Negative Affect Schedule (PANAS) is a widely used self-assessment tool in emotion research, which includes positive and negative dimensions. For this study, the negative dimension sub-questionnaire was used to measure the subjects' levels of negative emotions. Higher scores indicate stronger negative emotions at the time of testing, and lower scores suggests weaker negative emotions. The influence of emotion on attention to aggressive behavior was assessed by comparing eye-tracking data from the high negative affect group (PH) and the low negative affect group (PL) in response to aggressive stimuli.
The T-test results revealed significant differences in total fixation duration (TFD) and fixation counts (FC) between aggressive and non-aggressive stimuli for the PH and PL groups. The PH group had a significantly longer TFD and higher FC for aggressive postures than for non-aggressive postures, indicating that individuals with higher levels of negative emotions directed more attention to aggressive stimuli. In contrast, the PL group showed no significant difference in FC and TFD between aggressive and non-aggressive images. A possible explanation for the direct correlation between individuals with heighted negative emotions and attention preference towards aggressive images results from "threat detection and vigilance". Individuals experiencing high levels of negative emotions, i.e. anxiety, may exhibit increased vigilance and threat detection, causing them to focus more on aggressive stimuli, which are typically interpreted as potential threats. Previous studies reveal that socially anxious individuals exhibit selective attention for threat faces (Mogg, 2004; Pishyar, 2004; Klumpp,2009). Some other research suggests that socially anxious individuals have difficulty in shifting their attention away from threats (Amir, 2003). Furthermore, Rusting (1998) has proposed that individuals with high levels of negative affect possess an inherent dispositional tendency that leads them to process information in a way that aligns with their aggressive inclinations. This phenomenon can be considered an extension of emotionally congruent memory within the cognitive domain, and the theory also accounts for why individuals with high negative emotions exhibit an aggressive attentional bias. Above studies explain why people with heightened levels of negative emotions results in longer TFD and greater FC when viewing aggressive postures.
Higher scores on the CERQ-positive indicate that participants are more likely to employ positive strategies to interpret events and solve problems when faced with strong mood swings or sudden occurrences. A cross-analysis comparing CERQ scores to eye gaze data revealed that participants in the CERQ-positive-low group (CPL) exhibited lower TFD for aggressive behavior, while those in the CERQ-positive-high group (CPH) did not show a significant difference in gaze patterns between the two behaviors. The differences can be explained by cognitive appraisal. Cognitive appraisal involves evaluating the relevance of a situation to an individual's well-being through two stages: primary and secondary appraisal. In the primary appraisal, individuals quickly assess whether the scenario is relevant to their interests, such as determining if viewing an aggressive stimulus poses potential harm or benefit. In the secondary appraisal, they evaluate their ability to manage the threat or benefit at that moment (Folkman, 1986). Individuals of the CPH group engage in more adaptive cognitive reassessment, feeling more confident in their ability to control the situation. As a result, threatening information does not lead to significant emotional fluctuations for this group, resulting in no notable difference in their attention to aggressive versus non-aggressive images. In contrast, individuals in the CPL group struggle to employ effective emotion regulation and

ISSN 2959-6149

cognitive strategies. During their secondary evaluation of the situation, they may perceive themselves as lacking the necessary skills to cope, leading them to stabilize their emotions by avoiding potential threats and negative stimuli.

Scores on the CERQ-negative that are higher suggest that participants are inclined to use negative and pessimistic strategies when interpreting events and addressing problems during intense emotional fluctuations or unexpected events. The findings also show a correlation between CERQ-negative and attention to aggressive stimuli. Participants in the high negative emotion regulation group (CNH) displayed a significantly longer TFD and higher FC on aggressive images than on non-aggressive images. This trend indicates that individuals with a heightened tendency toward negative cognitive emotion regulation focus more on aggressive stimuli. In contrast, those in the lower CERQ-negative group (CNL) did not exhibit a significant difference in TFD and FC when viewing the two types of stimuli.

This phenomenon could be explained by the theory of emotional dysregulation, which is characterized by patterns of emotional experience or expression that hinder goal-directed behavior (Thompson, 2019). Individuals with high negative cognitive emotion regulation might find it challenging to effectively manage their negative emotions and may perceive situations through a pessimistic lens. This perspective could lead them to focus more intently on aggressive information that reflects their emotional state. Zhang's study (2021) identified that individuals who are cognitively susceptible to depression exhibit a negative attentional bias, marked by difficulties in disengaging from negative stimuli. Such cognitive traits are typically linked to negative thought patterns, an inclination to over-interpret negative events, and pessimistic future expectations (Parada, 2020). This aligns with the observation in this study and could account for the stronger attentional bias towards aggressive behavior in the CNH group.

Attentional bias plays a crucial role in how individuals process information, particularly when confronted with potential threats. Previous research has indicated that individuals who exhibit a stronger attentional bias toward threatening stimuli are also more likely to engage in aggressive behaviors afterward. Social learning theory suggests that individuals gradually develop aggressive responses to similar situations by observing and processing aggressive information (Bandura, 1973). Therefore, attentional bias not only influences an individual's perception of information but may also unconsciously enhance their aggressive tendencies. The findings of this study contribute to the understanding of the complex relationship between negative emotions and aggressive behaviors. This could benefit the design of educational and therapeutic programs aimed at improving cognitive emotion regulation abilities, while simultaneously mitigating aggressive behaviors and negative thoughts. From this perspective, Acceptance and Commitment Therapy (ACT) and Cognitive Behavioral Therapy (CBT) emerge as potentially effective interventions. ACT aims to enhance psychological flexibility by encouraging individuals to accept their emotions rather than avoid them. CBT, on the other hand, assists individuals in recognizing negative thought patterns and replacing them with more positive and realistic thoughts. By improving emotion regulation strategies through these methods, it is possible to address both indirect aggressive thoughts and behaviors. These therapeutic approaches can provide individuals with the tools to manage their negative emotions and reduce the likelihood of aggressive responses.

The present study has several limitations that should be considered for future research. Firstly, the sample size of 30 participants may restrict the generalizability of the findings. Future studies could recruit a larger and more diverse participant pool from various regions across China. Additionally, the study's focus on PCER and NCER might oversimplify the array of cognitive strategies that individuals use for emotion regulation. To capture a more comprehensive view, future research could incorporate additional dimensional questionnaires such as the Profile of Emotions (POE) or the Emotion Regulation Skills Questionnaire (ERSQ). Lastly, the current experiment assessed immediate responses to aggressive stimuli following the viewing of a single negative video, which may not fully capture the long-term effects or the cumulative impact of repeated exposure to aggressive content. Longitudinal studies could be conducted to explore these long-term effects and provide insights into how repeated exposure to aggression influences attentional biases and aggressive behavior over time.

5. Conclusion

The current study investigated the impact of negative emotions and cognitive emotion regulation strategies on aggressive behavior by employing the PANAS and CERQ alongside an eye-tracking experiment. The analysis of the data indicated that participants with elevated negative affect and those with higher scores in negative cognitive emotion regulation demonstrated increased attention to aggressive behaviors, which are reflected by higher TFD and FC. These findings emphasize the significance of negative emotions and cognitive emotion regulation strategies in the formation of attentional biases towards aggressive

information. The results suggest that interventions aimed at enhancing cognitive emotion regulation could be beneficial in reducing aggressive reactions and promoting emotional equilibrium. Future research could focus on developing specific strategies to enhance emotional regulation.

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