Watch the face and look at the body!

Reciprocal interaction between the perception of facial and bodily expressions

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Human emotion processes are traditionally investigated in the laboratory by using facial expressions. However, information from other sources, such as the emotion of the voice, the body or the surrounding context, seems to influence the way we perceive the face. In the current experiment compound stimuli consisting of faces and bodies expressing fear or happiness, with the same (congruent) or different (incongruent) emotion, were presented. Participants had to judge either the emotion of the face or the body. Our data clearly show that face and body expressions influence each other. Accuracy was negatively influenced by the incongruent emotion of the bodily expression, but only when the target face expressed a happy emotion. When a fearful or happy body had to be judged, both incongruent face emotions affected the accuracy similarly. The same pattern was observed for the reaction times for judgement of the body emotion, while no influence of the body was observed when the emotion of the face had to be judged. Our results indicate that face and body expressions influence each other but that the way the one biases the perception of the other is dependent on the specific emotion and on which the attention is focused. (*Netherlands Journal of Psychology*, 64, 143-151.)

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Faces do not appear to us to be completely isolated from other sources of information that may be helpful to recognise and react to their emotional expression. However, traditionally the study of how humans process emotional signals has focused on the underlying perceptual and neurophysiological processes of perceiving facial expressions without taking these other sources of information into consideration.

Many studies indicate that the face and its expression might comprise a special perceptual category processed by the brain in a specialised manner and involving dedicated brain regions. Given our evolutionary background in which detection of threat was of utmost importance for survival, this is not entirely surprising.

The fusiform gyrus has been put forward as the region dedicated to the perception of faces and their expressions. This is witnessed by a larger activity for faces than for other objects (Haxby, Horwitz, Ungerleider, Maisog, Pietrini, & Grady, 1994; Kanwisher, McDermott, & Chun, 1997; Sergent & Signoret, 1992) and an increase in activity when the face contains an emotion (e.g., Morris, de Gelder, Weiskrantz, & Dolan, 2001; Rotshtein, Malach, Hadar, Graif, & Hendler, 2001).

Similarly, the N170 event-related potential with as possible source the fusiform gyrus (Herrmann, Ehlis, Muehlberger, & Fallgatter, 2005; Pizzagalli, Lehmann, Hendrick, Regard, Pascual-Marqui, & Davidson, 2002, but see Henson, Goshen-Gottstein, Ganel, Otten, Quayle, & Rugg, 2003), is larger for faces than for other objects (Bentin et al., 1996) and is sensitive for the expression of the face (Batty & Taylor, 2003; Caharel, Courtay, Bernard, Lalonde, & Rebai, 2005; L. M. Williams et al., 2006).

A possible feedback mechanism (see Breiter et al., 1996; Morris, Öhman, & Dolan, 1998; Sugase, Yamane, Ueno, & Kawano, 1999) between the fusiform gyrus and the amygdala might explain the emotion sensitivity of the first region (and possibly of the N170, see Righart & de Gelder, 2006). Furthermore, patients with amygdala lesions are impaired in the recognition of facial expressions (Adolphs, Tranel, Damasio, & Damasio, 1994, 1995; Young, Aggleton, Hellawell, Johnson, Broks, & Hanley, 1995; Young, Hellawell, van de Wal, & Johnson, 1996). Moreover, faces containing an emotion are more easily detected (Hansen & Hansen, 1988) and reduce inattention in visual extinction and neglect patients (Tamietto, Latini Corazzini, Pia, Zettin, Gionco, & Geminiani, 2005; Vuilleumier & Schwartz, 2001).

As an expression can sometimes be ambiguous, additional sources of information have to be taken into account, such as tone of voice or the bodily expression. In those cases, recognition can be improved, but when the additional source is incongruent with the primary source, i.e. displaying a different emotion, reaction times are slowed down and judgement becomes more erroneous. In the study by Meeren, van Heijnsbergen, and de Gelder (2005) fearful and angry facial expressions were recognised faster and more accurately when the concurrently presented bodily expression was the same (congruent) rather than different (incongruent). The amplitude of the P1 event-related potential appeared larger for incongruent than congruent pairs. Van den Stock, Righart, and de Gelder (2007) showed that facial expressions, ranging on continuum from fear to happiness, were more frequently judged as expressing happiness when a happy instead of fearful bodily expression was shown concurrently.

Adopting the approach of these two previous studies, Aviezer et al. (2008) obtained similar results and showed the extent to which the perception of the facial expression was influenced by the expression of the body. The effect was modulated by the similarity between the emotion of the target face, and the emotion of the accompanying body (in descending order of influence: anger, sadness and fear).

Furthermore, activity of the amygdala and fusiform gyrus (Dolan, Morris, & de Gelder, 2001) and the amplitude of the N170 (Righart & de Gelder, 2006, 2008a) are influenced by the complementary affective information that accompanies the facial expression (emotional voice: Dolan et al., 2001; emotional scene: Righart & de Gelder, 2006, 2008a).

Whether the primary source of affective information is liable to influence is sometimes dependent on its own specific emotion and that of the additional source. Righart and de Gelder (2008a, 2008b) showed that the perception of a fearful face was not negatively influenced by the happiness-inducing context, but if a happy face had to be categorised, the fear-inducing context slowed down the response (Righart & de Gelder, 2008a, 2008b) and participants made more errors (Righart & de Gelder, 2008b). Using only (emotional) faces, Fenske and Eastwood (2003) and Hansen and Hansen (1988) reported similar results. In the first study, reaction times of emotional categorisation of the target face were negatively influenced by the negative faces that flanked the target if the target face itself contained a positive emotion. When the target contained a negative emotion and the flankers a positive emotion, no influence on reaction times was observed. In the second study, the influence of the angry distractor faces on the happy target face was larger than that of happy distractor faces on the angry target face. Negative emotions may hold attention if the target exhibits the negative emotion (Fox, Russo, Bowles, & Dutton, 2001), or may attract attention to the secondary source when the latter contains the negative affective information (Hansen & Hansen, 1988) and may thereby interfere with target processing.

These studies might suggest that the facial expression is taken as the primary source of information. However, when the other person is standing far away, the bodily expression is better visible than the face and might show an advantage. Furthermore, the special status of the face has been put in a more modest perspective recently. Bodies are also encoded rapidly (Meeren, Hadjikhani, Seppo, Hämäläinen, & de Gelder, submitted), the fusiform gyrus is also activated by images of bodies (Peelen & Downing, 2005) and modulated together with the amygdala by affective information of the body (de Gelder, Snyder, Greve, Gerard, & Hadjikhani, 2004; Hadjikhani & de Gelder, 2003; van de Riet, Grèzes, & de Gelder, in press). Just like faces, bodies capture attention (Downing, Bray, Rogers, & Childs, 2004), reduce attention deficits of neglect patients (Tamietto, Geminiani, Genero, & de Gelder, 2007), and are processed outside of awareness by patients with striate cortex lesions (de Gelder & Hadjikhani, 2006).

We recently investigated the influence of additional affective information on the processing of bodily expressions (van den Stock, Grèzes, & de Gelder, 2008). Emotion judgements of dynamic bodily expressions of fear and happiness were biased to the emotion of the concurrently presented fear and happiness-inducing vocalisations produced by humans or animals.

No studies so far have investigated the influence of facial expressions on the perception of body language. All the aforementioned studies investigated the influence of the body on the face (Meeren et al., 2005; van den Stock et al., 2007) or of the affective vocal expressions on the body (van den Stock et al., 2008).

In the current experiment, we studied this question by presenting emotionally congruent and incongruent face-body compounds, with the face or body expressing fear or happiness. The emotion of either the face or the body had to be categorised.

Based on prior studies, we hypothesised that emotional categorisation of the target (face or body) might benefit from the presence of a congruent context emotion (body or face) in comparison with an incongruent emotion with slower and/or less accurate responses for incongruent pairs. We predicted that this (in)congruency effect is dependent on the emotion of target and context. A target expressing happiness will be negatively influenced by the incongruent fearful context expression, while no effect will be seen of the incongruent context when the target expresses fear.

Methods

Participants

Eighteen right-handed healthy undergraduates were tested. They received course credits for participation in the experiment. All participants had normal or corrected-to-normal vision and declared having no history of neurological of psychiatric disorders. They all gave written consent and the study was in accordance with the Declaration of Helsinki.

Stimuli

Each stimulus consisted of greyscale pictures of faces and bodies with either a fearful or a happy expression resulting in four (2 x 2) possible stimulus combinations. Four male and four female face and body identities were used, each identity displaying a fearful or happy expression. Face and body pictures were taken from the Ekman and Friesen database and from our own database, respectively, and were previously validated (faces: Ekman & Friesen, 1976; bodies: van de Riet et al., in press) and included when they were recognised correctly more than 75% of the time.

Faces were fitted inside a grey oval shape, which masked all external aspects. Body stimuli were cut out, removing all background. The faces of the body pictures were covered with a grey mask that made the internal facial features invisible. Faces and bodies were scaled to the same height (300 pixels) and superimposed on each other, similar to the stimulus construction procedure as used in Boutet, Gentes-Hawn, and Chaudhuri (2002). This deviates from the procedure used in Meeren et al. (2005) and van den Stock et al. (2007) in which face-body compounds were constructed by positioning the head on top of the body. In the current procedure there is no clear advantage of one stimulus category over the other, as differences in eye movements are

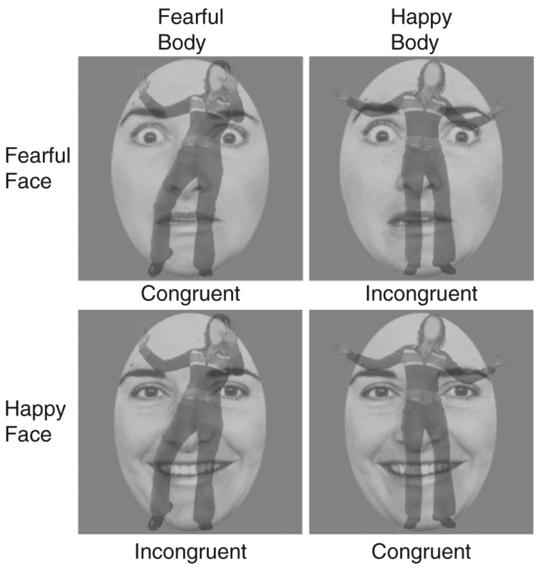

Figure 1
Examples of the compound stimuli presented during the experiment. A fearful facial expression was coupled to a fearful (congruent) or happy (incongruent) bodily expression. A happy facial expression was coupled to a fearful (incongruent) or happy (congruent) bodily expression.

avoided and both parts occupy the same position in the visual field.

Design and procedure

Participants were instructed on a trial-by-trial basis to judge the emotion of either the face or body. Before each compound stimulus was shown, participants were instructed whether to categorise the emotion of the face or the body by the word FACE or BODY appearing on the screen. This instruction screen stayed on for 1000 ms. A fixation cross appeared for 400 ms after which the compound stimulus was shown for 40 ms. Participants had to respond within the time frame of the subsequent grey screen (1200-1400ms) and fixation cross (400 ms). See Figure 2 for the trial sequence.

In previous studies in which the focus of attention was on the face or on the additional stimulus, emotion effects were present in designs in which trial types were presented randomly (Anderson, Christoff, Panitz, De Rosa, & Gabrieli, 2003; Vuilleumier, Armony, Driver, & Dolan, 2001), while absent when presented in a block design (Pessoa, McKenna, Gutierrez, & Ungerleider, 2002). We therefore chose the current design type, as in a block design, participants may have enough time to actively suppress the unattended stimulus (see M.A. Williams, McGlone, Abbott, & Mattingley, 2005).

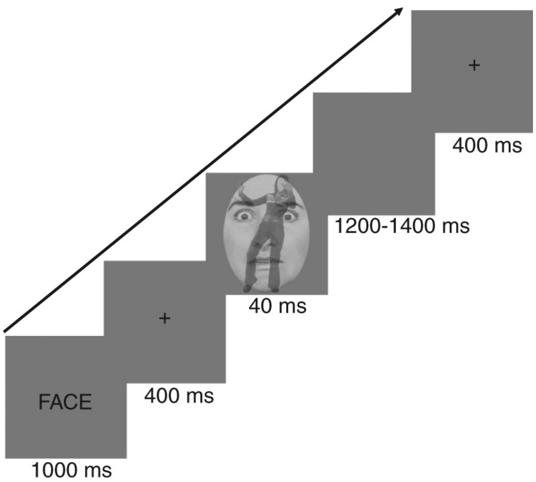

Figure 2
Sequence of the various parts of the trial and their duration. Participants were alerted by the instruction screen whether to judge the emotion of the face or the emotion of the body before presentation of the compound stimulus. Responses had to be made before offset of the fixation cross which succeeded the grey screen.

To avoid ceiling effect, we increased task difficulty by presenting the stimulus very briefly and limited the time frame in which the participants were supposed to respond.

Participants were sitting facing the monitor in a soundproof experimental boot and responded with the right index and middle finger. Ascription of each finger to each response category was counterbalanced over participants. E-prime (Schneider, Eschman, & Zuccolotto, 2002) was used for presentation of the stimuli and the registration of responses and reaction times. In each of the five blocks, the stimulus set of 64 different images was presented in a randomised order with a short break of two minutes between blocks. The experiment was preceded by a short practice session using different compound stimuli than the experimental ones.

Data analysis

Data (Reaction times and Accuracy) were analysed using two 2 x 2 repeated measures analyses of variance (ANOVAs) with the main factors Emotion Face (two levels: Fearful and Happy), Emotion Body (two levels: Fearful and Happy) for Judging Emotion Face and for Judging Emotion Body separately.

Interaction effects between Emotion Face and Emotion Body can indicate that congruent compounds are recognised better and/or faster than incongruent pairs. As we expect these congruency effects to be dependent on the emotion of target and context, for each emotion of the target, the congruent and incongruent emotions of the context were compared with separate paired-sample t-tests (see Righart & de Gelder, 2008a, 2008b).

Percentage correct responses were calculated by dividing the number of correct responses by the number of responses.

Results

Accuracy

Face Judgement

There was a main effect of Emotion Body ($F(1, 17) = 5.268$, $p = 0.035$), with better accuracies for happy than fearful bodies (see Figure 3, for graphs of the accuracy rates and the reaction times). The interaction between Emotion Face and Emotion Body almost reached significance ($F(1, 17) = 4.258$, $p = 0.055$). This congruency effect was dependent on the emotion of the face. Happy faces in the context of a happy instead of a fearful body ($t(17) = 2.961$, $p = 0.009$) were recognised better, while no difference was observed between a fearful face in the context of a fearful or a happy body ($t(17) = 0.825$, $p = 0.421$).

Body Judgement

There was an interaction effect between Emotion Face and Emotion Body ($F(1, 17) = 10.094$, $p = 0.006$). This congruency effect was not dependent on the emotion of the face or body. Fearful bodies were better recognised with a fearful than happy face ($t(17) = 2.143$, $p = 0.047$), while happy bodies were near-significantly better recognised in the context of a happy than a fearful face ($t(17) = 2.056$, $p = 0.055$).

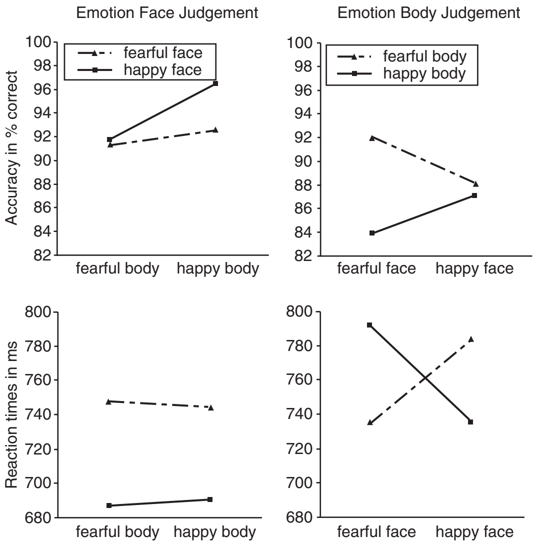

Figure 3
Accuracy for Face Judgement (left upper panel), accuracy for Body Judgement (right upper panel), reaction times for Face Judgement (left lower panel) and reaction times for Body Judgment (right lower panel).

Reaction times

Face Judgement

There was a main effect for Emotion Face, as happy faces were recognised faster than compounds containing fearful faces ($F(1, 17) = 17.709$, $p = 0.001$).

Body Judgement

There was an interaction between Emotion Face and Emotion Body ($F(1, 17) = 26.564$, $p < 0.001$). This congruency effect was not dependent on the emotion of the face or body. A fearful body with a fearful instead of a happy face ($t(17) = 4.161$, $p = 0.001$) and happy body with a happy instead of a fearful face ($t(17) = 3.190$, $p = 0.005$) were recognised faster than their incongruent counterparts.

Discussion

Our goal was to investigate the reciprocal influence between facial and bodily expressions of emotion as a function of the emotional expression displayed by each separately and the deployment of attention. Taken together, our data clearly show that face and body expressions influence each other. However, the specific pattern of reciprocal influence depends on the emotion displayed in the face and the body and whether the participants attend to either the face or the body.

Participants responded faster and more accurately to the emotion of the body when the emotion expressed by the face was the same (congruent) instead of different (incongruent). Less errors were made in judging the emotion of the face when it was coupled to a congruent bodily expression. This latter congruency effect was only present when a happy facial expression had to be categorised, indicating a negative influence of the incongruent fearful bodily expression. Happy faces were recognised faster than fearful faces, but this was not influenced by the emotion of the body.

First, faster reaction times for happy faces are in line with our previous results (van de Riet et al., in press) and those of other studies (Esteves & Öhman, 1993; Harrison, Gorelczenko, & Cook, 1990; Kirouac & Dore, 1983, 1984; Mandal & Palchoudhury, 1985; Righart & de Gelder, 2008a, 2008b; Stalans & Wedding, 1985). Second, our finding that congruence effects are a function of the emotion displayed is consistent with previous studies using face stimuli within a context consisting of other faces (Fenske & Eastwood, 2003; Hansen & Hansen, 1988) or paired with emotion-inducing scenes (Righart & de Gelder, 2008a, 2008b). Third, not all observed congruency effects were dependent on the emotion of the target and context. Fourth, contrary to Meeren et al.'s study (2005), reaction times for facial expression categorisation were not influenced by the emotion of the body.

These results clearly show that the face and the body do not exert the same influence on each other. A few explanations might be opted for this effect. First, there are face-body differences in stimulus size. The face stimulus is relatively larger, hence its larger influence. Second, face-body recognition differences are present. The facial expression is better recognised and is therefore more dominant. Third, face-body emotion differences in processing give rise to the observed differences.

Face-body differences in stimulus size

Although the face and the body were equal in height, they were not equal in width, with the face occupying larger parts of the visual field than the body. The size of an affective stimulus can have an effect on accuracy and speed of judgement, with higher ratings for arousal and valence (Codispoti & De Cesarei, 2007), shorter response times and higher accuracies (De Cesarei & Codispoti, 2006) for larger stimulus sizes. These effects might be due to a larger retinal size, indicative for a shorter distance between stimulus and observer (Loftus & Harley, 2005) and thereby prompting immediate action, or alternatively due to larger visibility of fine-grained details (De Cesarei & Codispoti, 2008).

In the current study, the face is possibly perceived as nearer to the observer and as more detailed than the body while in Meeren et al.'s experiment (2005) both face and body appear at equal distance, with a visibility advantage for the latter. Relative dominance in the percept might therefore be biased toward the emotion of the face in the current experiment while to the body in Meeren et al.'s study (2005).

Face-body emotion recognition differences

The claim we put forward before (de Gelder, 2006), that emotional body language is a less ambiguous signal than the expression of the face, seems to be in conflict with the current data and previous results, in which facial expressions presented in isolation were recognised better than (van de Riet et al., in press) or similar to (Meeren et al., 2005) bodily expressions.

Emotional body language might not, however, have the typical one-to-one relationship with specific emotions that has been assumed for basic facial expressions (e.g., Ekman, Friesen, & Ellsworth, 1972). In the current experiment, the actors expressing happiness were given a scenario that they were meeting an old friend after a long time. It is clearer from the body language than from the facial expression that someone is engaged in this kind of situation. However, as multiple bodily expressions can signify happiness, detecting happiness in a bodily expression becomes more difficult than detecting this emotion in the face, especially as cues such as movement are absent.

Face-body emotion processing differences

We did not see clear differences in emotional modulation (comparing fear and happiness) between face or body for the amygdala or fusiform gyrus in our former experiment (van de Riet et al., in press). This finding is corroborated by various other studies that show that the amygdala is not only activated more by fearful than neutral faces (Morris et al., 1998; Rotshtein et al., 2001) but similarly also more by fearful than neutral bodies (de Gelder et al., 2004; Hadjikhani & de Gelder, 2003). In addition, Sprengelmeyer et al.'s study (1999) showed that a patient with amygdala damage was not able to recognise fear expressed by face and body, while her performance for both the happy facial and bodily expressions was at ceiling.

However, Atkinson, Heberlein, and Adolphs (2007) showed that two amygdala lesion patients were not impaired in categorising static and dynamic pictures of fearful bodies and additionally, Peelen, Atkinson, Andersson, and Vuilleumier (2007) showed that emotional modulation of amygdala activity was present for happy but not for fearful dynamic bodily expressions.

Similarly, Stekelenburg and de Gelder (2004) also point to inherent differences as the amplitude of the N170 was modulated by the emotion of the face but not by the emotion of the body. However, it should be noted that these emotional face-body differences are more apparent than real. Similarly, for modulation of the N170 amplitude by facial expressions some studies do find effects (Batty & Taylor, 2003; Caharel et al., 2005; L.M. Williams et al., 2006), while others do not (Eimer & Holmes, 2002; Eimer, Holmes, & McGlone, 2003; Holmes, Vuilleumier, & Eimer, 2003; Schupp et al., 2004).

Whether the observed differences in the current data are due to differences between face and body in stimulus size, recognisability or processing by the brain needs to be further clarified. It is, however, clear from the present study that additional affective information is taken into account when the emotion of the face or the body has to be judged. Of interest, it seems that multiple factors can be instrumental in determining the relative weight of facial and bodily expressions in the whole percept. An issue, worth considering in further research.

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