

I Like it, but I'm not Sure Why: Can Evaluative Conditioning occur Without Conscious Awareness?

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1: Abstract

There is good evidence that, in general, autonomic conditioning in humans occurs only when subjects can verbalise the contingencies of conditioning. However, one form of conditioning, evaluative conditioning (EC), seems exceptional in that a growing body of evidence suggests that it can occur without conscious contingency awareness. As such, EC offers a unique insight into what role contingency awareness might play in associative learning. Despite this evidence, there are reasons to doubt that evaluative conditioning can occur without conscious awareness. This paper aims to critically review the EC literature and draw some parallels to what is known about autonomic conditioning. In doing so, some important general issues about measuring contingency awareness are raised. These issues are illustrated with a brief report of an experiment in which a sensitive measure of contingency awareness is compared against a commonly used measure.

2: Introduction

2.1. Classical Conditioning and the Measurement of Contingency Awareness

Classical conditioning is typically thought of as a behavioural change resulting from learning to *associate* two stimuli. Prokasy (1965) defined it as a set of experimental operations in which a contingency is established between a relatively neutral conditioned stimulus (CS) and a response-eliciting unconditioned stimulus (UCS). Autonomic conditioning in humans is typically established using a discriminative conditioning paradigm in which one CS (the CS+) is paired contingently with an aversive outcome such as an electric shock, whereas another (the CS-) is paired with no outcome. Before conditioning, responses to the CSs are comparable, but after conditioning the CS+ evokes a significantly different response (a conditioned response [CR]) than the CS-. Provided that the stimuli used as CS+ and CS- are counterbalanced across subjects, behavioural change to the CS+ can be attributed to it being associated with the UCS: because the CS- has no outcome with

which to become associated (see Field & Davey, 1998). Although, it is well-established that conscious processes¹ such as verbal instructions can alter CRs (Cook & Harris, 1937; Mowrer, 1938), this finding does not mean that conditioning occurs only when participants are aware of the contingencies. Many studies, using masking tasks in which the CS-UCS pairings are embedded such that subjects are distracted from the contingencies of conditioning, have investigated conditioning without contingency awareness (e.g. Chatterjee & Eriksen, 1960; Dawson, 1973; Öhman, Ellstrom & Bjorkstrand, 1976). Contingency awareness is measured *post hoc* with either a recall measure, in which subjects are asked to verbalise knowledge about when the UCS would be presented, or a recognition measure, in which subjects have to identify which CS preceded the UCS. When recall measures are used, researchers report conditioning in the absence of contingency awareness, however, when recognition measures are used conditioning occurs only in aware subjects (see Dawson, 1973, Dawson & Schell, 1987 for a review). When expectancy of the UCS is measured on a trial-by-trial basis conditioning occurs only after the trial at which the subject becomes aware of the contingencies (Dawson and Biferno, 1973; Öhman *et al.*, 1976, Dawson, Schell and Banis, 1986).

This literature highlights an important issue: the way in which contingency awareness is measured influences the conclusions drawn. This issue is pertinent to non-conditioning paradigms in which awareness of experimental contingencies is measured. Shanks and St. John (1994) have identified two criteria for assessing contingency awareness. The *information criterion* refers to the need to establish that the information obtained by an awareness measure is the same information responsible for any changes in performance. This criterion addresses the problem that subjects can form conscious hypotheses that affect responding, but that are not detected because the awareness

¹ Throughout this paper, references to awareness, or conscious processes refer to knowledge, at some level, of experimental contingencies (be they CS-UCS contingencies, implicit learning rules, or whatever).

measure is directed towards a different, but correlated, set of hypotheses (Dulaney, 1962; Dulaney & O'Connell, 1963). In terms of conditioning paradigms, this criterion relates to whether contingency awareness or demand awareness is measured? *Contingency awareness* is whether a subject has knowledge of which CS (or CSs) precedes the UCS (or UCSs). *Demand awareness* (or task awareness) is the subject's knowledge of what behavioural outcome is predicted. The distinction between the two types of awareness is not always clear. In the autonomic conditioning paradigm, a subject could be contingency aware but not demand aware by knowing that the CS+ always precedes the UCS without realising that responses to the CS+ should change. To be demand aware but not contingency aware, a subject would know that their response to the CS+ is expected to change, but not know which stimulus is the CS+.

The *sensitivity criterion* addresses the need to construct a measure that is sensitive enough to detect awareness: insensitive measure can lead to the erroneous conclusion that subjects are unaware (Shanks & St. John, 1994). The converse problem is that a measure can be oversensitive, leading to subjects being classified as aware when they believe that they are guessing (see Berry, 1994). The resolution of these problems depends on whether it is important to detect explicit, verbalizable knowledge, or to tap implicit knowledge. In autonomic conditioning procedures short recognition questionnaires are more sensitive than recall questionnaires (Dawson and Reardon, 1973).

2.2. Autonomic Conditioning Outside of Awareness

Subliminal conditioning, in which one (or more) of the stimuli is presented at a subthreshold level, circumvents the sensitivity problem. When this method is used there is evidence that a CR can be evoked by a CS presented out of awareness if the CS-UCS association was formed in awareness (Öhman, Dimberg, & Esteves, 1988). Wong, Shevrin & Williams (1994) replicated this finding and discovered brain responses to subthreshold presentations of the CS. Esteves, Dimberg and Öhman

(1994a) found that CRs to angry face CS+s survived backward masking but CRs to happy face CS+s did not (see also Esteves, Parra, Dimberg & Öhman, 1994b). These effects have been replicated for fear-relevant CS+s such as snakes and spiders with electric shock UCSs (see Öhman, Esteves & Soares, 1995 for a review). Öhman *et al.* (1995) concluded that awareness of the CS-UCS contingency is necessary only when the CS is fear-irrelevant (see Davey, 1992 for an alternative explanation of their work). Wong, Bernat, Bunce and Shevrin (1997) used Öhman *et al.*'s (1994a,b) paradigm to measure event-related brain potential (ERP) in a conditioning procedure in which the CSs were presented subthreshold. The preconditioning-postconditioning comparison of activity revealed 'that the CS+ maintains its activation ... while CS- decreases substantially' (p. 531). This finding is curious because if a specific association between the CS+ and UCS were formed, a change in response to the CS+ would be expected. However, scalp-recorded brain activity during conditioning revealed a significant discrimination between CS+ and CS-. However, the CS+ and CS- were not counterbalanced across subjects and, as noted earlier, this would be necessary to demonstrate *associative* learning (Field & Davey, 1998). Therefore, further work needs to be done to ascertain whether the learning observed by Wong *et al.* was associative, and whether it can occur using different stimuli as the CS+. Wong *et al.* (1997) took no electrodermal measures of CRs, so, although learning occurred at a neural level, it is not clear whether the neural learning would lead to behavioural CRs usually associated with aversive autonomic conditioning. Also, the neural learning appeared to be confined to the conditioning stage—postconditioning responses to the CS+ were the same as preconditioning—suggesting that learning was not strong enough to create behavioural change outside of the learning episode.

The discrepancy between earlier work that showed that contingency awareness was necessary, and more recent findings, appears to support a levels-of-learning model. Razran (1955, 1971) proposed that learning ranged from simple non-associative learning, through associative learning such a

classical conditioning, to complex verbally mediated learning. Congruent with this theory is the idea that a low-level learning process can occur outside of awareness but that behavioural *change* (indicative of conditioning) might require conscious processing. The autonomic conditioning literature fits this model with the qualification that conditioning-without-awareness appears to be restricted to ecologically relevant conditioning episodes (such as a fear-relevant CS preceding a fear-evoking UCS).

2.3. Other forms of Learning without Awareness

There are numerous examples that low-level, nonassociative, learning operates without awareness of experimental contingencies. First, humans seem capable of extracting rules governing complex systems (such as artificial grammars) that allow them to perform at better than chance level on tests, yet they cannot verbalise these rules (see Berry & Dienes, 1993 for an extensive review). Second, humans can acquire encoding biases, of which they are unaware, that influence subsequent judgements (Lewicki, 1986; Lewicki, Czyzewska & Hoffman, 1987; Lewicki, Hill & Bizot, 1988; Lewicki, Hill & Czyzewska, 1992; but see Hendrickx, De Houwer, Baeyens, Eelen, & van Avermaet, 1997 for an alternative perspective). Finally, there is evidence that preferences to neutral stimuli can be influenced by both repeated exposure under degraded viewing conditions (Kunst-Wilson & Zajonc, 1980) and priming using subthreshold presentations of positive and negative stimuli (Murphy & Zajonc, 1993). Zajonc (1980) specifically suggests that affect (responses of liking or disliking a stimulus) is so fundamental to organisms that it should be nonconscious and occur without cognition.

In conclusion, autonomic conditioning, as a general process, appears to occur in humans only when subjects are aware of the CS-UCS contingencies. However, there are certain responses of ecological importance (e.g. fear) that can be conditioned, or primed, without awareness. If affective responses

are so easily primed without awareness then these responses might form part of the ecologically-relevant responses that can be classically conditioned without contingency awareness. The conditioning of affective responses is known as evaluative conditioning (EC).

3: An Introduction to Evaluative Conditioning

Evaluative conditioning (EC) is the transfer of affect from one stimulus to another through a conditioning paradigm. Usually, an affectively neutral CS is paired with either a liked or disliked UCS, resulting in the CS acquiring the same valence as the UCS with which it was paired (Levey and Martin, 1975). EC is a paradigmatic example of classical conditioning and so, based on autonomic conditioning, should occur only when subjects are aware of the CS-UCS contingencies. However, because of the special nature of affective responses (see above) it is feasible that EC could occur without contingency awareness and, *prima facie*, this seems to be the case. If contingency awareness is not necessary for conditioning affective responses, then not only does EC appear to be a qualitatively distinct form of conditioning (cf. Davey, 1994), but it also supports other evidence that humans can learn at a pre-conscious level. This finding is congruent with a levels-of-learning account of conditioning in which basic, ecologically important, responses can be acquired without conscious processing. However, a review of the literature suggests that the conclusion that evaluative conditioning can occur without contingency awareness may be premature.

3.1. Evidence for Conditioning without Contingency Awareness using Visual Stimuli

3.1.1. Evidence from EC studies

Although early evidence suggested that attitudes could be conditioned without contingency awareness (e.g. Staats & Staats, 1957, 1958; Yavuz & Bousfield, 1959; and Pollio, 1963), Page

(1969, 1971, 1973, 1974) empirically refuted this work. Since then, several EC studies have led to the 'well-established' idea that evaluative responses can be elicited without contingency awareness. Only one study from the EC literature has systematically examined the role of awareness in EC (Baeyens, Eelen & Van den Bergh, 1990a). In this study, pictures of human faces were used as stimuli. Initially, the human faces were randomly presented to subjects who rated them along a scale ranging from -100 (dislike) through 0 (neutral) to +100 (like). Following these ratings, 9 stimuli were selected to act as UCSs: the three most highly rated faces (liked UCSs), the three most negatively rated faces (disliked UCSs), and 3 neutral faces (control UCSs). Nine neutrally rated faces were selected as CSs. This process yielded nine stimulus pairs: 3 Neutral CSs paired with Liked UCSs (N-L Pairs), 3 Neutral-Dislike (N-D) CS-UCS pairs and 3 Neutral-Neutral (N-N) pairs. These CS-UCS pairs were each presented ten times according to a randomised schedule. The CS appeared for 1s followed by a 3s trace interval then the UCS for 1s followed by an 8s gap before the next pairing (the inter-trial interval, ITI). Awareness was measured both concurrently and postexperimentally. Concurrent awareness was assessed by asking subjects to predict which type of picture (liked, disliked or neutral) would follow each CS during the conditioning phase. Postexperimental awareness was determined using a recall task. First, subjects were given each CSs in turn and asked to select the appropriate UCS from a portfolio of the entire stimulus set. This criterion requires precise knowledge of the CS-UCS pairings and so is relatively strong (Davey, 1994). Second, if a subject could not select the exact UCS for a given CS, a relatively weak criterion of whether they could identify the affective value of the UCS was used. The criteria adopted to indicate awareness were that the subject, for each CS, correctly identified the UCS *or* its valence. Concurrent awareness was indicated by whether a subject could correctly predict the affective value of the UCS on the last three conditioning trials of a CS-UCS pair. Baeyens *et al.*'s

concluded that ‘the number of contingencies a subject was aware of during conditioning *in no way* [italics added] influenced evaluative conditioning results’ (p. 14).

The results of this study are worth detailed scrutiny because it is the only attempt to test systematically the role of contingency awareness in EC. I have already discussed the importance of accurate assessment of awareness and there are many points worth considering about the assessment method and analysis used. First, according to the concurrent measurement of awareness, subjects were aware of the vast majority of the CS-UCS contingencies (83%). Baeyens *et al.* looked at the effect of the number of pairings of which a subject was aware. The main effect and all interactions involving this variable were nonsignificant implying that awareness did *not* influence conditioning. The variable describing the number of pairings of which a subject was aware had six levels and was treated between-subjects. Given that there were eight subjects and six levels of the variable, there must have been at least four groups that contained only a single subject making the analysis unreliable and lacking statistical power. It is not surprising, therefore, that the awareness variable was not significant — yet the absence of significance was taken to imply that conditioning occurred without awareness. Furthermore, there were six different levels of contingency awareness (out of a possible nine) and subjects were, on average, aware of 83% of pairings (between seven and eight pairings out of the nine). Therefore, it is reasonable to assume that few subjects fell into the categories of ‘aware of no contingencies’, ‘aware of 1 contingency’ or ‘aware of 2 contingencies’, which could also account for why no effect was found. Baeyens *et al.* commented that ‘For those *few* stimulus pairs for which subjects were *unable* to give correct concurrent awareness responses (5 N-L, 3 N-D pairs), means were in the expected direction but *not significantly so* (+5 and -2)’ [Baeyens *et al.*, 1990a: p. 14 italics added]. Not only does this statement confirm that awareness levels were very high, but also that conditioning effects were not

found in pairings of which subjects were unaware (although this analysis would have limited statistical power).

On a different group of eight subjects, Baeyens *et al.* used the postconditioning awareness measure described earlier. Comparing it with the concurrent awareness measures taken on the other eight subjects validated this questionnaire and overall it correctly classified 81.2% of contingencies. There was a 15% probability that a contingency of which a subject was unaware (from now on termed an *unaware contingency*) was misclassified as 'aware'. However, there was a much larger probability of 37% that a contingency of which the subject was aware (from now on termed an *aware contingency*) was misclassified. If the proportion of correctly/incorrectly classified aware contingencies (85/15) is compared to the proportion of correctly/incorrectly classified unaware contingencies (63/37), the Binomial test yields a highly significant result [$p < 0.001^2$]. This finding suggests that the contingencies classified as 'aware' were classified significantly more accurately than those classified as unaware. Therefore, the data for aware contingencies is more accurate than the data for contingencies classified as unaware. This finding has some serious implications for Baeyens *et al.*'s results and conclusions. For one thing, if unaware contingencies were classified significantly less accurately than aware contingencies, then it is more likely that some of the contingencies classified as *unaware* in their analysis were actually contingencies of which subjects were aware, than vice versa.

When only the contingencies of which subjects were unaware were analysed there was a significant differential rating between CSs in N-L and N-D pairings³. However, given that there was a significantly greater chance of classifying contingencies as *unaware* when subjects were aware of

²The Binomial statistics given here was calculated by the present author.

³As the authors themselves note, the data were a mix of data from the same subjects and data from different subjects, thus violating the independence assumption of the tests used.

them (see earlier), this conditioning *could* be due to the presence of misclassified contingencies. The results from the contingencies classified as 'aware' (which showed a stronger differential response pattern) are much less likely to be susceptible to a misclassification error, because the misclassification rate was significantly lower for these contingencies than for those classified as *unaware*.

Finally, Baeyens *et al.* claimed to have identified a sub-group who could be classified as unaware of all contingencies. This group of four subjects (an extremely small sample on which to base a conclusive finding) showed a significant differential response pattern to CSs paired with either liked or disliked UCSs. However, the problem of misclassification again arises: if 37% of contingencies classified as unaware, were in fact contingencies of which subjects were aware, then there should be, on average, 2.22 contingencies that were misclassified by the awareness questionnaire. So, on average, these subjects would have been aware of two or three out of the six affectively valenced contingencies; such awareness could contribute to the conditioning effect.

Although it may seem churlish to scrutinise this study so closely, it has been done to illustrate some important points about studying contingency awareness. (1) *Classification*: subjects are seldom aware or unaware of all aspects of an experiment and so it is important to be able to accurately classify whether a subject was aware or unaware of the particular facet of interest. (2) *Contamination*: if subjects are aware of some, but not all, contingencies of the experiment, it is important that this partial awareness does not contaminate data about contingencies of which the subjects are unaware. (3) *Definition*: EC researchers have settled for a definition of awareness that is dependent upon verbalisable knowledge (e.g. Baeyens, De Houwer & Eelen, 1994), yet there may be differences between what subjects can verbalise, and the knowledge that they actually have.

The question of whether conditioning can occur in the absence of awareness has been investigated less systematically in many other studies, but with varying degrees of support. Baeyens, Crombez, Van den Bergh, and Eelen (1988), took measures of awareness similar to Baeyens *et al.* (1990a) and calculated an index of awareness for each subject, which did not correlate with the differential response between CSs in N-L and N-D pairs. Ignoring questions regarding the validity of the index used, there is no reason to expect that awareness should correlate with ratings of the CSs, because this assumes a linear relationship between the two variables. It is possible that awareness has a discrete relationship with conditioning (i.e. if the subject is aware of a contingency beyond some threshold, then conditioning will occur for that contingency). Baeyens, Eelen, Van den Bergh, and Crombez (1989a) also took awareness measures using a weak criterion of whether subjects were aware of the manipulations rather than the CS-UCS contingencies (this measure relates to demand awareness). Baeyens, Eelen, Crombez and Van den Bergh (1992a) also took similar awareness measures to Baeyens *et al.* (1990a) but again constructed an index of awareness rather than looking at the effect of awareness on a particular contingency. They compared high and low awareness (based on a median split of the index of awareness) and found no between-group difference (but with only four scores per group this analysis lacked statistical power). Finally, Baeyens, Hermans and Eelen (1993) found no correlational evidence of the role of awareness but again this analysis was not done on a per-contingency basis.

In conclusion, much of this early work, using the visual paradigm, has led to refutable results. In addition, Field and Davey (in press) have identified an artefact within this 'typical' visual paradigm that led them to conclude that most of these early results (e.g. Baeyens *et al.* 1988, 1990a, 1993) do not represent conditioning. In one experiment (a replication of Baeyens *et al.*, 1988 using the paradigm described for Baeyens *et al.*, 1990a) they found conditioning effects only for CS-UCS pairs that were perceptually similar. However, these results were found in a non-paired and no-

treatment control group too. In a second experiment (using an identical procedure) they showed that conditioning-like effects were the product of subjects recategorizing the CSs on the basis of whether it was more perceptually similar to the salient liked or disliked stimuli in the set. This similarity-based behaviour created the illusion of conditioning because CS-UCS pairings in these paradigms are constructed based on similarity between the stimuli. In terms of contingency awareness these results offer an interesting interpretation as to why conditioning-like effects could arise without contingency awareness: because CS ratings are not caused by associations between the CS and UCS, CS ratings will be independent of the CS-UCS contingencies of conditioning. Hence, contingency awareness is unlikely to influence responses to CSs.

3.1.2. I Want to Buy it But I'm Not Sure Why: EC in an Advertising Context

So far, the evidence for EC without contingency awareness has been controvertible, however, evidence from the consumer-research literature is often cited as demonstrating that conditioning *can* occur without contingency awareness. Bierley, McSweeney and Vannieuwkerk (1985) used red, blue and yellow geometric shapes as CSs and the music from the movie Star Wars as a positive UCS in a discriminative conditioning paradigm. Two experimental groups were used: in one a red geometric shape always preceded the music (CS+) and a yellow shape was followed by nothing (CS-), in the other group the reverse was true. In both groups, blue geometric shapes were followed by music on 50% of the trials. A CS-only control group, in which the UCS music was never played, and a random control group, in which the UCS music was played randomly after the CSs (so, no colour reliably predicted the onset of the music) were also used. After conditioning, subjects rated their preferences for the geometric shapes by comparing them against a 'standard' blue circle. Data from subjects broadly classified as contingency unaware—based on the weak criterion that they could not detect a relation between the figures, the music and preferences for the music—were analysed. A significant group (red CS+ vs. yellow CS+ group) × CS-colour (red vs. yellow)

interaction was found indicating conditioning without awareness (although conditioning strengthened the effect). However, the comparisons with control groups necessary to demonstrate that learning was associative were not made.

Stuart, Shimp and Engle (1987) carried out four experiments investigating attitude change through conditioning. They used an analogous paradigm to Bierley *et al.* except that a neutrally valenced product (Brand L toothpaste) acted as a CS and positively valenced pictures acted as UCSs. The study included both experimental groups in which the CS predicted the positive scenes and control groups in which the CS, UCSs, and filler stimuli were presented randomly. Following the presentations, subjects rated brand L toothpaste along several affective dimensions. Stuart *et al.* took a global measure of awareness using an open-ended questionnaire tapping subjects' beliefs about the purpose of the experiment. Subjects were then classified as globally aware or unaware depending on whether they expressed a notion that certain stimuli were presented alongside pleasant pictures. Stuart *et al.* found that awareness was a significant factor in almost half of the experimental conditions but not in the remainder. They concluded that conditioning could occur without awareness of the task.

Unfortunately, Stuart *et al.* overlooked a very important finding: in all but one of the conditions yielding a significant main effect of task awareness, there was a nonsignificant interaction between awareness and the group to which the subject belonged (experimental or control). So, although task awareness influenced conditioning, it also affected responses in the control groups. Specifically, subjects globally aware of the contingencies had increased preferences towards the CS, *regardless of whether it predicted the UCS*. Therefore, the number of subjects classified as task aware in a particular group will influence the mean preference for the CS: the more subjects classified as task aware in a group the higher that group mean will be. As such, if there were more task-aware

subjects in the experimental groups than the control groups, then there would be increased preferences for the CS in the experimental group compared to the controls. Control subjects experienced no CS-UCS presentations, so these subjects are unlikely to be task aware (because they never experience the task). Support for the idea that experiencing pairings heightened task awareness comes from the finding that task awareness was prominent mainly in conditions in which there were several conditioning trials. If there were more task-aware subjects in the experimental groups than in the control groups then these groups would have inflated CS preferences. Therefore, the nonsignificant interaction between task awareness and the presentation schedule used suggests that conditioning trials were not responsible for the observed group differences.

The analysis of the task awareness data casts new light on what, *prima facie*, appeared to be robust and clear-cut conditioning effects without contingency awareness. In summary, Stuart *et al.*'s experiments provide little evidence of unaware affective transfer through associative learning because the effects of global awareness were similar in both experimental and control conditions. Interestingly, this study is frequently cited in the EC literature as evidence that conditioning can occur in subjects who are unaware of the contingencies compared to subjects in a nonpaired control.

Shimp, Stuart and Engle (1991) used Stuart *et al.*'s paradigm in a further 21 experiments but with *actual* brands of cola as CSs. Shimp *et al.* varied the brand of cola used as the CS and used random control groups for comparison. In the last 9 experiments, an awareness measure was used, which replaced open-ended questions with a more systematic method of assessment. After the study, subjects selected from four brands (the CS brand and three fillers) the brand that always preceded attractive visual scenes and stated how confident they were about their. If the subject selected the correct brand and indicated that they were 'somewhat certain' or 'absolutely certain' of their decision they were classified as contingency aware. This measure assesses contingency awareness

rather than the demand awareness measured by Stuart et al. (1987). Interestingly, when these nine studies were analysed with respect to contingency awareness, seven of the studies showed significant conditioning effects in subjects classified as contingency aware but not for either subjects classified as unaware or control subjects. Of these seven studies, four produced no conditioning effect when awareness was not considered and so contingency awareness could explain the conditioning effects.

Earlier, I suggested that a clear demarcation between demand awareness and contingency awareness is hard to find and the consumer research highlight this point. Intuitively it seems that contingency awareness could lead to demand awareness and this demand awareness could explain why conditioning effects are present only when subjects are aware of the contingencies. Allen and Janiszewski (1989) addressed this issue in two experiments. The first used *post hoc* measures of awareness whereas the second attempted to systematically manipulate awareness. While carrying out a distracter task, subjects experienced a discriminative conditioning procedure in which some Norwegian words (CSs) were preceded by positive reinforcement (subjects were congratulated for a correct decision) whereas others were followed by nothing. After the experiment, subjects indicated whether they liked or disliked each CS word. A postexperimental interview was used to assess whether subjects were unaware, contingency aware (aware that a certain word always predicted a successful response from the subject), or demand aware (aware that the presentations should influence their positiveness towards the word that was followed by positive information). A CS-only control was also used. A significantly higher preference for the CS words in the conditioning group compared to the CS-only control was found, and preferences for the CS+ were significantly greater than for the CS-. When the groups were split according to awareness the conditioning effects (group differences) was observed only in subjects classified as contingency aware or demand aware.

The second experiment replicated the first but awareness was manipulated by changing the instructions given to subjects. As well as a standard conditioning group, one group was instructed to pay careful attention to the words that they found easiest to get correct (this manipulation enhanced contingency awareness without affecting demand awareness by focussing attention on the CS-UCS presentations). Another group was told that people often rated more favourably the words they found easiest to get correct. This instruction informed subjects that the experimenter expected the CS to be rated more favourably, thus enhancing demand awareness without influencing contingency awareness. A significant within-group difference between preferences for the CS+ word and the CS- words was found in both the contingency-aware and demand-aware groups, but not in the unaware group. These two experiments support the idea that conditioning is dependent on awareness of some sort, although it is not clear that the demand aware group did not have some contingency awareness.

The consumer research literature provides some important evidence regarding the nature of EC. Much of the research is directly comparable to the standard discriminative EC paradigm (notably: Allen & Janiszewski, 1989), and nondiscriminative paradigms such as that adopted by Hammerl and Grabitz (1993, 1996) (notably: Stuart *et al.*, 1987; Shimp *et al.*, 1991; and Bierley *et al.*, 1985). The evidence from this literature strongly suggests that most of the conditioning effects can be explained by demand characteristics in the studies, contingency awareness or demand awareness. In short, awareness plays an important part in mediating the conditioning of affective responses but whether it is contingency awareness, demand awareness, or both that is responsible is unclear.

3.1.3. Evidence From Studies Using Subliminal Presentation of Stimuli

One way to dissociate contingency awareness from demand awareness is to present one or more stimuli subliminally, and then establish whether the subjects notice the subliminal stimulus.

Krosnick, Betz, Jussim and Lynn (1992) reported a study in which a target stimulus (a person) was primed by subliminal presentations (either 13ms or 9ms) of either a positive or negative affect-arousing image. Following the presentations, subjects rated the target person along a number of affective dimensions. The first experiment revealed significant differential responses to the target person dependent upon the emotion evoked by the subliminal prime but the authors had methodological reservations about the experiment. Experiment two addressed these reservations but revealed nonsignificant multivariate results (however, univariate analysis of the different affect scales revealed significant effects). The authors took no measure of the *change* in evaluation across conditioning and so there is little to suggest that these results represent associative learning rather than a simple priming effect (see Field & Davey, 1998).

De Houwer, Hendrickx and Baeyens (1997) report several experiments in which the UCS was presented subliminally (for 28.571 ms). Affectively neutral words, and nonwords, were used as CSs, and affectively positive and negative words acted as UCSs. The UCSs were masked by a row of Xs presented for 500 ms. In all experiments, subjects rated how each CS word made them feel by indicating a number between -10 (very negative) and +10 (very positive). Both a *subjective* and *objective measure* of contingency awareness was used. The subjective measure looked at whether subjects had noticed anything odd during the experiment that was not mentioned in the instructions (the instructions did not mention the affective UCSs). De Houwer *et al.* argued that if subjects report nothing unusual then they could not have consciously perceived the UCSs. The objective measure was a detection task in which subjects were re-exposed to the conditioning phase, but told to look out for the UCSs. After each presentation of the CS, subjects noted the valence of the proceeding word. Subjects performing above chance on this task were classified as aware. As with Krosnick *et al.*'s study, no attempt was made to assess whether subjects were aware of the emotion elicited by the UCSs. Subjects could be aware of the effect that the UCS has on them without

consciously perceiving it *visually*. This awareness would need to be measured to ensure that conditioning occurred outside of all conscious awareness.

The first of the four experiments failed to replicate the significant conditioning effects found by De Houwer, Baeyens and Eelen (1994). When analysing the two studies together, De Houwer *et al.* found no significant differences between the studies and concluded that the later was due to sampling variability. However, they acknowledged that their original success could also have been due to chance. The second experiment revealed significant differential responding, but both sets of CSs were rated fairly neutrally (mean for N-L pairs = 1.12, mean for N-D pairs = 0.61) regardless of the affective value of the UCS. Both sets of CSs were rated slightly positively, and given that baseline ratings were not taken before conditioning, this result cannot be taken as evidence that CSs *acquired* the valence of the UCS. Instead of randomly assigning CSs to UCSs, experiment 3 used fixed lists of CS words that were counterbalanced across. Analysis of subjects classified as unaware revealed evidence of discriminative learning but as with experiment two, all of the mean ratings were positive regardless of the value of the UCS (ratings ranged between 0.65 and 1.75). The significant conditioning effect was present in *only one* of the CS word-lists and item analysis revealed a nonsignificant effect of the type of UCS paired with a CS ($p < 0.10$). Experiment 4 combined the designs of experiments 2 and 3 but revealed no evidence of conditioning.

In three out of the five experiments (including De Houwer, Baeyens and Eelen, 1994), successful conditioning of contingency-unaware subjects was reported but in one of these experiments the effect was dependent on the CSs used. Two studies failed completely to find evidence of conditioning. A meta-analysis on the data, conducted by De Houwer *et al.*, indicated a significantly reliable conditioning effect but with a relatively small effect size ($r = 0.21$). It is noteworthy that there is a distinction between statistical importance of an effect and the substantive importance of

an effect. Although, this meta-analysis reveals a statistically important effect, the small effect size implies an effect of little practical importance. Nevertheless, these studies offer some evidence that EC can occur without contingency awareness but the process is not robust.

3.2. Evidence for EC studies using Gustatory Stimuli

Although the evidence from studies using visual stimuli is controvertible, there is a considerable body of work on EC using tastes. The taste paradigm combines the autonomic discrimination paradigm and visual EC paradigm: subjects experience two neutral tastes (CSs), one paired with a liked or neutral taste (water alone or with sugar added) and the other paired with a disliked taste (typically Tween20). Unlike the visual paradigm, the same CSs and UCSs are used across subjects and CSs are counterbalanced. This paradigm is important because the counterbalancing of CSs across UCSs rules out the artefact described by Field and Davey (1997, in press). Awareness has typically been measured using recall measures (e.g. Baeyens, Eelen, Van den Bergh & Crombez, 1990b; Baeyens, Crombez, Hendrickx, & Eelen, 1995) in which subjects are asked to identify which flavour was presented together with the nice or nasty taste. Typically very few subjects identify the correct CS flavour. Despite criticisms of this paradigm (see Field and Davey, 1997, 1998) these few studies do offer much better evidence that evaluative learning (about tastes) may not require conscious awareness of contingencies. For one thing it seems that subjects have particularly poor memory for the reinforcement history of flavours especially when identifying the medium in which a flavour was presented (Boakes, Stevenson & Prescott, submitted). This evidence suggests that the lack of awareness found in EC studies using flavours is due to specific difficulties in encoding flavour properties (See Stevenson, Boakes & Single, submitted). The fact that tastes appear unique in their encoding properties suggests that EC might mimic autonomic conditioning in that although conditioning usually occurs only in the presence of contingency

awareness, ecologically relevant associations can be learned without this awareness. Tastes represent a particularly important stimulus to an organism because of the possibly fatal consequences of ingesting a harmful substance and beneficial consequences of ingesting healthy substances. Theoretically, it makes sense that it is important to learn about tastes in a spontaneous way and this may be best achieved by learning without conscious control (Zajonc, 1980 makes a similar point regarding affect).

3.3. Measurement Issues in EC: Some Recent Findings

Shanks and St. John (1994) have noted that if a substantial time elapses between the test procedure and the measurement of awareness, there will be room for forgetting. In a study aimed at investigating this forgetting period, Fulcher and Cocks (1997) paired a series of pictures of flowers (CSs) with positive, negative or neutrally valenced words (UCSs). CSs and UCSs were counterbalanced across conditions making the procedure similar to the autonomic paradigm. After conditioning, one group rated the CSs before a recall awareness measure, a different group skipped the rating stage and recalled the UCS words immediately after conditioning. Subjects who rated the CSs before recall were significantly worse at recalling the UCS words than those who recalled the UCSs immediately, demonstrating that postconditioning assessments of awareness *underestimate* the level of awareness during conditioning. Fulcher and Cocks also found that when only the contingencies of which subjects were unaware were analysed there was no conditioning effect—conditioning occurred only in contingency-aware subjects. Apart from supporting the position that contingency awareness is necessary for EC to succeed, this study illustrates that the way in which awareness is measured can influence whether or not a subject is categorised as being contingency-aware or –unaware.

This study has important implications for evaluative conditioning experiments because awareness is generally measured after a test stage, therefore, these studies are not capturing 'hot-awareness'. This finding implies two things: (1) most EC studies have underestimated levels of awareness; and, (2) subjects classified as unaware of the contingencies may be aware during conditioning (and even at test) but performed poorly on awareness measures because of the interval between conditioning and the awareness measure. Baeyens *et al.*'s (1990a) method of concurrent measurement overcomes this problem, however, this procedure itself might heighten awareness making it difficult to obtain information about contingencies of which a subject is unaware.

4: Empirical Findings

4.1. Rationale

The evidence for the role of awareness in EC is complex, not least of all because many of the studies use non-comparable measures of awareness. Some studies have settled for measures of demand awareness, whereas others have focussed specifically on contingency awareness. The only common theme is that awareness has been measured in terms of verbalizable knowledge. Baeyens, De Houwer, and Eelen (1994) believe that awareness in EC should be linked to subjective, phenomenological experience and so verbal measures of awareness are sufficiently sensitive, however, they are insensitive according to Shanks and St. John's (1994) sensitivity criterion. Although verbalizable knowledge is a suitable start-point, Fulcher and Cocks have shown how the degree to which subjects can verbalise their knowledge is influenced by when awareness is measured. Verbal measures of awareness may also be influenced by subjects' reluctance to report knowledge of which they are unconfident. This observation may be true even in experiments where stimuli are presented subliminally (although De Houwer *et al.*'s, 1997, objective measure is likely to overcome this problem). The problem of having a paradigm that includes a period of forgetting

means that nearly all of the studies so far described are likely to have underestimated contingency awareness to some degree. This problem is not trivial because it prevents dissociation between evidence from subjects who were truly contingency-unaware and those who were contingency aware at some level but could not verbalise the knowledge they possess. Therefore, future work should aim to increase the sensitivity of verbal awareness measures, to reduce the period between conditioning and measurement of awareness, or to use alternative nonverbal measures.

Although this paper is primarily a review of the conditioning-without-awareness literature some empirical results will be presented that highlight the issues raised in this paper regarding the accuracy of verbal measures. Specifically it addresses the need to increase the sensitivity of verbal measures of contingency awareness. Baeyens *et al.*'s (1990a) study was partially replicated (awareness was measured only postexperimentally). The strong awareness measures employed by Baeyens *et al.* (see earlier) was compared against a more sensitive measure of awareness that relied on recognising CS-UCS contingencies. The awareness measure used was a recognition procedure, in which subjects distinguish real CS-UCS pairings from fake pairings containing the same CS and a different UCS of the same affective value as the real UCS. It seems reasonable to assume that if subjects can successfully discriminate, at a better than chance level, between the real and fake CS-UCS pairings, then they must possess some knowledge of the CS-UCS contingencies. The rationale was two-fold. First, the more sensitive awareness measure should provide more accurate classification of contingencies, resulting in more accurate data regarding whether EC can occur without contingency awareness. Second, this experiment should show that subjects in EC studies have greater contingency knowledge than previously used awareness measures suggest.

4.2. Method

Subjects: Thirteen subjects were used in all: five females and eight males. Their ages ranged from 19 to 27 years with a mean age of 21.38 years (SD = 2.26 years).

Stimulus Material: As with Baeyens *et al.*'s (1990a) experiment, colour photographs of human faces were used as CSs and UCSs. These photographs were scanned into a computer.

Procedure: The procedure used was ostensibly the same as that described for Baeyens *et al.* (1990a) (see earlier) except that the whole test was automated on a computer rather than using slide projections and image prints. The other differences were that only six stimulus pairs were used rather than nine and that the interval between stimuli in a pair was smaller (200 ms).

Preconditioning: Subjects rated 70 colour images of human faces on a computer screen using a scale ranging from -100 (dislike) through 0 (neutral) to +100 (like). Subjects were assured that their ratings would be strictly confidential and were asked to be completely honest about their judgements. They were also told to rely on their first, immediate and spontaneous reaction to each picture.

The two most highly rated faces and the two lowest rated faces were used as UCSs and eight neutral images (images with ratings close to zero) were used as six CSs and two control UCSs. CSs were randomly assigned to a UCS making six CS-UCS pairs: 2 × Neutral-Like (N-L); 2 × Neutral-Dislike (N-D); and 2 × Neutral-Neutral (N-N).

Conditioning: The six CS-UCS pairs were then presented 5 times each in a semi-randomised order. Each stimulus appeared on the screen for 1 second, the interval between stimuli in a pair was 200ms the inter-trial interval was 8 seconds.

Postconditioning: In this stage the CSs and UCSs used during conditioning were rated using the same scale as the preconditioning stage. To eliminate the chance possibility of CS-UCS pairs appearing consecutively at this stage, the stimuli were presented in blocks (namely all of the CSs followed by all of the UCSs or vice versa). Stimuli within each block were presented randomly.

Awareness Measures: There were two measures of contingency awareness used: A *strong* measure and a *recognition* measure. The strong measure was similar to one of the measures used by Baeyens *et al.* (1990a) and is called ‘strong’ because it measures precise knowledge of contingencies in a fairly strict way. Subjects were presented with each CS and asked to pick out the UCS from all of the remaining CS and UCS pictures. Subjects indicated whether they were *Completely Sure, Rather Sure, Rather Unsure* and *Completely Unsure* of their choice. The recognition measure differed in that subjects were expected only to differentiate actual CS-UCS pairings from decoy CS-UCS pairings. Subjects were presented with several pairs of faces. Each pair appeared in random order in the centre of the computer screen. Some of the pairs displayed were actual CS-UCS pairs from the conditioning stage, whereas others were pairs containing a genuine CS but a decoy UCS. The decoy UCS faces were selected from the preconditioning stage to have the same affective value as the actual UCS used during acquisition — however, none of these decoy UCSs actually appeared during conditioning. There were 12 pairs presented in this stage: the six actual pairs from acquisition ($2 \times N-L$, $2 \times N-D$, $2 \times N-N$) and six decoy pairings. Subjects were asked to indicate, for each pairing, whether they definitely remembered seeing that pair during the presentation stage (*Recognise*), whether they had a gut-feeling that they had seen the pair but did not remember it (*Know*), or if they definitely knew that they had not seen that pair (*No*). The order of awareness measures was counterbalanced.

For the strong measure, a contingency was classified as *aware* (i.e. the subject was aware of that contingency) if the subject could identify the exact UCS with which the CS was paired during conditioning or chose one of the same affective value. For the recognition measure, a contingency was classified as *aware* if two conditions were met: (1) the subject indicated that they recognised or had a feeling that they had seen the actual CS-UCS pairing during conditioning, and (2) the subject indicated that they definitely had not seen the decoy pairing for that CS.

4.3. Results

4.3.1. Comparison of the awareness measures

Table 1 shows the classification of contingencies for both the strong awareness measure and the recognition awareness measure. Of the 52 decoy pairings shown in the recognition procedure, only three pairings were given false positive responses (i.e. subjects said they recognised, or had a feeling they had seen the pairing when in fact they had not). This number is only 5.8% of the decoy pairings. Of these false positives, two were definitely recognised and the remaining one was a *know* responses (indicating that the subject merely had a feeling they had seen the pairing). These statistics show that subjects were capable of accurately distinguishing between pairs they had seen during the conditioning stage, and decoy pairs that they had not seen.

Insert Table 1 About Here

For the strong awareness measure, Table 1 shows that only 22 of the 52 affective pairings used (subjects were not required to identify the N-N pairings) were correctly identified (42.3%)⁴ indicating that subjects were aware of these contingencies. For the remaining 30 contingencies, subjects chose the incorrect UCS indicating a lack of awareness. Using the recognition measure,

more than twice as many CS-UCS contingencies were classified as ‘aware’ (45 contingencies or 86.5%). In terms of agreement between the measures, of the 22 contingencies classified as aware by the strong measure, 21 were similarly classified by the recognition measure⁵. There were only 6 pairings classified as *unaware* by both measures. A binomial test performed on the percentage of contingencies classified as aware and unaware by the recognition measure compared to the strong measure revealed a significant difference ($p < 0.001$). This result indicates that the recognition measure classified significantly more contingencies as ‘aware’ than the strong measure. In addition, the inter-rated reliability of the scales was extremely low ($\kappa = 0.136$, $p > 0.05$) indicating that there was a high level of disagreement between the scales.

These data demonstrate very simply how different measurement techniques lead to large differences between whether a subject is deemed aware or unaware of a contingency. When subjective verbal measures are used there is a danger that insensitivity within the measure leads to the erroneous conclusion that an effect has occurred in the absence of awareness simply because aware subjects are incorrectly classified. Subjects in EC studies possess more contingency awareness than strong measures indicate.

4.3.2. Exploratory Findings from the Recognition Measure

This study is the only EC study to employ a recognition measure of awareness that seeks to tap both verbalisable knowledge and more implicit knowledge. As such, the results of the recognition awareness measure are pertinent to the issue of whether conditioning can occur within the absence of contingency awareness. Table 2 illustrates the number of contingencies that subjects recognised,

⁴This finding indicates fairly low levels of specific awareness and the overall analysis revealed no significant conditioning effects.

⁵ The one contingency that was classified as *unaware* by the recognition measure was recognised by the subject but was classified as unaware because the subject had a feeling that he had seen the decoy pair

the number that subjects had a feeling they had seen, and those that subjects were unaware of — the results of the strong awareness measure are also included. Of the contingencies classified as aware by both measures, 71.4% were definitely recognised using the recognition measure. However, a much lower proportion (45.8%) of the contingencies classified as unaware by the strong measure were recognised using the recognition measure, with the remaining 54.2% being classified as ‘know’ responses. These proportions are significantly different using a binomial test ($p < 0.001$). This result suggests that the strong measure is not sensitive enough to detect awareness of contingencies that subjects have only a feeling that they have seen because proportionately more of these contingencies are misclassified by the strong measure. Therefore, by tapping verbalizable knowledge in the ‘traditional’ way, EC researchers are ignoring a great deal of information possessed by subjects.

Insert Table 2 About Here

Figure 1 shows the average change in ratings (postconditioning rating minus preconditioning rating) of CSs paired with liked and disliked UCSs. These changes are calculated relative to the changes observed in the control CSs paired with neutral UCSs. These changes are grouped according to whether the subject was explicitly aware of the contingency (recognise) or whether they just had a feeling that they had seen the contingency (know). Data for contingencies of which subjects were unaware are not presented because of the low number of cases (there was only one N-N control contingency that fell into the unaware category). Figure 1 shows that when subjects were explicitly aware of the contingencies, then CSs paired with liked UCSs were rated more positively compared to control CSs after conditioning, and CSs paired with disliked UCSs were rated more negatively compared to control CSs after conditioning. When subjects had only a feeling that they had seen a CS-UCS pair during conditioning no such effect was observed, instead CS rating

increased relative to the control CS ratings regardless of the type of UCS used during conditioning. In the few pairings of which subjects reported being unaware, CS ratings shifted very little regardless of whether a liked UCS ($\bar{X} = 0.00$) or disliked UCS ($\bar{X} = -5.00$) was used during conditioning.

The *post hoc* nature of the awareness measures means that awareness is not manipulated in a systematic way. As such, the contingencies experienced by a subject could all fall into a single category (e.g. recognised) or several categories (some may be recognised while others are not) and that the pattern of contingency awareness is not consistent across subjects. This highlights the important point that subjects all had some degree of contingency awareness (no subjects had all of their contingencies classified as unaware by the recognition measure). However, this poses statistical problems because data from a subject may contribute more to one measure of awareness than another. If the missing data were replaced with variable means, then there was a significant main effect of UCS Type [$F(2, 24) = 3.70, p = 0.040$] and Bonferroni contrasts revealed a marginally significant difference between N-L and N-D pairings [$F(1, 12) = 4.79, p = 0.049$] for contingencies that were recognised. However, this analysis cannot *and should not* be taken as evidence that differential conditioning between N-L and N-D pairs was established, because the replacement of missing data was substantial. These statistical problems apply to any study in which awareness is assessed as a *post hoc* measure and nearly all of the EC literature has measured awareness in this way (indeed Baeyens *et al.*, 1990a, were aware of this problem). As such, the data here are not presented as evidence that EC occurs only in the presence of contingency awareness, because there were too few contingencies of which subjects were unaware to draw any meaningful conclusions. Figure 1 suggests that there may even be a distinction between responding to contingencies of which subjects have explicit awareness and those of which subjects have only

implicit knowledge. However, the post hoc measures ensure that this interesting prospect must be speculative until a more systematic study can be done.

5: Conclusions

The data from the recognition awareness measure illustrate several points of general interest. (1) the *sensitivity* criterion of Shanks and St. John (1994) should be considered by any researcher interested in gauging awareness of experimental manipulations, contingencies or learning. The data presented here illustrate how different measures can lead to quite different conclusions regarding the awareness of subjects during experiments. For one thing it seems as though asking subjects to verbalise conscious knowledge may be a relatively insensitive measure of awareness that overlooks some of the knowledge that subjects possess. (2) to draw meaningful conclusions about whether awareness is necessary for a process to occur, it is imperative to try to manipulate awareness in a systematic way rather than merely measure it *post hoc*. There is a case for drawing conclusions from studies in which all subjects are unaware of all contingencies (i.e. subliminal conditioning), however, it is imperative that sensitive measures are used to ascertain that subjects were truly unaware. In addition, to verify that learning is associative, effects must be compared to nonpaired control groups. If awareness is not manipulated in a systematic way then accurate statistical analysis of the data is, in the majority of circumstances, going to be impossible. (3) there is tentative evidence that verbalizable knowledge of contingencies may lead to conditioning whereas nonverbalizable (a gut-feeling) knowledge may not. This finding suggests that there may be a threshold of awareness above which conditioning occurs. Hence, contingency awareness is not linearly related with the strength of conditioned responses. This implication has dramatic ramifications because many EC studies in which contingency awareness is measured have used an index of awareness that is assumed to correlate with CRs (e.g. Baeyens *et al.*, 1988;. 1989a; 1992a,

1993). In the light of the data in this paper, this methodology seems inappropriate and casts doubt on the conclusions from these studies.

Several points, specific to the EC literature are also raised by this review. First, relating to the systematic manipulation of contingency awareness, few of the studies purporting to show conditioning without awareness have systematically tried to inflate or decrease awareness in a subset of subjects. One of the few studies that has attempted to manipulate contingency- and demand-awareness (Allen and Janiszewski, 1989) found that awareness was crucial in establishing conditioning effects. A second, related point is the importance of distinguishing demand awareness from awareness of experimental contingencies. Many of the studies cited in the literature as supporting a conditioning-without-awareness view have used only global measures of awareness that are not only insensitive, but are also likely to capture demand awareness more than specific contingency awareness (e.g. Bierley *et al.*, 1985; Stuart *et al.*, 1987). Their conclusions are, therefore, unlikely to inform us of the role of contingency awareness. Finally, the data presented here illustrate how most EC studies have used measures of awareness that inflate the number of contingencies of which subjects are aware that are classified as unaware (e.g. Baeyens *et al.*, 1990a). Much of the literature has looked at awareness as a sideline to the main purpose of the experiment (e.g. Hammerl and Grabitz, 1993; Baeyens *et al.*, 1988; 1989a, 1989b; 1992a, 1992b; 1993) and has used awareness measures based on Baeyens *et al.* (1990a). These studies are likely to have (1) considerably underestimated the levels of contingency awareness; and (2) classified as unaware many contingencies of which subjects were aware. The use of subliminally presented stimuli does offer a more promising approach, but the evidence from these studies is very inconclusive. Notwithstanding the earlier criticisms, there is some support that conditioning can occur without awareness but studies using subliminally presented stimuli have by no means provided conclusive evidence that this is a robust and substantive finding. In addition, some more

recent studies contradict this work by suggesting that (1) contingency awareness may be crucial in establishing EC (Fulcher & Cocks, 1997; Shimp et al., 1991; Allen and Janiszewski, 1998); and (2) the post hoc nature of awareness measures may lead to a substantial underestimation of levels of awareness (Fulcher & Cocks, 1997).

To sum up the EC literature, there are many important measurement issues that suggest that few, if any, EC studies have genuinely captured associative learning without contingency awareness. Of course, this conclusion is not a final or damning one: indeed, the finding that conditioning occurs only in aware subjects does not eliminate the possibility that EC could never operate without awareness, it merely suggests that this possibility has yet to be demonstrated. This point is highlighted by the autonomic conditioning literature in which conditioning was believed to occur only in awareness, yet new evidence suggests that a subset of responses might be conditioned without awareness. On a theoretical level, there is a good deal to suggest that evaluative responses *should* be conditioned without awareness: (1) evaluations are a basic and ecologically important response (Zajonc, 1980); (2) levels-of-learning theories suggest that such basic responses should be conditioned outside of conscious control (Razran, 1955, 1971); and (3) if EC is not qualitatively distinct from autonomic conditioning (a position *not* held by Baeyens and his colleagues) then evaluative responses might be part of the ecologically-relevant response set (e.g. fear) that can be conditioned outside of contingency awareness. Alternatively, if EC is distinct from autonomic conditioning then general evaluations may not be conditioned without contingency awareness, but ecologically-important evaluations (such as taste) might form an important subset of responses that can be conditioned outside of awareness. If this possibility were so, then EC would mimic what has been found using autonomic conditioning. However, to discover which of these possibilities is true, several methodological issues must be addressed. (1) A study needs to be done in which contingency awareness is manipulated systematically across subjects. Completely aware and

completely unaware subjects then need to be compared against subjects who received unpaired CS-UCS presentations (see Field and Davey, 1998). (2) The role of nonverbalisable awareness needs to be investigated: the data presented in this paper show how the effect of verbalisable knowledge may be quite different to the effect of more implicit knowledge. (3) Awareness needs to be measured before subjects have the opportunity to forget contingencies of which they were aware. (4) Any measures of awareness that are used must be sensitive enough to detect the awareness that subjects possess.

To conclude, despite the fact that EC has entered conditioning folklore as a qualitatively distinct form of associative learning that can occur in the absence of specific contingency awareness, there are many reasons to question this finding — especially when visual stimuli are used. There are methodological problems that make it probable that researchers have underestimated contingency awareness, or have misclassified contingencies. Recent empirical work has begun to contest the conditioning-without-awareness view also, and there is now evidence that the results of some early EC studies using visual stimuli may have been an artefact of the experimental procedure (see, Field & Davey, 1997, 1998, in press; Shanks and Dickinson, 1990). Until new work addresses these issues there is little unequivocal evidence that evaluative conditioning without contingency awareness is a robust finding.

6: References

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Table 1: Table showing the number of contingencies classified as aware and unaware by both a strong awareness measure and a measure based on recognising experimental contingencies (see text for details).

		Recognition Measure		
		Aware	Unaware	Total
Strong Measure	Aware	21	1	22
	Unaware	24	6	30
	Total	45	7	52

Table 2: Table to show the number of contingencies that subjects explicitly recognised postexperimentally compared to those that subjects had only a feeling that they had seen, and those that were unrecognised (see text for details).

		Recognition Measure			
		Unaware	Aware		Total
			Recognise	Know	
Strong Measure	Unaware	6	11	13	30
	Aware	1	15	6	22
	Total	7	26	19	52

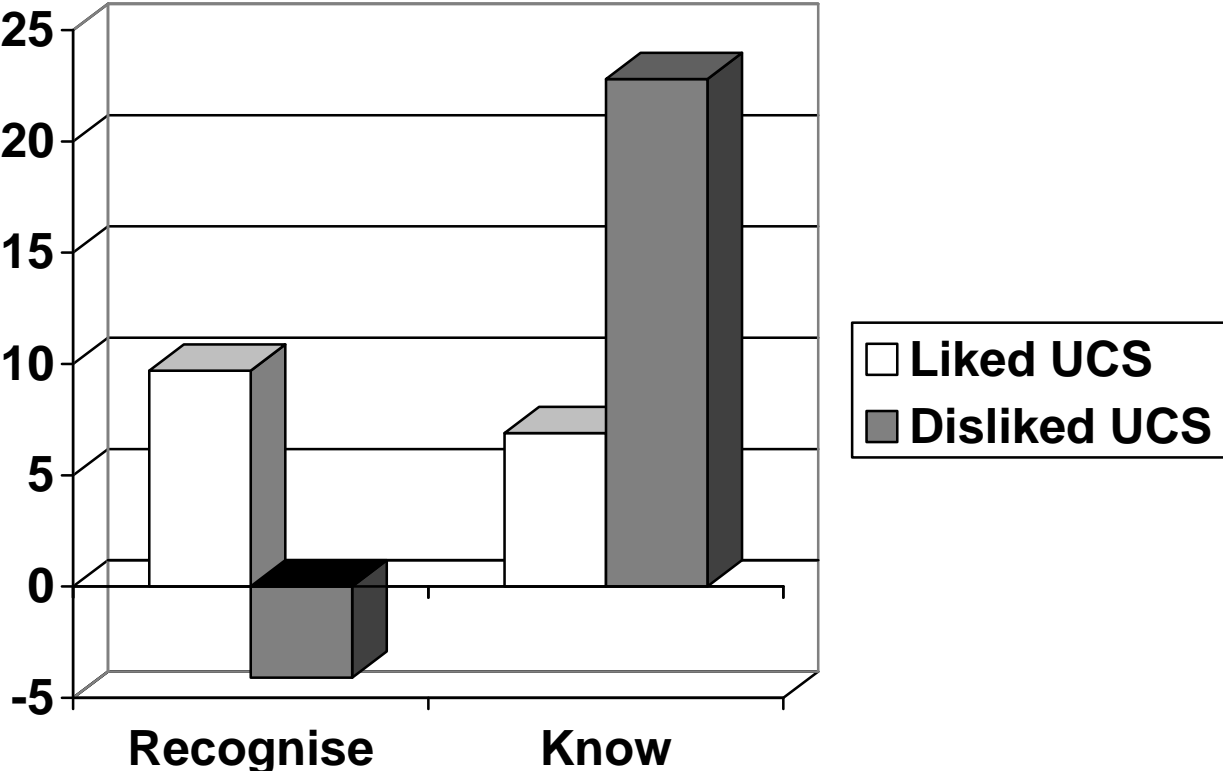


Figure 1 Legends:

Y-Axis: Mean change in CS rating relative to control CSs.

X-Axis: Level of Awareness

Title: Graph to show the changes in CS ratings relative to the N-N control CSs depending on whether a liked or disliked UCS was used during conditioning, and whether the subject recognised the contingency or had only a feeling that they had seen the contingency.