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Fear Detection and Visual Awareness in Perceiving Bodily Expressions

Bernard M. C. Stienen
Tilburg University

Beatrice de Gelder
Tilburg University and Harvard Medical School

Many research reports have concluded that emotional information can be processed without observers being aware of it. The case for perception without awareness has almost always been made with the use of facial expressions. In view of the similarities between facial and bodily expressions for rapid perception and communication of emotional signals, we conjectured that perception of bodily expressions may also not necessarily require visual awareness. Our study investigates the role of visual awareness in the perception of bodily expressions using a backward masking technique in combination with confidence ratings on a trial-by-trial basis. Participants had to detect in three separate experiments masked fearful, angry and happy bodily expressions among masked neutral bodily actions as distractors and subsequently the participants had to indicate their confidence. The onset between target and mask (Stimulus Onset Asynchrony, SOA) varied from −50 to +133 ms. Sensitivity measurements (d-prime) as well as the confidence of the participants showed that the bodies could be detected reliably in all SOA conditions. In an important finding, a lack of covariance was observed between the objective and subjective measurements when the participants had to detect fearful bodily expressions, yet this was not the case when participants had to detect happy or angry bodily expressions.

Keywords: emotion, masking, consciousness, bodily expressions

These last decades a number of research reports have concluded that emotional information can be processed without observers being aware of it (Barrett, Ochsner, & Gros, 2007; Kunst-Wilson & Zajonc, 1980). Many studies using facial expressions now provide direct and indirect evidence for visual discriminations of affective stimuli in the absence of visual awareness of the stimulus (e.g., de Gelder, Vroomen, Pourtois, & Weiskrantz, 1999; Dimberg, Thunberg, & Elmehed, 2000; Esteves, Dimberg, & Öhman, 1994; Jolij & Lamme, 2005; Tamietto et al., 2009). Not only neurologically intact but also clinically blind patients with hemianopia have shown on forced choice tasks that they can reliably guess the emotion not only of facial but also of bodily expressions presented in their blind field (de Gelder et al., 1999; Tamietto et al., 2009). This finding in patients can be seen as an absolute dissociation between what can be detected and what is consciously being seen. However, this phenomenon has been proved very difficult to replicate in healthy participants (Robichaud & Stelmach, 2003). The present study investigates the role of visual awareness in the perception of bodily expressions using a backward masking technique combined with confidence ratings.

Backward masking is one of the most widely used techniques for exploring processing of visual emotional information without awareness in neurologically intact observers. Esteves and Öhman (1993) found that short (e.g., 33 ms) presentation of a facial expression (happy and angry) replaced immediately by a neutral face (mask) with a longer duration (e.g., 50 ms) is below the participants' identification threshold. Esteves, Parra, Dimberg, and Öhman (1994) reported that participants prevented from conscious recognition of conditioned angry faces by backward masking still showed elevated skin conductance response to these faces, while Esteves et al. (1994) found that this response could not be conditioned when happy faces were used. Dimberg et al. (2000) used electromyography to show that participants respond to happy and angry faces with corresponding specific muscles in the face while not being conscious of the presentation of the faces.

A critical issue in many backward masking experiments concerns the measure adopted for visibility or visual awareness of the target. Most often this is assessed in a separate posttest session or after each block rather than on a trial-by-trial basis. This clearly complicates the interpretation of masking studies because visibility of the target covaries with the performance on each target presentation. Yet it is possible to combine detection measurements with confidence ratings on a trial-by-trial basis. This provides insight in how the actual detection performance relates to the confidence of this detection and thus visibility of the targets. Lau and Passingham (2006) performed an elegant masking study based on this idea. They presented their participants with masked diamonds and squares and asked them on each trial to identify the target and, next, to indicate whether they had seen the target. The onset between target and mask (stimulus onset asynchrony, SOA) varied from minus 50 to 133 ms. This method provided information about

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Bernard M. C. Stienen, Laboratory of Cognitive and Affective Neuroscience, Tilburg University; and Beatrice de Gelder, Laboratory of Cognitive and Affective Neuroscience, Tilburg University and Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School, Charlestown, Massachusetts.

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Correspondence concerning this article should be addressed to Beatrice de Gelder, Cognitive and Affective Neuroscience Lab, Tilburg University, PO Box 90153, 5000 LE Tilburg, The Netherlands. E-mail: b.degelder@uvt.nl

whether the participant was aware of the presence of a stimulus on a trial by trial basis and controls for the possibility that participants are likely to be more aware of the stimulus in the longer SOA trials. Lau and Passingham (2006) coined the term "relative blindsight" to refer to two SOA conditions where participants were performing equally in the identification task but differed in reporting whether they had seen the target or not.

We adapted this approach to investigate the relation between detection performance and confidence. In three experiments participants had to detect masked and unmasked emotional expressions (fear, angry, or happy) among masked and unmasked distractors (a neutral action; combing). The pictures and the mask were controlled for several factors such as lighting, size of the postures on the retina, contrast, and importantly the actors were uniformly dressed in black clothing. A mask was presented at 12 different SOAs varying from minus 50 to 133 ms. The participants were instructed to detect the emotional expression and subsequently to indicate whether they were sure or whether they were guessing. It is important that the different emotional expressions were not mixed within one design to prevent that dominant or more salient emotional expressions would influence the percept of the other emotions. Also, because a detection design is used one can be explicit in the instruction that participants have to detect the emotion of interest.

According to the definition of the "objective" criterion observers are perceptually unaware of a target when they perform at chance in a forced choice recognition task. Following the "subjective" criterion participants are unaware of the stimulus when they claim not to be able to discriminate perceptual information at better than chance level (Cheesman & Merikle, 1984). In this experiment the detection rates are used as the objective measurements, while the confidence ratings are used as the subjective measurements. In line with Lau and Passingham (2006) we expected to find relative dissociations between the two measurements. Because we used a pattern mask it is expected that the lowest detection performance and confidence will be around the SOA of 0 ms and will be U-shaped (Enns & Di Lollo, 2000). Following Lau and Passingham (2006) we conjectured that this U-shape implies that we can find SOA conditions where the detection performance is the same. We are specifically interested how this detection performance relates to the confidence of the participants. Based on reports in the literature (Esteves et al., 1994; Morris et al., 1996; Pessoa, Japee, & Ungerleider, 2005; Vuilleumier, Richardson, Armony, Driver, & Dolan, 2004) we also conjectured that the resulting patterns may be dependent on the specific emotional category.

Experiment 1

Our goal is to investigate the relation between objective (detection performance) and subjective (confidence) measurements of the perception of fearful bodily expressions.

Method

Participants

Twenty-three undergraduate students of Tilburg University participated in exchange of course credits or a monetary reward (16 women, 7 men, *M* age = 19.8 years, *SD* = 2.3). All participants had normal or corrected-to-normal vision and gave informed consent according to the declaration of Helsinki.

Stimuli

Photos of actors expressing fear and combing their hair were selected from a photoset. During the photo shoot pictures were projected on the wall facing the actor meant to trigger the fear response as natural as possible. Moreover, a short emotion inducing story related to the image projected was told by the experimenter. For the combing pictures the actors were asked to pretend that they had a comb in their hands and that they were straightening their hairs.

The faces of the selected photographs were covered with an opaque oval patch to prevent that the facial expression would influence the identification of the emotional body expression. The color of the patch was the average gray value of the neutral and emotional face within the same actor. In addition, the colors were saturated to white and black with the color of the mask as anchor point. In this way, the participants were forced to base their judgments on the contours of the body because by isolating only two colors the color differences within the clothing disappeared. A total of 16 pictures (2 fear/combing × 2 gender × 4 actors) were selected for use in the present study. Average height of the bodies was 7.78 degrees, the average maximum width (distance between the hands) was 2.83 degrees and the average waist was 1.39 degrees of visual angle.

Using Adobe Photoshop 7.0, a pattern mask was constructed by cutting the target bodies in asymmetric forms which were scrambled and replaced in the area occupied by the bodies. The parts were grouped with the restriction that parts containing white had to be grouped within the area occupied by the hands (which were saturated to white) and parts containing black had to be grouped within the area occupied by the bodies (which were black). Finally, the resulting picture was duplicated, rotated 180 degrees and pasted at the background to induce symmetry and extra noise to avoid the percept of a body. The result is the mask in Figure 1. The height of the mask was 9.85 degrees and the width was 6.48 degrees of visual angle. The mask covered the area of the stimuli completely.

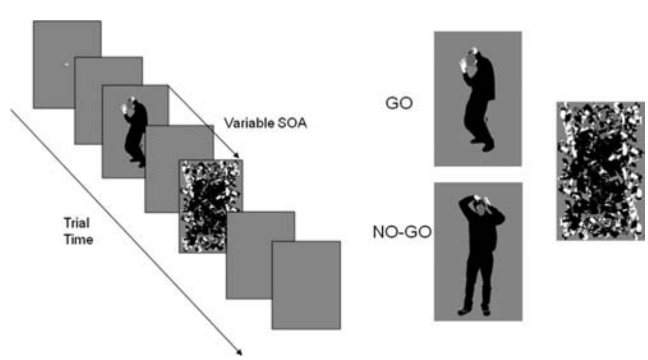

Figure 1. A visual representation of a trial (on the left), example fearful bodily expression and neutral bodily posture (middle), and the mask (right).

The stimuli were presented on a 17″ PC screen with the refresh rate set to 60 Hz. We used Presentation 11.0 to run the experiment. A white cross of 1.22 × 1.22 degrees was used as a fixation mark in the center of the screen. Finally, all stimuli were pasted on a gray background.

The SOA latencies were −50, −33, −17, 0, 17, 33, 50, 67, 83, 100, 117, and 133 ms. The actual presentation time was calibrated with the use of a photodiode and an oscilloscope measuring the latency between onset of the target and the mask. Negative SOA latencies represent forward masking and positive SOA latencies backward masking. When the SOA latency was −33, −17, 0, and 17 ms the target overlaps with the mask. The target was always presented at the foreground. Moreover a target-only condition and a mask-only condition were included. One complete run consisted of 224 trials (8 identities × 2 actions (fear/combing) × 14 timing conditions (including target-only and mask-only) which were randomly presented.

Procedure

Participants were comfortably seated in a chair in a soundproof experimental booth approximately 90 cm from the screen. A trial started with a white fixation cross on a gray background. The disappearance of this cross signaled the beginning of a trial. After 500 ms, the target stimulus appeared for 33 ms. Next, a mask was presented for 50 ms after a variable interval (sometimes the mask was presented first). The participants were instructed to push a predefined button using the index finger of their left hand as soon as they thought a fearful bodily expression was presented (GO) and to withhold their response when they thought the neutral action was presented (NO-GO). Two thousand milliseconds after the target a screen was presented with the text “Sure or Guessed?” They had to respond with the other hand with two different buttons on the same response box labeled with “Sure” and “Guessed.” The latter two buttons were counterbalanced across participants. It was stressed that they had to respond as accurate and fast as possible and that they could use their “gut feeling” if they did not have seen the body. Finally a gray screen was presented with a random duration between 17 ms and 767 ms. This jitter was added to prevent that the participants would be caught in a mechanical rhythm. In total the trials were on average 4025 ms.

Previous to the experimental sessions the participants performed two practice sessions consisting of 33 trials each (16 target-trials, 16 distracter-trials, and 1 mask-only trial). Other identities than the ones used in the main experiment served as targets. When the participants had more than 12 hits and gave notice of a full understanding of the procedures the main experiment was started. A total of four runs were presented adding up to a total of 896 trials. Every 112 trials there was a 3-min break. After the main experiment all targets were presented for 33 ms in order to validate the stimuli used as targets. The instruction remained the same for this session.

Analysis

Trials where participants failed to indicate their confidence within the duration of the trial were discarded.

The sensitivity to the signal (detection of expressions) was estimated by calculating the d-prime (*d*′). The *d*′ is a measure for the distance between the signal and noise distribution means in standard deviation units (Green & Swets, 1966). A *d*′ of 0 means that the participants are not able to discriminate the fearful bodily expressions from the neutral bodily actions. The *d*′ was calculated as:

$$d' = \Phi^{-1}(H') - \Phi^{-1}(FA')$$

Where H′ is the corrected hit rate and FA′ is the corrected false alarm rate. The function Φ^{-1} converts the rates into z-scores. The correction of the hit- and false alarm rates was performed to protect against ceiling effects as proposed by Snodgrass and Corwin (1988):

$$H' = (h + 0.5)/(h + m + 1)$$

$$FA' = (f + 0.5)/(f + cr + 1).$$

Where *h* is the number of hits, *m* is the number of misses, *f* is the number of false alarms, and *cr* is the number of correct rejections. See also Tamietto, Geminiani, Genero, and de Gelder (2007).

To assess whether participants could differentiate between the correct and incorrect answers confidence ratings were calculated. The number of sure responses when the detection of the emotional expression or the rejection of the neutral action was incorrect was subtracted from the number of sure responses when the response was correct. This was divided by the total number of correct and incorrect answers. A resulting value of zero would mean that the participants indicate subjectively that they are not more confident of their correct answers than their incorrect answers which is taken as a measure of subjective visual awareness. A similar approach was chosen by Cheesman and Merikle (1986) and Esteves and Öhman (1993) as a measure of the phenomenological experience of the participants’ perception of the targets.

We used this calculation because of the analogue with the d-prime. This means that information from all four cells (hits, misses, false alarms, and correct rejections) were used. Also, this method automatically controls for how well the participants are engaged in the task. If, for example, a participant would just randomly hit the detection button, but always indicates to be sure, the confidence measure when calculated as overall percent sure would end up being 100% while the *d*′ would not be higher than zero (for more details on the *d*′ analysis see Macmillan and Creelman, 1991). However, our measure of confidence would also result in a confidence rating of zero, because it automatically corrects for when the participants indicate to be sure, while their answer is wrong.

Separate multivariate analyses of variance (MANOVA) were performed on *d*′ values and confidence ratings with SOA latency (13 levels including target only trials) as a factor. Following Lau and Passingham (2006) the analysis is focused on the SOA conditions just lower and higher than the SOA condition with the lowest detection performance and confidence ratings. Because the fact that we use a pattern mask it is expected that the lowest detection performance and confidence ratings will be around the SOA latency of 0 ms (Enns & Di Lollo, 2000). Two SOA latency points were selected just before the falling edge of the curve and two after the rising edge of the curve.

Finally, we computed the area under the ROC curve for the relevant conditions in order to obtain a measure that does not assume equal variance of the distributions of the signal and the noise. There are four possible responses per stimulus type: 1) detection and sure; 2) detection and guess; 3) no detection and guess; and 4) no detection and sure. These responses were tabulated per stimulus category (emotion or neutral) and divided by the total amount of trials in that category to estimate a conditional probability. Next, we calculated the cumulative probability for each confidence level ranging from detecting an emotion with high certainty to not detecting an emotion with high certainty. Given that the target was an emotion this yields the hit rate, when a neutral action was presented this gives the false alarm rate. For more details see Macmillan and Creelman (1991). The actual graphs are not plotted because in several cases the ROC curves exactly align with each other.

Results and Discussion

One participant was discarded from analysis because he never indicated to be sure of his responses. In the validation session the fearful bodily expressions were correctly detected 91% of the cases ($SD = 12$) and the neutral action was correctly rejected 99% ($SD = 3$) of the cases, see Figure 6.

As shown in Figure 2a, the d' results show a classical pattern masking curve with the lowest point of the curve around SOA of 0 ms (Enns & Di Lollo, 2000). There was a main effect of SOA, $F(12, 10) = 26.57$, $p < .001$. The d' was above zero when the SOA was 0 ms, $t(21) = 9.26$, $p < .001$, indicating that the participants were capable of detecting the fearful bodily expressions. The confidence is plotted in Figure 2b. Also, a main effect of SOA is found here, $F(12, 10) = 78.12$, $p < .001$. Participants were still more confident about their correct than incorrect answers when the d' was at its lowest point. This is indicated by the confidence ratings being still significantly above zero when the SOA was 0 ms, $t(21) = 5.97$, $p < .001$.

SOA latencies of −50 and −33 ms were just before the falling edge of the curve while SOA latencies of +33 and +50 ms were just after the rising edge of the curve. Planned comparisons showed that detection performance is equal between SOA latencies of −50 and +33, −50, and +50, −33, and +33, and −33 and +50 ms; this was indeed confirmed with paired t tests showing no significant differences: resp. $t(21) = -.58$, $p = .566$; $t(21) = -.95$, $p = .355$; $t(21) = -.10$, $p = .924$; $t(21) = -.37$, $p = .716$. However, when performing statistical comparisons between the same SOA latencies on the confidence ratings it appeared that the confidence ratings differed significantly for the SOA latency pair −50 & +33 ms, $t(21) = 2.17$, $p = .042$. This was also the case for the comparison of the SOA conditions of −33 & +33 ms; the d' did not differ, while the confidence ratings did, $t(21) = 2.23$, $p = .037$. Similarly, the area under the ROC curve (A′) did not differ significantly for each of these conditions (all $p > .05$). Table 1 shows the d' and A′ per SOA latency.

While participants are equally capable of detecting the fearful bodily expressions in both SOA latency conditions, their confidence differed. The dissociation between the objective (what is detected) and subjective measures (the confidence about the detection) indicates that the mechanisms are independent. Lau and Passingham (2006) called this phenomenon “relative blindsight.”

The fact that we do not find a condition where the confidence ratings are not different from zero (indicating that the participants are guessing) while objective detection of expressions is above zero, does not force the conclusion that there is no unconscious processing of the stimulus. In fact, the relative difference indicates that different processes are at hand causing the subjective ratings to differ while the objective detection performance is on the same level. In Experiment 2 and 3 the question is addressed whether this phenomenon generalizes to different emotions or whether it is specific for fearful expressions.

Experiment 2

In the second experiment we asked whether the observed effect is specific for fear or whether it is driven by negative emotions in general. For this purpose we used angry bodily expressions as targets.

Method

Participants

Twenty-one undergraduate students of Tilburg University participated in exchange of course credits or a monetary reward (11 women, 10 men, M age = 21.8 years, $SD = 3.4$). All participants

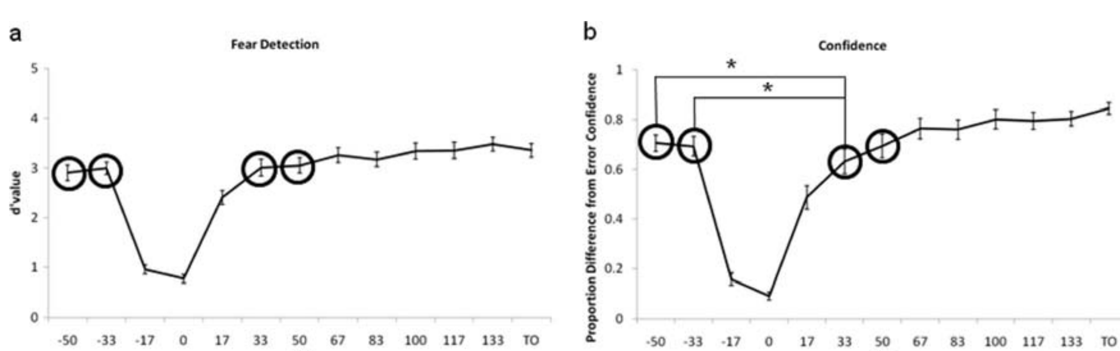

Figure 2. The detection performance and confidence when detecting fearful bodily expressions. Detecting fearful bodily expressions (a) seem to be equal at both sides of the U-shaped curve, while confidence ratings (b) seem to differ for SOA latency pairs −50 and 33 ms and −33 ms and +33 ms. Error bars indicate standard error mean. * $p < .05$.

Table 1
Area Under the Curve Values and d′ Values for Detecting Fearful, Angry, and Happy Bodily Expressions

	Fear		Angry		Happy	
SOA	A′	d′	A′	d′	A′	d′
−50	0.94	2.91	0.91	2.26	0.96	3.31
−33	0.94	2.99	0.87	1.87	0.93	2.84
+33	0.93	3.01	0.85	1.62	0.89	2.55
+50	0.94	3.05	0.91	2.27	0.94	3.04

had normal or corrected-to-normal vision and gave informed consent according to the declaration of Helsinki.

Stimuli and Procedure

The stimuli for this experiment were taken from the same photoset as in the first experiment, but this time we selected actors showing angry bodily expression. The average height of the bodies was 8.25 degrees, the average maximum width (distance between the hands) was 2.75 degrees and the average waist was 1.49 degrees of visual angle. See Figure 3 for an example.

The participants were instructed to push a predefined button as soon as they saw an angry bodily expression. The rest of the procedure was the same as in the first experiment.

Results and Discussion

One participant was discarded from analysis because she failed to answer within time limits of the trials. The angry bodily expressions were correctly detected 94% of the cases ($SD = 10$) and the neutral action was correctly rejected 99% ($SD = 3$) of the cases in the validation session, see Figure 6.

Figure 4 shows the detection performance and the confidence per SOA latency. Again, there was a main effect of SOA on the d' and on the confidence ratings: resp. $F(12, 9) = 35.16$, $p < .001$; $F(12, 9) = 203.07$, $p < .001$. Also, the lowest point was again when the SOA was 0 ms and also this time not only the detection performance but also the subjective confidence ratings were always above 0: resp. $t(20) = 6.28$, $p < .001$; $t(20) = 5.78$, $p < .001$.

The d' of the SOA latencies −50 ms and +50 ms and SOA latencies −33 and +33 ms did not differ, resp. $t(20) = -.07$, $p = .944$; $t(20) = 1.71$, $p = .10$, while in contrast with what we observed using fearful bodily expressions there was also no difference in the confidence ratings, resp. $t(20) = .90$, $p = .381$; $t(20) = 1.80$, $p = .087$. Moreover, the SOA latencies −50 and +33 ms and SOA latencies −33 and +50 ms differed significantly, resp. $t(20) = 4.88$, $p < .001$; $t(20) = -2.88$, $p = .009$, but so did the confidence ratings, resp. $t(20) = 4.27$, $p < .001$; $t(20) = -2.68$, $p = .014$. A′ values followed this pattern: SOA latency pairs −50 and +50 ms and latency pair −33 and +33 ms did not differ, resp. $t(20) = .68$, $p = .505$; $t(20) = 1.44$, $p = .166$, while the SOA latencies −50 and +33 ms and latency pair −33 and +50 ms differed significantly, resp. $t(20) = 4.48$, $p < .001$; $t(20) = -2.83$, $p = .010$. Table 1 shows the d' and A′ values per SOA latency.

Figure 3. An example stimulus of an angry expression (left) and a happy expression (right).

In sum, angry bodily expressions can be detected objectively and subjectively above chance even in the smallest absolute SOA latencies. However, when looking at the same SOA conditions as used with fearful body expressions the objective and subjective measures do not dissociate. This seems to indicate that the dissociation between measures is specific for fearful bodily expressions. The lack of covariance between subjective and objective measurements does not generalize to all negative emotions. The next question then is whether the phenomenon does extent to positive emotions such as happiness.

Experiment 3

Method

Participants

Twenty undergraduate students of Tilburg University participated in exchange of course credits or a monetary reward (14 women, 6 men, M age = 23.0 years, $SD = 4.6$). All participants had normal or corrected-to-normal vision and gave informed consent according to the declaration of Helsinki.

Stimuli and Procedure

Stimuli consisted of bodily expressions of happiness selected from the same photoset as in the first and second experiment. The average height of the happy bodily expressions was 8.75 degrees, the average maximum width (distance between the hands) was 4.83 degrees, and the average waist was 1.65 degrees of visual angle. See Figure 3 for an example.

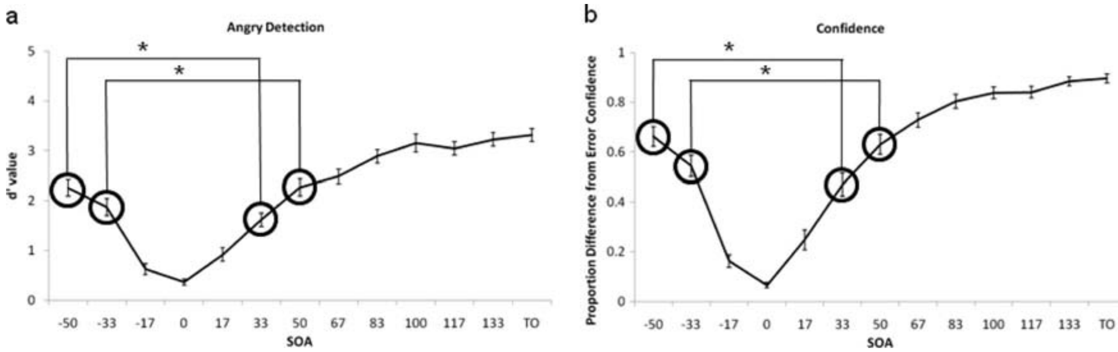

Figure 4. The detection performance and confidence when detecting angry bodily expressions. Detecting angry bodily expressions (a) and confidence ratings (b) seem not to dissociate when looking at the same SOA latency pairs as observed with fearful bodily expressions. Error bars indicate standard error mean. $^{*}p < .05$.

The participants were instructed to push a predefined button as soon as they saw a happy bodily expression. The rest of the procedure was the same as in the first experiment.

Results and Discussion

In the validation session happy bodily expressions were correctly detected 99% of the cases ($SD = 3$) and the neutral action 100% ($SD = 0$) of the cases, see Figure 6.

Figure 5 shows the detection performance and the confidence per SOA latency. Again, there was a main effect of SOA on the d' and on the confidence ratings: resp. $F(12, 8) = 27.62$, $p < .001$; $F(12, 8) = 79.52$, $p < .001$. Also, the lowest point was again when the SOA was 0 ms. In line with fearful and angry detection not only the detection performance but also the confidence ratings were always above 0 resp. $t(19) = 8.58$, $p < .001$; $t(19) = 8.76$, $p < .001$.

The d' of the SOA latency pairs −50 and +50 ms, −33, and +33 ms, and −33 and +50 ms did not differ significantly, resp. $t(19) = 1.51$, $p = .146$; $t(19) = 1.61$, $p = .124$; $t(19) = -1.07$, $p = .298$, however comparisons of the confidence ratings showed the same pattern, resp. $t(19) = 1.92$, $p = .072$; $t(19) = 1.80$, $p = .087$; $t(19) = -.73$, $p = .474$. When comparing the SOA latencies of −50 with +33 ms a significant difference for the d' appeared, $t(19) = 4.21$, $p < .001$, but this was also found for the confidence ratings, $t(19) = 3.90$, $p = .001$. Here A′ values followed the same pattern, the only SOA latency pair that significantly differed was −50 and +33 ms, $t(19) = 2.48$, $p = .023$. Table 1 shows the A′ and d' values.

The objective and subjective detection of happy and angry bodily expressions show the same pattern, but this is not the case for fear detection. This indicates that the lack of covariance is specific to fearful bodily expressions. To rule out that the differences in the results between the experiments could be accounted for by how well the emotion is recognized a 3 (experiment) × 2 (target, distractor) between-subjects analysis of variance (ANOVA) was done on the detection performance of emotional bodily expressions in the validation session. This showed that there was a main effect of emotion, $F(2, 57) = 4.44$, $p < .05$. Bonferroni corrected post hoc tests showed that only the detection of happy bodily expressions was different from the detection of fearful expressions. However, the validation data did not show a difference between detection of angry and fearful expressions.

General Discussion

We investigated the relation between the perception of bodily expressions, with and without awareness. Our results show that the detection of bodily expressions of fear shows less covariance with how confident participants are about this detection

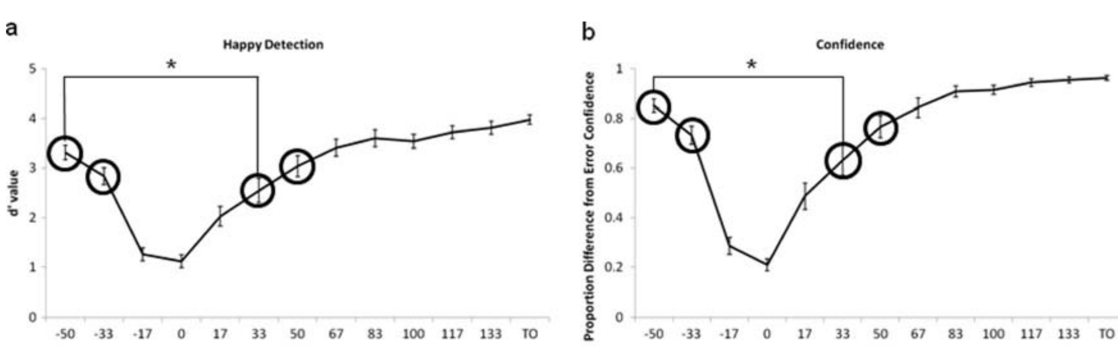

Figure 5. The detection performance and confidence when detecting happy bodily expressions. Detecting happy bodily expressions (a) and confidence ratings (b) seem not to dissociate when looking at the same SOA latency pairs as observed with fearful bodily expressions. Error bars indicate standard error mean. $^{*}p < .05$.

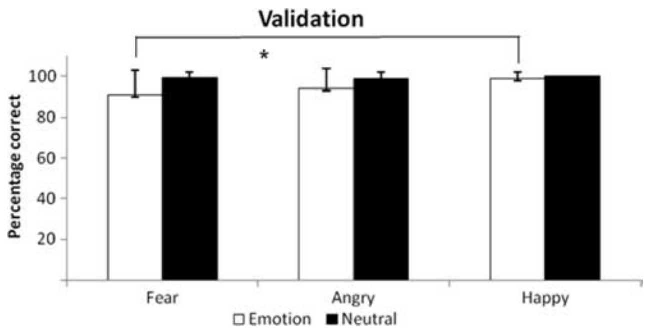

Figure 6. Correct detection of emotional bodily expressions and correct rejection of neutral bodily actions in the validation session. Only the detection of happy expressions differed from the detection of fearful expressions. Error bars indicate standard error mean. * $p < .05$.

than in the case of detecting angry and happy bodily expressions. This provides novel evidence for the processing of fear stimuli, which apparently depends less on the visibility of the expression itself using a stimulus category that is as familiar as it is salient in daily life.

The question remains why the detection of fearful bodily expressions seems to covary less with the subjective confidence than the detection of angry and happy bodily expressions. Öhman (2002, 2005) suggests that fear stimuli automatically activate fear responses and captures the attention as shown in visual search tasks where participants had to detect spiders, snakes, or faces among neutral distracters (Öhman, Flykt, & Esteves, 2001; Öhman, Lundqvist, & Esteves, 2001). The special status of fear stimuli is still a matter of debate, specifically in relation to the role of the amygdale (Duncan & Barrett, 2007; Pessoa, 2005). Theoretical models have been advanced arguing that partly separate and specialized pathways may sustain conscious and nonconscious emotional perception (LeDoux, 1996; Morris, Öhman, & Dolan, 1998; Panksepp, 2004; Tamietto et al., 2009; Tamietto & de Gelder, 2010). Our present findings are consistent with a recent study of Pichon, de Gelder, and Grèzes (in press) showing that threatening bodily actions evoked a constant activity in a network underlying reflexive defensive behavior (periaqueductal gray, hypothalamus, and premotor cortex) that was independent of the level of attention and was not influenced by the task the subjects were fully engaged in.

When visual signals are prevented to be processed by the cortical mechanisms via the striate cortex the colliculo-thalamo-amygdala pathway could still process the stimulus. This is in line with recent functional magnetic resonance imaging studies that have suggested differential amygdala responses to fear faces as compared to neutral faces when the participants were not aware (Morris et al., 1998; Whalen et al., 1998).

This process may play an important role in everyday vision by providing us unconsciously with important information about important affective signals in our surroundings. Further research using neurological measures will give us insight whether these pathways are indeed mediating the independency of detecting fearful signals from visual awareness.

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