Unawareness Is More Than a Chance Event: 
Comment on Lovibond and Shanks (2002)

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P. F. Lovibond and D. R. Shanks (2002) suggested that expectancy of the unconditional stimulus and emotional ratings are valid indexes of awareness in Pavlovian conditioning and that participants are aware if they can discriminate the conditional stimuli. However, research suggests that processes that are irrelevant to awareness affect these measures. Further, as awareness refers to conscious experience, a valid measure needs to index subjective state rather than discrimination ability. In support, research using subjective measures has demonstrated qualitatively different effects depending on whether participants reported being aware or unaware of the stimuli. In this research, participants reported being unaware of the stimuli even though they were clearly able to discriminate the stimuli. These findings question the validity of Lovibond and Shanks' concept of awareness and their suggestion of a close association between conditioning and awareness.

Imagine that a researcher asks you to participate in an experiment involving pictures of human faces. Before the experiment, you are shown two angry faces and two neutral faces and are instructed to push one button if you detect either one of the angry faces, however fleetingly, and another button if you do not detect either angry face. Because it seems to you that only neutral faces are shown during the experiment, you never indicate that you saw an angry face. After the experiment, however, the experimenter tells you that two pictures were actually presented on each trial: an angry face followed by a neutral face. Because the angry faces were shown briefly and followed immediately by neutral faces, the angry faces were backward masked by the neutral faces.

The experiment is repeated, but this time your task is to indicate which of the two angry faces was shown. After this second task, the experimenter asks if you were consciously aware of the angry faces. You respond that you noticed only neutral faces and that it felt as if you were guessing. However, the experimenter tells you that you did better than chance in discriminating between the two angry faces and concludes that you must have been consciously aware of the angry faces. Would you agree with this conclusion?

Consciousness is commonly considered to be critical to human existence. As consciousness appears to accompany significant episodes of feeling, thought, and behavior, folk psychology holds that consciousness is the critical mediator of all of these psychological events. This conviction also characterized the early years of psychology as a science and may account for the opposition to behavioral principles established by investigators of Pavlovian conditioning and operant conditioning (e.g., Brewer, 1974). Consistent with the view of a primary role of consciousness, Lovibond and Shanks (2002) suggested that Pavlovian conditioning is closely associated with awareness. However, recent evidence from combined efforts of cognitive psychology and neuroscience suggests strongly that conscious awareness plays a limited, albeit at times critical, role in the control of feeling, thought, and behavior (e.g., Bargh & Ferguson, 2000; Gazzaniga, 1998; Kihlstrom, 1987). Thus, Lovibond and Shanks's suggestion of a close association between Pavlovian conditioning and awareness differs from the current zeitgeist in psychology. Further, recent developments in research on unconscious perception (for reviews, see Merikle & Danemann, 2000; Öhman, 1999) and dual-process models that distinguish between expectancy learning and emotional conditioning (e.g., Öhman & Mineka, 2001) raise serious questions about the validity of Lovibond and Shanks's concept of awareness and their conclusion regarding a close association between Pavlovian conditioning and awareness. Because the purpose of this comment is to review this evidence, we focus on conceptual issues rather than detailed criticisms of Lovibond and Shanks's reviews of individual studies.

The main conceptual issue is illustrated in the thought experiment. Because Lovibond and Shanks (2002) considered participants to be aware of stimuli if they could discriminate among them above chance levels, they would agree with the experimenter in the scenario at the beginning of this article and conclude that you were consciously aware of the angry faces. In contrast, because evidence supports the validity of self-report measures of awareness, we would disagree with the experimenter and conclude that your performance on the first task provided a better index of your awareness than your ability to discriminate between the two angry faces. In other words, we suggest that participants can be unaware of the stimuli even if they can discriminate among them above chance levels. In a statistical sense, therefore, unawareness is more than a chance event. In contrast, Lovibond and Shanks regarded participants as unaware only if they were completely unable to differentiate among the stimuli. From their perspective, therefore, unawareness is a chance event.

Lovibond and Shanks: Unawareness Is a Chance Event

Like many researchers, Lovibond and Shanks (2002) apparently regarded the dissociation procedure as a valid approach to study-
ing the role of awareness in Pavlovian conditioning. The purpose of this procedure is to demonstrate that a measure of awareness yields no effects (exhibits null sensitivity) whereas another measure yields significant effects (Merikle & Reingold, 1992). For example, participants in the thought experiment might not discriminate above chance between the two angry faces on a forced-choice recognition task, but they might discriminate between the two angry faces in skin conductance responses (SCRs). If so, this dissociation between the two measures suggests that the SCRs were mediated by processes that did not require awareness (unaware processes). However, Merikle and Reingold (1992) have identified two critical assumptions regarding the measurement of awareness in the dissociation procedure. Because research suggests that Lovibond and Shanks’s measures of awareness do not fulfill both exhaustiveness and exclusiveness, the findings call the validity of their measures of awareness into question.

Exhaustiveness: Measuring All Aspects of Awareness

Lovibond and Shanks (2002) referred to this assumption as relevance and required that the measure of awareness “should measure all conscious knowledge that is relevant to the production of the CR [conditional response]” (p. 6). Lovibond and Shanks stated that the awareness measure should “focus on contingency awareness and US expectancy” (p. 6) and that awareness of the contingency between the conditional stimulus (CS) and the unconditional stimulus (US) can be measured best with concurrent ratings of US expectancy. Further, Lovibond and Shanks noted that “a concurrent expectancy test (like the self-assessment test of Öhman & Soares, 1994) and a recognition test do not yield concordant findings, with the former [expectancy test] but not the latter [recognition test] demonstrating contingency awareness” (p. 10). Thus, following Lovibond and Shanks, self-reported emotional ratings (e.g., Öhman & Soares, 1994) may also be used to measure awareness. In contrast, the authors criticized measures of participants’ ability to recognize the CSs because these measures are “unfairly biased toward finding ‘unaware’ conditioning” (p. 10). For example, in the scenario at the beginning of this article (the first task of the thought experiment), you indicated on each trial whether you saw an angry face. Lovibond and Shanks would argue that this measure was flawed because it could be affected by response biases. Thus, because of factors such as demand characteristics, you were probably just unwilling to indicate that you saw angry faces (response bias) even though you could recognize them. To support this argument, Lovibond and Shanks would probably refer to your performance on the forced-choice recognition task in which you discriminated between the two angry faces above chance.

Subsequent to the influential work of Eriksen (1960) and Holender (1986), chance performance on such forced-choice recognition tasks has been commonly used as an index of unawareness. However, Lovibond and Shanks (2002) argued that forced-choice recognition tasks are still too insensitive to provide exhaustive measures of awareness. They claimed that it is not necessary for participants to recognize or identify the conditional stimuli, as long as they can differentiate among them. Regarding the thought experiment, for example, Lovibond and Shanks would argue that even if you could not recognize the masked angry faces at all and therefore would perform at chance on the forced-choice recogni-

tion task, you might still be able to differentiate between the two masked angry faces because they looked somewhat different from each other. As empirical evidence for their argument, Lovibond and Shanks cited findings from a conditioning study involving masked spiders and snakes and a 4-s CS–US interval (Öhman & Soares, 1998). Because participants showed significant discrimination performance in terms of US expectancy, whereas they performed at chance in terms of forced-choice recognition of the CSs, Lovibond and Shanks advocated measures of US expectancy in favor of recognition tasks as exhaustive indexes of awareness. However, although the measures of awareness advocated by Lovibond and Shanks might fulfill the assumption of exhaustiveness, research suggests that the measures violate the assumption of exclusiveness.

Exclusiveness: Measuring Only Awareness

Lovibond and Shanks (2002) were concerned with using measures that capture all aspects of awareness; however, they provided no evidence that the awareness measures are sensitive only to aware processes. Merikle and Reingold (1992) referred to this assumption as exclusiveness: that the measure of awareness assesses only conscious but not nonconscious processes. Whereas Lovibond and Shanks regarded emotional ratings and US expectancy as valid measures of awareness, research from our laboratory suggests that unaware processes affect these measures. For that reason, emotional ratings and US expectancy might not fulfill the criterion of exclusiveness and thus may not be valid indexes of awareness.

Regarding emotional ratings, Öhman and Soares (1994) found that participants who were highly fearful of spiders (or snakes) reported more fear in response to masked pictures of spiders (or snakes) than to masked pictures of flowers or mushrooms, even though participants could not discriminate among the masked stimuli above chance. These results suggest that emotional ratings can differentiate between unrecognized stimuli in a context that has nothing to do with conditioning and in which awareness of CS–US contingency is irrelevant.

Regarding US expectancy, participants in the study by Öhman and Soares (1998) showed differential US expectancy, although they could not discriminate between masked spiders and snakes on a forced-choice recognition task. Because participants also showed conditional fear responses, Katkin, Wiens, and Öhman (2001) postulated that participants who were sensitive to their visceral activity could predict the occurrence of the US on the basis of visceral cues from the conditional fear response. To test this hypothesis, Katkin et al. used the same conditioning task as Öhman and Soares (1998) but in addition assessed participants’ general sensitivity to visceral activity. On the basis of their performance on a heartbeat detection task, participants were classified as good or poor heartbeat detectors. As in the study by Öhman and Soares (1998), participants showed SCR conditioning to masked stimuli. Although there were no group differences in SCR conditioning, only the good detectors showed differential US expectancy. These results are consistent with the idea that participants might have used the sensation of visceral cues associated with the conditioned fear response in their ratings of US expectancy. Because these results suggest that unaware processes affect US expectancy, US expectancy might not be considered a pure mea-
sure of awareness. Taken together, these findings argue against the use of emotional ratings and US expectancy as exclusive measures of awareness.

Further, because Lovibond and Shanks (2002) advocated measures of awareness that seem to have no direct relevance to awareness of CS–US contingency (e.g., emotional ratings), the authors implied that any verbal discriminative response indicates awareness. If so, it becomes logically impossible to demonstrate unaware processing by a verbal measure, as any discriminative verbal responding would, by definition, reflect awareness (Bowers, 1984).

Wiens and Öhman:
Unawareness Is More Than a Chance Event

We propose that participants can be unaware of stimuli even if they can discriminate among them above chance levels. Thus, unawareness is more than a chance event. As already argued by Bowers (1984), discrimination performance is irrelevant to awareness. Because awareness refers to participants’ conscious experience, a valid measure of awareness needs to assess the subjective state rather than participants’ ability to discriminate among the stimuli. That is, measures of awareness should assess whether participants notice the stimuli rather than whether they can discriminate among them. Therefore, in the present context, measures of awareness should assess whether participants notice the CS that the US is contingent on. Merikle and his colleagues (Cheesman & Merikle, 1984, 1986; Merikle & Danemann, 2000) further developed the distinction between noticing and discriminating by introducing the distinction between subjective threshold and objective threshold. Whereas the subjective threshold refers to stimulus levels at which participants report that they are unaware of perceiving (i.e., participants report that they do not notice the stimuli), the objective threshold refers to stimulus levels at which participants perform at chance on discrimination tasks. In the thought experiment, because you indicated that you did not notice the angry faces, these were presented below your subjective threshold; however, because you could discriminate between them above chance, the angry faces were presented above your objective threshold. This example illustrates that participants typically report that they are unaware of the stimuli even though they can discriminate among them above chance.

Qualitative Differences: When Unaware and Aware Processes Differ

Although awareness measures that index the subjective threshold (subjective measures) capture the phenomenological aspect of awareness better than awareness measures that index the objective threshold (objective measures), subjective measures can be confounded by variables such as demand characteristics and response biases. However, the framework of qualitative differences circumvents these potential problems with subjective measures. Merikle and his colleagues (for review, see Merikle & Danemann, 2000) proposed that if aware and unaware processes could be shown to differ qualitatively, such findings of qualitative differences would support the conceptual distinction between aware and unaware processes. Further, if qualitative differences could be indexed by subjective measures, such findings would also validate subjective measures of awareness.

Merikle and his colleagues have demonstrated qualitative differences in several independent areas of research (for review, see Merikle & Danemann, 2000). In this research, qualitative differences between unaware and aware processes were indexed by subjective measures of awareness. Also, because unaware processes had effects in one direction, whereas aware processes had effects in the opposite direction, these findings provide strong support for the distinction between unaware and aware processes. For example, Merikle and Cheesman (1987) studied effects of masking on participants’ ability to use strategy in a two-color variant of the Stroop task. On each trial of the task, participants were shown the word red or green, either masked or nonmasked, followed by a color patch that was either red or green. Participants were instructed to name the color of the patch as quickly as possible. Further, participants were informed that on 80% of all trials word and color of the patch would not match (e.g., the word red followed by a green patch) and that on 20% of all trials word and color of the patch would match (e.g., the word red followed by a red patch). Thus, nonmatching trials were more frequent than matching trials. Assuming that strategic action is a central aspect of consciousness, Merikle and Cheesman predicted qualitatively different effects for masked and nonmasked words. Because participants would be aware of the nonmasked words, they would be able to use the strategy of expecting nonmatches between words and color patches and would therefore respond faster on nonmatching than matching trials. In contrast, because participants would be unaware of the masked words, they would not be able to use the strategy of expecting nonmatches between words and color patches and would therefore respond faster on matching than nonmatching trials (Stroop effect). Indeed, results showed qualitatively different effects on reaction time depending on whether words were presented above (nonmasked) or below (masked) the subjective threshold. The conclusion that awareness was assessed with a subjective measure was supported by findings that participants showed Stroop effects only if they could discriminate the masked words above chance on objective measures of awareness (Cheesman & Merikle, 1984). In sum, these findings support the distinction between unaware and aware processes and also validate subjective measures of awareness.

Qualitative Differences in Pavlovian Conditioning

Research using backward masking suggests that qualitative differences can also be obtained in Pavlovian conditioning. For example, Öhman and his colleagues (e.g., Esteves, Dimberg, & Öhman, 1994; Öhman & Soares, 1993), have shown that responses conditioned to fear-relevant stimuli (snakes, spiders, angry faces) survive backward masking, whereas responses to fear-irrelevant stimuli (flowers, mushrooms, happy faces) do not, and that aver- sively conditioned responses can be acquired to masked fear-relevant stimuli but not to masked fear-irrelevant stimuli (Esteves, Parra, Dimberg, & Öhman, 1994; Öhman & Soares, 1998). Further, in a study that used an awareness measure that Lovibond and Shanks (2002) considered insensitive and thus invalid, Morris, Öhman, and Dolan (1998) showed that masked and nonmasked pictures yielded different patterns of brain activation, as measured by positron emission tomography (PET). In this study, participants
were conditioned to nonmasked pictures of two angry faces so that a noise was paired consistently with either one of the two angry faces. Then, brain-imaging PET data were collected during subsequent presentations of masked and nonmasked angry faces, while participants performed a recognition task. This recognition task was similar to the first task described in the thought experiment. That is, before the experiment, participants were shown two angry and two neutral faces and were instructed to push a button if they saw either angry face, however fleetingly, and another button if they did not see either angry face. Also, participants were not informed that during the collection of the PET data, two pictures were presented on each trial. On masked trials, an angry face was followed (masked) by a neutral face, whereas on nonmasked trials, a neutral face was followed by an angry face.

Results showed that participants recognized all of the nonmasked angry faces but none of the masked angry faces. In the analysis of the PET data, regional cerebral blood-flow responses were contrasted between the angry face that had been paired with noise (CS+ and the angry face that had not been paired with noise (CS−) during the conditioning task. The PET data showed differential activation effects for masked and nonmasked conditions. When angry faces were nonmasked, only activation in the left amygdala differentiated between CS+ and CS−. In contrast, when angry faces were masked, only activation in the right amygdala differentiated between CS+ and CS−. Follow-up analyses of the PET data showed that activation in the right amygdala to masked angry faces correlated with activation in the superior colliculus and pulvinar, whereas activation in the left amygdala correlated with other areas (Morris, Öhman, & Dolan, 1999). Because the results were obtained for stimuli that differed only in their conditioning history (of being paired with shock), strong conclusions can be drawn from these results. First, the findings replicate and extend prior research that demonstrated a critical role of the amygdala in conditioned fear (LeDoux, 1996). Second, the findings of specific activation of the superior colliculus and pulvinar to masked pictures suggest that the right amygdala was activated via a subcortical route, similar to the “low road” described by LeDoux (1996). Third, the findings of differential right-amygdala activation to masked pictures and differential left-amygdala activation to nonmasked pictures suggest that masked and nonmasked pictures yielded qualitatively different effects. Fourth, the finding that the qualitative differences were indexed by the awareness measure supports its validity. Therefore, Lovibond and Shanks’s (2002) suggestion that the awareness measure in the Morris et al. (1999) study was invalid seems unwarranted.1

Taken together, these findings provide evidence for qualitative differences in Pavlovian conditioning. Although the qualitative differences were indexed by awareness measures that Lovibond and Shanks (2002) regarded as invalid, the findings support the validity of these measures of awareness and raise questions about the utility of Lovibond and Shanks’s conceptualization of awareness. Thus, the findings support the notion that subjective measures are more valid indexes of awareness than objective measures.

The Role of Unawareness in Pavlovian Conditioning

Consistent with the view that consciousness is critical to human existence, Lovibond and Shanks (2002) concluded that Pavlovian conditioning in humans is closely associated with awareness and that the findings are overall most consistent with a weak form of single-process theory of conditioning in which the CR and awareness of the CS-US contingency index the same underlying process. However, we have presented five arguments that raise serious questions about the validity of these conclusions. First, whereas Lovibond and Shanks regarded emotional ratings and US expectancy as valid measures of awareness, research suggests that these measures can be affected by processes that are irrelevant to awareness and therefore that these measures might not be exclusive indexes of awareness. Second, because Lovibond and Shanks seemed to imply that any discriminate verbal responding indicates awareness, this position makes it logically impossible to prove verbal discriminative responding in the absence of awareness. Third, Lovibond and Shanks advocated objective rather than subjective measures of awareness. However, because awareness is a conscious experience, assessment of awareness needs to index the subjective state rather than mere discrimination ability. Fourth, because Lovibond and Shanks would classify participants as unaware only if they are completely unable to discriminate among the conditional stimuli, unawareness is, statistically speaking, considered a chance event. However, research suggests that unawareness is more than a chance event in that participants report to be unaware of the stimuli, although they can discriminate among the stimuli above chance. Fifth, conditioning research suggests that qualitatively different effects can be indexed by awareness measures that Lovibond and Shanks deemed invalid. In concert, these arguments raise serious questions about the validity of Lovibond and Shanks’s conceptualization of awareness and thus their conclusion of a close association between Pavlovian conditioning and awareness. Therefore, the findings reviewed by Lovibond and Shanks are consistent with a dual-process model in which separate pathways mediate aware and unaware processes (e.g., Öhman & Mineka, 2001).

1 A similar argument can be made regarding Lovibond and Shanks’s (2002) review of the Hamm and Vaitl (1996) study. Lovibond and Shanks suggested that the awareness measure in this study was invalid because participants went through an extinction phase, in which no shocks were administered, before they completed a questionnaire assessing their awareness of the CS-US contingency. However, the finding that the awareness measure indexed differences in conditioning of startle and skin conductance supports its validity. Results for a conditioning task involving shock as the US showed that whereas both aware and unaware participants showed similar startle conditioning, only aware participants showed skin conductance conditioning.

References


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