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BRIEF REPORT

Assessing the Impact of Anger State on the Three Attentional Networks With the ANT-I

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Anger is a negative and highly aroused emotion. Previous research has revealed that a high level of arousal can induce the participant in a physical preparation and self-awareness. The aim of this research was to study the influence of anger on the attentional network using the Attention Network Test–Interactions (ANT-I). This test has been developed in order to assess 3 attentional networks: alerting, orienting, and executive control. Here, participants were induced in anger using the autobiographic recall procedure or in a neutral mood before the realization of the ANT-I. As expected, the results showed a better alerting score for the angry group. The possible origin of this alerting gain related to the high level of arousal is discussed. The results obtained should enlighten the interaction between emotion and the functioning of the attentional system. They also may be relevant for applied fields related to anger.

Keywords: attention network test, anger state, phasic alertness, auditory signal, alerting

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Most studies about emotion and attention compared emotional with neutral stimuli processing to underline a bias of attention. It has been shown that stimuli inducing a high level of arousal have been related to difficulties in the disengagement of attention (e.g., Fox, Russo, Bowles, & Dutton, 2001). In particular, anger, which is characterized by a negative valence and a high arousal, can provoke an attentional focusing toward its source (Harmon-Jones, Gable, & Price, 2013). In order to better understand the effect of anger on attention, it could also be useful to study these effects on the processing of neutral stimuli.

According to Posner and Petersen (1990) attention is composed of three independent networks: alerting, orienting, and executive control. Fan, McCandliss, Sommer, Raz, and Posner (2002) designed the Attention Network Test (ANT), a single task assessing the efficiency of each attentional network at the same time. The ANT is the combination of a cueing task (e.g., Posner, Snyder, & Davidson, 1980) and a flankers task (Eriksen & Eriksen, 1974). Although the ANT was a reliable test, Callejas, Lupiáñez, Funes, and Tudela (2005) pointed out that both alerting and orienting scores were obtained from the same cue conditions, leading to a confused interaction between these networks. Thus, they developed the Attention Network Test–Interactions (ANT-I) to assess these two networks independently. They also made the orienting cue nonpredictive in order to assess exogenous rather than endogenous attention measured in the ANT.

The ANT and the ANT-I have already been used to assess the impact of emotional states on attention. In their study about the anxiety-state, Pacheco-Unguetti, Acosta, Callejas, and Lupiáñez (2010) observed that the alerting and orienting networks were positively impacted, whereas the anxiety-trait altered the executive control network. Moreover, Pêcher, Quaireau, Lemercier, and Cellier (2011) showed that sadness could affect the orienting function. To our knowledge, anger has not been studied using these tests.

This article aims to assess the impact of anger-state on neutral stimuli processing using the ANT-I. Knowing that anger is linked to a high level of arousal and that arousal can improve the sensitivity to the environment by implying a cognitive and physiological excitation (see Thayer, 1989), we expected an increased effi-
ciency of the alerting network. We did not expect any effect of anger on the orienting and the executive control networks.

Method

Participants

Forty-one volunteers (23 to 44 years; M = 31, SD = 6) took part in this experiment. Twenty were induced in anger using an autobiographical recall procedure (anger group, 13 females) and 21 in a neutral mood (control group, 15 females). Participants were randomly assigned to one of the two groups. The research protocol in this experiment. Twenty were induced in anger using an autono-me phones. We used the ANT-I paradigm, previously developed by Callejas et al. (2005).

Mood Induction

Participants were induced either in an angry or a neutral mood. In order to induce anger, the autobiographical recall procedure (anger group, 13 females) and 21 in a neutral mood (control group, 15 females). Participants were randomly assigned to one of the two groups. The research protocol was approved by the ethic committee of the French Institute of Science and Technology for Transport, Development and Networks.

Task and procedure. Participants had to indicate as fast and as accurately as possible the direction in which the central arrow pointed using the keypad (“4” for left and “6” for right).

Results

Scores of valence and arousal were presented in Table 1.

Valence Assessment

A repeated measures ANOVA on the 2 (mood) × 2 (moment) interaction was carried out with mood as an intersubject factor, moment as a within-subject factor, and mean rating for anger adjectives (BMIS) as a dependent factor. Analysis revealed a main effect of mood, F(1, 39) = 14.93, MSE = 0.77, p < .0001, and a main effect of the moment, F(1, 39) = 34.61, MSE = 0.10, p < .0001. Analysis also revealed a significant Mood × Moment interaction, F(1, 39) = 52.33, MSE = 0.10, p < .0001. Within groups, planned comparisons showed that the anger-group mean ratings for adjectives denoting anger increased between the first and the second mood check, F(1, 39) = 83.98, MSE = 0.10, p < .0001. No significant effect was found for the control-group planned comparison between the first and the second mood check, F(1, 39) = 0.93, MSE = 0.10, p = .34. Between-groups comparisons revealed no difference between the anger and the control condition.
groups for the first anger rating, $F(1, 39) = 1.45, MSE = 0.42, p = .23$. But a significant difference between the two groups for the second mood check was found, $F(1, 39) = 35.26, MSE = 0.46, p < .0001$. Note that three outliers were present in the anger group at Moment 1, which could reduce the effects on the attentional networks. Their potential influences were checked, but similar results were observed, and then these outliers were kept in the analysis.

**Arousal Assessment**

A repeated measures ANOVA on the 2 (mood) $\times$ 2 (moment) interaction was carried out with mood as intersubject factor, moment as within subject factor, and the Affect Grid mean ratings for arousal as dependent variable. Analysis revealed a main effect of mood, $F(1, 39) = 6.05, MSE = 4.82, p < .05$, and a main effect of moment, $F(1, 39) = 10.34, MSE = 0.58, p < .01$. Analysis also revealed a significant interaction between mood and moment, $F(1, 39) = 25.00, MSE = 0.58, p < .0001$. Within-groups planned comparisons showed that anger-group mean ratings for arousal dimension of the Affect Grid did not differ between the first and the second mood check, $F(1, 39) = 1.55, MSE = 0.58, p = .22$. The planned comparison between the two moments showed that control-group mean ratings for arousal dimension of the affect significantly decreased, $F(1, 39) = 20.02, MSE = 0.58, p < .0001$. Between-groups comparisons revealed no difference between the anger and the control group for the first arousal rating, $F(1, 39) = 0.49, MSE = 2.61, p = .49$, but a significant difference between the two groups in the second mood check, $F(1, 39) = 15.17, MSE = 2.79, p < .001$. Thus, the anger group was in a higher aroused state than the control group after the MIP.

**ANT-I**

As expected, neutral trials did not differ from congruent trials, $F < 1$, so we decided to exclude them from the analysis (Callejas et al., 2005).

**Response time (RT) analysis.** A 2 (mood) $\times$ 2 (auditory alert) $\times$ 3 (orienting cue) $\times$ 2 (congruency) repeated measures ANOVA was carried out with mood (anger/control) as a between-subjects factor, and auditory alert (tone/no tone), orienting cue (cued-location/uncued-location/no-cue), and congruency (congruent/incongruent) as within-subject factors. RTs faster or slower than two standard deviations from the mean per participant were filtered out and represented less than 3% of the trials.

The main effects of auditory alert, $F(1, 39) = 12.49, MSE = 3672, p < .01$, orienting cue, $F(2, 39) = 95.19, MSE = 2587, p < .0001$, and congruency factors, $F(1, 39) = 417.27, MSE = 4335, p < .0001$, were statistically significant, with RTs being faster in the tone than in the no-tone condition, and in the congruent than in the incongruent condition. Planned comparisons showed that RTs were faster in the cued-location than in the no-cue condition, $F(1, 39) = 111.01, MSE = 3125.8, p < .0001$, and the uncued-location condition, $F(1, 39) = 142.96, MSE = 2732.1 p < .0001$. We did not observe any statistical differences concerning the no-cue and uncued-location conditions, $F(1, 39) = 0.68, MSE = 1903.77, p = .41$. No significant main effect of mood was found (see Table 2).

The usual interactions between auditory alert and orienting cue, $F(2, 78) = 10.49, MSE = 1487, p < .0001$, and between orienting cue and congruency, $F(2, 78) = 9.40, MSE = 1920, p < .0001$, were also observed. No significant interaction was found, however, between auditory alert and congruency, $F(1, 39) = 1.59, MSE = 1155, p = .21$.

Importantly, the analysis also revealed the predicted interaction between auditory alert and mood, $F(1, 39) = 4.09, MSE = 3672, p < .05$.

**Complementary analysis.** Afterward, three one-way ANOVAs were carried out to test the effect of mood on the attentional networks scores. The three attentional scores were calculated following the ANT-I method (see Callejas et al., 2005; Figure 1). The alerting network score was calculated by subtracting the tone from the no-tone conditions, only considering the no-cue condition. The orienting network score was calculated by subtracting the cued-location from the uncued-location conditions. The executive control network score was calculated by subtracting the congruent from the incongruent conditions.

These analyses revealed an effect of mood on the alerting score, $F(1, 39) = 4.27, MSE = 10622.3, p < .05$. No significant effect of mood was found concerning the orienting score, $F(1, 39) = 2.22,$

<table>
<thead>
<tr>
<th>Cued location</th>
<th>Tone</th>
<th>No tone</th>
<th>Tone</th>
<th>No tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congruent</td>
<td>473 (49)</td>
<td>505 (74)</td>
<td>490 (113)</td>
<td>496 (111)</td>
</tr>
<tr>
<td>Incongruent</td>
<td>575 (67)</td>
<td>608 (89)</td>
<td>589 (123)</td>
<td>600 (118)</td>
</tr>
<tr>
<td>No cue</td>
<td>524 (45)</td>
<td>562 (67)</td>
<td>535 (148)</td>
<td>571 (137)</td>
</tr>
</tbody>
</table>

Table 2. Mean Correct Reaction Times in Milliseconds (SD) Obtained for the Two Groups as a Function of Auditory Signal, Orienting Cue, and Congruency.
We wondered if the larger alerting effects observed here were particularly associated with the arousal and/or the anger level. On one hand, correlations between the arousal ratings and the three attentional scores were calculated, but none were significant. On the other hand, the correlation between phasic alertness and anger valence ratings ($r = .43, p < .05$), and between the orienting and anger valence ratings ($r = .47, p < .05$), were significant. Those correlations suggest that the effects observed are specific to anger and not to a general state of arousal. Moreover, we wondered whether this larger effect could arise from a lack of vigilance for the control group rather than a real alertness increase for the anger group (lower arousal after a potentially boring or wearisome experimental session). The planned comparison between both groups for no-tone/no-cue trials was not significant, $F(1, 39) = 0.45$, $MSE = 10234.19, p > .05$, suggesting that participants were in a comparable state of vigilance.

Discussion

In this research, participants were induced so as to study the influence of anger on the three attentional networks: alerting, orienting, and executive control. As expected, the MIP was efficient in the induction of the valence dimension. Although the MIP did not lead to increased perceived arousal for the anger group, the two groups (control and anger) differed significantly in the arousal ratings at the second evaluation.

As expected, analysis showed that angry participants were faster than the control group when an auditory alert was present, revealing a greater alerting effect. However, no significant effect of anger was observed for the orienting or the executive control network. The increase of alerting effect observed here seems to be induced specifically by anger rather than arousal. This may explain the difference compared with the results obtained by Huertas, Zahonero, Sanabria, and Lupiañez (2011) for arousal induced by road safety and in designing driving assistance systems. Thus, it could be interesting to know whether angry drivers could take better advantage of the driving assistance systems that rely on auditory alerts. Studies about anger and attentional mechanisms could be very relevant in improving road safety and in designing driving assistance systems.

References


Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the efficiency of the MIP. High anger-trait participants could take more advantage of the auditory alert, and even more when they are experiencing anger.

Although the standard ANT-I tasks incorporate at least 288 trials, only 144 trials were run in this experiment to fit the duration of the MIP efficiency. Even if it could be difficult to compare the size of the attentional indexes with those reported elsewhere, it is nonetheless true that the effects observed on the RTs from the control group are consistent with those already observed in the literature (Callejas et al., 2005; Pacheco-Unguetti et al., 2010). These results suggest that the ANT-I is suitable to assess the attention during short periods like induced moods duration using a low number of trials.

Finally, understanding the effect of anger on attention could be useful in applied domains like driving. Indeed, it is known that experiencing anger while driving can cause a lack of attention for stimuli located away from the expected location of hazards (Stephens, Trawley, Madigan, & Groeger, 2013). However, Weinbach & Henik (2011) have showed that alertness could broaden the scope of the attentional focus. Thus, it could be interesting to know whether angry drivers could take better advantage of the driving assistance systems that rely on auditory alerts. Studies about anger and attentional mechanisms could be very relevant in improving road safety and in designing driving assistance systems.


