Relative Affective Blindsight for Fearful Bodily Expressions

Bernard M.C. Stienen
B.M.C.Stienen@uvt.nl

Beatrice de Gelder
B.deGelder@uvt.nl

Faculty of Social and Behavioural Sciences, Tilburg University
PO Box 90153, 5000 LE Tilburg, The Netherlands

ABSTRACT
Nonconscious affective perception has repeatedly been shown for facial expressions but not for bodily expressions while being highly salient and known to influence our behavior towards others. Lau & Passingham [7] found a case of relative blindsight using a parametric masking design. We used a comparable approach to find this relative case of blindsight for affective information in which the affective information can be processed independently of visual awareness. Participants had to detect masked fearful 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 milliseconds. D-prime as well as the confidence ratings showed that the bodies could be detected reliably in all SOA conditions. Importantly, a phenomenon which we coined relative affective blindsight was found, defined as two SOA conditions showing same d-prime values, while the confidence ratings differed.

Author Keywords
Emotion, masking, blindsight.

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INTRODUCTION
Backward masking is one of the most widely used techniques for exploring unconscious processing of visual emotional information in neurologically intact observers. Esteves and Öhman [4] 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 [5] 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, Dimberg and Öhman [3] found that this response could not be conditioned when happy faces were used. Dimberg, Thunberg and Elmehed [2] used EMG 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 most of the backward masking experiments concerns the measure adopted for visibility or visual awareness of the target. Most often this is assessed in a separate post test session. This clearly complicates the interpretation of studies using masking procedures because visibility of the target co-varies with the performance for each target presentation. To counter these methodological problems Lau and Passingham [7] performed an elegant parametric masking study. 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 milliseconds. This method provided information about 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 when the SOA value is larger and thus better visible. In particular, Lau and Passingham [7] 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 a similar approach to investigate whether bodily expressions can be detected independently of subjective visual awareness. Participants had to detect masked and unmasked fearful bodily expressions 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, 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 milliseconds. The participants were instructed to detect the emotional expression and subsequently to indicate whether they were sure or whether they were guessing.

In line with the methodology of Lau and Passingham [7] we expected to find this relative case of blindsight for affective information in which the affective information can be processed independently of visual awareness. Because we used a pattern mask it is expected that the lowest detection performance and confidence ratings will be around the SOA of 0 milliseconds and will be U-shaped [1]. Following Lau and Passingham [7] we conjectured that this U-shape implies that we can find SOA conditions where the objective performance is the same, but the confidence ratings are different.

METHOD

Participants

Twenty-three undergraduate students of The University of Tilburg participated in exchange of course credits or a monetary reward (16 women, 7 men, M = 19.8 years, SD = 2,3). All participants had normal to corrected-to-normal vision and gave informed consent according to the declaration of Helsinki.

Stimuli and Materials

Photos of actors expressing fear and combing their hairs 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 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 grey 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 x 2 gender x 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 maximum width was 6.48 degrees of visual angle. The mask covered the area of the stimuli completely.

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 x 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 values were -50, -33, -17, 0, 17, 33, 50, 67, 83, 100, 117 and 133 milliseconds. 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 values represent forward masking and positive SOA values backward masking. Moreover a target-only condition and a mask-only condition were included. One complete run summed up to a total of 224 trials (8 identities x 2 actions (Fear/Combing) x 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 chamber 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 milliseconds the target stimulus appeared for 33 milliseconds. After a variable interval the mask was presented for 50 milliseconds (sometimes the mask was presented first). This means that when the SOA value was -33, -17, 0 and 17 milliseconds the body and the mask overlapped. The body was always presented at the foreground. 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

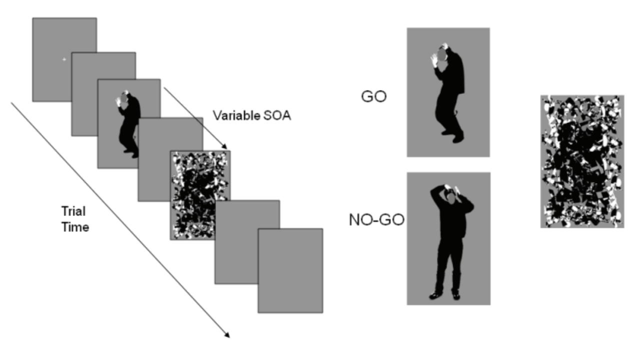

Figure 1. Visual representation of a trial (on the left), example target and distracter stimuli per detection task (middle right) and the mask (bottom right).

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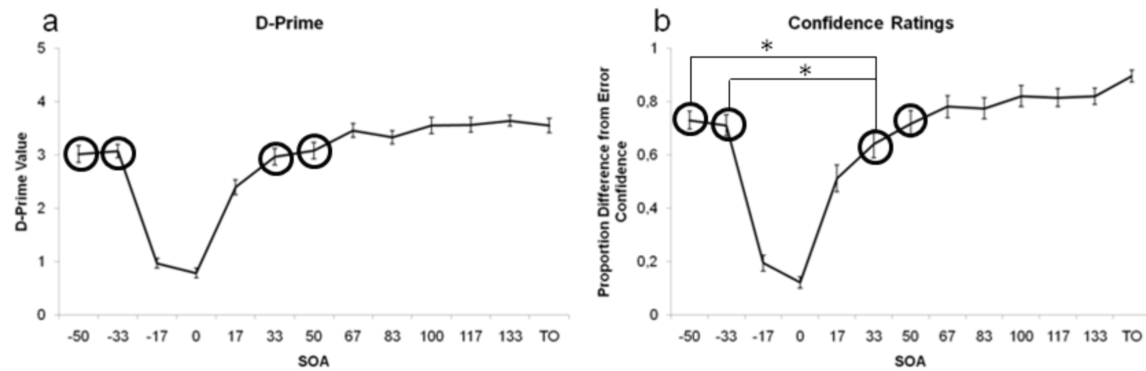

Figure 2. Detecting fearful bodily expressions as a function of SOA values (a) Confidence ratings as a function of SOA values (b) Error bars indicate standard error mean. * = *p* < .05.

two different buttons on the same response box labeled with "Sure" and "Guessed". These 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 milliseconds and 767 milliseconds. This jitter was added to prevent that the participants would be caught in a mechanical rhythm. In total the trials were on average 4025 milliseconds. See Figure 1 for a visual representation of a trial.

Previous to the experimental sessions the participants had to perform two practice sessions consisting of 33 trials each (16 target-trials, 16 distractor- 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. Before each run the trials were shuffled. Every 112 trials there was a 3 minute break.

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 [6]. A ***d'*** of 0 means that the participants are not able to discriminate the fearful bodily expressions from the neutral bodily actions. D-prime 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 [8]:

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

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 [9].

Confidence ratings were calculated in analogue with the d-prime in the sense that information from all four cells (hits, misses, false alarms and correct rejections) were used. Per SOA condition 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 then their incorrect answers which is taken as a measure of subjective visual awareness. This measurement will be called confidence ratings in the remaining paper.

RESULTS AND DISCUSSION

As shown in Figure 2a, the d-prime pattern shows a classical pattern masking curve with the lowest point of the curve when the SOA was 0 milliseconds [1]. There was a main effect of SOA as indicated by a MANOVA with SOA as a factor ($F(12,11) = 29.73$, $p < .001$). Interestingly, the d-prime was above zero when the SOA was 0 milliseconds ($t(22) = 9.64$, $p < .01$), indicating that the participants were capable of detecting the fearful bodily expressions. The confidence ratings are plotted in Figure 2b. Also, a main effect of SOA is found here ($F(12, 11) = 86.37$, $p < .001$). Strikingly, participants were still more confident about their correct than incorrect answers when the d-prime was at its lowest point. This is indicated by the confidence ratings being still significantly above zero when the SOA was 0 milliseconds ($t(22) = 5.76$, $p < .01$).

When exploring Figure 2a detection performance seems equal between SOA values of -50 & +33, -50 & +50, -33 & +33, and -33 & +50 milliseconds, this was confirmed with paired t-tests showing no significant differences. However, when performing statistical comparisons between the same SOA conditions on the confidence ratings it appeared that the confidence ratings differed significantly for the SOA value pair -50 & +33 milliseconds (t(22) = 2.23, $p < .05$). This was also the case for the comparison of the SOA conditions of -33 & +33 milliseconds; the d-prime did not differ, while the confidence ratings did (t(22) = 2.25, $p < .05$).

While participants are in some conditions equally capable in detecting the fearful body posture, the subjective confidence ratings differed. The dissociation between the detecting performance and the confidence ratings seems to indicate that the fearful bodily expressions are being processed independently of subjective visual awareness. This process could be playing an important role in everyday vision supporting us unconsciously with important information of our surroundings. However, while in creating our stimuli we took care of triggering a fear response in the actors as natural as possible a drawback of the laboratory setting is that the spontaneous observation of fear is difficult to simulate.

Further research using neurological measures could give us insight which pathways are indeed mediating the independency of detecting fearful signals from visual awareness and how it interacts with other sources of information like auditory or other visual information like the face. Finally, it should also be examined if this phenomenon is general to the perception of all emotions or whether it is specific to the perception of fearful signals.

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