"Unconscious Anxiety": Phobic Responses to Masked Stimuli

Arne Öhman and Joaquim J. F. Soares

Phobias may be defined as intense, irrational fears of specific objects or situations that cannot be voluntarily controlled or reasoned away and that lead to avoidance of the phobic situation (Marks, 1969). Phobias, therefore, often appear peculiarly dissociated from the intentional, verbal–cognitive control that typically is held to characterize normal psychological functioning. To capture this aspect of phobias, psychoanalysts have interpreted them as unconscious ways of coping with anxiety. By investing the unconsciously originated anxiety in a symbolically related external object, which can be avoided, it is assumed that the ego can be saved from manifest anxiety (e.g., Freud, 1909/1955).

An alternative contemporary perspective anchors irrational fears in early, automatic information-processing mechanisms that are inaccessible to intentional control. For example, Öhman (1987, 1993a; Öhman, Dimberg, & Esteves, 1989; Öhman & Soares, 1993) has proposed that a preattentive, automatic analysis of some types of emotionally relevant stimuli is sufficient to activate components of a phobic reaction such as autonomic responses. These preattentive stimulus analysis mechanisms are unconscious both in the sense that they work outside of the focus of attention and that they are inaccessible to introspection and verbal reports (cf. Greenwald, 1992). This implies that important components of phobic responses are set in motion before the phobic stimulus is represented in awareness as the subject consciously identifies what he or she is reacting to. Therefore, conscious perception of the phobic stimulus occurs against a background of rising physiological activation that is likely to feed back to the stimulus appraisal process, further enhancing the fear (see, e.g., Mandler, 1975). Thus, phobias appear to be involuntary and irrational because the fear response is initiated before conscious, intentionally controlled processes come into play.

An important implication of this theoretical perspective is that reportable conscious awareness of the eliciting stimulus is not necessary for evoking the physiological responses often taken as being indicative of emotion. Empirical examination of this hypothesis requires that physiological responses be dissociated from conscious perception of the stimulus. Backward masking (i.e., preventing recognition of a target stimulus by an immediately following masking stimulus) provides one method to achieve this purpose. It appears to allow relatively complete analysis of the target stimulus but prevents its conscious representation (Marcel, 1983).

Previous work in our laboratory has explored the effect of backward masking on emotionally relevant visual stimuli. Esteves and Öhman (1993) examined masking of emotional expressions in facial stimuli by an immediately following mask portraying a neutral face. They reported that a 30-ms target mask interval resulted in complete masking. That is, the subjects both performed and felt that they performed randomly in a forced-choice recognition task and were able to see only one stimulus (rather than two). Similarly, Öhman and Soares (1993) reported that a 30-ms interval between target pictures showing snakes or spiders, on the one hand, and masks, consisting of similar pictures lacking any central object on the other, did not result in above-chance recognition performance. These masking parameters were used in subsequent experiment to demonstrate that skin conductance responses (SCRs) to emotionally relevant stimuli could be elicited outside of the subject's awareness. Using facial stimuli, Öhman et al. (1989) conditioned SCRs to nonmasked presentations of angry or happy faces in normal subjects before presenting test trials in which the conditioned and control stimuli were presented under masking conditions that precluded their conscious perception (i.e., a 30-ms masking interval). Similar experiments were reported by Soares and Öhman (1993a, 1993b; Öhman & Soares, 1993), who used snakes and spiders as fear-relevant, and flowers and mushrooms as fear-irrelevant, conditioned stimuli (CSs).
In both cases, SCRs conditioned to fear-relevant stimuli (angry faces; snakes or spiders) survived masking, whereas masking abolished differential responses to fear-irrelevant stimuli (Öhman et al., 1989; Öhman & Soares, 1993; Soares & Öhman, 1993a, 1993b). Thus, in support of Öhman's (1987, 1992, 1993a; Öhman et al., 1989) theorizing, it appears that autonomic responses to emotionally relevant stimuli can be elicited in conditions in which the subjects did not consciously perceive the relevant eliciting stimulus.

The purpose of this study was to extend these results from “laboratory analogs” of phobias (Öhman, 1979a) to real phobias. When phobics are confronted with their feared object, they show an immediate, sympathetically dominated, autonomic response peaking within 5–10 s after the stimulus. It includes, for example, enhanced SCRs, peripheral vasoconstriction, and acceleration of the heart (e.g., Fredrikson, 1981; Hare, 1973; Hare & Blevings, 1975). This response, of course, represents a much more intense, and presumably more genuine, emotion than autonomic responses conditioned to fear-relevant stimuli in normal individuals (Fredrikson, 1981). Thus, by selecting subjects highly fearful of snakes or spiders and then exposing them to masked pictorial representations of their feared object, we could determine whether they would show larger SCRs to the feared than to nonfearred control material, as well as larger responses to phobic stimuli than nonfearful controls. A successful demonstration of this type would indicate that real emotions can be elicited from preattentive stimulation. This study also allowed self-ratings of affect to be used as dependent variables as a supplement to the autonomic index. The self-ratings included dimensions of arousal, valence, and control dominance (i.e., whether the person feels in control of or feels controlled by the stimulus; Lang, 1980).

The primary hypothesis was that the autonomic components of the phobic response would be discernible in fearful subjects regardless of whether they were exposed to masked or nonmasked presentations of their feared stimulus. For the emotional rating data, there is less basis for an unequivocal hypothesis. On the one hand, ratings may be taken to reflect the final emotional outcome, and as such they would be highly dependent on conscious processing of the stimulus. On the other hand, the emotional ratings could be sensitive to the bodily response presumed to be elicited by masked stimuli, and then one could expect an impact on ratings even in the masked condition.

However, the interpretability of the findings would rest entirely on how convincing a case can be made to the effect that the masking procedure was effective. Even though previous work (Esteves & Öhman, 1993; Öhman & Soares, 1993) consistently has indicated that a 30-ms masking interval effectively precludes perception of the target, one cannot take for granted that these data are generalizable to a population of fearful subjects. For example, one could argue either that phobics are sensitized to identify their feared object on the basis of minimal cues or that phobics have an avoidance bias that may result in elevated thresholds. Thus, before proceeding to test the main hypothesis of the study, we found it necessary to perform a forced-choice identification experiment (see Holender, 1986) to determine whether fearful subjects would differ from normal subjects in the recognition of masked phobic stimuli.

### Experiment 1

The purpose of this pilot experiment was to examine whether fearful subjects would differ from nonfearful ones in recognizing masked presentations of pictures of snakes and spiders, with pictures of flowers and mushrooms serving as control stimuli. The procedure was identical to that established by Öhman and Soares (1993). The masking pictures consisted of randomly cut, reassembled, and rephotographed pictures of snakes, spiders, flowers, and mushrooms. The subjects, who were selected to be either fearful or nonfearful, were asked to report whether of the four stimuli (snake, spider, flower, and mushroom) preceded the mask in randomly ordered target–mask pairs with varying stimulus onset asynchronies (SOAs) between the target and the mask. In addition, they were required to give estimates of their confidence in the decisions.

### Method

#### Subjects

The participants in the experiment were selected from a pool of 825 undergraduates (509 women and 316 men), who were tested with a set of 12 questionnaires. The fearful participants in this experiment had to score above the 90th percentile on either one of the Snake Fear Questionnaire or the Spider Fear Questionnaire (Fredrikson, 1983; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) and below the 50th percentile on the other. The nonfearful participants had to score below the 50th percentile on both of the questionnaires. Eight men and 8 women were selected from this pool of subjects. Four subjects (2 women and 2 men) were afraid of snakes but not of spiders, whereas the reverse was true for the remaining 4 fearful subjects (2 women and 2 men). The 8 nonfearful control subjects typically had a score of 0 (i.e., they did not endorse any of the fear items). The age range for the subject group was 21–43 years (M = 27.1 years). The subjects participated on an informed-consent basis and were paid approximately $15 for their participation.

#### Design and overview

The subjects were exposed to pairs of stimuli, one target and one mask. The variables of the experiment were groups (fearful vs. nonfearful), type of target (snake, spider, flower, and mushroom), and the SOA between target and mask (20, 30, 50, 80, 120, and 180 ms). The control condition involved two successive mask exposures of 20 and 30 ms without any intervening interval. There were six replications for each condition, making a total of 168 randomly ordered trials for each subject. Thus, the design was a 2 X 4 X 7, Group X Stimulus Type X SOA (including control), split-plot factorial with one between-subjects variable and two within-subjects variables.

#### Apparatus and material

The subjects were seated in an armchair inside a Tegnér (Stockholm, Sweden) sound-isolated experimental room (2.5 m X 2.0 m X 1.8 m), with the apparatus located outside of the room. The visual stimuli were 24-mm X 36-mm color slides of snakes, spiders, flowers, and mushrooms used as targets and randomly cut, reassembled, and rephotographed pictures of snakes, spiders, and so forth, as masking stimuli (see Öhman & Soares, 1993). Thus, the masks retained the colors and general texture of the targets but were constructed to involve multiple, complex contours and to lack any perceivable central object. There were six different exemplars for each of the stimulus categories that were randomly paired with 24 different masks. Eight additional masks were randomly paired for the control trials.

The targets and masks were projected from outside of the chamber by two Sawyer projectors equipped with high-speed shutters (Vincent Associates Uniblitz 214 L, Rochester, New York) with carefully adjusted overlapping projection fields on to a milk-colored glass screen in front of the subject. The size of the resulting picture was 14 cm X 21 cm,
which was viewed at a distance of 1 m by the subject. A 2-mm light-
emitting diode (LED) was placed in the center of the glass screen. It
served as a fixation point to alert the subject that a stimulus was immi-
nent. The exposure durations of the stimuli as well as the onset and
offset of the LED were controlled by electronic timers.

Procedure. After being seated in front of the screen, the subjects
were shown unmasked examples of the stimuli being used in the experi-
ment. They were instructed that they would be exposed to pairs of
rapidly presented stimuli and that their task was to guess which of the
four stimulus categories (snake, spider, flower, and mushroom) was rep-
resented on the first picture of each pair. They responded by circling the
appropriate stimulus category on a response sheet. They were further
asked to indicate their confidence in the answer by ticking a 10-cm vi-

sual analog scale numbered 1, 3, 5, 7, and 9 at equal intervals and la-
mbeded guess under an area limited by 1 and 3, believe under 5, and sure
under Areas 7–9. The instruction emphasized that the stimuli were brief
and that the subject had to fixate the LED whenever it was lit in order
not to miss stimuli. The LED was always lighted 3 s before presentation
of targets (or masks in control trials). The subjects were exposed to 10
training trials involving target–mask pairs or the control condition.
They were given the opportunity to ask questions before the experiment
proper started. Except for the 20-ms SOA condition, wherein the target
was terminated by the mask, target duration was always 30 ms and the
mask was always exposed for 100 ms.

Data reduction and statistical analyses. The percentage of correct
responses were the “hits” (i.e., the proportion of trials for a given condi-
tion in which the stimulus was correctly identified, such as a snake stim-
ulus being labeled a snake by the subject). To measure the subjects’ read-
iness to use a particular response, false-alarm rates for the different re-
sponse categories were calculated as the proportion of trials in which
nonsnake target stimuli at a particular SOA were labeled as snakes, non-
snake stimuli as spiders, and so forth. A similar estimate of response
bias was derived from the control trials with no target, in which the pro-
portion of trials each response category was used was calculated. Given an absence of response bias and four response alternatives, both
false-alarm rates and control-level responding should center around
25%, as should the proportion of correct responses for unrecognizable
stimulus conditions. These parameters were statistically evaluated with
Group × Stimulus Type × SOA analyses of variance (ANOVA). Mean
confidence ratings for correct responses for each Stimulus Type × SOA
series were computed for each subject and were subjected to ANOVAs.
False-alarm confidence was also examined, but only for conditions hav-
ing frequent error responses (i.e., for SOA 100 ms and less). In deter-
mining the level of significance for F ratios from variables involving
repeated measurement, we used the most conservative Greenhouse-
Geisser correction, which involved 1 df in the numerator and 14 df in
the denominator.

Results

The mean percentage of correct responses is shown in the top
panels of Figure 1 for the nonfearful (left) and fearful (right)
groups. Performance improved with increasing SOAs as shown
by the highly significant effect of this variable, \( F(1, 14) = 410.44, p < .0001 \). As shown by the significant effect of stimulus
type, \( F(1, 14) = 8.41, p < .05 \), and by follow-up Tukey tests,
spiders were overall more difficult to recognize than snakes,
flowers, and mushrooms (\( Ms = 49.4\% \), 55.3%, 60.3%, and
56.2%, respectively). Probably because of the poor performance
for the spider condition, particularly among fearful subjects at
longer SOAs, the Stimulus × SOA interaction, \( F(1, 14) = 5.51, p < .05 \), was significant. There was no main effect of groups
(\( F < 1 \)).

As shown by the shorter SOAs in Figure 1, the percentage of
correct responses were at the expected level for random perfor-
mance in both groups. This is highlighted in the left side of Ta-
ble 1, which shows correct responses, responses to the mask-
only control condition, and false alarms for the various response
categories with the 30-ms SOA. It is obvious in these data that
there was no evidence that the performance level for correct
responses exceeded the control and false-alarm rates. If any-
thing, the level of responding tended to be lower for correct re-
sponses. Furthermore, there were no obvious differences be-
tween fearful and nonfearful subjects.

The confidence ratings (see Figure 1, lower panels) increased
with SOA, \( F(1, 14) = 129.91, p < .0001 \). Even though the func-
tion appears to have a slower rise among fearful subjects, the
interaction between group and SOA was not significant.

As shown in the right part of Table 1, the confidence at the
30-ms SOA was close to the guess region of the confidence scale,
and it was similar for correct responses and false alarms but
somewhat lower for the control condition.

Discussion

Consistent with our previous data (Öhman & Soares, 1993),
the results of this experiment showed that SOA was the strongest
variable determining correct recognitions. As before, an SOA of
about 100 ms was necessary for confident, correct recognition
performance. More important, there were few indications that
the recognition functions differed between fearful and nonfear-
ful subjects, particularly at the short SOAs. The only reliable
differences between groups pertained to poorer performance for
the spider pictures at the long SOAs. This difference could
almost be entirely attributed to a female spider phobic who was
reluctant to use the spider label at SOAs in which she had a hint
that a spider actually was present, whereas she was less reluctant
to use this label in other stimulus conditions. She also contrib-
uted to the overall worse performance with spiders than with
the other stimuli. The most important finding of the experiment
is that a 30-ms SOA resulted in chance performance in both
fearful and nonfearful subjects. From the subject’s viewpoint
(as revealed in confidence ratings), the performance at this SOA
was taken as reflecting random guessing. Thus, this condition
could be used for testing the main hypothesis of this study: that
phobic responses may be elicited from masked stimuli.

Experiment 2

The purpose of this experiment was to compare responses of
fearful and nonfearful subjects to feared and nonfeared stimuli
that were presented either masked or nonmasked.

Method

Subjects. The participants in the experiment were selected from
the pool of undergraduates described in Experiment 1. Thus, the fearful
participants had to score above the 95th percentile on either one of the
Snake Fear Questionnaire or the Spider Fear Questionnaire and below
the 50th percentile on the other. The nonfearful participants had to
score below the 50th percentile on both of the questionnaires. Sixteen
participants were recruited to each of the snake- and spider-fearful
groups, and 16 served as nonfearful controls. The age range was 19–44
years ($M = 24.7$ years). There were 27 women and 21 men (9 women and 7 men in the snake group, 10 women and 6 men in the spider group, and 8 women and 8 men in the control group). An additional 10 subjects were run but were eventually discarded because of equipment failure. The subjects participated on an informed-consent basis and were paid approximately $30 for their participation.

**Design.** The fearful ($n = 32$) and nonfearful ($n = 16$) subjects were exposed to presentations of masked and nonmasked pictures of snakes, spiders, flowers, and mushrooms. The design was a $3 	imes 2 	imes 4 	imes 8$ factorial (Kirk, 1968) with group (snake fearful, spider fearful, and controls) as a between-subjects variable and presentation (masked vs. nonmasked exposure), stimuli (snakes, spiders, flowers, and mushrooms), and trial (1–8) as within-subjects variables.

**Apparatus.** The experiment was run in the same laboratory as Experiment 1, using the same chamber for the subject and the same equipment and material for stimulus presentations.

Electrodermal activity was measured by Beckman Ag/AgCl electrodes, 8 mm in diameter and embraced in plastic cups filled with isotonic electrode paste (0.05 M NaCl), by means of a Hagfors-type constant voltage circuit (Venables & Christie, 1973). Electrodermal responses were continuously recorded on paper on a Hewlett-Packard 7700 polygraph. The electrodes were placed on the palmar sides of the second phalanges of the first and second fingers of the nondominant hand by help of self-adhesive electrode collars.

The electronic timers controlling the exposure durations of the stimuli as well as the LED were automatically activated by relay detectors that were triggered by preprogrammed pulses from a two-channel tape recorder that determined the intertrial intervals. The sequence of the stimuli was determined by their position in the projector tray.

**Experimental phases.** The experiment consisted of a masked and a subsequent nonmasked presentation phase. The order of presentation was not balanced because it was suspected that exposure to nonmasked presentations before the masked presentation could result in less efficient masking. Thus, asymmetrical transfers were expected between the two possible orders. This means that the order effect was a confounding variable in the comparison between masked and nonmasked stimulus presentations. However, because the main interest was on responses to masked stimuli, we considered it more important to guarantee uniform masking effects with maximal power for between-stimulus-type comparisons than to provide unbiased comparisons between masked and nonmasked stimulus presentations. In the masked presentation phase, the subjects were exposed to 8 masked trials of each of the stimulus types (snakes, spiders, flowers, and mushrooms). A similar procedure was used during the nonmasked presentation phase, but the stimuli were shown without any masking. The stimuli were presented in randomized order with the restriction that only two successive exposures of each stimulus type were allowed.

**Stimulus parameters.** Following the results of Experiment 1, the masked condition involved 30-ms exposure of the target stimulus, immediately followed by a 100-ms exposure of the masking stimulus. A

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**Figure 1.** Forced-choice recognition performance in terms of the percentage of correct answers (Panels A and B) and confidence ratings (Panels C and D). The data are plotted as a function of the stimulus onset asynchrony (SOA) between the target stimuli (snake, spider, flower, or mushroom pictures) and the masks. The control condition involved two successive presentations of different masks.
unconscious stimulation may induce a nonspecific bias to rate stimuli. Nevertheless, because there are data to suggest that scales were reversed to reflect disliking and lack of control in the presence of high disliking, and lack of control, the valence and control-dominance of control. However, because fear would be indicated by high arousal, rated so that a high score reflected control and a low score reflected lack; and control-dominance was measured with SAM (self-ratings of arousal, valence, and control-dominance of control). They were expressed as numbers per minute. Other dependent variables were the SAM (self-ratings of arousal, valence, and control-dominance to each picture) and identification tests.

Dependent variables. The autonomic variables consisted of specific SCRs to stimuli and spontaneous SCRs emitted between stimulations. SCRs were scored as changes in conductance exceeding 0.05 μS initiated 1–4 s after the onset of each stimulus (Proksy & Kumpfer, 1973). In order not to obscure potential differences in SCRs between fearful and control subjects, we did not use range correction or other transformation procedures. Spontaneous SCRs above 0.05 μS were counted for a prestimulation period before the first stimulus and in the interstimulus interval during a period starting with the completion of the latency window for the SCRs to the stimuli and ending with the onset of the LED. They were expressed as numbers per minute. Other dependent variables were the SAM (self-ratings of arousal, valence, and control-dominance to each picture) and identification tests.

Data analyses. SCR data were evaluated with ANOVAs and nonorthogonal Tukey tests. No trials were excluded. Spontaneous SCR frequency data were analyzed with ANOVAs. Before the statistical analyses, they were summed for a 20-s prestimulation (baseline) period and for 15–25-s durations in the interstimulus intervals during the stimulus series. The SAM data were evaluated with ANOVAs and nonorthogonal Tukey tests. In all ANOVAs, the most conservative Greenhouse–Geisser correction for significance level was used in evaluating F ratios for variables involving repeated measurement. Recognition data were analyzed by scoring the means of the masked and nonmasked stimulus presentation during a test phase after the termination of each experimental condition.

Results

SCRs. The ANOVA showed a clear main effect of stimulus, F(1, 45) = 5.43, p < .05, with overall larger responses to phobic than to neutral stimuli. More important, the interaction between groups and stimulus was clearly significant, F(1, 45) = 9.33, p < .01. This interaction could be attributed to the larger responses to snakes among snake-fearful subjects than among spider-fearful and control subjects (ps < .01 for both comparisons according to Tukey tests) and to larger responses to spiders among spider-fearful subjects than among subjects in the other two groups (ps < .01 for both according to Tukey tests), with no
between-groups differences in responses to flowers and mushrooms (see Figure 2A and 2B).

This pattern was obvious in responses to both masked and nonmasked stimulus presentations because the interaction among groups, stimulus, and presentation did not approach significance, $F(1, 45) = 0.56, ns$. In addition, the main effect of group approached significance, $F(2, 45) = 3.11, p < .055$, with snake-fearful subjects showing overall larger responses than control subjects ($p < .05$ by Tukey test). Responses declined in magnitude both within, $F(1, 45) = 4.03, p < .05$, and between, $F(1, 45) = 4.53, p < .05$, stimulus presentation series.

**Spontaneous SCRs.** The group effect was not significant at baseline after instruction but before the masked and nonmasked stimulus presentation series. However, during stimulation, the overall group effect was significant, $F(2, 45) = 6.81, p < .003$, with both snake- and spider-fearful subjects showing more fluctuations than control subjects, $F_{s}(1, 30) = 13.26$ and $6.27, ps < .001$ and .02, respectively. As shown by the marginally significant interaction between groups and presentation, $F(2, 45) = 3.07, p < .0563$, these effects were somewhat clearer during masked than nonmasked stimulus presentation (see Figure 3A and 3B). Thus, there were differences among the experimental groups in spontaneous SCRs in-between stimulation, but not at baseline, and this effect was somewhat clearer during the first masked stimulus series.

**The SAM test.** The effects were similar across the three rating dimensions (i.e., arousal, valence, and control–dominance; see Table 2). Most important, the effects of stimulus, $F(1, 45) > 19.24, p < .001$, and the interactions between groups and stimulus, $F(1, 45) > 8.95, p < .01$, were reliable for valence, arousal, and control–dominance. The interaction could be attributed to an enhanced rating of potentially phobic stimuli in the fearful subjects ($p < .05$ by Tukey for comparisons between fearful and nonfearful groups), with no between-groups differences in the ratings of neutral stimuli. As a result of this interaction, there was also a main effect of group in all three dimensions, $F(2, 45) > 6.61, p < .004$. Finally, the subjects tended to produce higher ratings or fear-relevant stimuli when they were presented nonmasked than when they were masked, whereas there was little effect of masking on ratings to neutral stimuli (see Table 2). However, because of the conservative tests used, the interaction between stimulus and presentation just missed the 5% level of significance.

### Table 2

<table>
<thead>
<tr>
<th>Condition and group</th>
<th>Arousal</th>
<th>Negative valence</th>
<th>Lack of control</th>
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<tbody>
<tr>
<td></td>
<td>Sna</td>
<td>Spi</td>
<td>Flo</td>
</tr>
<tr>
<td>Masked presentation</td>
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<td></td>
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<tr>
<td>Snake-fearful subjects</td>
<td>4.7*</td>
<td>1.8</td>
<td>1.8</td>
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<tr>
<td>Spider-fearful subjects</td>
<td>2.0</td>
<td>4.4*</td>
<td>1.6</td>
</tr>
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<td>1.3</td>
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<tr>
<td>Nonmasked presentation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Snake-fearful subjects</td>
<td>5.6*</td>
<td>2.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Spider-fearful subjects</td>
<td>2.5</td>
<td>5.3*</td>
<td>1.1</td>
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<tr>
<td>Controls</td>
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<td>1.3</td>
<td>1.0</td>
</tr>
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* $p < .05$ compared with the other two groups for this stimulus condition.
significance for ratings of arousal, \( F(1, 45) = 3.69, p < .10 \), and dominance, \( F(1, 45) = 3.36 \), and was clearly significant only for valence, \( F(1, 45) = 11.71 \). This latter effect was partly attributable to the finding that neutral pictures tended to be rated as less negative during nonmasked presentations (see Table 2). Thus, in general, the data from the SAM ratings closely paralleled the SCR effects. However, masking had at least some effects on the ratings (i.e., ratings tended to be lower for masked than for nonmasked fear-relevant stimuli).

The identification test. As shown in Table 3, few of the subjects were able to provide correct identifications of masked stimuli, whereas recognition was close to perfect for nonmasked stimulus presentations. The typical answer for masked presentation was “grass,” “pebbles,” “rocks,” and the like. Among the snake-fearful subjects, 1 subject correctly responded “snake” to the masked snake, none of the spider-fearful subjects recognized any masked stimulus presentations, and among the controls, 2 subjects recognized masked snakes and 2 subjects recognized masked flower stimuli. For nonmasked stimulus presentations, recognition was somewhat better for neutral (flowers and mushrooms) than for potentially phobic (snakes and spiders) pictures.

Table 3
Correct Recognitions (%) of Masked and Nonmasked Single Presentations of Snakes (Sna), Spiders (Spi), Flowers (Flo), and Mushrooms (Mrm) in Snake-Fearful, Spider-Fearful, and Control Subjects

<table>
<thead>
<tr>
<th>Condition and group</th>
<th>Recognition (%)</th>
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<tr>
<td></td>
<td>Sna</td>
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<tr>
<td>Snake-fearful subjects</td>
<td>6.3</td>
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<tr>
<td>Spider-fearful subjects</td>
<td>0.0</td>
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<tr>
<td>Control subjects</td>
<td>12.5</td>
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<tr>
<td>Nonmasked presentation</td>
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<td>Snake-fearful subjects</td>
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<td>Spider-fearful subjects</td>
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<td>Control subjects</td>
<td>93.8</td>
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</table>

Because 1 snake-fearful subject responded “snake” when exposed to a masked snake stimulus in the test series, we performed an ANOVA on the snake group data excluding this subject. Removing this subject from the snake-fearful group still left a highly significant \( F \) ratio for the stimulus effect in this group, \( F(1, 14) = 12.21, p < .0001 \), with no interaction between stimulus and presentation.

General Discussion

According to the results of Experiment 1, fearful subjects were as unsuccessful as nonfearful subjects in recognizing masked presentations of snakes or spiders when the stimuli were exposed for 30 ms and immediately followed by a 100-ms mask. Nevertheless, the results of Experiment 2 showed that snake-fearful subjects showed enhanced skin conductance responding specifically to snake stimuli, and spider-fearful subjects to spider stimuli, regardless of masking conditions. Thus, masked, non-recognizable phobic stimuli were as effective as nonmasked, clearly recognizable ones in eliciting physiological components of the phobic response in fearful subjects. Control subjects, on the other hand, did not differentiate between stimuli and were below the fearful subjects in response to the feared stimuli. Thus, these results suggest that autonomic responses associated with emotion can be elicited merely after a preattentive analysis of the elicitng stimulus. These data, therefore, appear to confirm the experimental hypothesis derived from Öhman’s (1987, 1992, 1993a) theory of the preattentive activation of emotion.

Evidence of emotional responding to masked phobic stimuli was not limited to the skin conductance modality but was evident also in emotional ratings. Using the SAM to assess fear, fear increases would be manifested as increases in arousal and disliking of the stimulus and in less experienced control. As shown in Table 2, exactly this pattern was observed because phobic subjects rated themselves as more aroused, as more disliking, and as less in control when exposed to their phobic as compared with control stimuli, whereas the ratings of control subjects did not discriminate between stimulus categories. However, the ratings were generally higher and the effect of stimulus tended to be clearer after nonmasked than after masked presentations.
stimulus presentations. These data suggest that the phobic subjects experienced fear even to phobic stimuli that they could not consciously identify. Thus, not only did we observe an SOA-dependent dissociation between verbal recognition performance (as assessed in Experiment 1) and SCRs (in Experiment 2), but there was also a dissociation between recognition and verbal responses as manifested in emotional ratings. This latter dissociation suggests that some information about the stimuli became available to introspection and the verbal–cognitive system. However, this information did not influence the conscious perceptual identification of the stimuli because it was not reflected in recognition performance. One interpretation of this dissociation is that the subjects based their ratings on feedback from the bodily response. Thus, they might have felt their bodies responding and based their ratings on this response rather than on information from the stimulus, much like what would be expected from the James–Lange theory of emotion (James, 1884).

Because the SCR is a pervasive component of the orienting reflex (OR; e.g., Öhman, 1979b), it could be argued that our results reflected attention rather than emotion. Emotional stimuli almost by definition are effective attention catchers (e.g., Öhman, 1987), and perhaps the effect we observed on the SCR reflected an attentional switch with an associated OR, rather than the activation of an emotional response. However, phobics confronted with nonmasked presentations of their phobic object do not show an OR but a defense reflex, characterized among other things by heart rate acceleration rather than heart rate deceleration (e.g., Fredrikson, 1981; Hare & Blevings, 1975). Thus, there is little question that nonmasked phobic stimuli result in emotional responses when presented to fearful subjects. However, because we used only the SCR, our results are somewhat ambiguous on this point. Therefore, it is important that the emotional ratings of the stimuli showed parallel results because they suggest that emotional processes were activated in the subjects. The similarities in the results for the masked and nonmasked conditions could imply that a preattentive analysis was sufficient to activate the complete emotion, which was intensified only by conscious recognition of the stimuli in the nonmasked condition. An alternative notion is that only components of the emotional response (e.g., an initial OR) can be preattentively activated but that our dependent measures were not sufficiently sensitive to capture the difference between this partial response and the more complete response occasioned by the nonmasked stimuli. Analysis of this problem would require a more complete psychophysiological assessment of the effects of masked phobic stimuli, involving, for example, heart rate recordings.

The identification test that followed each of the experimental phases in Experiment 2 was included to give a rough test of whether the subjects changed their thresholds as a function of exposure. Because this test involved only one presentation of each stimulus condition, it was, of course, insensitive compared with the forced-choice procedure used in Experiment 1. Nevertheless, the results were consistent with those of Experiment 1 in providing little evidence of stimulus identification. Given that the subjects were informed before Experiment 2 that phobic stimuli may be involved in the stimulus series, they might have been biased to answer with their phobic objects given the ambiguity of the masked stimuli. Yet, none of the spider-fearful subjects admitted recognizing any of the masked stimuli, and only 1 subject in the snake group responded “snake” when exposed to a single masked snake stimulus in the test series. Nevertheless, the spider group showed clearly enhanced SCRs and ratings to masked spider pictures, and removing the data for the subject in the snake group, who identified a snake, did not alter the results. However, we cannot definitely rule out that the subjects might have become briefly and momentarily aware of the stimulus at some of the masked presentations because this possibility can only be conclusively excluded with continuous measurement of awareness (Holender, 1986). The consistent failure to find any evidence of recognition with the present masking parameters, however, would suggest that such momentary awareness could be present only at a tiny minority of the trials. It seems unlikely that effects as pervasive as the ones we observed could reflect only a minority of the trials, although this possibility cannot be completely ruled out. Continuous measurement of awareness as a method to guard against this threat to the validity, however, is likely to change the conditions of the experiment, thus giving rise to an alternative set of interpretational problems.

Spontaneous skin conductance responding is closely associated with state anxiety (e.g., Lader, 1967) and emotional arousal (e.g., Bohlin, 1976). Thus, the spontaneous SCR data could be taken to suggest that the effects of masked phobic stimuli were not restricted to the immediate impact of the stimulus but resulted in activation effects that outlasted the stimulus duration. Even though the baseline data were taken after the instruction suggesting that phobic stimuli may be presented, there was no difference between groups at this stage. Thus, merely threatening that phobic stimulation may be imminent was not sufficient to induce elevated levels of spontaneous SCRs in fearful subjects. However, when they were exposed to masked presentations of phobic stimuli, clear elevations in the rate of spontaneous SCRs were observed. Yet, it is difficult to definitely tie our results to the nonconscious activation of phobic anxiety in phobic subjects. For example, fearful subjects may be more prone to become nonspecifically activated by the ambiguity provided by the masked stimuli. Furthermore, masking was completely confounded with order of presentation. Thus, it is impossible to rule out between-series habituation as a factor behind the elevated responding of phobic subjects during masked stimulation.

Our results seem to imply that sensory feedback from the phobic response may reach awareness before or perhaps simultaneously with the conscious perception of the phobic stimulus. Thus, as suggested by the classic James–Lange theory (James, 1884), the bodily response appears to be activated before the conscious emotional experience. Because the phobic stimulus becomes consciously perceived against a background of rising physiological arousal, victims of phobia may feel that they are becoming overwhelmed by an automatic, inevitable fear. Consequently, attempts to voluntarily control it appear fruitless, and the only action alternative is to flee the situation. Thus, our data and theoretical interpretations provide a good explanation of the irrationality of phobias.

An interesting question raised by these findings concerns the origin of the elevated response of fearful subjects to phobic
stimuli. According to one theory of phobias (Öhman, Dimberg, & Öst, 1985; Seligman, 1971), phobic responses represent the confluence of a biologically derived readiness to acquire fears to some potentially deadly situations and learning episodes in which fear was elicited in such situations. In support of this theory, humans acquire more persistent conditioned responses to pictures of snakes and spiders paired with a mild electric shock than to similarly presented pictures of flowers or mushrooms (McNally, 1987; Öhman, 1993b). Furthermore, in recent studies (Öhman & Soares, 1993; Soares & Öhman, 1993a, 1993b) using normal subjects, we demonstrated that conditioned SCRs to such fear-relevant stimuli consistently survived backward masking, whereas conditioned responses to fear-irrelevant stimuli did not. Thus, the data for normal subjects conditioned to snakes and spiders looked highly similar (albeit on a smaller scale) to those for phobic subjects that we report in this article. This similarity thus supports the contention of the preparedness theory that phobia may result from conditioning experiences.

There are data available from animal experimentation that suggest a neural mechanism for the type of effects we have reported. LeDoux and co-workers (LeDoux, 1990) have demonstrated in studies of conditioned emotional responses in rats that there is a direct neural pathway from the thalamus to the amygdala, which thus bypasses the normal route by the cortex in eliciting conditioned fear. This pathway is assumed to mediate crude aspects of the conditioned stimulus to the fear effector system of the central amygdala in order to facilitate quick avoidance of potentially hazardous situations. If a similar system is operating in humans, it would allow quick access of crude stimulus features to the neural mechanisms eliciting autonomic responses. In this way, such responses may be under way before full processing of the stimulus is disrupted by the mask, thus producing the dissociation between the autonomic indexes and conscious perception that we observed.

This theoretical analysis does not necessarily require full semantic analysis of the stimulus at the unconscious level (LeDoux, 1990; Öhman, 1992) but suggests that individual features of fear-relevant stimuli may be sufficient to activate autonomic responses. Thus, our results do not necessarily confirm that unconscious mechanisms are smart in the sense that they perform complex and flexible tasks, matching conscious mental processes in the power to decide "what is best for us" (Loftus & Klinger, 1992). The mechanisms we are uncovering may be "good for us" not in a personal but in an evolutionary sense because they help to promote prompt avoidance of potential threats to survival that have plagued humankind throughout its evolution (Öhman, 1993a). This function, however, may be based on routinized biologically built-in feature analyzers specifically tuned to stimulus features suggesting threats, such as potentially poisonous beasts or angry humans (see Öhman, 1992, 1993a), rather than on a full analysis of the semantic meaning of the stimulus. Thus, even though our results support the psychoanalytic contention that phobias are rooted in the unconscious, they do not necessarily support a view of a "smart" unconscious that may patronize consciousness by deciding what is bad for it. However, our data add to a growing literature supporting the claim that unconscious mechanisms are important in psychology (Bornstein & Pittman, 1992), and, in our interpretation, they are not inconsistent with the conclusion that "unconscious cognition has been found to be severely limited in its analytic capability" (Greenwald, 1992, p. 775).

Our results have obvious relations to the research by Mathews, MacLeod, and co-workers demonstrating a nonconscious, preattentive bias in anxiety patients to have their attention captured by potentially threatening stimuli (Mathews, 1990; MacLeod & Rutherford, 1992). However, it remains unclear whether this responsivity to threat is associated with psychophysiological responding. The limited evidence for such an association comes from dichotic listening paradigms (Foa & McNally, 1986; McNally et al., 1987), which can be challenged on the grounds that it is likely to reflect momentary shifts in attention from the attended to the rejected channel (Dawson & Schell, 1982; Holender, 1986; Trandel & McNally, 1987). Thus, in reconciling our findings with those on a processing bias for threat in anxiety, Öhman (1993a) argued that there may be two routes for the unconscious capture of attention by generally threatening and by biologically fear-relevant stimuli. The preattentive activation of phobic responses would be based on a direct link between feature-detector systems and physiological arousal (see Öhman, 1992), somewhat similar to the thalamic-amygdala link isolated by LeDoux (1990) for the conditioned emotional response in rats. The processing bias in anxiety, on the other hand, would reflect a semantic, schema-driven bias to pick up threat, which would be less directly linked to physiological activation. These propositions were then used as the cornerstones for a model of anxiety trying to integrate anxiety phenomena from all the different anxiety disorders (see Öhman, 1993a).

References


Received May 1, 1992
Revision received August 3, 1993
Accepted August 11, 1993