When a smile becomes a fist: the perception of facial and bodily expressions of emotion in violent offenders
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**When a Smile Becomes a Fist:**
The Perception of Facial and Bodily Expressions of Emotion in Violent Offenders

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<td>Kret, Mariska; University of Amsterdam, Psychology De Gelder, B.; Maastricht University, Maastricht Brain Imaging centre</td>
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When a Smile Becomes a Fist:

The Perception of Facial and Bodily Expressions of Emotion in Violent Offenders.

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Abstract

Previous reports have suggested an enhancement of facial expression recognition in women as compared to men. It has also been suggested that men versus women have a greater attentional bias towards angry cues. Research has shown that facial expression recognition impairments and attentional biases towards anger are enhanced in violent criminal male offenders. Bodily expressions of anger form a more direct physical threat as compared to facial expressions. In four experiments we tested how 29 imprisoned aggressive male offenders perceive body expressions by other males. The performance of all participants in a matching-to-sample task dropped significantly when the distracting image showed an angry posture. Violent offenders misjudged fearful body movements as expressing anger significantly more often than the control group. When violent offenders were asked to categorize facial expressions and ignore the simultaneously presented congruent or incongruent posture, they performed worse than the control group, specifically, when a smile was combined with an aggressive posture. Finally, violent offenders showed a greater congruency effect than controls when viewing postures as part of an emotionally congruent scene, and did not perform above chance when categorizing a happy posture presented in a fight scene. The results suggest that violent offenders have difficulties in processing emotional incongruence when aggressive stimuli are involved and a possible bias towards aggressive body language.

Keywords: Aggression, Violent offenders, Body language, Context, Attention, Emotion Attribution
Introduction

Emotional cues shown in the face and body serve as crucial regulators of social behavior (Frijda, 1986; de Gelder et al., 2006). For example, expressions of anger represent an immediate threat to one's safety. Emotional expressions are readily detected and they prompt quick responses in the observer (Becker et al., 2007; Fox et al., 2000; Schupp et al., 2004; Bannerman et al., 2009). But the perception of and the responsiveness to aggressive cues may vary with gender and with personal history. Threat is detected particularly well when expressed by men (Becker et al., 2007; Zebrowitz et al., 2010; Ohman & Dimberg, 1978; Marinkovic & Halgren, 1998). Impaired recognition and misinterpretation of facial expressions as signs of threat have been observed in male offenders (Gery et al., 2009; Hoaken et al., 2007; McCown et al., 1986; Sato et al., 2009), a group with high exposure to aggression from an early age (Lansford, 1995). Moreover, Mazurski et al. (1996) observed an enhanced electrodermal response in men only during exposure to angry male faces. This would suggest that this perceptual bias is linked to male-male aggressive challenges (i.e., fight mode).

Studies using aggressive offenders have made the link between aggression and impaired recognition of facial expressions. But the aggressive menace is clearer when the angry face is accompanied by whole body signals. This is shown by the fact that viewing body expressions triggers activity in action preparation areas (de Gelder et al., 2004; Grèzes et al., 2007). Kret et al. (2011) observed that men, as compared to women showed higher activation of motor preparation areas when they observed threatening male versus female body expressions. Following this line of reasoning, we predicted that aggressive men are even more sensitive to the threatening cues of other men. We investigated this hypothesis in a highly aggressive group of offenders selected based on the type of crime they committed (aggressive offence towards a male victim), on their trajectory of recidivism of similar offences and on their aggressive behavior in prison. In four experiments, we tested whether violent offenders can 1) match emotions in static postures, 2) recognize emotions from dynamic bodies, 3) recognize facial expressions
The perception of threat in violent offenders when the body expression is emotionally incongruent and, 4) recognize bodily expressions when the social context is emotionally incongruent.

A general emotion recognition impairment in violent offenders was not predicted. However, we expected to find group differences in the implicit effects of aggressive body language. More specifically, in Experiment 1, we expected a stimulus gender effect in the sense that the presence of angry male signals would interfere more with matching performance in the violent offender group than angry female signals or other emotional expressions. We expected a similar pattern in the control group (men would be distracted most by angry male body language), but a more pronounced effect in the offenders. Based on previous studies that showed that men, and especially aggressive men interpret others’ intentions as hostile (Sancilio et al., 1989; Waas, 1988), in Experiment 2, we expected differences in the error rates in that the offender group would more often than the control group recognize dynamic bodily expressions of emotion as being angry. Our final hypothesis was that the performance of the offender group would suffer from an emotionally incongruent context, especially when the distracting context showed aggression (a body and scene context in Experiment 3 and 4 respectively).

Methods

Participants

Twenty-nine violent incarcerated male offenders participated. They were incarcerated in three Dutch prisons, Z (N = 11), K (N = 11), D (N = 7) and convicted for armed robbery with aggravated assault causing bodily harm, threats and violence (N = 16) or homicide (N = 13). Their average age was young (mean age: 31.65 years, range 19-61 years old), yet ten individuals had been convicted before for similar crimes, on average on 4.50 (SD 2.41) occasions. All crimes for which the participants were convicted at the time of testing were directed towards another adult man. They were imprisoned for 2.78 years (SD 2.79) ranging from four months to 12.22 years and were convicted for 4.65 years (SD 3.80) ranging from six months to 15.75 years. Our aim was to test the most aggressive offenders: those who most often got into fights with other men, who were perceived as aggressive by the staff and who had a
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history of recidivism outside prison. To locate such offenders, a list of candidates was made by the research department of the Headquarter of the Dutch Judicial Service Commission based on specific articles of law, including articles about criminal charges for violent offences against persons—e.g., assault causing bodily harm, wounding, attempted homicide, homicide, armed robbery with aggravated assaults, threats and extreme violence. The list was shortened to exclude people older than 65 and people from the psychopathy department. We approached the psychologists, social workers and guards and selected the candidates from amongst this list which they thought were most suitable based on 1) number of recidivisms, 2) aggressive behavior in prison, 3) health. Half of the offenders who were approached agreed to participate. Six out of twenty-nine offenders indicated to have sought psychological treatment: three for aggression regulation problems, two for depression (one was on medication), two for stress, and one for fatigue, as assessed with a 15 item questionnaire that included questions about past and present medical and psychological problems.

The control group consisted of thirty-one males matched on age (mean age: 32.31 years, range 18-62 years old). The control group consisted of similar nationalities as the offender group and included uneducated and unemployed men. The controls were recruited from the technical and maintenance staff of the university, via advertisements in community centers, an integration course for ethnic minorities, and a reintegration course for unemployed people. Exclusion criteria included a neurological or psychiatric history or a criminal record. See Table 1 for details. All participants received a small financial compensation. The study was conducted in accordance with the ethical provisions of the institutes and the Declaration of Helsinki.

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1 We discussed all these characteristics of the candidates in great detail. In order to select the most aggressive offenders, we looked at their history of recidivisms (data was available from 1996 on) and the number of times they got into fights with other prisoners (after which they were put in the isolation cell, which is always recorded). But we also discussed their health, their current situation and whether it would be practically possible at all to test certain subjects. After that, we approached these people and asked whether they would like to participate.
Table 1. Participants

<table>
<thead>
<tr>
<th>Nationalities</th>
<th>Violent offender group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dominican Republic, Iraq, Israel, 3 x Morocco, 3 x Netherlands Antilles, Pakistan, Republic of Cape Verde, 4 x Republic of Surinam, Serbia, 7 x The Netherlands, Trinidad and Tobago, 3 x Turkey, Yugoslavia</td>
<td>Armenia, Belgium, 2 x Canada, France, Germany, 4 x Indonesia, 2 x Iraq, Ireland, Nepal, Republic of Cape Verde, 2 x Republic of Surinam, Serbia, 9 x The Netherlands, 4 x Turkey</td>
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<table>
<thead>
<tr>
<th>Education &amp; Work</th>
<th>Violent offender group</th>
<th>Control group</th>
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<tbody>
<tr>
<td></td>
<td>3 only finished primary school</td>
<td>1 only finished primary school</td>
</tr>
<tr>
<td></td>
<td>11 only finished high school</td>
<td>2 only finished high school</td>
</tr>
<tr>
<td></td>
<td>11 finished MBO</td>
<td>10 finished MBO</td>
</tr>
<tr>
<td></td>
<td>1 finished WO</td>
<td>8 finished HBO</td>
</tr>
<tr>
<td></td>
<td>8 had to quit their study but might continue</td>
<td>2 finished WO</td>
</tr>
<tr>
<td></td>
<td>6 were studying at MBO level in prison</td>
<td>4 studying in higher education</td>
</tr>
<tr>
<td></td>
<td>26 worked in prison</td>
<td>5 unemployed</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Mean age</th>
<th>Violent offender group</th>
<th>Control group</th>
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<tbody>
<tr>
<td>31.65 years, range 19-61 years old</td>
<td>32.31 years, range 18-62 years old</td>
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</table>

WO = Masters’ degree at science university. Can only be entered after 6 years of highest level high school.
HBO = Bachelors’ degree at non-science university. Can be entered after 5 years of medium level high school.
MBO = 2-3 year practical school which starts after lowest level/4 years of high school.

Materials and procedure

The experiments were administered in consulting rooms in the prisons and at Tilburg University. The experimenter was present in the experimental room with the participant without the presence of any another person. The testing situation for the control group was kept as similar as possible (i.e., the experiments in both groups ran intermixed in the same months, the same equipment was used and the same test-leader was present during the task. The test-leader always followed a typed-out protocol). The experiment ran on Presentation software (Neurobehaviorial Systems, San Francisco, CA), implemented on a laptop (Latitude E5500, Dell) with a 60Hz refresh rate. Distance to the computer screen was 60cm. The order of the experiments and the labels on the response box was counterbalanced. Instructions were given in Dutch, English, French or Turkish. Each experiment included five practice trials and the procedure was repeated when an error was made.
Experiment 1. Matching bodily expressions

Materials and procedure

A matching task was used to investigate how emotions were recognized without the use of verbal labels. The task was to indicate whether the left or right posture presented at the bottom of the screen showed the same expression as the top one. No time limits were set, and no feedback was provided, except during the test trials. Three different same sex actors were shown per trial. Materials consisted of 72 grey-scale photographs representing angry, fearful, happy and sad postures with the face blurred (310 pixels in height). We included images of 24 actors (half male, half female) that were correctly recognized above 70% in a validation study (de Gelder & van den Stock, 2011).

Data analysis

Main and interaction effects of accuracy were tested in a mixed multilevel model with the following fixed factors: Group (offender or control): Target expression (four emotions), Distractor expression (four emotions), Sex (male or female actor), Group * Sex, Group * Target expression, Group * Distractor expression, Target expression * Sex, Distractor expression * Sex, Group * Target expression * Sex, Group * Distractor expression * Sex. A random intercept was included, as well as a random intercept for each trial. This allowed each trial to have its own intercept across participants, in addition to the random intercept per participant. The benefit of analyzing the data in a multilevel model is that data is never averaged over conditions, i.e., all individual trials, nested within subjects are included in the model and consequently the variance within individuals is maintained. This is especially recommended when the subject group is quite heterogeneous (which is for example often the case in patient studies). The goal of this analysis is not to search for specific effects, but to end up with a model that best fits the data. In other words, to have a final model in which the variance is explained most optimally. It is common to start with a full model and drop non-significant factors one by one, starting with the higher order interactions (Garson, 2012).
Results

There were significant main effects for target emotion $F(3, 1.421) = 13.869, p < .001$ and distracting emotion $F(3, 1.421) = 21.165, p < .001$, an interaction between target and sex of the actor $F(3, 1.421) = 3.734, p = .011$ and marginally significant interactions between sex of the actor and distractor $F(3, 1.421) = 2.103, p = .081$ and group * target $F(3,1.421) = 2.160, p = .091$. Sad postures were most accurately recognized (Mean = 99%, SE = .4), followed by happy (Mean = 94%, SE = 1.3), fearful (Mean = 91%, SE = 2.0), and angry expressions (Mean = 86%, SE = 2.7). Angry postures were somewhat better recognized from a male vs. female actor (Mean = 90%, SE = 3.0 vs. Mean = 82%, SE = 4.1, $p = .099$) and fearful postures were better recognized from a female vs. a male actor (Mean = 95%, SE = 1.80 vs. Mean = 84%, SE = 3.5, $p = .001$). Accuracy was lowest when the distracting posture expressed anger (Mean = 82%, SE = 3.1) vs. fear (Mean = 93%, SE = 1.7), happy (Mean = 97%, SE = 1.0), sad (Mean = 99%, SE = .5), $p$-values < .001. Angry and happy postures were somewhat more distracting when the actor was male vs. female ($p = .099$ and $p = .021$). Follow-up comparisons of the interaction group * target did not reveal any significant effects.

A confirmation of our hypothesis (that violent offenders’ performance would drop when the distracting picture showed an aggressive male), would have required a significant three-way interaction between Group * Distractor expression * Sex. However, this interaction was not significant $F(3, 1.421) = 2.249, p = .20$ because the control group showed a similar pattern and were both mostly distracted by angry male postures. See figure 1.
Figure 1. Matching to sample task

![Graphs showing accuracy of matching targets and distractors by sex and emotion]

Fig. 1. The line-graphs show the data from all participants. The light blue line within the dotted circle shows the accuracy when the distracting image was an angry posture. Both groups were mostly distracted by angry, male postures which can be seen for both groups separately in the bar graphs.

Conclusion: In both groups, performance was lowest by the presence of a distracting angry male body. We would have expected this effect to be somewhat larger in the violent offender vs. control group, but although numerically consistent with our hypothesis, this was not confirmed statistically. Men from both groups were distracted mostly by threatening male body postures. Angry male postures attracted the attention and possibly triggered an approach response. This explanation would be in line with a recent study that actually showed that psychopathic offenders lacked the automatic avoidance of angry facial expressions. Interestingly, the lack of avoidance responses was related to levels of instrumental aggression and probably not specific for psychopaths but generalizable to other aggressive populations.
The perception of threat in violent offenders (von Borries et al., 2012). Another bias which has been reported in aggressive populations is the hostile attribution bias, i.e., a tendency to see situations as threatening (Dodge et al., 1990). In Experiment 2, we investigate whether this bias extends to bodily movements.

**Experiment 2. Dynamic bodily expression of emotion**

*MATERIALS AND PROCEDURE*

Two-second video clips of bodily expressions that were recognized above 90% correct by Tilburg University students, were selected from amongst our own stimulus database (Kret et al., 2011). We selected angry, fearful and happy bodily expressions from 10 male actors. Participants were instructed to categorize the emotion and choose among four options: anger, fear, happy or neutral. Neutral was included as response option to not restrain participants to choices limited to the target emotions (Hastings et al., 2008). At the end of a video, a blank screen with a question mark appeared. Once a participant responded, a blank screen appeared for 2-3 seconds after which a fixation cross was presented.

**Data analysis**

Main and interaction effects for accuracy were tested in a mixed multilevel model with ‘body expression’ (anger, fear or happy) and ‘group’ (offender or control) as fixed factors. A random intercept was included for each participant, as well as a random intercept for each trial. As in Experiment 1, we did not average trials over conditions. We also tested whether the two groups differed in the specific errors they made.

**Results**

The interaction between group and emotion [F(2, 4.428) = 8.554, p < .001] showed that offenders were worse than controls in recognizing fear (Mean = 86%, SE = 2.0 vs. Mean = 92%, SE = 1.3, p < .01). There was a main effect of emotion: angry expressions were recognized less accurately than fear and happiness [F(2, 4.428) = 33.947, p < .001]. Both groups made more anger vs. happy or fear
misclassifications \( (p < .001) \) but the offenders showed a stronger bias which was significantly different from the control group for fearful movements. These were more often than the control group interpreted as angry \( [F(1, 1.195) = 4.351, p < .05] \) but not as happy \( (p = .450) \). In addition, the groups did not differ in recognizing happy expressions as angry \( (p = .372) \) or fearful \( (p = .979) \), anger as fearful \( (p = .983) \) or happy \( (p = .916) \). See figure 2.

**Figure 2. Recognition rates of dynamic bodily expressions of emotion**

*Fig 2.* Different stimulus exemplars. Violent offenders were worse in recognizing fear than the control group and recognized this emotion as anger more often than the control group. *\( p < .05 \).*
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As predicted, violent offenders were worse than controls in recognizing fear from body movements and misinterpreted this emotion as anger (Sato et al., 2009). This result is partly in line with Sato et al. (2009). In that study, three additional emotional expression categories were used including disgust. They observed that offenders misjudged disgusted (but not fearful) faces as angry more often than controls. The difference between that study and the current study may be due to methodological issues. An alternative interpretation for the anger-interpretation bias that offenders seem to have, is that violent offenders are less sensitive to fearful movements than the control group.

In a naturalistic situation, emotions are expressed dynamically, with the body and the face, and in a valid context in which other people are often present. By manipulating these characteristics one by one rather than all at once (i.e., the dynamics (Experiment 2), the face context (Experiment 3), and the scene context (Experiment 4)), we will get more insight into which factors contribute to misrecognitions and attentional biases. As we just mentioned, in real life, one sees the face combined with a body which influences how the face is perceived (Meeren et al., 2005). The next experiment tests whether violent offenders have a deficit in categorizing a facial expression in the context of a threatening male body expression. The body context is manipulated and either shows the same, or a different expression as the face.

**Experiment 3. Facial expression recognition with congruent or incongruent body expression**

*Materials and procedure*

Face-body compound images were created by pasting emotionally congruent or incongruent body expressions below emotional faces of eight new male actors. The validation of these stimuli is described in Kret et al., (2013). The stimuli were briefly (100ms) presented to avoid ceiling effects and to provide space for the interference of body expressions (Kret & de Gelder, 2010; Kret & de Gelder, 2012). The same emotions were used as in Experiment 2. Participants were asked to categorize the facial expression and ignore the body. After a response, a grey screen appeared on which after 5700ms, a fixation cross was presented for 300ms. In total, 72 pictures were shown (3 facial expressions * 3 postures * 8 actors). We
The perception of threat in violent offenders predicted that violent offenders would be impaired in recognizing a happy or fearful face when an angry posture was presented simultaneously.

Data analysis

Main and interaction effects of group and emotion on accuracy and reaction time were tested in a generalized mixed model with the following fixed predictors: ‘facial expression’ (3: anger, happy, fear) and ‘bodily expression’ (3: angry, happy and fearful postures) and ‘group’ (2: offender or control). Only the reaction times on correct trials were analyzed. In addition, reaction times above 4000ms were not included in the analysis (0.83%). A random intercept was included, as well as a random intercept for each trial.

Results

Accuracy: Generally, faces were better recognized when paired with a congruent vs. incongruent posture \[F(2, 4.297) = 36.277, p < .001\] all comparisons \(p\)-values < .001). There was an interaction between group, emotion of the face and body posture \[F(4, 4.291) = 6.988, p < .0001\]. Offenders were less accurate than controls \[F(1, 4.291) = 12.133, p < .005\]. However, the three-way interaction shows that offenders were not always less accurate than the control group. As expected, violent offenders differed mostly from the control group when happy faces were accompanied with angry bodies \(p < .001\). In addition, they were worse than controls when categorizing happy faces with happy bodies and angry faces with happy and fearful bodies \(p\)-values < .005). There were some additional effects that did not survive a Bonferroni correction: violent offenders were worse in recognizing a happy face above a fearful body \(p = .029\) and were somewhat better than the control group in recognizing fearful faces paired with angry bodies \(p = .035\). To test whether the major result, that happy faces with angry bodies were particularly difficult to recognize for the offender group, not just due to the incongruence between the two emotional signals, but due to the angry body posture, we calculated a difference score between happy faces paired with angry minus fearful bodies and compared both groups. This yielded a significant difference between
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The two groups ($p = .01$). In addition, within the offender group, accuracy was lower when happy faces were paired with angry versus fearful bodies ($p < .001$). See figure 3 and table 2.

Reaction time: There was a significant interaction between group, emotion of the face and body posture [$F(2, 2.864) = 3.750, p < .001$]. There were main effects for bodily expression [$F(1, 2.864) = 9.813, p < .0001$] and for facial expression [$F(2, 2.864) = 51.840, p < .001$]. Both groups recognized the three facial expressions faster when paired with a body that expressed the same vs. a different emotion (all $p$s < .001). Most interestingly, violent offenders were slower than the control group in categorizing happy faces when paired with angry postures ($p = .013$). The two groups did not differ in any other condition ($p > .152$). See figure 3 and table 2.

Figure 3. Emotionally congruent and incongruent face-body compounds

[Fig 3. Violent offenders were worse in recognizing a happy face when the body expressed anger.]
Table 2.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Control group</th>
<th>Violent offenders</th>
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<tr>
<td></td>
<td>Reaction Time</td>
<td>Accuracy</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Face</td>
<td>Body</td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>Anger</td>
<td>755.31</td>
</tr>
<tr>
<td>Fear</td>
<td>1358.74</td>
<td>63.21</td>
</tr>
<tr>
<td>Happy</td>
<td>1495.84</td>
<td>76.64</td>
</tr>
<tr>
<td>Fear</td>
<td>1358.74</td>
<td>57.43</td>
</tr>
<tr>
<td>Happy</td>
<td>1358.74</td>
<td>57.43</td>
</tr>
</tbody>
</table>

Table 2. Significant differences between the two groups are printed in bold. The most significant differences are found in the condition where happy faces were paired with an aggressive posture.

Conclusion: As predicted, violent offenders were impaired in categorizing a happy face when the posture expressed aggression. In the final experiment we investigated whether the recognition of a happy posture is influenced by the social scene and more strongly so in violent offenders than in controls.

Experiment 4. Bodily expression recognition in congruent or incongruent social scenes

Eight happy and angry postures from the same set as previously described were included. Angry (fight), happy (party) and neutral (sports) scenes were selected from the Internet (for details see Kret and de Gelder (2010)). Emotionally congruent or incongruent postures were placed in the scenes. Participants were given a two-alternative forced choice task and were instructed to focus on the main figure, ignore the scene, and categorize the body emotion. A trial started with a fixation cross on a grey screen (300ms), a stimulus (100ms), followed by a grey screen shown until button press.

Data analysis Effects of bodily expression recognition accuracy in congruent or incongruent scenes and reaction times were tested in mixed multilevel model with ‘body expression’ (anger or happy), ‘scene emotion’ (anger, neutral, happy) and ‘group’ (offender or control) as fixed factors. A random intercept
was included, as well as a random intercept for each trial. Due to strict time schedule regulations, the data of one offender could not be collected, as he had to return to his cell.

**Results**

**Accuracy:** There was an interaction between group, emotion of the scene and body expression \([F(2, 5.227) = 19.454, p < .001]\) supported by two-way interactions between body expression * scene emotion \([F(2, 5.227) = 134.849, p < .001]\) and group * body expression \([F(1, 5.227) = 6.688, p < .01]\) and a main effect of body expression \([F(1, 5.227) = 62.392, p < .001]\). Both groups showed a congruency effect (all \(p\)-values < .05), but interestingly, this effect seemed stronger in the offenders. To confirm this statistically, we ran an analysis on the difference scores between the recognition of happy bodies in a happy minus angry scene and angry bodies in an angry minus happy scene and found a main effect of group \([F(1, 232) = 4.947, p < .05]\). In addition, violent offenders also showed a difference between the congruent conditions and the neutral context condition, whereas the control group did not (happy postures in happy context and angry postures in angry vs. neutral context, \(p s < .005\)). When categorizing happy postures in an angry context, violent offenders were not different from chance \((p = .992)\). However, the control group was not better than chance either \((p = .113)\) and the two groups did not significantly differ in this condition \((p = .159)\), which might be due to the floor effect. The greater congruency effect for happy bodies in the offender group was mainly (yet not fully) explained by the fact that they were somewhat better in recognizing happy bodies in a happy scene than the control group \((p < .05)\). See figure 4.

**Reaction times:** There was an interaction between body and scene emotion \([F(2, 3.330) = 6.048, p < .005]\). Reaction times for angry bodies were shortest when presented in an angry scene (\(p\)-values < .01). See figure 4.

**Conclusion:** The results are partly in line with our hypothesis. As predicted, violent offenders could not recognize happy body expressions when a fight was presented simultaneously. However, the control
The perception of threat in violent offenders faced great difficulties in this condition and although the effect seems amplified in the offender group, it may actually be more generalizable to men in general, like the findings of Experiment 1.

**Figure 4. Recognition of body expressions in congruent and incongruent social scenes**

Fig 4. Both groups, but especially the violent offenders, were better in recognizing body postures when these were placed in a congruent versus incongruent context. Violent offenders in particular were impaired in recognizing happy body postures when a fight was presented in the background.
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Discussion

In a situation where aggressive body language contrasts with a smiling face or where a happy posture seems out of place in an aggressive scene, violent offenders’ behavior is influenced disproportionately by the presence of threat signals. The four experiments are consistent in their results. First, both violent offenders and the control group were impaired in matching postures when the distracter image was an aggressive male posture. Second, violent offenders tended to misjudge fearful body movements as aggressive more often than the control group. Third, violent offenders were impaired in recognizing a happy face when simultaneously presented as part of an aggressive posture. Fourth, violent offenders and control participants were impaired in recognizing a happy posture when viewed against the background of a violent scene.

Previous studies have shown a deficit in facial expression recognition in aggressive offenders (Gery et al., 2009; Hoaken et al., 2007; McCown et al., 1986; Sato et al., 2009) and psychopaths (Marsh & Blair, 2008). Our study adds to this research by showing strong responses towards aggressive postures, a direct physically threatening stimulus. Moreover, consistent with the literature on aggression in the male population, enhanced effects were observed for male body expressions. This result is not due to impaired body expression recognition. Overall, violent offenders performed similar to the control group; they could match body expressions, correctly identify emotional body movements, and recognize postures in a congruent or neutral context. Difficulties arose where multiple emotional cues were present, and particularly when threatening postures had to be ignored. In line with our previous studies in healthy populations, we found in Experiment 3 that facial expressions were better recognized when accompanied by a body that expressed the same emotion (Meeren et al., 2005). Similarly, in Experiment 4, we observed that body expressions were best recognized in a social scene that expressed the same emotion (Kret & de Gelder, 2010). This congruency effect was observed in both groups. In Experiment 3 and 4, violent offenders performed equally well on the congruent trials as the control group, but were extra impaired in recognizing emotions in the incongruent conditions, especially when the context was aggressive. It could be that violent offenders derive different meaning from certain incongruent combinations than controls.
some situations, contexts or postures are more informative for a correct interpretation of emotion and offenders may be more sensitive to these signals. In that sense, it might be unfair to conclude that violent offenders are impaired in recognizing facial expressions in the context of incongruent body cues. For example, a person with a happy posture among fighting people may not signal happiness but some sort of encouragement. If this is the case than it may not be that the offenders are “wrong”, but just that they use different information than controls to deduct what the person is signaling. Another example of how the construction of affective meaning may be different for offenders than controls is the happy faces in combination with angry postures. When people have firsthand experience with fights, a smiling person with an aggressive posture may be extra threatening because it may signal confidence and dominance or a laugh in the face. However, differences in attention to contextual cues between the two groups cannot explain that the effects were particularly strong when the context showed anger. To explain that specificity, we think it is important to keep in mind that the offenders in our study were convicted for extremely violent crimes against other men. They were screened by the staff to include the most aggressive individuals who got into fights a lot in and out of prison. It is well known that a large percentage of violent offenders grew up in a violent environment (Lansford, 1995). In such environments, it may have been adaptive to attend to contextual cues and quickly respond and perhaps over-react to cues of threat or mis-judge expressions as threatening (better safe than sorry). Earlier studies have suggested an interpretative bias in aggressive populations (Dodge, 1990; Copello & Tata, 1990; Black et al., 1997) and the current study supports this as well.

Previous studies have shown the impact of low IQ on crime (Hirschi & Hindelang, 1977) and on emotion recognition impairments (Rojahn, 1995). Although IQ was not measured, the control participants were selected from low social economic status groups, most of them had a low education level and some of them were unemployed. We presume that matching on education level may be better than matching on IQ as school has well known positive effects on social and cognitive skills that maintain in adult life (Hatch et al., 2007). But still, we faced some difficulties here too. Some prisoners were unable to continue their studies in prison but said they would pick this up again when they got out. The motivation not to
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study is totally different from someone who has the opportunity to study but chooses otherwise. Importantly, the findings in our study cannot be explained by differences in IQ or education level as overall performance was the same between the two groups. The general bias towards angry expressions, (being distracted by them, interpreting other emotions as anger) is different from being good or bad at recognizing anger explicitly. Violent offenders were not better than control subjects in putting a verbal label to an angry expression. In fact, they were sometimes even worse than the control group in labeling angry expressions. Importantly, the major effects are in the more implicit measures such as interpretation biases and contextual effects of anger and these are independent of intelligence, SES and race (Dodge & Price, 1990) and likely related to the aggressive trait of the offenders.

One limitation of our study is that various possible factors may have differed between the two groups. Living in a violent environment like a prison may have influenced the results of our study. However, we did conduct some exploratory analyses to investigate whether imprisonment in itself influenced the effects². Overall, we did not find clear evidence that the observed major findings were influenced by the length of imprisonment. The bias towards aggressive body language does not seem to be increased with imprisonment. In contrast, in Experiment 1 we actually found some indication that the new, least experienced prisoners were more distracted by threatening male body language than the prisoners who already spend half their lives in jail, and this was independent of their younger age. Future studies could include non-aggressive prisoners as a second control group. However, that brings other difficult issues as well, and it is complicated to establish a control group that contains offenders that are of equal intelligence, non-aggressive, and with equally long sentence and imprisonment.

Research has shown a strong connection between elevated testosterone levels and increased aggressiveness (Archer, 2006) and attention to angry faces (Van Honk et al., 1999; Van Honk et al., 2001). It has been suggested that testosterone may facilitate approach towards signals of dominance

² In order to keep the focus of the manuscript on the main results, we decided to not report these analyses in the results section. However, the authors can provide the output on request.
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challenge (Wirth & Schultheiss, 2006). In addition, being exposed to high doses of testosterone prenatally (as measured via digit ratios), correlates with the propensity to engage in aggressive behavior in adult life (Bailey & Hurd, 2005) and predicts sensitivity to threatening faces (Kret & de Dreu, 2013). Previous studies found that offenders have smaller digit ratios, i.e., a higher prenatal exposure to testosterone and observed a clear link with criminal behavior (Hanoch, Gummerum & Rolison, 2012). The effects that were observed in the current study can possibly partly be explained by these biological markers. That said, childhood environment may have played an important role as well. Many offenders grew up in violent environments with aggression in their daily routine (Cima et al., 2008; Driessen et al., 2006; Heide & Solomon, 2006; Hosser et al., 2007; Kopp et al., 2009; Lansford, 1995; Lindberg et al., 2009; Poythress et al., 2006. In turn, individuals exposed to a chronic early adverse history manifest higher levels of trait anger and anger reactivity than individuals who have not been exposed to such a harsh early history (Gardner, 2008). Shahinfar et al. (2001) reported a relation between exposure to violence and social information processing difficulties among incarcerated adolescents.

It is difficult to say where the bias towards threatening body language that we observed in our study originated. But the important finding of our study is that there is such a bias and this opens doors to therapeutic interventions. Fortunately, learned responses can be modified, especially in the young and non-psychopathic. In recent years, cognitive-behavioral interventions including aggression regulation courses have been developed and implemented in Dutch forensic institutions and given the declining number of offences, this approach seems successful (CBS, 2011: http://statline.cbs.nl). We believe that the new insights from our study may help to improve these interventions.

In summary, our study shows that violent offenders, aggressive men who had committed a violent offence with a male victim, and who have a strong tendency to get involved in fights, have problems with mixed emotional signals with a particular bias towards threatening body language, resulting in lower task performance and incorrect interpretations of happy signals (face or body) when a threatening context (body or scene) is provided.
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