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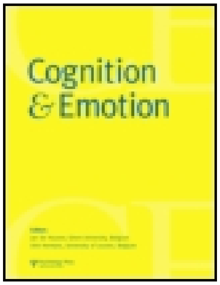

Cognition & Emotion
Publication details, including instructions for authors and subscription information:
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Relative contributions of face and body configurations: Perceiving emotional state and motion intention

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Available online: 15 Aug 2011

To cite this article: Betsy App, Catherine L. Reed & Daniel N. McIntosh (2011): Relative contributions of face and body configurations: Perceiving emotional state and motion intention, Cognition & Emotion, DOI:10.1080/02699931.2011.588688

To link to this article: http://dx.doi.org/10.1080/02699931.2011.588688

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COGNITION AND EMOTION
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Psychology Press
Taylor & Francis Group

BRIEF REPORT

Relative contributions of face and body configurations: Perceiving emotional state and motion intention

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This study addressed the relative reliance on face and body configurations for different types of emotion-related judgements: emotional state and motion intention. Participants viewed images of people with either emotionally congruent (both angry or fearful) or incongruent (angry/fearful; fearful/angry) faces and bodies. Congruent conditions provided baseline responses. Incongruent conditions revealed relative reliance on face and body information for different judgements. Body configurations influenced motion-intention judgements more than facial configurations: incongruent pairs with angry bodies were more frequently perceived as moving forward than those with fearful bodies; pairs with fearful bodies were more frequently perceived as moving away. In contrast, faces influenced emotional-state judgements more, but bodies moderated ratings of face emotion. Thus, both face and body configurations influence emotion perception, but the type of evaluation required influences their relative contributions. These findings highlight the importance of considering both the face and body as important sources of emotion information.

Keywords: Nonverbal displays; Emotional state; Motion intention.

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Emotion displays involve multiple channels of expression. Darwin (1872) emphasised faces and bodies as two key sources of emotion information. Previous work has tended to examine the influence of faces or bodies on observers' emotion judgements in isolation, but a full understanding of emotion perception requires the determination of what information is displayed in each source and how that information is integrated by the perceiver. Because faces and bodies may convey different dimensions of emotions (App, McIntosh, Reed, & Hertenstein, 2011; Barrett & Russell, 1999), the relative influence of facial and body configurations in compound displays that combine faces and bodies may differ as a function of the observer's goals (e.g., identifying an emotion or choosing a behavioural response). Typically there is concordance in the emotions

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http://www.psypress.com/cogemotion DOI:10.1080/02699931.2011.588688

displayed in the facial and body components of compound displays. Here, however, we used comparisons between emotionally congruent and incongruent displays (e.g., a frightened face atop angry fists) to assess the relative contribution of each component to the perception of compound displays. From a multidimensional, functionalist approach to emotion, determining how a person is feeling and where she or he will move next are two key adaptational processes. Is s/he angry or afraid? Is s/he about to attack or retreat? Thus, we examined two types of emotion-related judgements: the subjective emotional state and the motion intention of the observed person.

Faces are rich sources of emotion information. We look to faces to make inferences regarding how others evaluate events in the social and physical environment; facial displays can imply that an individual has experienced a loss or detects a threat, for example (Fridlund, 1991, 1994). We use these inferences to decide how to interact with that individual or the environment, thereby increasing our odds of physical or social survival. For social animals, this process of perceiving and responding to others is ongoing. It is therefore supported by neural mechanisms evolved to allow fast processing of facial displays that occurs with little or no effort, often outside conscious awareness (Haxby, Hoffman, & Gobbini, 2002).

Scientists' understanding of emotion display processing is derived primarily from the study of facial configurations. However, the body is receiving increasing empirical attention as a source of emotion information. Research on bodies in isolation from faces has revealed specialised neural networks for body-based emotion processing. Regions of occipitotemporal cortices involved in the visual processing of bodies, particularly extrastriate body area (EBA) and regions of fusiform cortex (fusiform body area; FBA), appear to be selectively sensitive to bodily displays of emotion over neutral bodies or faces (e.g., Kret, Pichon, Grèzes, & de Gelder, 2011; Peelen, Atkinson, Andersson, & Vuilleumier, 2007). Emotional modulation of regions involved in processing body and face stimuli, whether category selective or not, may be mediated by feedback connections from the amygdala (e.g., Peelen et al., 2007; Vuilleumier, Richardson, Armony, Driver, & Dolan, 2004). Like facial emotion, these neural mechanisms contribute to the rapid processing of body emotion occurring as early as 100–120 ms following stimulus onset (Meeren, van Heijnsbergen, & de Gelder, 2005).

The study of faces and bodies in isolation from one another has provided key insights into emotion display processing, but faces and bodies rarely appear separately in the natural world. It is therefore necessary to examine how emotion information is extracted from compound displays (displays that include the face and body together). Accordingly, research has started to investigate how information from facial and body configurations are integrated. Meeren and colleagues (2005) presented participants with static compound images of faces (angry or fearful) on bodies (angry or fearful) paired so they were either emotionally congruent or incongruent. Participants indicated whether the stimulus face was angry or fearful. ERP revealed differences between congruent and incongruent stimuli as quickly as 110 ms post stimulus onset, indicating that face–body display integration occurs early in the processing stream. Behavioural data revealed that relative to congruent stimuli, judgements of facial displays for incongruent stimuli were slower and less accurate, thus indicating the influence of emotion information conveyed through the body on perceptions of facial emotion. In a similar demonstration, Hietanen and Leppänen (2008, Experiment 2) found that happy and angry hand movements influenced participants' judgements of emotion displayed by static faces that were presented concurrently. These emotion cues from the body are an especially powerful influence on judgements of facial emotion when the facial display is ambiguous (i.e., a blend between archetypal displays from two discrete emotion categories; Van den Stock, Righart, & de Gelder, 2007). Together, these findings indicate that emotion displayed by the body can alter judgements of facial emotion.

These studies demonstrate that judgements are made based on both facial and bodily sources in compound displays, but important questions

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remain regarding the processes by which information from the body is integrated with information from the face. Specifically, how do facial and body configurations contribute jointly to perceptions of compound displays? Furthermore, trying to decide how someone feels is just one of several inferences made based on the configuration of that person's face and body; another important emotion-related inference is determining how the person is going to move. Early theorising (Darwin, 1872) acknowledged the value of recognising affective displays as indicators of action intentions such that those who could make accurate inferences about how others were about to move were more likely to survive and reproduce. Given the important role of the body for movement prediction (Núñez Sánchez, Sicilia, Guerrero, & Pugnaire, 2005), the body may be relied upon more heavily than the face for judgements of motion intention. Here we tested *whether the relative contributions from face and body varied depending on the* type *of judgement*.

The current study addressed these questions by examining two types of judgements: emotional state and motion intention. From a communicative perspective, emotions serve multiple interpersonal functions (Keltner & Haidt, 1999). Two important ways in which emotional displays influence the behaviour of others are by: (1) communicating one's internal state (e.g., displaying sadness elicits helping behaviour that facilitates an individual's ability to cope with loss); and (2) communicating one's behavioural intentions (e.g., displaying anger communicates one's intentions to attack, thereby eliciting submissive behaviour on the part of observers). Previous work (e.g., Ekman, Friesen, & Ancoli, 2001) has shown that observers use cues from a person's outward expressions to infer how that person feels internally. In the context of this study, emotional-state judgements are defined as inferring from a static image the degree to which an individual feels a particular emotion. In addition to signalling one's internal state, nonverbal displays signal behavioural intent (e.g., Ekman et al., 1972) and are used to anticipate an individual's movement. Here we define judgements of motion intention as inferring from a static image whether an individual intends to move forward (approach) or backward (withdraw).

Facial bias in judgements of emotional state

Research on decoding facial displays demonstrates that individuals use the face to identify others' emotional states (e.g., Jellema & Pecchinenda, 2005; Tan, Jellema, & Pecchinenda, 2007). Studies assessing nonverbal behaviour in the context of deception corroborate the link between facial displays and perceived emotional state. Although emotions are expressed concurrently through face and body, observers look to facial cues more than body cues when gauging how someone feels (Ekman, 2001). Based on these findings, we predicted that observers would rely more heavily on facial configuration than body configuration when decoding an individual's emotional state.

Body bias in judgements of motion intention

Emotion displays communicate to observers not just what an individual is feeling, but also what specific associated actions are intended. There may be several possible actions accompanying an emotional state. For example, fear upon hearing a sudden, loud noise might cause someone to freeze, whereas fear upon seeing a bear might cause someone to run. These different locomotor actions may be unrelated to the individual's facial configuration. In both cases, the facial display of the individual experiencing fear may involve raised brows, but the body display associated with each situation may differ. From a communicative perspective, faces provide a wealth of information but this information may sometimes be ambiguous with regard to predicting which of several possible emotion-related actions will be used. Observers may therefore look to a person's body configuration more than facial cues to determine how that person intends to act.

Kinematic analyses of athletes imply a strong association between body configuration and perception of motion intention. Success in many sports depends on accurately predicting an opponent's future movements. Coaches tell players, "Where his belly button goes, his body goes" (Pausch & Zaslow, 2008, p. 39), meaning players should look to body cues to best anticipate the direction in which an opponent is likely to move. Analyses of athletes' body parameters corroborate this idea that bodies communicate action intention. In one study, analyses of soccer goalkeepers' body configurations revealed two variables—angle of knee extension and flexion—that predicted whether goalkeepers would dive to the left or right during penalty kicks (Núñez Sánchez et al., 2005). Thus, body configurations provide motion-intention cues.

Neuroimaging studies provide further evidence for a possible body bias in perceiving motion intention. Imaging data indicate that some of the brain regions involved in visual processing of bodies are also involved in detecting others' action intentions. For example, activation of the EBA, a region that activates in response to static bodies and body parts, is enhanced when observing goal-relevant actions compared to goal-irrelevant biological motion (Takahashi et al., 2008), suggesting that the EBA is involved in processing not only bodies but also others' action intentions. Similar overlap exists with regard to visual processing of body *emotion* and action: observing body displays of fear activates brain areas that are involved in observing action, including the premotor cortex, supplemental motor area, inferior frontal gyrus, middle frontal gyrus and parietal cortex (de Gelder, Snyder, Greve, Gerard, & Hadjikhani, 2004). Together, these findings indicate a strong connection between body configuration and perceptions of motion. We therefore predicted that observers would rely more heavily on body configuration than on facial configuration when decoding an individual's motion intention.

Face and body display integration

Previous work showed that judgements of facial emotion are influenced by concurrently presented body displays (Hietanen & Leppänen, 2008; Meeren et al., 2005; Van den Stock et al., 2007). Similarly, we expected that emotional information from the face and body would interact. Specifically, we predicted emotional-state and motion-intention judgements would be different in congruent versus incongruent displays. Judgements of incongruent displays were expected to be biased in the direction of the more informative source given the type of judgement.

Present study

This study had two parts in which participants viewed static compound images of faces (angry or fearful) on bodies (angry or fearful) paired so they were either emotionally congruent or incongruent. Participants viewed the same stimuli in both parts of the study, but Parts 1 and 2 differed in terms of the judgement task. In Part 1, participants viewed images and indicated whether each image appeared about to move toward or away from them. Part 1 tested the body-bias hypothesis for motion-intention judgements using judgement and reaction time data. In Part 2, participants viewed the images, but indicated the extent to which each image displayed the emotions anger, fear, disgust, and sadness. This tested the facial-bias hypothesis for judgements of emotional state. This emotion intensity rating task was used in Part 2 because it allowed us to investigate whether the integration of face and body information altered overall perception, and therefore the labelling, of the viewed emotion. In both parts, judgements of congruent stimuli were compared to incongruent stimuli to test the hypothesis that perceptions of compound displays integrate information from both the face and body sources.

METHOD

Participants

Participants were 30 right-handed students who received extra credit in psychology courses (24 females; age: $M = 19.67$, $SD = 1.14$).

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Stimuli

Face–body congruent stimuli were colour photographs of models (five males and five females) posing the emotions anger and fear using their faces and bodies. Emotion displays varied on four components—two pertaining to facial configuration (brow and mouth position) and two pertaining to body configuration (arm/hand position and torso lean). Angry facial displays were characterised by knitted brows and pursed lips or bared teeth. Angry body postures consisted of clenched, raised fists and a forward torso lean. Fearful facial expressions were characterised by raised brows and an open mouth. Fearful body postures included outwardly facing palms raised defensively at the wrists and a backward torso lean. Each model posed each emotion twice, and pilot testing was used to select the photograph for each model that conveyed the most anger and the photograph that conveyed the most fear for a total of 20 face–body congruent images. Face–body incongruent stimuli were created using photo-editing software. Each model's angry face was combined with his or her fearful body and the reverse for a total of 20 face–body incongruent images. Examples of congruent and incongruent images can be found in Figure 1.

In Part 1, 80 stimuli were created that measured 5.75 cm by 7.25 cm or 4.00 cm by 5.00 cm. To ensure the experiment was completed within 45 minutes and to limit fatigue, a random subset of 16 images was selected for Part 2 consisting of four 4.00 cm by 5.00 cm images (two congruent: angry face/angry body, fearful face/fearful body; two incongruent: angry face/fearful body, fearful face/angry body) from two male and two female models. We selected only smaller-sized stimuli to ensure that participants could easily see the entire stimulus.

Procedure

Participants provided consent and were seated in a chair with their heads 45 cm from the middle of the computer screen. In Part 1, each trial began with a fixation cross presented for 1000 ms in the centre of the screen, followed by the stimulus presentation. Participants' task was to indicate as quickly as possible whether each stimulus appeared about to move toward or away from them. Responses were made by pressing one of two

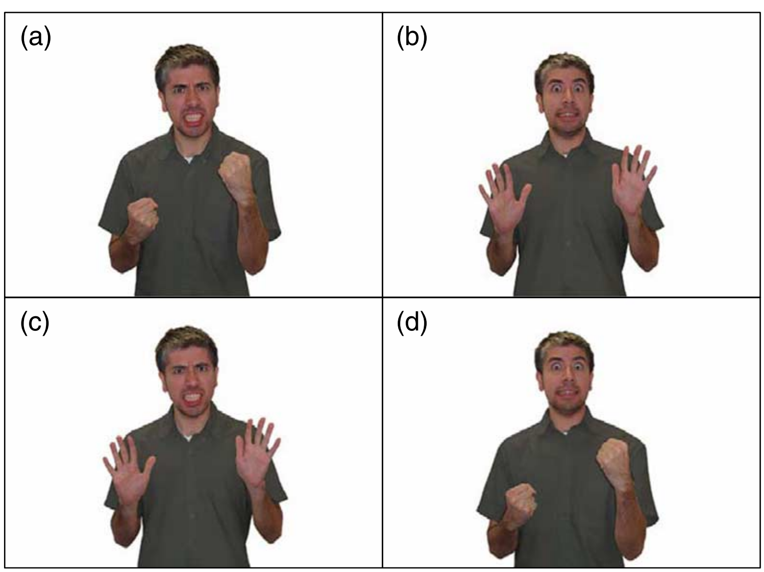

Figure 1. *(a) Angry face on angry body (congruent anger) stimulus. (b) Fearful face on fearful body (congruent fear) stimulus. (c) Angry face on fearful body (incongruent) stimulus. (d) Fearful face on angry body (incongruent) stimulus.*

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designated buttons, one using the left index finger and the other the right. "Toward" and "Away" button assignments were counterbalanced across participants. Stimuli were presented in four blocks of 40 trials. All 40 stimuli of the same size (including both congruent and incongruent stimuli) comprised a block, and blocks were presented in ABBA order with the size of stimuli in Block 1 counterbalanced across participants. Each stimulus was presented once per block, and stimuli were randomised within each block.

In Part 2, stimuli were presented in the centre of the screen above the question, "How much [anger, fear, disgust, sadness] is in this picture?" Participants' task was to respond using one of three right-hand button responses: 1 = *none*, 2 = *some*, and 3 = *a lot*. Although the stimulus components only varied in anger and fear, participants were asked to rate the amount of disgust and sadness to determine whether any potential changes in the categorisation of emotions arose when incongruent face and body information were integrated. Stimuli were presented four times, accompanied once by each of the four emotion questions for a total of 64 trials. Stimuli were presented randomly in a single block.

RESULTS

Part 1: Motion-intention judgements

To determine if congruent stimuli were judged faster than incongruent stimuli, mean response times were calculated for each condition for each participant. Trials for which response time exceeded 2.5 standard deviations above the grand mean response time were excluded from analysis. A Face Emotion (2) $\times$ Body Emotion (2) $\times$ Stimulus Size (2) repeated-measures analysis of variance (ANOVA) was conducted and revealed a significant Face Emotion $\times$ Body Emotion interaction, $F(1, 29) = 15.34$, $p = .001$, $\eta_p^2 = .35$. Post hoc *t*-tests indicated that participants categorised congruent stimuli ($M = 1100.21$ ms, $SD = 668.97$) more quickly than incongruent stimuli ($M = 1295.93$ ms, $SD = 651.13$), $t(29) = 3.92$, $p = .001$, $\eta_p^2 = .35$. There were no effects of Stimulus Size, $F\text{s} < 1$, therefore all subsequent analyses were collapsed across this variable.

For motion-intention judgements, the proportion of toward and away judgements were calculated for each condition for each participant. Chi-square analyses of toward/away responses revealed that in congruent conditions, participants were more likely to judge angry stimuli as about to move toward them, $\chi^2(1) = 748.92$, $p < .001$ (90%), and fearful stimuli as about to move away from them, $\chi^2(1) = 877.23$, $p < .001$ (93%). In incongruent conditions, consistent with our hypothesis, stimuli with angry *bodies* were more likely to be perceived as moving forward, $\chi^2(1) = 106.80$, $p < .001$ (65%), and those with fear *bodies* were more likely to be perceived as moving away, $\chi^2(1) = 47.20$, $p < .001$ (60%). Figure 2 depicts the mean proportion of toward versus away responses for each stimulus type.

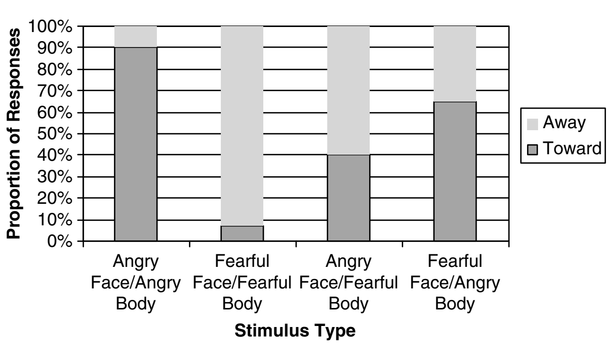

Figure 2. *The mean proportion of away versus toward responses for each stimulus type in Part 1.*

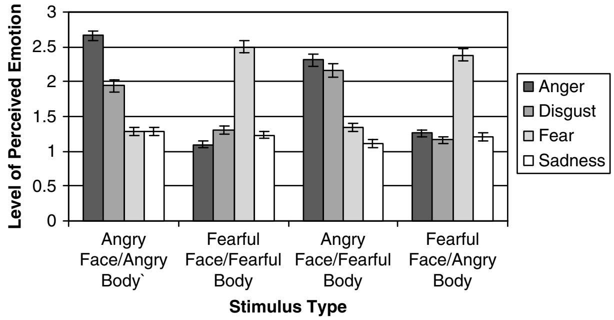

Figure 3. *The mean level of four emotions perceived in each stimulus type in Part 2. Bars represent* ± 1 *SE.*

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Part 2: Emotional-state judgements

For emotional-state judgements, mean levels of perceived emotion were calculated for each condition and participant. A Face Emotion (2) $\times$ Body Emotion (2) $\times$ Emotion Judgement (4) repeated-measures ANOVA revealed a significant three-way interaction, $F(3, 87) = 13.93$, $p < .001$, $\eta_p^2 = .32$ (Figure 3). As expected for the congruent stimuli ratings, post hoc *t*-tests indicated higher ratings of anger than any of the other emotions (disgust, fear, and sadness) for angry face/angry body stimuli and higher ratings of fear for fear face/fear body stimuli. For angry face/fearful body stimuli, anger ratings were higher than fear, $t(29) = 10.56$, $p < .001$, $\eta_p^2 = .79$, and sadness, $t(29) = 14.54$, $p < .001$, $\eta_p^2 = .88$, but not disgust, $t(29) = 1.36$, $p = .19$, $\eta_p^2 = .06$. For fearful face/angry body stimuli, fear ratings were higher than all other emotions, *p*s $< .001$, η_p^2s $= .78$–$.80$.

To understand the influence of incongruent stimuli on perceptions of single emotions, we compared perceptions of emotions across stimuli. For disgust, a *t*-test was conducted comparing ratings of disgust for angry face/angry body stimuli versus angry face/fearful body stimuli. Ratings of disgust were higher for angry face/fearful body stimuli than for angry face/angry body stimuli, $t(29) = 2.56$, $p = .02$, $\eta_p^2 = .19$. For anger, a *t*-test comparing angry face/angry body with angry face/fearful body revealed that the congruent stimuli ($M = 2.67$, $SD = 0.34$) were perceived as angrier than the incongruent stimuli ($M = 2.32$, $SD = 0.44$), $t(29) = 3.88$, $p = .001$, $\eta_p^2 = .34$. However, fearful face/fearful body stimuli ($M = 2.48$, $SD = 0.47$) compared to fearful face/angry body stimuli ($M = 2.38$, $SD = 0.52$) were perceived as equally fearful, $t(29) = 1.32$, $p = .20$, $\eta_p^2 = .06$. There were no differences in sadness perceptions across stimuli.

DISCUSSION

This study examined the extent to which the face and the body in compound displays influence observers' judgements of emotional states and motion intention. Our data confirm previous work that face and body information is integrated in emotion perception (e.g., Meeren et al., 2005). The degree to which the face emotion was endorsed was moderated by bodies; angry faces on fearful bodies were perceived as less angry than face–body congruent angry stimuli, and fearful faces on angry bodies were perceived as less fearful than face–body congruent fear stimuli.

Interestingly, participants perceived as much disgust as anger in the angry face/fearful body stimuli, and the angry faces on fearful bodies were perceived as more disgusted than angry faces on angry bodies. This finding suggests that integrating incongruent face and body information did not just attenuate the intensity of perceived anger. Rather, it changed the nature of (or at least the label assigned to) the perceived emotion. This underscores the importance of looking at perceptions of faces and bodies together. Including more information by adding a body to a face or a face to a body does not produce simple dimensional changes but instead can alter the overall perception of the display. Moreover, the finding that participants perceived little disgust in fearful faces on angry bodies indicates that combining angry components and fearful components does not always yield perceptions of disgust. The *sources* of emotion information matter. The observed pattern may indicate that disgust was interpreted to include contempt and disdain, not just "core disgust" (Rozin, Lowery, & Ebert, 1994). The angry emotion on the face combined with a fearful (retreating) body suggests contempt or disdain, whereas fear and an approaching body do not.

Novel to this study, our findings show that faces and bodies convey different information that is revealed during different types of judgements. Body configuration was more predictive of participants' responses in motion categorisation than was facial configuration, supporting our body bias hypothesis of motion-intention judgements. Despite having fearful faces (an emotion associated with withdrawal behaviour), stimuli with angry bodies were more likely to be perceived as about to move forward; despite having angry faces (an emotion associated with approach behaviour), stimuli with fearful bodies were more likely to be perceived as about to move away. In contrast, faces tended to influence emotion-state judgements more than bodies, supporting our facial bias hypothesis of emotional-state judgements. Incongruent stimuli with angry faces on fearful bodies were perceived as angrier than those with fearful faces on angry bodies, and incongruent stimuli with fearful faces and angry bodies were perceived as more fearful than stimuli angry faces with fearful bodies. This pattern of results indicates that people look to the face for emotional categorisation, but focus on the body for motion intention.

Research on nonverbal emotional communication has focused largely on perceptions of discrete emotional states. However, observers use nonverbal displays to make inferences about many dimensions of emotion, including behavioural intentions. As indicated in the present study, the tie between bodies and action may be closer than between faces and action; therefore, increased attention to bodies and compound displays may yield a better understanding of what is communicated in nonverbal emotion displays.

The findings presented here are consistent with a functionalist conceptualisation of emotions and raise additional questions regarding the role of compound displays in emotion communication. Many definitions of emotion focus on subjective experience, but functionalist definitions place primary importance on emotion's role as a tool to change or influence the environment in some way that is meaningful to the individual (Barrett, 1993). The present findings suggest that different nonverbal sources may be best suited for conveying different kinds of information. More specifically, the present finding that the face and the body differ in what type of information is conveyed supports other work showing that the face and body are differentially suited to display dissimilar types of emotions (App et al., 2011). These studies examined the face and body, but future research should examine nonverbal displays that encompass other channels (e.g., App et al. found that touch communicates different types of emotions). Here, we limited our investigation to visual channels, but integrating emotion information in nonvisual channels and even across sensory modalities should also be examined, like perceiving displays comprising a face and body coupled with paraverbal emotion cues. Further, in this study participants judged static displays. Although implied motion extracted from static images is processed in much the same way as dynamic information (Urgesi, Moro, Candidi, & Aglioti, 2006), dynamic stimuli would provide an even more comprehensive understanding of how information is integrated across multiple sources.

Depending on the context, a single emotion may require different behavioural responses. There may be more information in a compound display than simply identifying what the emotion is. The present study suggests that people weigh facial and body information differently depending on what type of judgement is required. Future research should assess what other types of information are best conveyed by other sources.

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Manuscript received 10 November 2010
Revised manuscript received 9 March 2011
Manuscript accepted 20 April 2011
First published online 000

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