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BRIEF REPORT

Reduced Transfer of Affective Value to Instrumental Behavior in Violent Offenders

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Instrumental or goal-directed aggression is a core feature in violent offenders with psychopathic tendencies. To understand this type of behavior, previous work in the field of aggression has focused on affective processing, with mixed results. We propose that instrumental aggression is best understood in terms of the consequences of affective processing for instrumental behavior rather than affective processing per se. Therefore, we assessed the degree of affective biasing of instrumental action in a group of violent offenders with psychopathic tendencies and healthy controls using a validated affective decision-making task. Participants learned whole body approach-avoidance actions upon instrumental targets based on monetary feedback, while being primed by aversive versus appetitive facial stimuli. Unlike controls, instrumental behavior in violent offenders was not influenced by the affective stimuli. Specifically, violent offenders showed reduced instrumental avoidance in the context of aversive (vs. appetitive) stimuli relative to controls. This finding suggests that reduced affective biasing of instrumental behavior may underlie the behavioral anomalies observed in violent offenders with psychopathic tendencies. More generally, the finding underscores the relevance of examining the interaction between affect and instrumental behavior for a better understanding of dysfunctional behaviors in psychiatric populations.

General Scientific Summary
Goal-directed aggression is a core feature in violent offenders with psychopathic tendencies. Our findings suggest that violent offenders show reduced affective influence on instrumental behavior compared to healthy controls, possibly contributing to aggressive behaviors in this population.

Keywords: violent offenders, psychopathic tendencies, affective biasing, instrumental action, decision making

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Instrumental or goal-directed aggression is a core feature in violent offenders with psychopathic tendencies. Typically, these offenders are not affected by social affective cues that would normally discourage violent instrumental acts. For instance, the facial expression of a suffering victim would not hinder the use of violence to obtain a victim's money in these individuals (Glenn & Raine, 2009). To explain such behavior, previous work in the field of aggression has largely focused on alterations in affective processing, with mixed results. Some studies have reported abnormalities in the processing of aversive affect (Blair, 1999; Blair et al., 2004; House & Milligan, 1976; Lykken, 1957; Patrick, Bradley, & Lang, 1993), whereas other studies have not found such abnormalities in violent offenders with psychopathic tendencies (Arnett, Smith, & Newman, 1997; Glass & Newman, 2009; Newman & Kosson, 1986; von Borries et al., 2010). In contrast with these studies, here we applied insights from contemporary literature on the interaction between affect and instrumental behavior. Rather than studying affective processing per se, we propose that an understanding of instrumental aggression requires us to study the consequences of affective processing for instrumental action. In the current study, we tested the hypothesis that violent offenders with psychopathic tendencies exhibit reduced affective influence on instrumental action.

Instrumental behavior refers to actions that are outcome-oriented. It is well-known that instrumental behavior can be biased by affect (Damasio, 1997). The impact of affect on instrumental behavior is illustrated, for example, by the finding that chicks cannot learn to run away from a food cup in order to obtain food (Hershberger, 1986). In this example, the (appetitive) affective value of food is naturally coupled with an innate tendency to approach the food. This affective approach response hampers the instrumental run-away (or avoidance) response to obtain the food. Such affective biasing also exists in humans as evidenced by empirical work, where aversive and appetitive stimuli have been shown to facilitate or suppress instrumental responses (Bray, Rangel, Shimojo, Balleine, & O'Doherty, 2008; Cavanagh, Eisenberg, Guitart-Masip, Huys, & Frank, 2013; Geurts, Huys, Ouden, & Cools, 2013a; Guitart-Masip, Duzel, Dolan, & Dayan, 2014; Lovibond, Chen, Mitchell, & Weidemann, 2013; Ly, Huys, Stins, Roelofs, & Cools, 2014; Talmi, Seymour, Dayan, & Dolan, 2008). Thus, appetitive and aversive values transfer to and interact with instrumental behavior. Generally, affective biasing of behavior is crucial for healthy adaptive behavior (Damasio, 1997). Abnormal interactions between affect and instrumental behavior have been suggested to play an important role in behavioral anomalies observed in psychiatric disorders (Dayan, Niv, Seymour, & Daw, 2006; Seymour & Dolan, 2008) and aggression in particular (Crockett & Cools, 2015; Geurts, Huys, den Ouden, & Cools, 2013b).

To study affective biasing of instrumental behavior in relation to aggression, we compared a group of violent offenders with varying degrees of psychopathic tendencies to a group of healthy controls on a recently developed paradigm, in which we combined an affective decision-making task with a stepping platform (Ly et al., 2014). The task required participants to learn by trial and error, based on monetary outcomes, to make whole body approach/avoidance actions in response to instrumental targets, while being primed by affective (angry/happy) faces. Using this paradigm, we have previously shown in healthy participants that angry (vs. happy) face-primes facilitate instrumental avoidance (vs. instrumental approach), indicating affective biasing of instrumental action (Ly et al., 2014). We hypothesized that affective biasing would be reduced in violent offenders (vs. controls). Thus, we anticipated that violent offenders would exhibit reduced potentiation of instrumental avoidance (vs. approach) by angry (vs. happy) face-primes.

Method

Participants

Thirty-eight male inmates were recruited from high-security forensic psychiatric institutes (Pompestichting and Oldenkotte) in the Netherlands. They have received a court-imposed placement under a hospital order with at least four years of imprisonment for committing violence offenses repeatedly, including murder, slaughter, battery, rape, while suffering from psychiatric illness or disorder. As a control group, 19 healthy men, without criminal records and a history of psychiatric disorders were recruited from the staff of the same institutes. Considering the uniqueness of the population, the testing environment, and the time period when testing was possible, these were the maximum numbers of inclusion (we aimed for a total of 40 violent offenders and 20 controls). For a detailed description of the characteristics of the sample, see online supplementary material.

Following previous studies (Brazil et al., 2011; von Borries et al., 2010, 2012), exclusion criteria were all major Axis-I and Axis-II disorders except for cluster B personality disorders in violent offenders, psychotropic medication, cannabis or other drug use one week before, alcohol or oxazepam use within 24 hr before experiment, visual disorder, and neurological disorder. Furthermore, individuals with conditions affecting posture and limb movements—not eligible for the experimental task—were excluded.

All participants received oral and written information about the experiment and gave written informed consent. They received payment as a reimbursement for participation. The study was performed in accordance with the Declaration of Helsinki and approved by the local ethical committee.

Experimental Paradigm

Following Ly et al. (2014), we combined the affective decision-making task with a balance board to assess the degree to which whole body instrumental actions are influenced by affective face stimuli (see Figure 1). Participants performed the affective decision-making task on the balance board, which allows accurate assessment of bodily movement (see Figure 1B). Affective and instrumental visual stimuli were presented on a screen in front of them while performing the task. During the task, participants had to learn optimal responses—by trial and error—to instrumental targets based on monetary feedback (wins/losses of €0.20). Instrumental responses consisted of whole body go- and no-go-responses upon the instrumental targets (see Figure 1B). Participants responded in two action-contexts, an approach- or an avoidance-context, indicating whether a go-response upon an instrumental target was an approach- or an avoidance-action (see Figure 1A). The action-contexts alternated in blocks. To induce affective influence on the instrumental response, a task-irrelevant (angry/happy) face stimulus was presented on each trial prior to

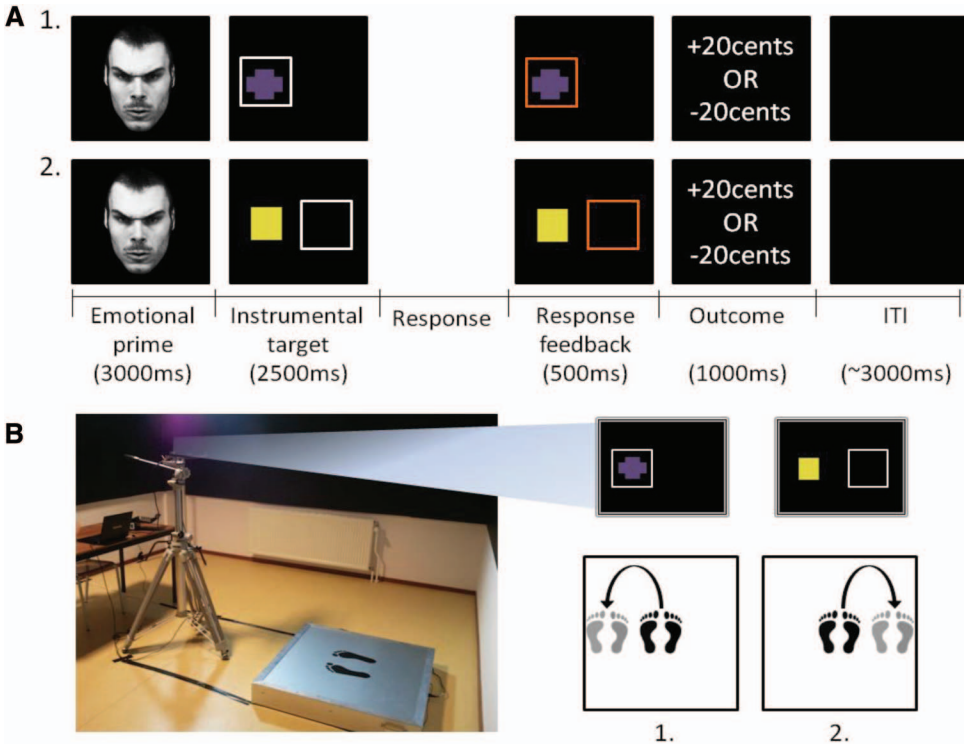

Figure 1. Panel A: Affective decision-making task. Trial events from the (1) approach block and (2) avoidance block. After face-prime offset (3,000 ms), the instrumental target appeared, to which subjects were required to make a go- or no-go-response within 2,500 ms. Response feedback (500 ms) was provided before the monetary outcome (1,000 ms). In these examples a go-response had been recorded as indicated by the orange-colored squares during the response feedback phase. The duration of the intertrial interval was 3,000 ms on average. Panel B: Balance board apparatus (left) and examples of a go-response (right) in (1) the approach block and (2) the avoidance block. Approach-go: sideway step on the balance board toward the side of the instrumental target (1). Avoidance-go: sideway step on the balance board away from the side of the instrumental target (2). Approach-/avoidance- no-go-responses involved remaining stationary at the center of the balance board. See the online article for the color version of this figure.

the presentation of an instrumental target. This resulted in a multifactorial design, with affective prime (angry/happy), action-context (approach/avoidance), and optimal response (go/no-go) manipulated independently. For a detailed description of the experimental set-up and task, see the online supplementary material or Ly et al. (2014).

Procedure

In a first session, participants were screened by interviews and questionnaires. During the second session, participants were first prepared for the affective decision-making task by practicing on the balance board until they felt comfortable with stepping while maintaining their view on the screen. They received instructions for the task before each block of trials.

Data and Statistical Analyses

One participant responded deterministically to the affective faces in the first block due to misunderstanding of the instructions and was excluded from these analyses. Thus, analyses were performed on data of 37 violent offenders and 19 controls.

Posturographic data-analyses were performed in MATLAB R2009b (The MathWorks, Natick, MA). Statistical analyses were performed using IBM SPSS Statistics 19 (IBM Corp., Armonk, NY).

Affective Decision-Making Task

Affective biasing of instrumental action. Following Ly et al. (2014), we calculated the proportion of instrumental go-responses (P_{go} = go/[go + no-go]), and reaction time (RT) of optimal instrumental go-responses. Mixed-design analysis of variance (ANOVA) was used for our main analyses. Two ANOVAs with P_{go} and RT as dependent variables were performed with emotion (angry/happy) and action-context (avoidance/approach) as within-subject variables, and group (violent offenders/controls) as between-subjects variable to assess whether the groups differed in affective biasing of instrumental action.

The groups differed significantly in age and IQ (see online supplementary materials). Because the groups are not randomly selected, and the covariate is a preexisting group difference, it is misguided to control for age and IQ differences by covarying these variables; an analysis of covariance (ANCOVA) could lead to potentially spurious

results (Miller & Chapman, 2001). We therefore conducted the analyses without controlling for these differences in age and IQ. To explore and rule out any potential influence of age and IQ, additional analysis with a subsample of the violent offenders that best matched the control group-average on age and IQ was conducted. These additional analyses yielded comparable results with the primary analyses (see online supplemental materials).

Accuracy. To assess whether performance was above chance for the violent offenders and the controls separately, we tested the proportion of optimal responses against 0.50 using one-sample *t* tests. Moreover, a one-way ANOVA with group (violent offenders/controls) as factor and the proportion of optimal responses as dependent variable was used to assess whether there were group differences in accuracy across the task as a whole. For all analyses, significant interaction effects were followed up by simple (interaction) effects analyses. Alpha was set at .05.

Results

Affective Decision-Making Task

Affective biasing of instrumental action. Mean proportion of go-responses (P_{go}) and RT are presented in Table 1. Consistent with our hypothesis, we observed reduced transfer of affective value to instrumental action in violent offenders compared with controls. This was substantiated by an ANOVA of P_{go} revealing a significant Group (violent offenders/controls) × Emotion (angry/happy) × Action-context (avoidance/approach) interaction effect, $F_{(1,54)} = 4.85$, $p = .032$, $\eta_p^2 = 0.082$, 95% CI [0.000, 0.239]. This interaction was due to the violent offenders differing significantly from controls in terms of their affective bias of instrumental approach-avoidance (see Figure 2). As expected, this interaction effect was due to the presence of an affective bias effect in the controls, $F_{(1,18)} = 7.94$, $p = .011$, $\eta_p^2 = 0.306$, 95% CI [0.018, 0.550], but not in the violent offenders, $F_{(1,36)} = 0.54$, $p = .469$, $\eta_p^2 = 0.015$, 95% CI [0.000, 0.160]. Specifically, post hoc simple effects analyses suggested that the affective bias effect in controls was driven by enhanced P_{go} for instrumental avoidance after angry versus happy faces, $F_{(1,18)} = 5.67$, $p = .029$, $\eta_p^2 = 0.240$, 95% CI [0.000, 0.499]. No other significant simple (interaction) effects were found (all Fs < 2.25).

Table 1
Data on the Affective Decision-Making Task

Condition	Violent offenders	Controls
Proportion of go-responses		
Avoidance		
Angry	56.6 (2.3)	56.9 (1.9)
Happy	54.9 (2.0)	51.0 (2.5)
Approach		
Angry	56.9 (2.2)	53.3 (1.7)
Happy	56.4 (2.2)	55.4 (1.9)
Reaction time		
Avoidance		
Angry	1414.4 (28.4)	1356.8 (52.8)
Happy	1421.6 (32.9)	1373.5 (55.1)
Approach		
Angry	1310.4 (37.8)	1280.5 (48.3)
Happy	1301.9 (35.5)	1275.5 (44.7)

Note. Mean proportion of go-responses (%) and reaction times (ms) for instrumental avoidance and approach (SEM) after angry and happy face primes for the violent offenders and the control groups separately.

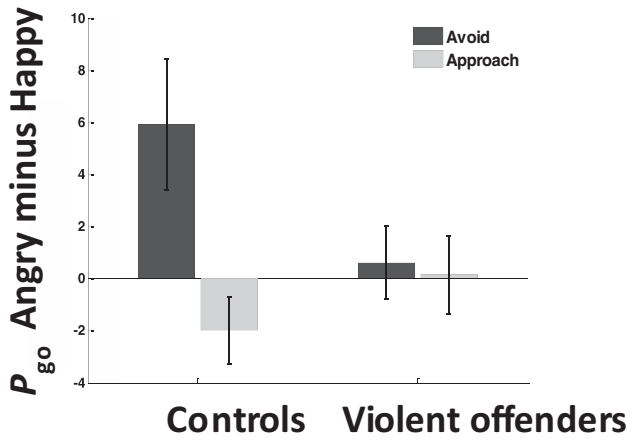

Figure 2. Affective biasing of instrumental action for controls and violent offenders. Controls (vs. violent offenders) demonstrate enhanced avoidance (vs. approach) after angry versus happy faces, suggesting that the violent offenders versus controls show a decreased affective bias effect on instrumental action. Error bars represent standard error of the mean.

The above effects were not accompanied by effects on the speed of responding. ANOVA of RTs showed a significant main effect of action-context (avoidance/approach), indicating that instrumental approach was faster than instrumental avoidance in general, $F_{(1,54)} = 13.73$, $p < .001$, $\eta_p^2 = 0.203$, 95% CI [0.044, 0.373], but there were no other significant main and interaction effects (all Fs < 1.00).

Accuracy. Across the task as a whole, performance was better than chance for both the controls ($M = 59.53$, $SEM = 1.60$), $t(18) = 5.97$, $p < .001$, $d = 1.370$, 95% CI [0.728, 1.992], and the violent offenders ($M = 55.53$, $SEM = 1.50$), $t(36) = 3.75$, $p < .001$, $d = 0.601$, 95% CI [0.261, 0.965]. Moreover, there was no significant difference between the groups in terms of overall accuracy, $F(1, 54) = 2.89$, $p = .095$, $\eta_p^2 = 0.051$, 95% CI [0.000, 0.195]. Finally, additional ANOVAs of P_{go} with overall accuracy as a covariate showed that our critical effect of interest (the affective bias effect) did not vary as a function of overall accuracy (Emotion × Action × Accuracy; $F(1, 53) = 1.46$, $p = .132$, $\eta_p^2 = 0.027$, 95% CI [0.000, 0,155].[1] Thus, the difference in affective biasing effect between the violent offenders and controls cannot not be explained by any effect on nonspecific cognitive processing, such as decreased task engagement, in the violent offenders.

Discussion

The present study shows that violent offenders with psychopathic tendencies exhibit reduced affective biasing of instrumental

[1] Similar results were obtained using signal-detection analysis. There was no difference between the groups in terms of d' as a sensitivity index, $F(1, 54) = 0.768$, $p = .385$, $\eta_p^2 = 0.014$, 95% CI [0.000, 0.126]. Finally, additional ANOVAs of P_{go} with d' as a covariate showed that our critical effect of interest (the affective bias effect) did not vary as a function of d' (Emotion × Action × d'; $F_{(1,53)} = 0.053$, $p = .819$, $\eta_p^2 = 0.027$, 95% CI [0.000, 0.040]).

action versus healthy controls. Specifically, instrumental avoidance (vs. approach) was potentiated by angry (vs. happy) faces in healthy controls, but not in violent offenders. This suggests that reduced transfer of affective value to instrumental action might represent a psychological mechanism that contributes to instrumental aggression observed in violent offenders.

This is the first study showing that violent offenders lack affective biasing of instrumental action. Our finding is in line with a previous finding that violent offenders with psychopathic tendencies show reduced automatic avoidance tendencies upon angry faces (von Borries et al., 2012). However, the present study extends this prior work by showing that violent offenders show abnormal transfer of such affective responses to instrumental avoidance. Broader literature involving aggression have mainly focused on affective processing per se, with inconsistent findings, suggesting subdued affective responding (Blair et al., 2004; House & Milligan, 1976; Lykken, 1957; Patrick et al., 1993), but also intact or even hypersensitive affective responding (Arnett et al., 1997; Glass & Newman, 2009; von Borries et al., 2010). The present finding highlights the importance to investigate the consequences of affective processing for instrumental action, rather than studying affective processing per se, in order to better understand behavioral anomalies. This idea is particularly relevant in light of contemporary literature suggesting that disordered behavior involves abnormal interactions between systems regulating affective and instrumental responses (Dayan et al., 2006).

In fact, a recent fMRI study indicated that violent offenders do not differ from controls in amygdala signaling during affective face processing, but rather differ in the degree to which the amygdala signaling interacts with prefrontal regions associated with affective action control (Volman et al., 2016). In line with this, data from our control tasks suggest that the lack of an affective bias in the violent offenders in the current study is unlikely to be explained by reduced affective processing per se (see online supplementary material). These preliminary findings need to be replicated in future studies including thorough behavioral and physiological tests assessing different components of affective processing (e.g., recognition and responding) to disentangle whether our current effects are explained by reduced affective processing per se, or rather the transfer of affect to instrumental action. Furthermore, future studies could benefit from including a neutral control condition in order to disentangle whether effects for behavior in violent offenders were specific to the aversive or appetitive domain (angry vs. happy).

Given the heterogeneity in the current patient sample and violent offenders in general, it is crucial for future research to tease out what characteristics or subtypes are conceptually related to reduced affective biasing of instrumental action. Our exploratory analyses suggest that reduced affective biasing effect in the violent offenders is associated with a combination of low anxiety and high premeditative aggression score (see online supplementary material). It is important to note, that this finding is based on self-reports and the aggression scores were remarkably low in the offenders considering their violence offense history. Therefore, we cannot rule out a bias in these data, for instance through dishonest answering. Given this inherent limitation of self-reports, especially when applied in this type of population, we have to interpret this result with caution (Kockler, Stanford, Nelson, Meloy, & Sanford, 2006; Kuyck, De Beurs, Barendregt, & Van den Brink, 2013). Nevertheless, the finding is consistent with literature suggesting a modulatory role of anxiety in subtyping of aggression (i.e., reactive vs. instrumental; Crowe & Blair, 2008; Frick & Ellis, 1999). Future research is necessary to provide a better understanding of the current findings in relation to aggression.

In sum, the results show that violent offenders versus healthy controls exhibited reduced transfer of affective value to instrumental behavior. Our findings converge with the clinical observation that individuals with a violence offense history are typically not affected by social affective cues that would discourage instrumentally aggressive acts (Glenn & Raine, 2009). This finding underscores the relevance of examining the interaction between affective processes and instrumental action for a better understanding of aggression-related anomalies. Finally, this research offers a new approach to investigate the role of affective biasing of behavior in different psychopathological conditions.

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