Journal of Experimental Psychology:
Learning, Memory, and Cognition
2007, Vol. 33, No. 1, 130–144

0278-7393/07/$12.00 DOI: 10.1037/0278-7393.33.1.130

Aware and (Dis)Liking: Item-Based Analyses Reveal That Valence Acquisition via Evaluative Conditioning Emerges Only When There Is Contingency Awareness

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Evaluative conditioning (EC) refers to changes in the liking of an affectively neutral stimulus (the conditioned stimulus, or CS) following the pairing of that stimulus with another stimulus of affective value (the unconditioned stimulus, or US). In 3 experiments, the authors assessed contingency awareness, that is, awareness of the CS–US associations, by relying on participants' responses to individual items rather than using a global method of assessment. They found that EC emerged on contingency aware CSs only. Of note, whether the CSs were evaluated explicitly (Experiments 1 and 2) or implicitly (Experiment 3) did not make a difference. This pattern supports the idea that awareness of the CS–US associations may be required for valence acquisition via EC.

Keywords: implicit learning, conditioning, awareness, attitudes, advertising

The present research focuses on a major antecedent of attitude formation, namely, evaluative conditioning (EC). EC refers to changes in the liking of an affectively neutral stimulus (the conditioned stimulus, or CS) after its pairing with another stimulus characterized by strong affective value (the unconditioned stimulus, or US). EC has been shown to be a robust mechanism (De Houwer, Baeyens, & Field, 2005; De Houwer, Thomas, & Baeyens, 2001). It is a ubiquitous phenomenon, as people's evaluations of various everyday objects (e.g., paintings, consumer products, people, or ideas) would seem to arise from EC. EC has been invoked in a wide range of applications, including therapeutic (e.g., Baccus, Baldwin, & Packer, 2004; Lipp & Purkis, 2005), social–cognitive (Olson & Fazio, 2002; Walther, Nagengast, & Trasselli, 2005), marketing (e.g., Stuart, Shimp, & Engle, 1987; Walther & Grigoriadis, 2004), and political (Pleyers, 2006; Razran, 1954) issues.

A fair deal of controversy subsists regarding the conditions under which EC emerges (for recent reviews, see De Houwer et al., 2005; Lovibond & Shanks, 2002). Specifically, an intense debate concerns the role of contingency awareness in producing EC effects (e.g., Field, 2000; Lovibond & Shanks, 2002). Definitions of contingency awareness highly depend on the given method of its assessment. In the case of *concurrent* measures, contingency awareness can be considered as the knowledge that a particular CS precedes a specific US (e.g., Baeyens, Eelen, & Van den Bergh, 1990; Field, 2000) or that a certain CS precedes a US that evokes a particular emotional response (e.g., Baeyens et al., 1990). If *recollection* measures are used, it can be defined as the ability to recollect the valence or content of CS–US associations (e.g., Field & Moore, 2005). Recollection measures involve a stronger memory component but have the advantage of not explicitly drawing participants' attention to the content of CS–US associations during the conditioning phase, which likely facilitates learning (Lipp & Purkis, 2005).

As pointed out by Field (2000), one should also distinguish between contingency awareness and demand awareness, which refers to participants' ability to report the experimental hypotheses. A participant can be demand aware without necessarily being contingency aware, and vice versa. Many EC studies supporting a conditioning-without-awareness account have used global measures of contingency awareness that were likely to capture demand awareness more than specific contingency awareness (e.g., Bierley, McSweeney, & Vannieuwkerk, 1985; Stuart et al., 1987). This confusion has been a major factor underlying the highly inconsistent conclusions reached in the EC literature (discussed further below).

In addition to divergences in the definition of contingency awareness (see Davey, 1994; Fulcher & Cocks, 1997; Lovibond &

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This work benefited from Action de Recherche Concertée Grant ARC06/11-337. We are grateful to Jan De Houwer, Andy Field, Ottmar Lipp, Florence Stinglhamber, and Eva Walther for their valuable comments on an earlier version of this article.

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Shanks, 2002), research on EC also has taken advantage of a variety of experimental designs in order to assess EC effects. As a matter of fact, a substantial level of disagreement can be found regarding the relevance of using specific paradigms for the study of EC effects. Numerous EC studies have used questionable designs, that is, designs that fail to counterbalance or randomly assign the content of CS–US pairings. As a result, these studies remain ambiguous as to the nature of the processes involved (see Field & Davey, 1999; Lovibond & Shanks, 2002; Shanks & Dickinson, 1990). Other studies have adopted intersubject manipulation of the valence of CS–US associations, with participants exposed either to negative and neutral or to positive and neutral stimuli, possibly resulting in mood effects (see Lovibond & Shanks, 2002).

A limited number of studies have used better experimental designs and provided relatively more precise assessments of contingency awareness but have differed with respect to the way the role of contingency awareness in EC was analyzed. A first set of studies made use of *participant-based analyses*. In some of them, researchers used a recall task (in which participants were asked to recall the US picture for each CS or at least its *valence*) to specifically assess contingency awareness and assigned participants to an "aware" or an "unaware" subgroup according to whether they were able to report (almost) all or (almost) none of these USs (e.g., Fulcher & Hammerl, 2001, Experiments 1 and 2; Hammerl & Fulcher, 2005; Hammerl & Grabitz, 2000). In addition to using participant-based analyses, other studies combined contingency awareness and demand awareness criteria in order to categorize participants into an awareness level. These criteria were generally assessed using general questions presented to participants in a postexperimental questionnaire. A typical demand awareness item is "Summarize below what you believe was the purpose of this study" (Allen & Janiszewski, 1989). An example of a contingency awareness item is "Do you think that particular pictures were combined with other particular pictures?" (Walther, 2002). Responses were used to assign participants to one of three categories (e.g., 1 = *unaware*, 2 = *contingency but not hypothesis aware*, and 3 = *contingency and demand aware* in Allen & Janiszewski, 1989; 1 = *not aware*, 2 = *aware of different phases and/or change of valence in the experiment*, and 3 = *aware of the contingencies and/or demand* in Walther, 2002). Of importance, however, is that participants are rarely either aware or unaware of all CS–US contingencies (see also Field, 2000, 2001). Even when one tries to systematically manipulate awareness, it is extremely difficult to create experimental conditions such that one group of participants is aware of all contingencies and another group of participants is aware of none of the contingencies (see Fulcher & Hammerl, 2001, for such an attempt). Instead, participants tend to be aware of some contingencies but not others.

In another set of studies, the magnitude of the EC effect was *correlated* with an index of awareness assigned to the participant (i.e., number of CS–US pairings correctly reported: Baeyens, Crombez, Van den Bergh, & Eelen, 1988; Baeyens, Eelen, Crombez, & Van den Bergh, 1992; Baeyens, Hermans, & Eelen, 1993; confidence in correctly vs. incorrectly reported contingencies: Olson & Fazio, 2001, Experiment 1). However, as highlighted by Lovibond and Shanks (2002), correlational analyses of the relationship between awareness and conditioning are likely to be relatively uninformative. Low correlations would be expected if the relationship between awareness and the conditioned response magnitude is nonlinear, or if performance on either measure is at floor or ceiling or is restricted in range. The same expectation would arise in the presence of performance variables affecting conditioned response magnitude while not influencing awareness. In light of these considerations, Lovibond and Shanks concluded that correlational analyses potentially represent the weakest tests of the assertion that EC may occur in the absence of contingency awareness.

The Present Research

We believe that the ongoing controversy on the role of contingency awareness in EC is largely due to the use of questionable designs for testing EC and/or the use of a diversity of sometimes questionable procedures for assessing or analyzing contingency awareness. The use of problematic methods for assessing contingency awareness in combination with suboptimal designs or analyses has contributed to the emergence of inconsistent conclusions concerning the role of contingency awareness in the EC literature. Whereas contingency awareness did not moderate EC effects in some studies (e.g., Baeyens et al., 1990; De Houwer, Baeyens, & Eelen, 1994; De Houwer, Hendrickx, & Baeyens, 1997; Fulcher & Cocks, 1997; Hammerl, Bloch, & Silverthorne, 1997; Krosnick, Betz, Jussim, & Lynn, 1992; Levey & Martin, 1975, 1987; Martin & Levey, 1987; Trodank, Byrnes, Wrzesniewski, & Rozin, 1995), other studies have revealed the presence of EC effects only among contingency aware participants (see Field, 2000, for a review) or showed contrast effects among contingency aware participants (Fulcher & Hammerl, 2001).

In the present research, we decided to adopt a well-controlled within-subject design in which the content of CS–US pairings was counterbalanced or randomized across participants. The latter procedure is considered to be the most satisfactory for investigating EC in terms of its internal validity and efficient use of resources and participants (De Houwer et al., 2001). Such designs further make it very likely that any differences in postconditioning measures can be attributed to the CS–US association rather than to properties intrinsic to a particular CS (De Houwer, Baeyens, Vansteenwegen, & Eelen, 2000).

As to the role of contingency awareness, we decided to rely on an item-based analytic strategy. Specifically, we compared the magnitude of the EC effects on CSs that could or could not be correctly linked to the US that they had been paired with. In the remainder of the article, we refer to *contingency aware* and *contingency unaware* CSs to address these two categories of items, respectively. The idea is straightforward: If EC can emerge in the absence of explicit access to CS–US associations in memory, then EC should be obtained on both contingency aware and contingency unaware CSs. In contrast, if EC does not occur in the absence of explicit access to the CS–US contingency in memory, then EC should emerge on contingency aware CSs whereas no EC should be found on contingency unaware CSs.

It should be noted that such an analytic procedure has been used in an investigation reported by Baeyens et al. (1990). However, this study involved a questionable assignment method (Lovibond & Shanks, 2002). More specifically, it was more likely that some contingencies classified as unaware were in fact contingencies of which participants were aware than vice versa. The item-based analyses we decided to use here are also conceptually close to "per-contingency" analyses recently emphasized by Field and Moore (2005; see also Field, 2000, 2001). The latter work is taken into account in the General Discussion.

We conducted three experiments, each consisting of three phases. The first phase aimed at conditioning participants' attitudes toward unknown brands (CSs) by systematically pairing these brands with affective pictures (USs). The second phase was devoted to the assessment of participants' evaluation of the CSs. In the final phase, we measured participants' awareness of the CS–US contingencies (and also of the experimental EC hypothesis, in Experiment 1). All three experiments used similar materials and the same conditioning procedure. In Experiment 1, the outcomes resulting from participant-based and item-based analytic strategies were directly compared. In Experiments 2 and 3, we focused on the more satisfactory item-based analyses and extended the findings obtained in Experiment 1 by adopting a stronger assessment of contingency awareness. Specifically, whereas Experiment 1 required participants to pair the valence of the CSs and USs in the recall task, Experiments 2 and 3 required them to report the *content* of the CS–US pairs. The latter is considered a stronger criterion for awareness assessment (see Davey, 1994) and appears of significance in light of the above described debate concerning the sensitivity of measures of contingency awareness (e.g., Field, 2000).

Of critical importance, too, is the application of an *implicit* evaluation task in Experiment 3, whereas Experiments 1 and 2 used explicit evaluations of the CSs. Specifically, an affective priming task was used in Experiment 3 (for recent reviews on this task, see Klauer, 1998; Klauer & Musch, 2003), which yielded several advantages. Notably, this task was directly relevant for examining the role of contingency awareness on the early *valence acquisition* stage. This task does not involve evaluations of the CSs but involves evaluative decisions on affective words that followed conditioned CS primes. The affective priming task used in Experiment 3 thus creates a situation in which participants would find it extremely difficult to deliberately respond in certain ways. Therefore, it provides a straightforward indication of the valence previously acquired by the CSs. In addition, the fact that participants have little control over their response when performing the task made it then possible to examine the EC effects in a context where experimental demands are hardly likely to operate. Finally, the use of an implicit task for assessing participants' conditioned responses enabled the examination of the role of contingency awareness on implicit, more automatic attitudes (as opposed to explicit, controlled attitudes addressed in Experiments 1 and 2).

With the materials and conditioning procedure used in the present experiments we also sought to extend earlier studies in significant methodological and practical ways. First, to achieve proper conditions for comparing the magnitude of the EC effects on contingency aware CSs versus contingency unaware CSs (i.e., item-based analysis), we designed a conditioning phase that comprised four CSs^{+} and four CSs^{-} within participants. Although the number of CS–US pairs varies considerably across EC studies, prior EC studies have typically used fewer CSs (e.g., one CS^{+} by Shimp, Stuart, & Engle, 1991; Stuart et al., 1987; one CS^{+} and one CS^{-} by Allen & Janiszewski, 1989; Diaz, Ruiz, & Baeyens, 2005; Olson & Fazio, 2001, 2002; Walther, 2002; Walther & Grigoriadis, 2004).

Second, we used common stimuli as CSs (e.g., milk, chewing gum), thereby increasing the ecological validity and practical significance of the findings. Note that using such products as CSs allows the use of a larger set of dependent measures for examining EC effects. Hence, our first two experiments involved various affective evaluations of the CSs (e.g., spontaneous feelings toward the CSs), as typically used in EC studies, but also more behavioral responses (e.g., intention to buy). This allowed a detailed examination of EC effects as well as the evaluation of consistency between the different dependent measures.

Finally, to further improve the ecological validity of our findings, we used simultaneous presentation of the CSs and USs. This feature has rarely been used in earlier studies (for an exception, see Olson & Fazio, 2001, 2002), which typically have presented the CS prior to the US (forward conditioning procedure) or, sometimes, after the US (backward conditioning procedure; see De Houwer et al., 2001; Stuart et al., 1987).

Experiment 1

Method

Participants and Design

Ninety-six French-speaking undergraduate students of the Catholic University of Louvain at Louvain-la-Neuve participated for course credit. The design of the study included valence (positively vs. negatively conditioned CSs) as a two-level within-subject factor.

Materials

CSs. The eight CSs were common consumption products, and the specific brands used (in French) were unknown to the participants. Whereas some products really existed but were available only in other countries, others were created in our laboratory for the purpose of our experiments. Each CS had been pretested to (a) elicit a neutral affective response and (b) be different from existing brands within the product category. This was done because it is assumed that the use of a novel CS is more likely to give way to a conditioned response. The eight brands used were Muesli Luxury, Toothpaste Mendo, Water Kinley, Toilet Paper Vlaush, Chips Thins, Chewing Gum Beemans, Milk Pelotin, and Orange Juice Paquito. The brand names were in French, and none of them had a semantic meaning (which could have been likely to give rise to inferences about CSs).

USs. Our eight USs consisted of four positive (USs^{+}) and four negative (USs^{-}) pictures taken from the International Affective Picture System (IAPS) CD-ROM (Lang, Bradley, & Cuthbert, 1999), which contains a set of affective stimuli with normative affective ratings collected over 10 years. The US pictures were carefully chosen to be non-gender-specific. As indexed by the IAPS data, the USs^{+} and USs^{-} were of opposite valence but of equivalent emotional intensity. The IAPS numbers of the US pictures are displayed in the Appendix.

Procedure

Participants were tested in a computer room in groups of 3 to 8 individuals. They were greeted by a male experimenter and seated in front of an individual computer. The first screen displayed the following instructions:

> The study deals with perceptual processing of various stimuli. It comprises two phases. In the first phase, you will see various stimuli appearing on the screen. These stimuli will be presented in a random order by the computer program (you don't have to memorize them, no recall task will be used). In the second phase, you will simply be asked to spontaneously answer a set of questions. Please press the space bar to start the experiment.

Conditioning phase. During this phase, participants saw eight CS–US pairs appearing on their computer screen. The pairs consisted of a presentation of one US, occupying the entire screen, on which a CS was superimposed. The CS appeared on the inside of a white square (6 × 6 cm) located at the bottom of the screen (see Figure 1 for examples of CS–US^{+} and CS–US^{-} pairs). Each of the eight CS–US pairs was displayed on the computer screen for 1 s and was directly followed by a dark screen for 1,500 ms. Each pair was presented seven times, resulting in a total of 56 presentations appearing in a random order (see Figure 1).

Figure 1. An example of CS–US^{+} (top) and CS–US^{-} (bottom) used in Experiment 1. The CSs are superimposed on the USs. CS = conditioned stimulus; US = unconditioned stimulus.

Four CSs were paired with a positive picture (i.e., CSs^{+}) and four CSs with a negative picture (i.e., CSs^{-}). For a given participant, an arbitrary CS picture was always paired with the same US picture. However, CS–US assignments were counterbalanced across participants. Even though this procedure does not guarantee that all CSs were neutral for each participant (in spite of the pretest), it guarantees that slight variations in the CSs' valences were randomly distributed across conditions. This procedure rules out undesirable stimulus selection effects (e.g., Field & Davey, 1999).

Global feelings and specific evaluations of the CSs. After the conditioning phase, dependent measures were collected. A given CS was presented in the center of the screen (the size corresponding to the conditioning phase), and several questions appeared sequentially beneath the CS. Participants responded by pressing a number on their keyboard. Participants were first asked to spontaneously express their *global feelings* toward the CSs (the order of which was counterbalanced) on a 9-point scale ranging from 1 (*very negative feelings*) to 9 (*very positive feelings*).

Next, participants were given separate sheets of paper and were asked to systematically evaluate each CS on four *specific evaluative* dimensions—namely, attractiveness (1 = *unattractive*, 7 = *attractive*), pleasantness (1 = *unpleasant*, 7 = *pleasant*), intention to purchase the product (e.g., "All things considered, if I were soon to go to the supermarket and if I had to buy [milk], how many chances out of five would there be that I would buy the [milk Pelotin]?"; from 0 to 5), and intention to recommend the product ("If the [milk Pelotin] were available, would I recommend it to other people?"; from 1 = *certainly not* to 7 = *certainly*). Because responses to these four questions were highly correlated (α = .92), they were transformed into a 9-point scale and averaged to create a single evaluative index.[1]

Awareness assessment. Participants subsequently completed a questionnaire assessing their awareness of the experimental hypotheses and the CS–US associations. The open-ended questions read as follows:

> What do you think is (are) the hypothesis(ses) that is (are) being tested in this study?
>
> Has something drawn your attention during the experiment? If so, what was it?
>
> When evaluating the different products to which you were exposed during the experiment, did you have the impression that you were supposed to respond in a particular way? If so, in which way?
>
> Can you state anything about the stimuli presentation (on the computer screen)?

Given that such an open-ended measure is more likely to tap demand awareness than contingency awareness (or at least mix up the two constructs, as indicated above), the second part of the

[1] We varied the scale format on these four dependent variables (with response options varying from 5- to 7-point scales) to avoid a routine mode of response. We transformed these scores into 9-point scores (e.g., scores on the 7-point scales were multiplied by 9/7) before averaging them into the single evaluative index.

questionnaire specifically addressed contingency awareness. Participants were asked to indicate, for each of the eight products, whether it had been paired with a positive, a negative, or a neutral picture during the first phase of the experiment, or whether they had no idea of the valence of the picture. They were also asked to report their confidence in each one of their answers on a 3-point scale (*not really sure*, *rather sure*, or *absolutely sure*).[2]

On the basis of this questionnaire, participants were categorized into one of four levels of awareness: 0 = the participant showed no awareness or merely mentioned the presentation of positive and/or negative stimuli; 1 = the participant was possibly aware of the experimental hypothesis (participants were classified as "hypothesis aware" if they mentioned the broad idea that the experiment dealt with "the influence of pictures on the perception of products"); 2 = the participant correctly reported at least five out of the eight CS–US associations; and 3 = the participant showed both hypothesis and contingency awareness (i.e., both the Level 2 and Level 3 criteria were met).

Results

General EC Effects

The CSs^+ were rated significantly more positively than the CSs^- for both global feelings ($M = 5.66$, $SD = 1.33$ vs. $M = 4.31$, $SD = 1.33$, respectively), $F(1, 95) = 58.30$, $p < .002$, and the evaluative index ($M = 5.01$, $SD = 1.13$ vs. $M = 4.07$, $SD = 0.92$), $F(1, 95) = 50.45$, $p < .002$. A strong EC effect was therefore demonstrated.

Correlations Between the EC Effects and the Number of Correctly Reported CS–US Pairings

As was done in other studies (e.g., Baeyens et al., 1988, 1992), we correlated the overall magnitude of the EC effects (i.e., mean difference in the rating of CSs^+ vs. CSs^-) with the number of correctly reported CS–US pairings. This correlation was .30 ($p < .004$) on global feelings and .15 (*ns*) on the evaluative index. Although the first correlation suggests an association between EC and contingency awareness, no such association emerges with the second correlation. In other words, the correlational findings are not consistent across dependent variables.

EC Effects and Participant-Based Assessment of Contingency Awareness

In line with earlier studies, we found it important to consider various levels of awareness (e.g., Allen & Janiszewski, 1989; Walther, 2002). According to our open-ended questionnaire, 18 (19%) participants fell into Level 0, 32 (33%) into Level 1, 2 (2%) into Level 2, and 44 (46%) into Level 3. These results suggest that contingency awareness as defined in the specific measure used here may result in participants' sensitivity to the research hypothesis (as currently, and rather broadly, defined; compare the *N*s at Levels 2 [very small] and 3 [very large]).

A strong EC effect was obtained for participants falling under Level 3 of awareness for global feelings ($M = 5.98$, $SD = 1.14$ for CSs^+ vs. $M = 4.20$, $SD = 1.21$ for CSs^-), $F(1, 43) = 45.95$, $p < .001$, and for the evaluative index ($M = 5.01$, $SD = 1.11$ for CSs^+ vs. $M = 3.90$, $SD = 0.93$ for CSs^-), $F(1, 43) = 25.20$, $p < .001$ (inclusion of the 2 participants falling into the Level 2 of awareness did not alter this pattern). More important, however, a significant EC effect was obtained with regard to the global feelings item when considering the Level 0 of awareness ($M = 5.07$, $SD = 1.24$ for CSs^+ vs. $M = 4.42$, $SD = 1.43$ for CSs^-), $F(1, 17) = 7.19$, $p < .02$, as well as the Level 1 of awareness ($M = 5.50$, $SD = 1.51$ for CSs^+ vs. $M = 4.40$, $SD = 1.50$ for CSs^-), $F(1, 31) = 11.39$, $p < .003$. As for the evaluative index, the EC effect approached significance among participants who fell into the Level 0 of awareness ($M = 4.43$, $SD = 1.30$ for CSs^+ vs. $M = 3.98$, $SD = 0.79$ for CSs^-), $F(1, 17) = 2.69$, $p < .12$; and a significant EC effect was obtained among participants who fell into the Level 1 of awareness ($M = 5.35$, $SD = 0.97$ for CSs^+ vs. $M = 4.34$, $SD = 0.97$ for CSs^-), $F(1, 31) = 25.46$, $p < .001$. These participant-based analyses thus suggest that EC effects emerge under conditions of both contingency awareness and contingency unawareness.

A one-way analysis of variance (ANOVA) with level of awareness as the between-subjects factor (Levels 2 and 3 were collapsed in a broad "Level 2" because the former level included only 2 participants) and magnitude of the EC effects as the dependent variable revealed the presence of a significant effect for global feelings, $F(2, 95) = 3.44$, $p < .05$. Tukey's post hoc test showed that the EC effect was greater in Level 2 than in Level 0 (mean difference = –1.14, $SE = 0.50$, $p < .05$). However, no effect emerged for the evaluative index, $F(2, 95) = 1.67$, *ns*. Thus, the latter analysis did not suggest a clear relation between awareness and EC.

EC Effects and Item-Based Assessment of Contingency Awareness

A CS was categorized as contingency aware when a participant correctly reported the valence of the US that had been paired with this specific CS. CSs that did not meet this criterion were categorized as contingency unaware. The mean number of contingency aware pairings was 4.74 ($SD = 1.68$) out of a maximum of 8.

We first adopted repeated measures ANOVAs using CS type (CS^+ vs. CS^-) and CS awareness (contingency aware vs. unaware CS) as our within-subject factor. The main effect of CS type was significant for both global feelings, $F(1, 59) = 20.14$, $p < .001$, and the evaluative index, $F(1, 59) = 23.65$, $p < .002$, with more positive ratings of CSs^+ than CSs^-. It is important to note that this CS type effect was moderated by CS awareness both on global feelings, $F(1, 59) = 37.74$, $p < .001$, and on the evaluative index, $F(1, 59) = 23.07$, $p < .001$, with the EC effects obtained on contingency aware but not contingency unaware CSs. Specifically, for global feelings we found $M = 5.85$ ($SD = 0.24$) for positive–aware, $M = 3.64$ ($SD = 0.24$) for negative–aware, $M = 4.72$ ($SD = 0.24$) for positive–unaware, and $M = 4.97$ ($SD = 0.23$) for

[2] The confidence measure failed to reveal any significant results in either Experiment 1 or Experiments 2 and 3: The correlation between the EC effect and the mean level of confidence on the contingency aware CS–US pairings was about .05 for global feelings and about .08 for the evaluative index in Experiment 1, about .03 for both global feelings and the evaluative index in Experiment 2, and about .08 for the priming effect in the affective priming task in Experiment 3. Thus, the confidence measure is not discussed further in the article.

negative–unaware. For the evaluative index, we obtained M = 5.27 (SD = 0.19) for positive–aware, M = 3.63 (SD = 0.18) for negative–aware, M = 4.52 (SD = 0.21) for positive–unaware, and M = 4.62 (SD = 0.16) for negative–unaware.

Telling as these results may be, the above repeated measures design resulted in a substantial loss of data. This is due to the fact that only a limited number of participants showed contingency awareness simultaneously on at least one CS^+ and one CS^- *and* contingency unawareness on at least one CS^+ and one CS^-. To circumvent this problem and gain additional power, we reconsidered the EC effects separately on the aware CSs^+ and CSs^- and on the unaware CSs^+ and CSs^-. As expected, considerably more participants were simultaneously aware on at least one CS^+ and one CS^- *or* simultaneously unaware on at least one CS^+ and one CS^-.

The conclusions were similar to those reached when the full design was used. As shown in Figure 2, a significant EC effect emerged on the contingency aware CSs in that aware CSs^+ were rated more positively than aware CSs^-, both for global feelings (respectively, M = 5.97, SD = 1.67 vs. M = 3.74, SD = 1.71), $F(1, 87) = 72.23$, $p < .001$, and for the evaluative index (M = 5.32, SD = 1.36 vs. M = 3.69, SD = 1.30), $F(1, 87) = 58.79$, $p < .001$. In contrast, no EC effect emerged on the contingency unaware CSs for either global feelings (M = 4.79, SD = 1.79 for unaware CSs^+ vs. M = 4.98, SD = 1.74 for unaware CSs^-), $F(1, 66) < 1$, *ns*, or the evaluative index (M = 4.59, SD = 1.55 for unaware CSs^+ vs. M = 4.60, SD = 1.19 for unaware CSs^-), $F(1, 66) < 1$, *ns*. Both analyses therefore reveal EC effects only in the context of contingency aware trials.

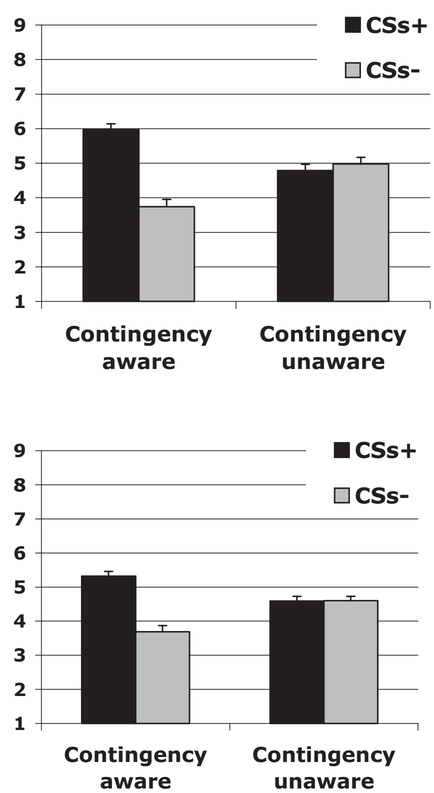

Figure 2. Mean evaluation of CSs^+ and CSs^- on contingency aware and contingency unaware CSs (Experiment 1). Top: Global feelings measure. Bottom: Evaluative index. Higher values in both cases reflect more positive attitudes about the brand product. CS = conditioned stimulus.

Discussion

When participants are classified into different levels of awareness (i.e., participant-based analyses), it may seem that those showing no or low awareness (i.e., Levels 0 and 1) expressed significantly more positive feelings toward CSs^+ than CSs^-. This finding would seem to indicate that EC can occur in the absence of contingency awareness. However, we argued that participant-based assessments of contingency awareness are potentially misleading (as are correlational analyses). It is noteworthy that participants who were classified into Level 0 of awareness according to the open-ended questions correctly reported an average of 3.12 (SD = 0.78, n = 17) CS–US pairings, whereas 3.72 (SD = 1.33, n = 32) CS–US pairings were correctly reported by participants falling into Level 1, 7.50 (SD = 0.71, n = 2) by participants falling into Level 2, and, finally, 5.98 (SD = 0.98, n = 44) by participants falling into Level 3. Hence, the fact that some participants apparently reported no awareness or merely mentioned the presentation of affective stimuli in the open-ended questions does not indicate that those participants could not report any of the eight pairings. Similarly, simply being classified into the highest level of awareness does not signify that participants were able to correctly report all of the CS–US pairings. The item-based analyses we conducted overcome this loss of statistical information and reveal EC effects on contingency aware but not contingency unaware CSs.

The latter finding suggests that EC may not emerge in the absence of explicit access to CS–US associations in memory. However, a careful reader might suggest that our (so-called weak) contingency awareness measure reflected participants' inference about (rather than recollection of) the valence of the USs. According to this argument, a successfully conditioned CS would elicit an affective reaction that could be used as a cue for inferring the nature of the US paired with this CS. In other words, when asked to recall the CS–US pairings, participants would infer that the valence of the US must be consistent with the way they feel about the CS. If so, an EC effect should occur even when participants indicate an incorrect US, but one of the same valence as the correct one. A second experiment was conducted in order to rule out this inferential account of the data. We minimized the possibility that the observed effects could arise owing to nonassociative processes by testing for participants' recollection of the precise US picture instead of participants' recall (or inference, as some might argue) of the US valence. If the item-based findings obtained in Experiment 1 were to be replicated in Experiment 2 with this better criterion for contingency awareness, it would be difficult to argue that participants' responses on the recollection task (i.e., matching each CS picture with its US picture) merely reflect affect-based inferences.

Experiment 2

Method

Participants

A total of 106 undergraduate students at the Catholic University of Louvain at Louvain-la-Neuve took part in the experiment.

Materials and Procedure

The materials, the conditioning procedure, and the dependent measures were similar to those used in Experiment 1 with the two exceptions that the last specific evaluative dependent variable (i.e., recommendation intention) was removed to simplify the procedure and the awareness assessment was modified. To the extent that the use of open-ended questions confounded contingency awareness and demand awareness and resulted in questionable participant-based conclusions, this questionnaire was dropped. Rather, we chose to exclusively use a picture-bound recognition task for assessing contingency awareness (as used by Baeyens et al., 1990). For each of the eight CS pictures (the order of which was randomized), participants were presented with eight US pictures used during the conditioning phase and were asked to indicate (by hitting the corresponding number of the US) the one with which it had been paired. They could also respond "I don't know" by pressing the number 9. If they selected a US, they were also asked to communicate how confident they were about their answer by indicating a number ranging from 1 (*quite uncertain*) to 6 (*quite certain*).

Results

General EC Effects

As in Experiment 1, the responses on the three specific evaluative questions were averaged into an evaluative index after appropriate transformation (α = .93). A strong EC effect was obtained in that the CSs$^+$ were rated significantly more positively than the CSs$^-$ both for global feelings (M = 5.78, SD = 1.22 vs. M = 4.16, SD = 1.34), $F(1, 105) = 112.81$, $p < .002$, and for the evaluative index (M = 4.99, SD = 1.19 vs. M = 4.12, SD = 1.13), $F(1, 105) = 34.98$, $p < .002$.

Correlations Between the EC Effects and the Number of Correctly Reported CS–US Pairings

As in Experiment 1, we correlated the overall magnitude of the EC effects (i.e., mean difference in the rating of CSs$^+$ vs. CSs$^-$) with the number of correctly reported CS–US pairings. This correlation was .17 ($p < .08$) for global feelings and .13 ($p < .17$) for the evaluative index. Thus, in contrast to Experiment 1, the correlational analyses no longer suggested an association between EC and contingency awareness.

EC Effects and Item-Based Assessment of Contingency Awareness

A CS was categorized as contingency aware when correctly paired with its US picture. The mean number of aware pairings was 6.81 (SD = 1.80) out of a maximum of 8. As in Experiment 1, we first examined the results in the context of a repeated measures ANOVA using CS type and CS awareness as our two within-subject factors and then considered the EC effects separately on aware and unaware CSs$^+$ and CSs$^-$.

The full design revealed the presence of a main effect of CS type on global feelings, $F(1, 21) = 5.03$, $p < .04$. More important, a CS Type $\times$ CS Awareness interaction was obtained on both global feelings, $F(1, 21) = 11.57$, $p < .003$, and the evaluative index, $F(1, 21) = 6.16$, $p < .025$, with EC effects obtained on contingency aware but not on contingency unaware CSs. For global feelings, we found M = 6.05 (SD = 0.26) for positive–aware, M = 4.19 (SD = 0.36) for negative–aware, M = 4.63 (SD = 0.37) for positive–unaware, and M = 4.96 (SD = 0.30) for negative–unaware. For the evaluative index, we obtained M = 5.31 (SD = 0.31) for positive–aware, M = 4.42 (SD = 0.29) for negative–aware, M = 4.22 (SD = 0.32) for positive–unaware, and M = 4.70 (SD = 0.26) for negative–unaware.

Next, we considered the EC effects separately on the contingency aware and contingency unaware CSs. A significant EC effect was obtained on the contingency aware CSs both for global feelings (M = 5.92, SD = 1.26 for aware CSs$^+$ vs. M = 4.04, SD = 1.43 for aware CSs$^-$), $F(1, 101) = 132.67$, $p < .002$, and for the evaluative index (M = 5.09, SD = 1.27 for aware CSs$^+$ vs. M = 4.04, SD = 1.23 for aware CSs$^-$), $F(1, 101) = 42.68$, $p <$ .002. In contrast, no EC effect emerged on the contingency unaware CSs for global feelings (M = 4.79, SD = 1.62 for unaware CSs$^+$ vs. M = 4.85, SD = 1.56 for unaware CSs$^-$), $F(1, 25) =$ 1.02, *ns*, or for the evaluative index (M = 4.29, SD = 1.43 for unaware CSs$^+$ vs. M = 4.54, SD = 1.29 for unaware CSs$^-$), $F(1, 25) < 1$, *ns* (see Figure 3).

Discussion

Experiment 2 replicated the findings of Experiment 1 even though we adopted a more stringent criterion for contingency

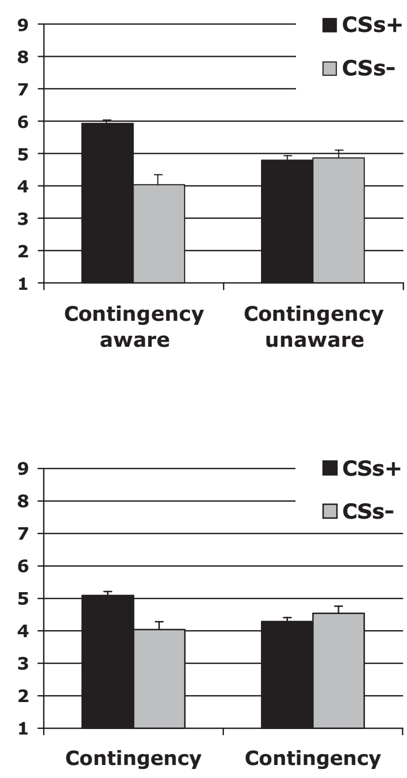

Figure 3. Mean evaluation of CSs$^+$ and CSs$^-$ on contingency aware and contingency unaware CSs (Experiment 2). Top: Global feelings measure. Bottom: Evaluative index. Higher values in both cases reflect more positive attitudes about the brand product. CS = conditioned stimulus.

awareness. Specifically, our item-based analysis confirmed the existence of EC effects on contingency aware CSs but not on contingency unaware CSs. In contrast, the more traditional, and admittedly questionable, correlational analyses failed to reveal stable relations between contingency awareness and EC, showing nonsignificant correlations in this second experiment.

Experiment 2 also allowed a closer examination of the inferential account of the findings, according to which participants selected the valence of the US on the basis of their evaluative judgment of the CS. This account requires that EC effects also be obtained when participants select an incorrect US with the same valence as the correct one. However, this was not the case, for global feelings ($M = 4.81$, $SD = 1.29$ for CSs^{+} vs. $M = 5.14$, $SD = 1.57$ for CSs^{-}), $F(1, 6) = 0.13$, *ns*, or for the evaluative index ($M = 5.29$, $SD = 1.09$ for CSs^{+} vs. $M = 3.91$, $SD = 1.42$ for CSs^{-}), $F(1, 6) = 4.73$, *ns*. One might argue that the lack of significant findings on these items is due to the low number of available observations (i.e., seven). Note, however, that the scarcity of such cases is also problematic for the inferential account. As a matter of fact, this account cannot easily explain why participants were much more likely to pick correct-valence, correct-content USs rather than correct-valence, incorrect-content USs. In other words, the fact that participants almost always selected the correct US (and not just another US of the same valence) questions the viability of the inferential account, according to which the data collected in the context of the recollection task merely reflected an inferential process.

Impressive as our results may be, it remains that participants' ratings in the above experiments were under voluntary control. As a consequence, the explicit evaluations expressed by our participants are open to the intrusion of a series of influences other than the one we are strictly interested in—namely, valence acquisition via EC. To address this issue, our third experiment used an implicit measure of attitudes, thereby providing us with a better indicator of valence acquisition. In turn, this allowed us to examine and compare the emergence of EC effects on contingency aware and contingency unaware trials in a more satisfactory way.

Experiment 3

In Experiment 3, we sought to generalize the findings of Experiments 1 and 2 by using an implicit and unobtrusive evaluative procedure, namely, the affective priming task (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). In a standard affective priming task (for an alternative implicit measure of attitude, see De Houwer, 2003), a series of positive and negative target stimuli is presented, for which prompt evaluations as either "positive" or "negative" are required. These target stimuli are preceded by brief presentation of a positive or negative prime stimulus (a word or picture). Data show that the time to evaluate the valence of target stimuli is shorter when the prime and the target have the same rather than different valence (for recent reviews, see Klauer, 1998; Klauer & Musch, 2003). This affective priming effect has now been established in a great number of studies. It has been obtained for a variety of stimuli (attitude objects), such as words (Bargh, Chaiken, Govender, & Pratto, 1992; Chaiken & Bargh, 1993; Fazio et al., 1986; Hermans, De Houwer, & Eelen, 1994; Klauer, Rossnagel, & Musch, 1997), nonsense words or pictures of human faces for which an affective meaning was only recently learned (De Houwer, Hermans, & Eelen, 1998; Hermans, Vansteenwegen, Crombez, Baeyens, & Eelen, 2002), simple line drawings (Giner-Sorolla, Garcia, & Bargh, 1994), complex real-life color pictures (Fazio, Jackson, Dunton, & Williams, 1995; Hermans et al., 1994), and odors (Hermans, Baeyens, & Eelen, 1998).

The affective priming effect is based on the automatic processing of the affective valence of the prime. In other words, it is unobtrusive and does not depend on controlled response strategies (Hermans, Baeyens, & Eelen, 1998; Hermans, Crombez, & Eelen, 2000; Hermans, De Houwer, & Eelen, 2001; Hermans, Van den Broeck, & Eelen, 1998). Because CSs are not evaluated in the context of an affective priming task (rather, what is evaluated is a valenced word following a CS prime), this procedure allows one to measure the valence acquired by the CSs without relying on any explicit evaluation of the CSs. Thus, this task is particularly suited for examination of valence acquisition, as it allows one to rule out experimental demand accounts of the obtained effects. Note that only a few studies have used the affective priming paradigm to assess EC effects and indeed successfully so (i.e., Field, 2003; Hermans, et al., 2002; Olson & Fazio, 2002). In sum, the affective priming task can be seen as a relevant tool for assessing the role of contingency awareness in valence acquisition via EC.

Method

Participants

A total of 129 undergraduate students at the Catholic University of Louvain at Louvain-la-Neuve took part in the experiment.

Materials and Procedure

The materials, conditioning procedure, and contingency awareness assessment were similar to those used in the previous experiments with the exception that this time, participants' attitudes were assessed unobtrusively, that is, via an affective priming task. Specifically, immediately after the acquisition phase, participants were told that various words would be presented in the center of their computer screens. For each of these words, they were asked to indicate, as quickly as possible, whether it was positive (by hitting the key labeled *P*) or negative (by hitting the key labeled *N*). To minimize measurement noise, we asked participants to position a finger on the *N* key and another on the *P* key. They were also told that prior to the presentation of the words, pictures would be very briefly exposed, which they would not have to pay attention to. Clearly, their task was only to decide as quickly and as accurately as possible whether the presented words were positive or negative and then indicate their response by pressing the corresponding key.

The affective priming task consisted of 64 randomly presented experimental trials preceded by 8 randomly presented practice trials. A trial consisted of a target presentation (an affective word, written in black Courier New font of size 17, appearing on a white background in the center of the screen) subsequent to a 120-ms presentation of a prime (a CS picture, appearing inside a white square of 6×6 cm in the center of the screen, again on a white background). Primes and targets were separated by a 50-ms blank screen, which resulted in a stimulus onset asynchrony of 170 ms. Intertrial delays were set to 2,000 ms. For the experimental trials, each of the eight CSs was presented eight times, four times followed by a positive word and four times by a negative one. In fact, each CS was followed twice by a specific positive (and a specific negative) word and twice by another specific positive (and another specific negative) word. The four specific different words that were assigned to a given CS were counterbalanced across participants. We also ensured that none of the words was semantically related to the CS prime with which it was paired (based on the results of a pretest). In the eight practice trials, each CS was presented once and followed by either a positive or a negative word (the affective valence of the target word for a given CS was also counterbalanced across participants).

After this affective priming task, the contingency awareness assessment (i.e., recognition task) was administered as a final phase of the experiment.

Results

Data Processing

The data from trials for which an incorrect response was given were excluded from the analyses. In addition, all response latencies shorter than 200 ms or longer than 1,500 ms were excluded to reduce the influence of outlier responses (the same criterion used by Hermans et al., 2002; 4.6% of all observations).

General EC Effects

A significant affective priming (and thus an EC) effect was obtained in that response latencies for affectively congruent pairs were shorter than for affectively incongruent pairs (M = 705.99, SD = 109.75 vs. M = 727.28, SD = 112.45, respectively), $F(1, 127) = 35.56$, $p < .001$.

Correlations Between the EC Effects and the Number of Correctly Reported CS–US Pairings

As in Experiments 1 and 2, we correlated the overall magnitude of the EC effects (i.e., mean differences in the latencies of affectively congruent pairs vs. affectively incongruent pairs) with the number of correctly reported CS–US pairings. This correlation was .03 (*ns*), which may suggest either no significant association between EC and contingency awareness or, more reasonably, the inability of correlational analyses to detect such an association.

EC Effects and Item-Based Assessment of Contingency Awareness

As in Experiments 1 and 2, a CS was categorized as contingency aware when correctly paired with its US picture. The mean number of aware pairings was 6.95 (SD = 1.64) out of a maximum of 8.

We first analyzed the data in the context of a repeated measures ANOVA using affective congruence (affectively congruent vs. affectively incongruent) and CS awareness (contingency aware vs. unaware CSs) as our within-subject factors. Next, we considered the EC effects independently on the aware and unaware CSs.

As far as the repeated measures ANOVA is concerned, there was no indication of the presence of a congruence main effect, $F(1, 55) = 2.44$, *ns*. More important, however, a Congruence $\times$ CS Awareness interaction was obtained, $F(1, 55) = 5.85$, $p < .019$, with an affective priming effect on contingency aware but not on contingency unaware CSs (M = 702.55, SD = 115.48 for congruent aware; M = 727.24, SD = 127.46 for incongruent aware; M = 718.85, SD = 129.13 for congruent unaware; M = 713.19, SD = 125.48 for incongruent unaware).

We then considered the EC effects separately for the contingency aware and contingency unaware CSs. A significant affective priming (i.e., EC) effect was obtained on contingency aware CSs (M = 704.31, SD = 111.24 for affectively congruent pairs vs. M = 727.76, SD = 117.25 for affectively incongruent pairs), $F(1, 126) = 35.38$, $p < .001$. In contrast, no affective priming effect emerged for contingency unaware CSs (M = 718.46, SD = 128.00 for affectively congruent pairs vs. M = 713.76, SD = 124.43 for affectively incongruent pairs), $F(1, 56) = 0.19$, *ns* (see Figure 4). Note that again, neither did an EC effect occur when considering CSs for which participants did not indicate the correct US but indicated one of the same valence (M = 726.16, SD = 152.31 for congruent pairs vs. M = 743.58, SD = 112.84 for incongruent pairs), $F(1, 29) = 0.54$, $p < .47$.[3]

Discussion

The results obtained in Experiments 1 and 2 using an explicit verbal evaluative measure were replicated in the context of a task throughout the course of which evaluative responses were assessed unobtrusively by way of an affective priming procedure. Specifically, response latencies were shorter for affectively congruent pairs than for affectively incongruent pairs when considering the aware CSs. In contrast, this difference was not significant when considering the unaware CSs. The use of the affective priming task in this experiment made it extremely difficult for the participants to deliberately respond in certain ways. The findings go a long way to suggest that the role of contingency awareness is already effective on the early valence acquisition stage. In other words, contingency awareness is required not only for the formation of explicit attitudes but also for the development of noncontrolled, implicit attitudes.

General Discussion

The EC literature suggests that associative processes are involved in the acquisition and modulation of likes and dislikes.

[3] Complementary analyses conducted after log transformation of the reaction times further corroborated the evidence for the necessity of contingency awareness in EC. Again, the repeated measures ANOVA (using affective congruence and CS awareness as our within-subject factors) failed to indicate the presence of a congruence main effect, $F(1, 55) = 3.61$, *ns*. More important, however, a Congruence $\times$ CS Awareness interaction was obtained, $F(1, 55) = 5.01$, $p < .03$, with an affective priming/EC effect occurring on contingency aware but not on contingency unaware CSs (M = 2.83, SD = 0.01 for congruent aware; M = 2.85, SD = 0.01 for incongruent aware; M = 2.84, SD = 0.01 for congruent unaware; M = 2.84, SD = 0.01 for incongruent unaware). And again, when considering the effect on the contingency aware and contingency unaware CSs separately, a significant affective priming/EC effect was obtained on the contingency aware CSs (M = 2.83, SD = 0.06 for affectively congruent pairs vs. M = 2.85, SD = 0.06 for affectively incongruent pairs), $F(1, 126) = 47.74$, $p < .001$, whereas no affective priming/EC effect emerged on the contingency unaware CSs (M = 2.84, SD = 0.07 for both affectively congruent and affectively incongruent pairs), $F(1, 56) = 0.03$, *ns*.

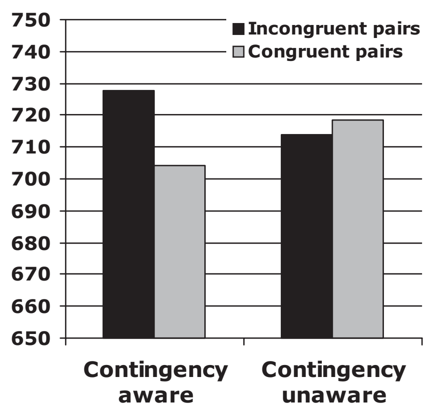

Figure 4. Mean response times (in milliseconds) for affectively congruent and incongruent trials in the affective priming task on contingency aware and contingency unaware CSs (Experiment 3). CS = conditioned stimulus.

However, the conditions under which these processes emerge have long been a matter of controversy, as revealed by the debate concerning the role of contingency awareness in EC. We argue that a relevant test of the role of contingency awareness in EC requires the incorporation of strong experimental designs, sensitive and objective assessments for contingency awareness, and item-based—as opposed to the more problematic participant-based and correlational—analyses.

To examine these important issues, we conducted three experiments in which we conditioned four CS–US^{+} and four CS–US^{-} parings, the contents of which were counterbalanced across participants. The participant-based analysis conducted in Experiment 1 revealed that even participants (apparently) showing no or low contingency awareness expressed more positive attitudes toward the CSs^{+} than the CSs^{-}. As for the analyses correlating the magnitude of the EC effects with the number of correctly reported CS–US pairings, they failed across the experiments to provide reliable information about the role of contingency awareness with regard to EC effects. These findings may be considered as indicative that contingency awareness is not necessary for EC to occur. Our claim, however, is that participant-based and correlational analyses are misleading. On the one hand, the participant-based approach disregards the fact that participants are rarely either aware or unaware of all CS–US contingencies (see also Field, 2000, 2001). On the other, our findings suggest that correlational analyses conducted at the interindividual level may prove problematic when one wishes to address the issue of contingency awareness in the context of EC (see also Lovibond & Shanks, 2002, for problems linked to correlational analyses in conditioning). This is because these analyses are sensitive to restriction-of-range issues. This limitation is less likely to apply to analyses that examine the data at the intraindividual level, such as the ones we relied on in the present research (i.e., item-based analyses). Interestingly enough, the present study confirms that the latter type of analyses is sensitive enough to detect the role of awareness even in the presence of very unbalanced numbers of contingency aware versus unaware items, provided there is a sufficient number of items in total.

The item-based analyses we conducted revealed EC effects only on CSs that could be correctly linked to the valence (Experiment 1) or content (Experiments 2 and 3) of the USs they had been paired with. The use of item-based, within-subject analyses revealed that the role of contingency awareness in EC is both effective (i.e., in spite of the availability of a fair sample size, no EC effect emerged on the contingency unaware CS–US pairings) and reliable (i.e., the necessity of contingency awareness was consistently found in three experiments using explicit and implicit evaluative measures). Together, the open-ended questions used in Experiment 1 and, even more so, the implicit nature of the evaluative responses in Experiment 3 (creating a situation in which participants would have found it extremely difficult to deliberately respond in certain ways) allow us to argue that our results are not attributable to experimental demands. Finally, the results obtained in the last experiment suggest that the role of contingency awareness in EC can be traced back to the valence acquisition stage and is effective in the formation of both explicit (controlled) and implicit (more automatic) attitudes.

Practical and Theoretical Implications of the Present Findings

At the practical level, our results suggest that social marketers and advertisers may benefit from being both overt and consistent concerning the affective stimuli they associate with their brands. Indeed, conditioning may be effective only when CS–US pairings are fairly rooted in consumers' minds. Another practical contribution of the present research lies in the simultaneous pairing procedure adopted. Whereas in visual EC studies the CS is typically presented prior or sometimes subsequently to the US (i.e., forward and backward conditioning), our investigation demonstrates that EC can be obtained with a conditioning procedure that presents the CS–US pairing in one instance. This procedure yields ecological advantages in that the simultaneous presentation of stimuli can be more easily implemented in the real world (e.g., with billboard advertising). Finally, the use of everyday products and behavioral intention measures also greatly contributes to the practical significance of our findings.

At the theoretical level, the present findings question conclusions drawn by previous EC studies that have been reported in the emotion and social cognition literature, as they indicate that EC does not occur in the absence of contingency awareness. This finding may be interpreted as indicative that contingency awareness *causes* EC effects (the strong stance). Alternatively, this finding may suggest that EC and contingency awareness are caused by a third underlying factor (the weak stance). The amount of attention directed toward the CS may serve as a plausible candidate here. Several authors have suggested that attention directed toward a CS increases the strength of the associative connection between that CS and its US (e.g., Mackintosh, 1975; Rescorla & Wagner, 1972). This associative effect may in turn enhance both EC effects and contingency awareness. The role of attentional processes has been supported in recent studies that reported reduced EC effects among participants engaged in a secondary task during the conditioning phase (i.e., counting backward from 300; see Field & Moore, 2005) and enhanced EC effects among highly involved participants and those scoring high in need for cognition (Priluck & Till, 2004).

The present studies cannot—and were not designed to—disentangle between these strong and weak stances. But at the very least, they suggest that valence acquisition via EC will emerge only when there is also contingency awareness. To some extent, the latter issue is reminiscent of the current debates concerning the somatic marker hypothesis (SMH; Damasio, Tranel, & Damasio, 1991), a widely discussed hypothesis in the affective learning literature. Whereas the paradigm typically used for addressing the SMH (i.e., the Iowa Gambling Task) has long been considered cognitively impenetrable, recent research that adopted more sensitive awareness assessments raised serious doubts about this assumption (Maïa & McClelland, 2004; see Dunn, Dalgleish, & Lawrence, 2006, for a critical assessment of the SMH), thereby leaving the door open for alternative interpretations of the effect.

More generally, the findings reported here also pertain to the literature on implicit cognition and, more specifically, implicit learning. As Shanks (2005) suggested in a recent review of implicit learning, "[B]earing in mind that conditioning represents one of the simplest learning preparations imaginable, . . . [stating] that conditioning does not occur without awareness would seem to place a very major question mark over the possibility of learning without awareness" (p. 208). It would thus seem that the present research may contribute to advancing our understanding of implicit learning processes.

Apparent Discrepancies Between the Present and Past Research

The present findings cast doubts on two sets of studies that were interpreted as revealing strong and consistent evidence that EC is independent of contingency awareness. The first set of studies used "subliminal" stimulus presentation (De Houwer et al., 1994; De Houwer, Hendrickx, & Baeyens, 1997; Krosnick et al., 1992; Niedenthal, 1990) and assumed that if the CS or US of a CS–US pairing were exposed "subliminally" it would be unlikely for participants to become aware of that pairing. Of interest, the studies by Krosnick et al. (1992) as well as those by Niedenthal (1990) were questioned on methodological grounds. To be sure, a nontrivial issue is that these studies relied on between-subjects designs. Specifically, in these studies some participants were presented with positive USs and others with negative ones, thereby leaving open the possibility that the positive and negative USs induced nonassociative changes in affects in these groups (Lovibond & Shanks, 2002). As for the studies by De Houwer et al. (1994, 1997), inconsistencies in the results cast doubts on the reliability of their effects (Lovibond & Shanks, 2002). Two of the five experiments (including that by De Houwer et al., 1994) failed to find evidence of conditioning, and in one of the three experiments that reported successful conditioning, the effect was dependent on the CSs used.

It may be noted that an EC experiment by Fulcher and Hammerl (2001, Experiment 3) also used brief US presentations (i.e., smiling or frowning faces exposed for either 12.5, 25, 50, or 125 ms) prior to the presentation of the CSs (i.e., Chinese ideographs). During this conditioning phase, participants were asked to make a forced-choice decision on whether the rapidly presented faces were smiling or frowning. The results indicated that, overall, participants were unable to recognize the facial expression when one frame was presented but that recognition accuracy increased with exposition time. Although participants were unable to recognize the US presented for merely 12.5 ms, an EC effect emerged, but only for individuals who scored low on a reactance measure, whereas an opposite (i.e., contrast) effect occurred for the high-reactance participants. De Houwer et al. (2001) has already noted the small magnitude of the observed EC effects (as in the above-mentioned "subliminal" EC studies) as well as the low reliability of the findings. One may also claim that this experiment fails to yield reliable results with reference to the relation between contingency awareness and EC in that only awareness of the US exposition (and not of the contingency knowledge) was assessed.

In a recent investigation conducted by Dijksterhuis (2004), participants' "self" was successfully conditioned via an associative procedure involving subliminal presentations. However, as interesting as these results may be, one might doubt that they fall into the realm of EC effects. Most selves are probably associated with both positive and negative attributes and schemas, the level of activation of which may be enhanced through processes unrelated to learning. In other words, these studies may have more to do with self-construal than with implicit learning effects. Even more problematic is the fact that five of the six studies compared a condition in which the self was associated to positive words (conditioned-self condition) with a condition in which the self was associated to neutral words (control condition). As acknowledged by the author, this design may have resulted in diffuse mood effects, because only positive words were activated in the conditioned-self condition. In a sixth experiment (i.e., Experiment 2), positive words were activated in both the control and conditioned-self conditions, but the self was activated in the latter condition only, thereby unbalancing the "CS" (i.e., self) presentations for the control and conditioned-self conditions.

In our opinion, the strongest subliminal study reporting EC effects is that of Field and Moore (2005, Experiment 2). The authors reported evidence for EC effects of similar magnitude on subliminally and supraliminally presented CS–US pairings. In a first experiment, they used supraliminal presentations and examined EC effects at the per-contingency level of analysis. This was done by testing a statistical model in which within-subject evaluations of four CSs (two CSs^{+} and two CSs^{-}) were predicted by a between-subjects factor (i.e., participants were randomly assigned to a distraction or an enhanced attention condition), controlling for four varying covariates that reflected participants' level of awareness for each of the four CS–US pairings and four varying covariates that reflected participants' evaluation of the CSs before the conditioning phase. In this study, the parameters for the awareness covariates proved to be nonsignificant.

It is important to note that Field and Moore (2005, Experiment 1) examined the role of awareness by considering data obtained in conditions where either participants were all aware of the contingencies (i.e., attention enhanced condition) or no evaluative conditioning effect was found (i.e., distraction condition). This state of affairs may be suboptimal for a proper test of the role of awareness in EC. It should further be noted that Field recently obtained findings that strongly suggest the role of awareness in EC. Indeed, he acknowledges that the conclusions we reached in the present study appear "entirely consistent with what [he is] now experiencing" (A. P. Field, personal communication, January 20, 2006), in the context of different designs. Note that earlier work by Field had also raised doubts as to whether EC could emerge in the absence of contingency awareness (Field, 2000).

A second set of studies that could be regarded as indicative that attitudes can be conditioned in the absence of contingency awareness comes from Olson and Fazio (2001, 2002). In one of their experiments, the awareness measure consisted of a difference score that reflected participants' confidence when reporting a correct versus an incorrect covariation estimate (Olson & Fazio, 2001, Experiment 1). The authors showed that their EC effect was not correlated with this awareness score. Because only one CS^+ and one CS^- were used in that study, the correlation analysis they reported is reminiscent of the item-based analyses we conducted here. However, the awareness measure applied is conceptually different from the one used in the present research in that it reflected participants' relative confidence in correct and incorrect contingency judgments. This assessment of contingency awareness relies on the theoretical assumption that confidence relates linearly to awareness (e.g., holding constant the confidence level on a correctly reported covariation, a participant is considered more aware of the true nature of this covariation when providing very confidently, as compared with moderately confidently, a correct covariation estimate). Also, leaving methodological or measurement considerations aside, it should be noted with regard to Olson and Fazio's divergent pattern of results that the confidence data in our experiments showed little relationship either to accuracy of US identification or to affective ratings.

In two other experiments reported by Olson and Fazio (2001, Experiment 2; 2002), the awareness assessment procedure relied on a funneled questionnaire whose last and most direct contingency awareness item read, "Did you notice anything unusual about the words and images that were presented with the Pokemon Metapod and Shelder?" Both Shanks and Dickinson (1990) and Field (2000) convincingly discussed the limitations of such a broad assessment of contingency awareness, which relies on verbalization reports and likely combines contingency and demand awareness. It is our opinion that one should prefer recognition questionnaires in which the participants must select the correct CS–US contingency compared with recall assessments for awareness (see Dawson & Reardon, 1973, concerning the relative sensitivity of recall and recognition tests of contingency knowledge). The risk of miscategorizing a participant as contingency unaware increases if the task is characterized by restricted potential for demonstration of access to a memory trace for the contingency (i.e., recall relative to recollection). Conceptually, awareness assessments that use a recall task would assume, say, that people should be considered as unaware of the name of a colleague if they are unable to recall her name on the spot, even though they are perfectly able to identify her name in the context of a recollection task. Most readers would agree that such a definition of unawareness is very liberal. Finally, it would also seem more legitimate to draw conclusions on the basis of significant findings (the significant moderation of EC by contingency awareness replicated in the three studies reported here) rather than nonsignificant ones (the nonsignificant results obtained on the covariate parameters in the two studies reported by Field & Moore, 2005, as well as the nonsignificant correlations reported by Olson & Fazio, 2001, 2002).

The contrast between our findings and the position advanced by other researchers who have not only claimed that EC operated unconsciously but also suggested that contingency awareness may inhibit rather than facilitate EC (Fulcher & Hammerl, 2001; Hammerl & Fulcher, 2005; Hammerl & Grabitz, 2000; Walther, 2002) cannot be overestimated. As noted in the introduction (or in the above discussion, as to Fulcher & Hammerl, 2001, Experiment 3), these studies are questionable on methodological grounds. Walther (2002) used participant-based analyses and combined contingency awareness and demand awareness (broad) criteria in order to assign participants to an awareness category. Using haptic stimuli, Hammerl and Grabitz (2000), Hammerl and Fulcher (2005), and Fulcher and Hammerl (2001, Experiments 1 and 2) categorized their participants in an "aware" or an "unaware" subgroup according to whether they were able to report (almost) all or (almost) none of the USs out of the CS–US pairs used. As for the last experiment by Fulcher and Hammerl (2001, Experiment 3, mentioned above), which used visual stimuli, the awareness measure dealt with the valence of the briefly exposed US rather than with the CS–US contingencies.

Limitations and Perspectives for Future Research

It is important to state again that the present study did not intend to draw definitive conclusions about EC effects or the role of awareness in general. As correctly noted by De Houwer et al. (2005), the processes involved in EC effects may depend on the nature of the stimuli used. Conclusions obtained in the context of visual stimuli may not hold for other stimuli categories, such as taste or odor (e.g., Baeyens, Eelen, Van den Bergh, & Crombez, 1990; but see Field & Davey, 1997, 1998; Field, 2005). Therefore, a question of importance for future research is whether the conclusions presented here generalize to other categories of stimuli, including tastes and odors. More generally, future research might provide supportive evidence that EC emerges in the absence of contingency awareness and that it does so even in the context of visual stimuli. However, the present research does suggest that this claim remains premature and needs stronger empirical evidence.

Another limitation of our study may arise from the fact that, as in most EC experiments, contingency awareness was measured after the conditioning and evaluation phases. Shanks and St. John (1994) noted that post hoc assessments of contingency awareness are problematic in that a lack of reported awareness at the time of assessment may not necessarily imply that there was no awareness during the conditioning phase or even during the test phase. According to this argument, it would be preferable to assess contingency awareness during conditioning rather than afterward. This assumption has been supported by Fulcher and Cocks (1997), who demonstrated that the post hoc nature of awareness measures may lead to an underestimation of levels of awareness. As already mentioned, however, asking participants at the moment the CS is presented whether they expect the US is also likely to direct attention to that relationship. In a study by Baeyens and colleagues (1990), the proportion of CS–US pairings reported in a postconditioning recognition task increased from 18% to 77% when participants were completing a concurrent assessment that consisted of predicting which type of US (liked, disliked, or neutral) would follow each CS during the actual conditioning phase. In any case, one would have a difficult time arguing that our post hoc assessment of contingency awareness invalidates our conclusion that EC is contingent on contingency awareness. If anything, interference and effects of oblivion should have operated against our findings by artificially inflating EC effects on contingency unaware CSs, owing to misclassification of contingency unaware items. Thus, even though we would readily agree that our post hoc assessment of contingency awareness may face sensitivity issues, one should note that it was sensitive enough to demonstrate that valence acquisition via EC is dependent on contingency awareness. It might also be mentioned here that a study of evaluative learning (using physiological indices of stimulus valence) carried out by Purkis and Lipp (2001) in which contingency awareness was assessed online with an expectancy dial failed to find evidence for evaluative learning in unaware participants or in aware participants before they became aware.

Another potential limitation may relate to the relatively high levels of awareness in our experiments. A substantial amount of data therefore needed to be neglected when aware and unaware items were compared within participants (i.e., 61 out of 96 in Experiment 1, in which a recall task was used; 23 out of 106 in Experiment 2, in which a recollection task was used; 57 out of 129 in Experiment 3, also with the recollection task). This was due to the fact that only a limited number of participants showed both contingency awareness simultaneously on at least one CS^+ and one CS– *and* contingency unawareness on at least one CS^+ and one $CS^–$. However, this problem was circumvented by considering the EC effects separately on the aware CSs^+ and $CSs^–$ and on the unaware CSs^+ and $CSs^–$. These analyses were carried out on a large number of observations, because many more participants were simultaneously aware on at least one CS^+ and one $CS^–$ *or* simultaneously unaware on at least one CS^+ and one $CS^–$ (i.e., n = 89 for aware CSs and n = 68 for unaware CSs in Experiment 1; n = 101 for aware CSs and n = 27 for unaware CSs in Experiment 2; and n = 128 for aware CSs and n = 58 for unaware CSs in Experiment 3). Moreover, if anything, data for unaware CSs were in the direction opposite that of the EC effects (i.e., CSs^+ rated more negatively than $CSs^–$).

On a related note, it might be argued that our awareness measures were somewhat oversensitive, thus potentially promoting consideration of a CS as aware when in fact it was not (i.e., a participant may have indicated by mere chance the right US of a pairing of which he or she was actually unaware). Such an account is undermined by the facts that participants had the option to indicate that they had no idea about the correct US and that when they pointed out a US they almost always selected the correct one (and not just another US of the same valence). The likelihood of participants indicating the correct US by chance was only 1/8 in our two last experiments, a probability smaller than that found in most EC experiments that rely on broader criteria for contingency awareness (e.g., recall of merely the US valence, or use of open-ended questions, which can easily lead to a conclusion of awareness). In any case, this state of affairs should not have prevented us from finding an EC effect for unaware CSs (i.e., "no EC in the absence of contingency awareness").

Conclusions

EC is a ubiquitous phenomenon involving important theoretical and practical implications. A better understanding of EC would provide key theoretical insights about the processes involved in learning and memory. It would also constitute a notable contribution for numerous clinical, social, marketing, or even political phenomena in which the acquisition of likes and dislikes is of major importance. The findings reported here demonstrate that, provided that appropriate designs, sensitive assessments of contingency awareness, and sensitive analytic strategies are being used, EC seems not to be found in the absence of explicit access to the content of CS–US associations in memory. This pattern was obtained using both explicit and implicit evaluation tasks (where the CSs were not directly evaluated), thus strongly suggesting that contingency awareness is required for valence acquisition via EC (in the context of explicit as well as implicit attitudes). In all experiments, there was essentially no sign of EC on pairings that participants were unable to report. The pattern of findings appears to be both clear cut and replicable. It contradicts the prevailing view concerning the relationship between EC and contingency awareness. As we discussed, our findings may mean that valence acquisition in EC is either caused by or simply co-occurs with participants' awareness of the CS–US associations.

The present research was not aimed at putting an end to the passionate debate concerning the possibility of purely affective learning processes, or regarding the extent to which EC represents a nonpropositional form of learning that is distinct from Pavlovian conditioning. Rather, our ambition was to clarify the role of contingency awareness in EC. We hope to have achieved this goal by reporting a set of findings that strongly suggest the part played by contingency awareness in EC. Of interest, our data show that this role is already effective at the valence acquisition stage. As additional insights, the studies reported here cast serious doubts on the reliability of participant-based and correlational analyses for examining these effects and confirm the importance of adopting sensitive and objective rather than vague and subjective assessments of awareness. Finally, because we used ecological materials and procedures, the present research should prove useful for practitioners interested in gaining a better understanding of the modulation of likes and dislikes.

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Appendix

IAPS Numbers of the US Pictures Used in Experiments 1, 2, and 3

Experiment and valence	IAPS numbers
Experiment 1	
USs+	2387, 2442, 4608, 4700
US−	2715, 2750, 6360, 6561
Experiments 2 and 3	
USs+	4608, 4700, 8200, 8460
US−	2715, 2750, 6360, 6561

Note. IAPS = International Affective Picture System; US = unconditioned stimulus.

Received January 23, 2006
Revision received May 23, 2006
Accepted May 25, 2006 ■