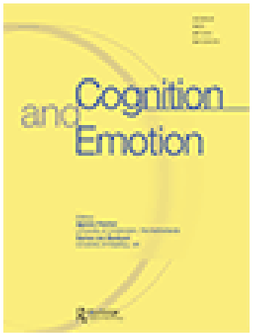

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Drawn to danger: trait anger predicts automatic approach behaviour to angry faces

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ABSTRACT

Most people automatically withdraw from socially threatening situations. However, people high in trait anger could be an exception to this rule, and may even display an eagerness to approach hostile situations. To test this hypothesis, we asked 118 participants to complete an approach-avoidance task, in which participants made approach or avoidance movements towards faces with an angry or happy expression, and a direct or averted eye gaze. As expected, higher trait anger predicted faster approach (than avoidance) movements towards angry faces. Crucially, this effect occurred only for angry faces with a direct eye gaze, presumably because they pose a specific social threat, in contrast to angry faces with an averted gaze. No parallel effects were observed for happy faces, indicating that the effects of trait anger were specific to hostile stimuli. These findings suggest that people high in trait anger may automatically approach hostile interaction partners.

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People generally display automatic avoidance tendencies in response to potentially harmful stimuli (e.g. Chen & Bargh, 1999; Rotteveel & Phaf, 2004). For instance, when using reaction time tasks such as the approach-avoidance task (AAT), participants respond faster to negative stimuli such as angry faces with pushing a joystick or a lever (avoidance behaviours) than pulling a joystick or a lever (approach behaviours). By contrast, automatic approach tendencies typically occur when people encounter potentially rewarding stimuli, such as smiling faces (e.g. Chen & Bargh, 1999; Rotteveel & Phaf, 2004). Thus, automatic approach and avoidance tendencies adhere to a hedonic pattern, by maximising people's engagement with pleasurable stimuli, while minimising people's engagement with harmful stimuli.

Automatic tendencies towards approach and avoidance are presumably a universal mechanism found in all human beings (and indeed, even in non-human animals; e.g. Carver & Harmon-Jones, 2009; Russell, 2003). Nevertheless, there appears to be important individual differences in automatic approach and avoidance tendencies. For instance, people high in social anxiety have been found to display markedly stronger avoidance reactions to social threats (e.g. Heuer, Rinck, & Becker, 2007; Roelofs et al., 2010). In the present article, we highlight another source of individual differences in automatic approach and avoidance tendencies that may reverse people's default avoidance reaction to social threats, namely, trait anger.

Trait anger is a stable personality dimension of anger proneness or the tendency to experience state anger (Spielberger, Jacobs, Russell, & Crane, 1983). Numerous studies have shown that trait anger predicts more angry feelings (i.e. state anger) and aggression in provoking situations. First, studies conducted in the labs have shown that trait anger predicts state anger and aggressive behaviour (e.g. Bettencourt, Talley, Benjamin, & Valentine, 2006). In more naturalistic situations, people with higher levels of trait anger also tend to respond with more anger and aggression,

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such as in automobiles with other drivers (e.g. Deffenbacher, Lynch, Oetting, & Yingling, 2001), and at home with family members (e.g. Barbour, Eckhardt, Davison, & Kassinove, 1998).

A notable characteristic of people higher in trait anger is that they display high levels of approach motivation. More specifically, higher trait anger predicts greater left (than right) cortical activity, which is an indicator of approach motivation (Harmon-Jones & Allen, 1998). This motivational profile may render people high in trait anger more inclined to react with approach behaviour towards threat than their counterparts low in trait anger. Indirect evidence for this idea comes from research that has shown that people high (rather than low) in trait anger have been found to respond to anger-provoking images – but not negative images related to disgust/fear or positive images – with increased left-hemispheric activation, which is an important neurological marker of approach motivation (Harmon-Jones, 2007). In view of these findings, we hypothesised that people high (rather than low) in trait anger may diverge from the general hedonic pattern in their automatic approach and avoidance tendencies. Specifically, people high (rather than low) in trait anger should display an automatic tendency to approach rather than avoid when they are confronted with a hostile situation.

In the current experiment, we sought to test whether trait anger indeed moderates automatic approach-avoidance tendencies in response to threat. Specifically, we asked participants who varied in trait anger to complete an AAT (e.g. Radke, Roelofs, & de Bruijn, 2013; von Borries, et al., 2012). We modified the task, such that participants responded to angry and happy faces (male and female) with an averted or direct eye gaze by pulling (approach) or pushing (avoidance) a computer joystick.

In line with previous research (e.g. Chen & Bargh, 1999; Rotteveel & Phaf, 2004), we predicted that participants with lower levels of trait anger would display a relative avoidance bias towards threatening stimuli. By contrast, we predicted that participants with higher levels of trait anger would display a relative approach bias towards threatening stimuli. More specifically, we expected participants with high levels of trait anger to respond faster with approach responses rather than avoidance responses to angry faces with direct eye gaze. Angry faces with direct gaze tend to be recognised more quickly (Adams & Kleck, 2003), and engage the amygdala more (Adams, Gordon, Baird, Ambady, & Kleck, 2003), and do not signal motivational affordances to interact (Roelofs et al., 2010). As such, angry faces with direct eye gaze constitute a stronger social threat than angry faces with averted eye gaze. However, as a comparison, we also included angry faces with averted eye gaze. This enabled us to establish whether the approach bias towards angry faces reflect approach behaviour in response to social threat, and not to negative stimuli in general.

Method

Participants and design

Participants were 118 undergraduate students (79 women, $M_{age} = 19.79$, $SD_{age} = 1.99$, range = 17–28) from the VU University Amsterdam who were paid €3,50 (about $4.50) for their voluntary participation. The AAT had a 2 (movement: push vs. pull) × 2 (target emotion: anger vs. happy) × 2 (target gaze direction: direct vs. averted) within-subjects factorial design. To assess whether there were differences in how fast people reacted, we measured the reaction from stimulus onset and the initial movement of the joystick displacement (initiation times).[1] Individual differences in trait anger were measured as a moderator. Participants' sex did not interact with any of the effects reported in the present research, so we do not further discuss this variable. We determined the required sample size using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). With an assumed small effect size (Cohen's $f = 0.10$) of the present $2 \times 2 \times 2$ (within-subjects) interaction, with an additional predictor, we determined the required sample size to be $N_{required} = 116$ to detect the predicted interaction with a power of $1 - \beta = 0.90$.

Procedure and materials

Participants were tested in private research cubicles. They were told that the study was about cognition, behaviour and personality. To measure participants' approach and avoidance tendencies towards anger-relevant and anger-irrelevant stimuli, we adapted the well-validated AAT (Rinck & Becker, 2007). Participants were instructed to respond as fast and accurate as possible to the emotional expression of pictures of faces by pulling a joystick towards themselves or away from themselves. In response to pulling, the picture grew bigger; in response to pushing, the picture grew smaller. Thus, the task combined both proprioceptive (i.e. arm movements; Rotteveel & Phaf, 2004) and

exteroceptive (i.e. zooming; Neumann & Strack, 2000) cues of approach and avoidance. We used this combination of cues to disambiguate the joystick task and prevent participants from interpreting a pushing movement with the joystick as approaching the stimulus on the screen and a pulling movement with the joystick as avoiding the stimulus on the screen (see Eder & Rothermund, 2008, on the importance of this response mapping).

The stimulus set consisted of two expressions (angry versus happy), of either a female or male actor (10 different actors of each sex), with a direct or averted eye gaze, resulting in 80 different stimuli (Radboud Faces Database (RaFD), Langner et al., 2010). A total of 360 experimental trials were presented in random order within each block (see below), with the restriction that no more than three pictures of a single category were presented in sequence (cf. Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). The trials were grouped in four separate blocks.

The sequence of movement instructions was counterbalanced: Half of the participants started with two blocks pulling angry facial expressions and pushing happy facial expressions and ended with two blocks with the opposite instructions. The other half of the participants received the opposite sequence of instructions. Thirty practice trials were presented before the first block, and 20 before the third block. The practice stimuli contained two pictures of the same female actress, with a happy and an angry facial expression with a direct gaze. This female actress was different from the ones used in the experimental trials. Reaction times were recorded at the initial movement of the joystick and the maximum displacement of the joystick. For all analyses, the initiation times were used as dependent variable, that is, the time between stimulus onset and the initial movement of the joystick displacement (see Rotteveel & Phaf, 2004). Participants were seated approximately 60 cm from the computer screen. To prevent the influence of differences in right versus left hemisphere activations due to the use of the right versus left hand, we asked participants to operate the joystick with their right hand. Thus, differences in lateral activation due to motor activation could not account for the observed effects.[2]

After the AAT, participants completed a Dutch version of the Trait Anger Scale (Spielberger et al., 1983; for a review, see Wilkowski & Robinson, 2008), which asks people to rate themselves on 10 items such as "When I get mad, I say nasty things", on visual analogue scales (1 = *does not fit to me,* 100 = *fits perfectly to me*). An overall trait anger score was obtained by averaging the items ($M = 43.83$, $SD = 12.58$; Cronbach $\alpha = .83$). Thus, trait anger was used as a continuous variable rather than as a dichotomous variable in our analyses. We administered the trait anger scale after the AAT to rule out potential priming effects of filling out scale scores. A debriefing followed.

Results

Participants with error percentages above 25% were discarded as outliers (4 participants). Following standard procedures (Ratcliff, 1993) response times longer than 1500 milliseconds were discarded as outliers and excluded from analysis. In addition, incorrect responses to approach or avoidance trials were excluded, which resulted in a total exclusion of 7.6% of all trials. Median response times (e.g. Rinck & Becker, 2007; Radke et al., 2013; Wiers et al., 2011) were calculated for correct responses for each level of the three experimental factors: motivation (approach, avoidance), emotion (angry, happy), and gaze (direct, averted). All reported response times are in milliseconds.

Most relevant to our theoretical analysis is the contrast between the response times for angry and happy faces with a direct gaze. We therefore also calculated AAT scores, as previous researchers have done (Heuer et al., 2007; Radke et al., 2013; Wiers et al., 2011). Specifically, we subtracted the median response time for pushing (avoidance) minus the median response time for pulling (approach): Positive values reflect a relative approach bias (faster approach than avoidance responses), whereas negative values a relative avoidance bias (faster avoidance than approach responses) towards the specific category of stimuli.

Main hypotheses

We conducted a repeated-measures analysis of covariance (ANCOVA) with motivation, emotion and gaze direction as within-subjects factors, with trait anger as a moderator and median response times as dependent variable. Recall that we predicted that participants with higher levels of trait anger would have an approach instead of avoidance bias towards angry faces with a direct eye gaze. Consistent with this, the predicted four-way interaction between motivation, emotion, gaze direction and trait anger was significant, $F(1, 112) = 4.23$, $p = .042$, $\eta^2 = .04$.

To interpret this interaction, we conducted separate analyses by gaze direction. For responses to faces with a direct eye gaze, we found a significant three-way interaction between motivation, emotion and trait anger, $F(1, 112) = 4.20$, $p = .043$, $\eta^2 = .04$. For both emotional facial expressions we looked at the correlations between trait anger and the individual AAT scores (positive values indicate relative approach bias, negative values indicate relative avoidance bias). As expected, we found a significant positive correlation between the AAT scores and trait anger for angry faces, $r = .24$, $p = .009$, revealing a relative approach bias to angry faces with a direct eye gaze for individuals high in trait anger.

As can been seen in Figure 1, the latter interaction effect signified that participants with higher trait anger reacted with relative faster approach/pulling movements than avoidance/pushing movements in response to angry faces with a direct eye gaze, the reverse of the pattern in people with low trait anger. However, for happy faces, there was no significant correlation between the AAT scores and trait anger, $r = -.08$, $p = .442$. Participants' level of trait anger was not related to their approach/pulling or avoidance/pushing movements in response to happy faces with a direct eye gaze (see Figure 2). In contrast to the results for direct eye gaze, the interaction between motivation, emotion and trait anger was not significant, $F(1, 112) = 0.33$, $p = .566$, $\eta^2 = .00$, for averted eye gaze.[3]

Further effects

First, and consistent with previous findings (e.g. Chen & Bargh, 1999; Rotteveel & Phaf, 2004), there was a significant interaction between motivation and emotional expression, $F(1, 112) = 5.21$, $p = .024$, $\eta^2 = .04$. In response to happy faces, approach movements ($M = 588.52$, SD = 72.55) were faster than avoidance movements ($M = 605.48$, SD = 78.15), $t(113) = 3.37$, $p = .001$. In contrast, in response to angry faces, avoidance movements ($M = 589.43$, SD = 74.99) were faster than approach movements ($M = 606.19$, SD = 74.58), $t(113) = -3.24$, $p = .002$. Thus, in general, participants displayed an avoidance bias towards angry faces, but an approach bias towards happy faces.

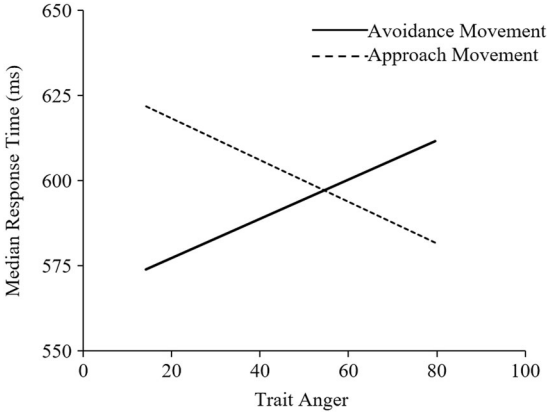

Figure 1. Responses to angry faces with direct eye gaze as a function of trait anger and movement type, corrected for within measurement variability (Loftus & Masson, 1994).

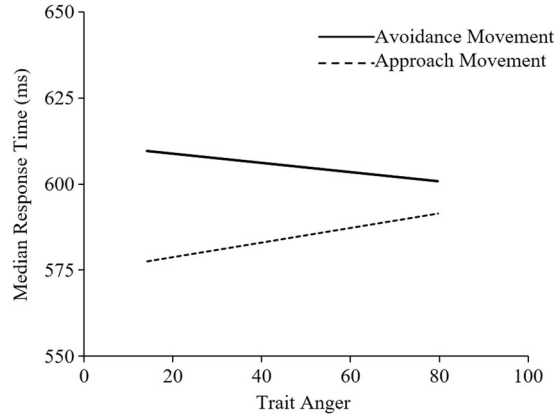

Figure 2. Responses to happy faces with direct eye gaze as a function of trait anger and movement type, corrected for within measurement variability (Loftus & Masson, 1994).

In addition, there was a three-way interaction between motivation, emotion and gaze direction, $F(1, 112) = 4.54$, $p = .035$, $\eta^2 = .04$. Separate analyses of direct and averted gaze direction revealed a significant interaction between motivation and emotion for both eye gaze directions. For direct eye gaze stimuli, avoidance movements in response to angry faces ($M = 591.23$, SD = 78.07) were faster than approach movements in response to angry faces ($M = 603.52$, SD = 72.49), $t(113) = -2.15$, $p = .034$. In contrast, approach movements in response to happy faces ($M = 583.80$, SD = 70.80) were faster than avoidance movements to happy faces ($M = 605.67$, SD = 78.72), $t(113) = 4.08$, $p < .001$.

For averted eye gaze, avoidance movements in response to angry faces ($M = 589.10$, SD = 76.02) were again faster than approach movements in response to angry faces ($M = 610.19$, SD = 78.98), $t(113) = -3.77$, $p < .001$. But for happy faces with averted eye gaze direction, approach movements ($M = 595.06$, SD = 78.68) did not differ from avoidance movements ($M = 604.51$, SD = 80.58), $t(113) = 1.62$,

$p = .108$ (see Figure 5 in supplemental materials). These results suggest that participants have an avoidance bias towards angry faces, regardless of eye gaze direction. However, participants only had an approach bias towards happy faces with a direct eye gaze, but not towards happy faces with an averted eye gaze.

Finally, repeated-measures analysis showed a three-way interaction between motivation, gaze direction and trait anger $F(1, 112) = 6.21$, $p = .014$, $\eta^2 = .05$. The correlations between the approach-avoidance effect scores for both direct and averted gaze direction and trait anger revealed a positive relation between trait anger and the effect scores of direct eye gaze, $r = .13$, $t(113) = 1.42$, $p = .157$, but a negative relation between trait anger and the approach-avoidance effect scores of averted eye gaze, $r = -.09$, $t(113) = -0.98$, $p = .332$. The latter finding signifies that increased trait anger was related to an increased approach bias towards faces with a direct eye gaze, but an increased avoidance bias towards faces with an averted eye gaze. However, neither of the separate correlations was significant.

Discussion

Most people automatically back away when they are confronted with threatening stimuli (e.g. Chen & Bargh, 1999; Rotteveel & Phaf, 2004). In the present research, however, we hypothesised that people high (rather than low) in trait anger may be an exception to this general rule, by reacting with automatic approach behaviour towards socially threatening stimuli. In line with this, the results of the present experiment showed that participants with higher levels of trait anger responded faster to angry faces with approach than avoidance movements compared to participants with lower levels of trait anger.

Why would people with high trait anger be prone to approach angry faces? According to one influential account, trait anger is related to cognitive processing biases, which lead them to interpret social situations in a more hostile manner (Wilkowski & Robinson, 2008). From this cognitive perspective, the results of this experiment could be due to a hostile processing bias among high trait-anger people, which leads them to be especially responsive towards angry faces (Wilkowski & Robinson, 2008). However, a hostile attribution bias should lead high trait-anger people to respond faster to angry faces regardless of whether they are approaching or avoiding the faces. Instead, the results were moderated by motivational direction; people with high trait anger respond relatively faster with approach than avoidance movements. Thus, the results complement previous findings on cognitive processing biases among people high in trait anger.

Moreover, the present findings are consistent with a situated motivation model of trait anger (Koole & Veenstra, 2015), which proposes that trait anger is linked to situation-specific increases in approach motivation in anger-relevant situations. This situated perspective can be contrasted with prior motivational research that has emphasised links between trait anger and general, cross-situational increases in approach motivation (Carver & Harmon-Jones, 2009). A general link between trait anger and approach motivation would lead to the prediction that trait anger would be associated with an overall approach bias. Instead, the results showed that trait anger was only associated with increased speed of making approach rather than avoidance movements when participants were faced with anger-relevant stimuli (i.e., angry faces with direct gaze). Thus, the results show not so much that trait anger is linked to approach motivation in general, but rather that trait anger is linked to a more specific tendency to relative increased activation of approach motivation in anger-relevant situations. Taken together, this pattern strongly supports a behavioural link between trait anger and approach motivation, and is consistent with the notion that trait anger is a situated motivational disposition.

The present experiment leaves several questions to be addressed by future work. A first question is whether situated increases in relative approach motivation are merely a side effect of high trait anger or whether these motivational dynamics are a causal mechanism that drives the effects of trait anger on state anger. If the latter is correct, then contextual shifts in motivational orientation may change anger management processes among people varying in trait anger, and might thus work as anger regulator. More research is needed to test this key prediction of a situated motivation model of trait anger (Koole & Veenstra, 2015). Another question that remains concerns the role of differences in right versus left hemisphere activations in the present findings. Although we took steps to minimise differences in lateralisation in our study, it cannot be ruled out that individual differences played a role in the effects of trait anger. Future work is needed to address this matter.

Though preliminary, the present results could have implications for developing a new generation of interventions for people with anger management problems. Current interventions for anger management problems are predominantly targeted at changing cognitive biases, which lead to hostile interpretations of a situation (e.g. Wilkowski & Robinson, 2008). The present findings, in conjunction with other research-linking trait anger to approach motivation (e.g. Harmon-Jones & Allen, 1998), suggest that such cognitive interventions may be complemented with motivational interventions, which seek to reduce approach motivation in people with anger management problems. Research in the domain of substance abuse suggests that basic motivational tendencies can be conditioned or trained (e.g. Wiers et al., 2011). Such trainings might be adapted to improve anger management skills among people with high trait anger. We are currently conducting studies that follow up on this idea.

In sum, the present findings shed important new light on the link between trait anger and automatic approach-avoidance tendencies. Most people are inclined to avoid social threats. People with high trait anger, however, appear to be an exception to this general rule, as they may actually be inclined to automatically approach social threats.

Notes

1. In addition to the initiation time we also measured movement time, that is, the time needed to move the joystick from the middle position to the most extreme position. Initiation time reflects the cognitive process of stimulus evaluation, response selection, and programming the execution of the motor movement (see Rotteveel & Phaf, 2004). The initiation time of the movement is relatively independent of the motor movements itself. Indeed, our results showed no relation between initiation time and movement time, neither did we find any effects when we tested our hypotheses using movement time as dependent variable. As such we do not discuss movement time as dependent variable any further.
2. Fourteen participants reported that they were left handed. Because of the uneven numbers of left- and right-handed participants, adding handedness to the model would result in unreliable effects. Consequently, we could not investigate the effect of handedness.
3. See Figures 1 and 2 in the supplemental materials for scatterplots of the relation between trait anger and the approach-avoidance task scores for angry and for happy faces with direct eye gaze, and Figures 3 and 4 in the supplemental materials for line plots of the relation between trait anger and approach versus avoidance responses towards angry and happy faces with averted eye gaze.

Disclosure statement

No potential conflict of interest was reported by the authors.

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