Published in final edited form as:
J Pers Soc Psychol. 2009 May ; 96(5): 933–948. doi:10.1037/a0014747.

Implicit Misattribution as a Mechanism Underlying Evaluative Conditioning

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Abstract

Evaluative conditioning (EC) refers to the formation or change of an attitude towards an object following that object's pairing with positively or negatively valenced stimuli. We provide evidence that EC can occur through an implicit misattribution mechanism in which an evaluative response evoked by a valenced stimulus is incorrectly and implicitly attributed to another stimulus, forming or changing an attitude towards this other stimulus. Five studies measured or manipulated variables related to the potential for the misattribution of an evaluation, or "source confusability." Greater EC was observed when participants' eye gaze shifted frequently between a valenced and neutral stimulus (Studies 1 & 2), when the two stimuli appeared in close spatial proximity (Study 3), and when the neutral stimulus was made more perceptually salient than the valenced stimulus due to its larger size (Study 4). In other words, conditions conducive to source confusability increased EC. Study 5 provided evidence for multiple mechanisms of EC by comparing the effects of mildly evocative valenced stimuli (those evoking responses that might more easily be misattributed to another object) to more strongly evocative stimuli.

Keywords

evaluative conditioning; attitudes; attitude formation; misattribution

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Social psychological theory on attitude formation has historically received comparatively little attention compared to other aspects of attitude theory such as structure, function, and change (Eagly & Chaiken, 1993). One theoretically underdeveloped area of inquiry into attitude formation is called evaluative conditioning (EC). EC occurs when an attitude towards a stimulus forms or changes due to that object's pairing with positively or negatively valenced stimuli. An object's "mere spatio-temporal co-occurrence" with a valenced stimulus can affect subsequent evaluations of that object (Baeyens, Vansteenwegen, Hermans, & Eelen, 2001). Staats and Staats (1958) introduced the notion that such mere association could form attitudes, likening the phenomenon to Pavlovian classical conditioning and importing from it the terms conditioned stimulus (CS) and unconditioned stimulus (US) to refer to the object that receives valence and gives valence, respectively. In their work, CS words (nationalities like Swedish and German) were projected onto a screen as the experimenter spoke aloud US words (like gift, happy, bitter, and failure) such that one nationality was consistently paired simultaneously

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with positive words and another was paired with negative words. In a cover story, participants were told the experiment concerned simultaneous learning and their task was only to learn both lists. Participants later judged the nationality paired with positive words to be more pleasant than the nationality paired with negative words.

Evaluative Conditioning and Pavlovian Conditioning

Later research exposed major differences between attitudinal conditioning and Pavlovian classical conditioning (PC), aside from the basic distinction that the former concerns attitudes and the latter typically focuses on behaviors. Martin and Levey first introduced the term “evaluative conditioning” in 1978. Thus, theory distinct to EC is a relatively recent development. EC has been described as a phenomenon similar at a procedural level to PC, but as a distinct type of learning at the psychological process level (for a review, see De Houwer, Thomas, & Baeyens, 2001). On one hand, Pavlovian classical conditioning (PC) reflects a kind of signal or expectancy learning in which the CS acts as a signal for the occurrence of a US in a particular context (Rescorla, 1988). In PC, a reflexive, conditioned response to the CS develops that prepares the organism for the US. EC, on the other hand, does not necessarily reflect signal learning and often displays functional properties inconsistent with signal learning. For example, in PC when the CS is presented repeatedly in the absence of the US, no longer signaling its occurrence, extinction happens; the conditioned response disappears. EC, in contrast, is more resistant to extinction (Baeyens, Crombez, Van den Bergh, & Eelen, 1988). Following conditioning, CS presentations in the absence of the US do not tend to eliminate EC effects. Another functional property of PC is its sensitivity to the statistical contingencies of CS-US co-occurrence, in other words, the consistency with which the two co-occur. The utility of a signal depends, of course, on the reliability with which it predicts an event. Consequently, the acquisition of a response in PC is sensitive to the statistical contingency between CS and US occurrence. Studies involving manipulations of CS-US statistical contingency in EC procedures have not revealed EC to be sensitive to such contingencies but instead to the absolute number of CS-US pairings (e.g. Baeyens, Hermans, & Eelen, 1993). Based on the characteristics differentiating it from PC, EC has been argued to reflect a fundamentally different kind of learning produced by processes distinct from those of PC (e.g. Baeyens, Eelen, Crombez, & Van den Bergh, 1992; Martin & Levey, 1994).

Though EC appears to be distinct from PC, this does not imply that PC is irrelevant to attitudes. Traditional PC research has focused on the development of a conditioned response rather than the evaluative consequences of conditioning procedures for the CS, but such consequences can occur. Consider, for example, an initially neutral tone (CS) that signals the onset or cessation of a painful shock. These outcomes can produce disliking or liking for that signal (e.g. Cacioppo, Marshall-Goodell, Tassinary, & Petty, 1992; Zanna, Kiesler, & Pilkonis, 1970). Developing an evaluative response to a signal of a hedonically relevant event, much like developing a conditioned behavioral response, can have functional value in preparing the learner for the impending event. Nevertheless, not all EC studies can be explained from a PC perspective. First, many EC methodologies are unlike PC methodologies and make it difficult to argue that participants are learning that the CS signals the impending occurrence of a hedonically consequential event (e.g. Staats & Staats, 1958). Second, as already mentioned, various studies find that the functional properties of EC (like resistance to extinction) are inconsistent with what would be expected if CS liking varied as a function of the signal value of the CS.

Evaluative Conditioning Theory

Recently, EC has garnered revived interest from social psychologists (see Walther, Nagengast, & Trasselli, 2005). Although important demonstrations of conditioning-related phenomena have been reported (e.g. Dijksterhuis, 2004; Jones, Pelham, Carvallo, & Mirenberg, 2004; Walther, 2002), evaluative conditioning itself remains poorly understood. Inconsistent empirical findings abound in EC research, such as in the much contested issue of the of the relationship between EC and contingency awareness (Fulcher & Hammerl, 2001; Pleyers, Corneille, Luminet, & Yzerbyt, 2007; Walther & Nagengast, 2006), as in whether an intact amygdala is necessary for EC (Coppens, Vansteenwegen, Baeyens, Vandenbulcke, Van Paesschen, & Eelen, 2006; Johnsrude, Owen, White, Zhao, & Bohbot, 2000), or as in the extent to which EC is resistant to extinction (Baeyens et al., 1988; Lipp, Oughton, & LeLievre, 2003). EC also remains a notably ephemeral phenomenon subject to unexplained failure (for a discussion, see Rozin, Wrezesniewski, & Byrnes' (1999) aptly titled article "The elusiveness of evaluative conditioning"), indicating that its boundary conditions remain poorly understood (De Houwer, Thomas, & Baeyens, 2001).

The inconsistency of findings regarding the characteristics of EC and of the very effect itself raises questions about its underlying mechanism. These unresolved problems in the literature increasingly point to the likelihood that mere co-occurrence between objects can influence attitudes in multiple ways. Researchers may be studying different phenomena that share the outcome of a transfer of valence. Indeed, most empirical endeavors have not been explicitly tied to a particular theoretical model of EC. We agree with recent theorizing that EC is best defined as an *effect* (rather than a process or theory) and thus could come about in multiple ways (De Houwer, 2007). By delineating various models of EC and matching them to compatible experimental procedures, frameworks will exist to specify what moderators and boundary conditions characterize EC *when produced through a particular mechanism*. Towards this end, we propose a novel conceptual model of EC in which an evaluation evoked by the US is implicitly misattributed to the CS.

An Implicit Misattribution Model

People are commonly observed making mistaken attributions about their psychological experiences, and this seems particularly true of affective or evaluative experiences. The specific cause of one's feelings is not always evident, and they are therefore subject to processes of attribution. A classic example of such (mis)attribution in social psychology was in research conducted by Schachter and Singer (1962). Their two-factor theory of emotion posits that emotion reflects the combination of affective arousal and appropriate cognition, cognition reflecting contextual information that gives emotion fuller psychological meaning. Schachter and Singer (1962) injected participants with a shot of "suproxin," actually adrenaline, and found that the ambiguous state of arousal was malleable with respect to context and could be mistaken for other feelings when that arousal was attributed to an angering or euphoric event. More recently, Russell (2003) theorized that emotional experience is initiated by activations of the underlying affective dimensions of valence and arousal, forming *core affect*. In his model of an emotional episode, a crucial component is the attribution of core affect to a perceived cause, which is sometimes obvious and sometimes not.

Evidence for such misattribution of affect was offered by Schwarz and Clore (1983), who showed that individuals' momentary affective states caused by the weather could be misattributed to a sense of general life satisfaction, but not when the immediate, local cause of that affect was made salient. Storms and Nisbett (1970) found that insomniacs responded differently to placebos depending on what effect they were led to believe these placebos would have, which influenced interpretations of their later nighttime arousal. Ironically, when participants expected placebos to increase arousal, they interpreted their arousal as externally caused (by the pill) and actually managed to sleep sooner; but when participants expected the placebos to decrease arousal, they interpreted their arousal as internally caused (by themselves) and fell asleep later than usual. These studies, which are a mere sampling of research in the misattribution tradition (see also Dutton & Aron, 1974; Zanna & Cooper, 1974; Zillman, Katcher, & Milavsky, 1972) suggest that internal states can be experienced differently according to the nature of salient environmental cues and other sources (e.g. past experience, disposition, etc.) to which they might reasonably be attributed.

Such misattribution may be one way to produce EC. The proposed mechanism is one in which the transfer of valence from CS to US occurs as a result of an implicit misattribution process. Because the actual source of an experienced evaluation is not always clear to individuals, it can be subject to misattribution. EC occurs when an evaluation of the US is mistakenly attributed to the CS, and consequently the CS comes to acquire the valence originally associated with the US. We refer to this process as implicit because individuals are not required to explicitly engage in thoughtful evaluation of either object. Instead, the process is presumed to begin with exposure to a US automatically activating the associated attitude (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). The process is also viewed as implicit in that individuals are not necessarily thought to experience uncertainty regarding the source of an experienced evaluation, nor are they thought to consciously scan their environment, searching for the source of an evaluation. Moreover, while individuals have introspective access to the outcomes of attributional processes they need not have introspective access to the processes themselves (Nisbett & Wilson, 1977). Rather, the linking of experienced evaluations to external causes is believed to occur at an early stage of perceptual-cognitive processing. In sum, we view the sort of misattribution that would typically produce EC as generally exhibiting features of implicit processing.

Direct evidence that evaluative transfer can occur rapidly in a single episode comes from the affect misattribution procedure (Payne, Cheng, Govorun, & Stewart, 2005) and the foundational research upon which it is based (Murphy & Zajonc, 1993). In this research, participants made pleasant/unpleasant judgments about evaluatively neutral pictographs. These pictographs were immediately preceded by valenced prime stimuli. Participants were more likely to judge the pictograph to be pleasant when it was preceded by a positive than a negative stimulus, even when instructed not to allow the primes to bias responses to the pictographs. Effectively, then, participants were mistaking their reactions to the primes for reactions to the pictographs.

Another phenomenon relevant to the implicit misattribution mechanism comes from the visual perception literature. “Illusory conjunction,” also called “feature migration,” involves incorrectly combining the visual features of two or more objects. Treisman and Schmidt (1982) first introduced the concept with an anecdote involving a man about to greet a seemingly recognized colleague on a busy street when “he realized that the black beard belonged to one passerby and the bald head and spectacles to another” (p. 109). They empirically demonstrated the phenomenon in a variety of experimental tasks. For example, under certain conditions, exposures to a display containing a red T, a blue N, and a green X were often followed by the illusory conjunction report of having seen a blue T. Subsequent research assessing guessing rates more firmly established that the phenomenon involves true errors of feature integration (Ashby, Prinzmetal, Ivry, & Maddox, 1996). While we have no desire to push the parallel too far, illusory conjunction provides an intriguing example of the sort of transfer of stimulus elements that appears similar to EC. Of course, evaluative responses are not stimulus elements per se, but as previously noted such responses are known to occur early in visual processing (e.g., Murphy & Zajonc, 1993; Roskos-Ewoldsen & Fazio, 1992). Moreover, they seem no more inextricably bound to their sources than do visual stimulus features. The source of a given affective experience is often unclear, and thus attribution has been afforded a major role in theories of affect (Schachter & Singer, 1962; Russell, 2003). In sum, both the social psychological literature on the misattribution of affect and the visual perception literature on feature migration provide a basis for suggesting that EC may involve an implicit process of misattribution.

Overview

Five studies tested the implicit misattribution model using a common logic. If EC occurs through misattribution, then it will be moderated by variables that affect the likelihood that an evaluation of the US might be misattributed to the CS. We refer to this likelihood as “source confusability,” which could be increased or decreased in various ways. Predictions about source confusability can be drawn straightforwardly from the attribution literature. Broadly, source confusability is high when the CS and US are compatible in the sense that evaluation evoked by the US could plausibly have been evoked by the CS, when the source of the experienced evaluation is ambiguous, and when the CS and US are processed in close temporal continuity. Some minimal level of source confusability is necessary for EC to plausibly occur through implicit misattribution. The present studies measure or manipulate variables influencing the likelihood of source confusion and measure their influence on EC.

All five studies share a computer-based EC procedure designed to minimize the likelihood that participants would exhibit contingency or demand awareness (see Olson & Fazio, 2001). Demonstrations of the procedure’s ability to produce EC with novel CS stimuli (Olson & Fazio, 2001; 2002) and to influence previously learned attitudes (Olson & Fazio, 2006) are available. These conditioning effects have been indicated by explicit measures of attitude (Olson & Fazio, 2001), by the ease of associating the CS with the categories pleasant versus unpleasant as measured by performance on an IAT (Olson & Fazio, 2001), and by the automatic activation of positivity or negativity when the CS were presented as subliminal (Olson & Fazio, 2002) or supraliminal primes (Olson & Fazio, 2006) in an evaluative priming procedure. Moreover, these effects have been obtained when participants showed no evidence of being able to recognize the CS-US pairings.

In this general procedure, CS-US pairs are presented supraliminally and simultaneously. By embedding these pairs in a rapid, non-rhythmic stream of perceptual events and engaging participants in a task not involving the CS-US pairs, however, CS-US covariation is subtle. Participants, who have agreed to undergo an experiment titled “Surveillance,” are informed that the purpose of the study is to examine “attention and rapid responding.” Participants are presented with a rapid, non-rhythmic stream of words and images, (e.g. a picture of an airplane, a basket, the word “concrete” and so on). Participants are told these are “distracter” items “randomly selected from our database.” Items appear at various locations on the screen, sometimes alone and sometimes in pairs. These filler trials are randomly ordered and at least one third of the “trials” involve the presentation of a blank screen, thus creating the aforementioned non-rhythmic quality of the visual presentation. Participants are instructed to be vigilant for the presentation of particular target items and to respond with a button-press when they appear, as one does approximately every 24 s. Critical CS-US pairings are embedded in this stream at fixed intervals. No single US appears more than once, but one CS is paired with a set of positive US and one with a set of negative US. This feature sets this procedure apart from many EC procedures in which a given CS appears repeatedly with a single US. In those procedures, specific associations between the CS and the US are more likely to develop (see the general discussion for further consideration of this issue).

Like Olson and Fazio (2001, 2002), the present research used as CS two largely unknown cartoon characters that had been normatively pre-selected for neutrality. The particular stimuli were chosen for practical reasons, including that these cartoon characters can plausibly be construed as being either positive or negative. US items consisted of words and images selected for being moderately positive or negative. Extremely valenced items were avoided because of their likelihood of triggering contingency and demand awareness. US words were selected on the basis of pre-testing, while US images were selected based on normative data provided by Ito, Cacioppo, and Lang (1998). EC was measured by subsequent liking judgments of the two CS.

Study 1

The implicit misattribution mechanism suggests that EC should occur more readily under conditions of greater source confusability. Such confusability could arise because the two objects are processed simultaneously or in close temporal continuity, leading to difficulty distinguishing which stimulus was responsible for the evaluative reaction. If this is the case, it should be possible to predict EC from measurable aspects of information processing such as attention. Study 1 sought to provide initial evidence for an implicit misattribution mechanism of EC by measuring individuals' visual attention and patterns of eye gaze while participating in the Olson and Fazio (2001) EC procedure. Previous research has established that covert attention is correlated with overt eye gaze, and that use of an eye tracker, which provides a nearly continuous point estimate of visual gaze, can capture attentional phenomena (see e.g., Kruschke, Kappenman, & Hetrick, 2005). But what patterns of eye gaze should lead to EC? While this study was to some extent exploratory, we reasoned that source confusion should be facilitated when the CS and US are processed in immediate temporal contiguity. Thus, each shift of visual fixation between CS and US should act as an opportunity for misattribution. In Study 1, it was hypothesized that individual differences in attention shifting between CS and US would correlate positively with the magnitude of the observed EC effect.

Participants

Thirty-one male (n = 22) and female (n = 9) undergraduates participated for partial course credit or $10 compensation.

Procedure

Surveillance Conditioning Procedure—The conditioning procedure followed Olson and Fazio (2001) closely. Participants were seated at a computer, given the instructions and the cover story for the EC procedure, and given a packet containing the targets for which they would be attending. The conditioning procedure consisted of 5 blocks, each with a different target, which was also a cartoon character stylistically similar to the CS. Ten target presentations appeared per block. Responses to these targets were recorded in order to ensure participants understood the instructions and were attending to the display. Each block consisted of 86 trials of 1.5 s duration each. Eight CS-US pairs, four including the positive CS and four including the negative CS (all US were moderately valenced words and IAPS images as in Olson & Fazio, 2001), appeared in each block. In total, each CS was paired with a unique US on 20 occasions. Though the filler stimuli vary in position, the CS and US always appear in fixed positions, centered within the right and left halves of the screen. Whether the CS or US appeared on the left versus right was counterbalanced across trials. Which CS cartoon was paired with positive US (the CS+) and which was paired with negative US (the CS-) was determined by random assignment.

During the conditioning procedure, participants' eye gaze was measured using a light, unobtrusive head-mounted eye tracker[1]. The apparatus used was an Applied Science Laboratories H6 head-mounted, left monocular eye tracker. It utilized the pupil/corneal reflection technique for measuring eye movements. Before participants received the standard

[1]The eye tracker was located at the Ohio State University Center for Cognitive Science's Eye Tracking Lab, and the experiment was administered by Eye Tracking Lab's trained personnel.

surveillance task instructions, the eye tracker was worn, adjusted, and carefully calibrated with respect to participants' visual fixations on 12 predetermined points on the computer monitor.

Eye gaze data were collected only during the critical trials involving a CS-US pairing. Participants received normal instructions urging them to attend to the screen at all times and to respond as quickly as possible when a target appeared. The usage of an eye tracker was conveniently consistent with the standard cover story concerning attention and rapid response. In order to provide analyzable eye gaze data, two "areas of interest" were identified for each critical trial in the computer display corresponding to the CS and US. Each trial was divided into fifteen 100 ms bins. For each bin, the time spent fixated on the CS, on the US, and elsewhere was recorded. This allowed for the coding of several variables pertaining to eye gaze. These included the number and duration of visual fixations on the CS and US, the order of those fixations, duration of saccades (eye movements), location of fixation (left or right side of screen), and number and direction of shifts. A shift was identified as having occurred when a fixation on the CS immediately followed a fixation of the US (or vice versa) without an intervening fixation outside these areas of interest.

Evaluation—Following the EC procedure, participants rated the two CS as well as other cartoons on a 30 item forced-choice measure in which participants were presented with pairs of stimuli and were asked to indicate which image they preferred with a button-press. Of these pairs, 10 included one or both CS. Filler trials were included to avoid participants inferring that the study especially concerned the two CS cartoons. Two filler trials always preceded the first critical trial, and subsequent critical trials appeared at fixed points separated by filler trials. On two occasions participants were asked to choose between the CS+ and CS−. The remaining comparisons were between either the CS+ or the C− and other similar cartoons identified in pre-testing as being relatively neutral. Participants were instructed that these ratings were required to decide which particular stimulus items would be used in an upcoming version of the experiment, and that they should choose which image they preferred. Further they were informed that they did not need a reason for liking one more than the other and should "go with [their] gut reaction." A *conditioning score* was calculated from this data according to the choice that would be expected if the procedure was effective in creating the expected attitudes toward the two CS. A score of 1 was assigned to any trial in which the participant chose the CS+ or the image appearing opposite the C−. A score of −1 was assigned to trials in which participants chose the C− or the image opposite the CS+. The sum of these coded responses served as conditioning score, which could range from −10 to +10.

Post-Experimental Questionnaire—Lastly, participants were asked to fill out a post-experimental questionnaire, which had two purposes. First, it assessed liking for and familiarity with the CS cartoons (which were from the cartoon "Pokemon") in general. Liking toward the category Pokemon was measured on a 7-point scale anchored at "Very negative" and "Very positive." The familiarity measure entailed the summation of affirmative responses to an 8-item checklist of familiarity-related items such as "own Pokemon collectibles," and "have watched Pokemon show or movie." Secondly, the questionnaire assessed contingency and demand awareness (see Field, 2000) through a series of funneled questions. The final two questions asked whether participants felt they were supposed to respond in any particular way during the evaluation task and whether they noticed anything about the presentation of the CS images. Throughout the reported studies, participants showing contingency awareness (i.e. those who reported accurately the rule governing CS-US covariation in the open-ended questionnaire) or demand awareness (those who reported the expected influence of CS-US covariation on liking ratings) were excluded from data analysis. Excluding contingency aware participants provides further evidence that EC can occur in its absence when operating through the proposed mechanism. Also, individuals aware of CS-US contingencies are much more likely to demonstrate EC effects through mechanisms *other than* implicit misattribution, potentially obscuring the effects of measures or manipulations that were predicted to moderate EC when occurring through implicit misattribution but not through other mechanisms. Additionally, in all EC procedures demand awareness is problematic because it can produce artifactual liking ratings that do not reflect true attitude change (Page, 1974). Demand aware individuals are likely to comply with their perceptions of the experimenter's expectations and provide liking ratings consistent with EC, even when no EC occurs.

Results

Two participants were excluded from analyses on the basis of their responses to the post-experimental questionnaire. They displayed demand awareness, that is, were able to deduce that the conditioning procedure was intended to influence their subsequent evaluation of the CS stimuli. A third participant was excluded because of incomplete eye gaze data due to technical failure. Thus, the final sample included 28 participants.

Conditioning

Observed conditioning scores ranged from −6 to 10: $M = .64$, $SD = 4.50$. A significance test of the mean participant's conditioning score against the chance value of zero did not provide evidence of EC overall: $t < 1$. Certainly, the sample size, which is small relative to earlier experiments using this conditioning procedure (Olson & Fazio, 2001, 2002), may have contributed to the lack of statistically reliable conditioning. However, the null effect points to the very elusiveness of evaluative conditioning so frequently noted by researchers in this domain and to the importance of illuminating the issue of mechanism. For the present purposes, the important question is whether eye gaze variables can be used to distinguish those participants who showed evidence of conditioning from those who did not.

Eye Gaze

Eye tracker data indicated that participants diligently performed the surveillance task insofar as participants spent the vast majority of each 1500 ms critical trial either fixated on the CS, on the US, or in saccade ($M = 1350$) with the remaining time spent fixated outside of the areas of interest. Participants almost always fixated at least once on each element of a CS-US pairing. On average, participants fixated on both stimuli on 37.25 of 40 critical trials (93.1%). Thus, participants were clearly fulfilling the task demands; they were surveying the items on the screen to see if either was the designated target whose presence they were to detect.

Participants displayed a number of systematic tendencies in their patterns of eye gaze. Generally, participants scanned the screen left to right. The average number of trials on which the first fixation was on whichever stimulus was on the left ($M = 25.6$) was larger than the number of trials in which the first fixation was on the right ($M = 14.0$), $t(27) = 3.70$, $p = .001$. Participants' first fixations also tended to more often be on the CS ($M = 22.4$), rather than the US ($M = 17.3$), $t(27) = 4.44$, $p < .001$. Likely, this is because participants were explicitly engaged in the task of looking for cartoon figures, making the CS attention-grabbing. On average, participants fixated on the CS ($M = 2.20$) and the US ($M = 2.29$) an equal number of times in any given trial, $t(27) = 1.25$, ns. The average duration of those fixations, however, was generally longer for the US ($M = 255$ ms), likely because of their novelty, hedonic relevance, and perceptual complexity relative to the CS ($M = 217$ ms), $t(27) = 5.18$, $p < .001$. Thus, it seems that task demands led participants to fixate initially on the CS, but that it was the US that participants found more captivating.

As individual difference measures, none of these variables were significantly correlated with conditioning score. Most notably, conditioning score was not correlated with the average number of fixations on the CS (*r* = .06, ns.), US (*r* = .03, ns), or both (*r* = .05, ns); or with the average duration of fixations on the CS (*r* = −.16, ns), US (*r* = .07, ns), or both (*r* = −.03, ns)

Shifts in Eye Gaze

Of the eye gaze variables coded, only one was found to be related to conditioning score: attention shifting. On the average trial, participants shifted their eye gaze directly from CS to US or vice versa 1.7 times. Across the 40 critical trials, the total number of shifts in eye gaze between CS and US by any individual averaged 69.3, but substantial variability was observed with respect to this tendency for eye gaze to vacillate between the two stimuli (*SD* = 17.5). The total number of shifts in eye gaze directly from CS to US or vice versa was positively correlated with conditioning score: *r* = .35, *p* = .066. As participants more frequently shifted their eye gaze between the two stimuli, their conditioning scores were likely to increase. Regression analyses predicting the conditioning score were conducted to explore this relationship further. When number of shifts was entered in a regression along with a dummy variable representing CS counterbalancing condition, statistically significant effects of both eye shifts (β = .52, $t(25) = 2.8$, $p < .01$) and CS counterbalancing condition (β = .43, $t(25) = 2.3$, $p < .05$) emerged. The latter effect simply indicates that one CS was better liked overall than the other[2].

Shifts were also summed separately by direction. Participants more often shifted directly from CS to US than vice versa because of the aforementioned tendency to focus first on the CS: $t(27) = 4.9$, $p < .01$. Correlations with conditioning score for CS to US shifts (*r* = .36) and US to CS shifts (*r* = .32) were similar in magnitude. When the two directional shift variables are entered separately into a regression with CS counterbalancing condition to predict conditioning scores, neither shift variable was a unique predictor of conditioning score (CS to US: β = .25, $t < 1$.; US to CS: β = .28, $t < 1$), indicating that the relationship between shifting and conditioning score did not depend on whether that shift was from CS to US or vice versa[3]. Together, however, these two shifting variables predicted EC. Added to the effect of CS counterbalancing condition, the two variables increased R^2 by .23, a significant change: $F(2, 24) = 3.8$, $p < .05$.

Another question that follows is whether shifting multiple times *on a single trial* was associated with greater conditioning. For each participant, shifting frequency was computed for every trial. While the average number of shifts between US and CS per trial was just under two (*M* = 1.7), instances of more than three of these shifts per trial were rare (on average, 1 in 40 trials). Thus, a multiple regression was conducted predicting conditioning score from four independent variables: number of trials on which only one shift occurred, number of trials on which exactly two shifts occurred, number of trials on which three or more shifts occurred, and CS counterbalancing condition. Notably, this regression analysis does not suffer from the problem of complete dependence between predictor variables because participants can also make a direct CS-US shift zero times during a given trial. The resulting coefficients are shown in Table 1. Though number of trials on which a single shift occurred was a marginally significant unique predictor of conditioning score, it is apparent that the pattern of eye gaze most predictive of EC was the frequency of shifting three or more times between CS and US on a single trial.

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[2]Given the nature of the eye gaze variables, measurement error is of little concern. However, one may wonder about the extent to which individual differences in eye gaze tendencies were evident on a trial to trial basis. Internal consistency analyses revealed strong consistency across the 40 trials. Alpha coefficients were, respectively, .82, .81, and .91 for gaze duration on CS, US, and both; .88, .83, and .91, for number of fixations on CS, US, or both; and .91 for number of shifts in eye gaze.

[3]Some may argue that a misattribution account should expect that shifting attention from the US to the CS should increase EC but not vice versa. This relies on the logic that an evaluation must be evoked by the US before it can be misattributed to the CS. We argue, on the other hand, that an evaluation can be attributed to something encountered either before or after that evaluation. Indeed, exposure to an object *precedes* evaluation of that object; so, normatively, attributions should be made to an object encountered immediately before an experienced evaluation.

Discussion

Study 1 provided evidence that individuals who processed the CS and US in close temporal continuity were more likely to show evidence of evaluative conditioning. This study extends beyond previous studies of the role of attention in EC by showing that not only do manipulations that reduce attention to CS-US pairings attenuate EC (Field & Moore, 2005), but also that EC can be increased when attention frequently alternates between CS and US. The number of eye gaze shifts between the CS and US uniquely predicted conditioning score. The number of trials on which participants shifted their eye gaze three or more times between CS and US was especially predictive of conditioning score. We interpret this finding as suggesting that repeatedly shifting attention between the CS and US increased source confusion. The emergence of the relationship between attention shifting and EC in the absence of relationships between conditioning score and similar eye gaze variables such as absolute number of fixations or their duration lends credence to the interpretation that EC was increased by the processing of CS and US in immediate temporal continuity.

This evidence concerning the relationship between attention shifting and EC, however, is limited by its correlational nature. A possible alternative explanation is that attention shifting did not foster source confusion, but rather source confusion fostered attention shifting. In other words, if individuals experienced uncertainty over the source of an evaluation, this may have motivated efforts to resolve this uncertainty by comparing the two stimuli, which would involve attention shifting. In order to provide causal evidence for our claim, Study 2 manipulated shifting of attention. We hypothesized that heightened attentional shifting, and the resultant processing of the CS and US in close temporal continuity, would increase EC.

Study 2

Study 2 attempted to replicate the primary finding from the previous study experimentally. Attention shifting between the CS and US was manipulated by causing the images to flash briefly in a rapidly alternating sequence. It was expected that these flashes would draw the attention back and forth between the two stimuli, simulating the natural pattern of eye gaze that was found to most facilitate EC. Flashing stimuli have been previously demonstrated to be effective at capturing visual attention (Chappell, Hine, Acworth, & Hardwick, 2006).

Participants

134 male ($n = 76$) and female ($n = 58$) undergraduates participated for partial course credit.

Procedure

Conditioning—The conditioning procedure again followed Olson and Fazio (2001). Which CS appeared with positive US and which appeared with negative US was again determined by random assignment between participants. The manipulation of primary interest involved the presentation of the CS-US pairs. In the “flash” condition, the CS and US disappeared briefly in alternating fashion a total of four times. Specifically, the pairs appeared on the screen simultaneously as usual for 300 ms, at which time one of the two stimuli disappeared for 25 ms and then reappeared. 275 ms later, the other stimulus disappeared for 25 ms and then reappeared. 275 ms later, the first stimulus disappeared and reappeared again, and finally the second stimulus disappeared and reappeared again, following the same time scheme. This manipulation creates the appearance that the stimuli are flashing rapidly back and forth. Whether it was the CS or US that flashed first was counterbalanced across trials. In the no-flash control condition, CS-US pairs appeared as normal for the full duration of the 1500 ms trial. In both conditions, however, approximately half of the filler trials involved flashes. This ensured that all participants were exposed to episodes of flashing and that the CS-US critical trials did not stand out within the flashing condition.

CS-US Memory Recognition Task—Prior to the post-experimental questionnaire, a recognition test was introduced, assessing explicit memory for CS-US covariation. The recognition test was included in order to test the possibility that CS-US flashing might enhance contingency awareness beyond the extent to which this was already assessed by the self-report post-experimental questionnaire. As in Olson and Fazio (2001), following evaluation of the CS, participants were informed that some of the images they saw may have been presented together with some degree of regularity and were asked to provide covariation estimates for several pairs of images. Each CS was presented nine times, each time with a different item selected from three positive US, three negative US, and three neutral filler items. Depending on CS counterbalancing condition, each CS had indeed appeared once with all three positive or all three negative US but not with US of the opposing valence. Neither CS ever appeared with any filler item. Participants responded on a scale from 1 ("I'm confident that the two items never appeared together") to 3 ("I don't know") to 5 ("I'm confident that the two items appeared together at least once"). Several pairs of filler items also appeared.

Results

Data from 4 participants were excluded because they clearly did not take the surveillance task seriously or failed to comprehend its instructions. These participants made a high number of errors during the surveillance task, more than three standard deviations beyond the mean number of errors, which was 2.9. An additional 23 participants (13 from the flash condition, 10 from the control condition) were excluded for demonstrating contingency or demand awareness on the post-experimental questionnaire. Data from 107 participants remained.

Conditioning

Conditioning score was examined by a 2 (CS counterbalancing: which cartoon was CS+ and which CS−) X 2 (CS-US presentation: flash vs. control) between-subjects ANOVA. A significant main effect of CS-US presentation condition showed that conditioning scores were higher in the flash condition ($M = 1.22$) than in the control condition ($M = -.56$), $F(1, 106) = 4.36$, $p < .05$. No other main effect or interaction was significant, F's < 1. A significant EC effect was observed in the flash condition, in which the mean conditioning score was greater than zero, $t(52) = 2.09$, $p < .05$, but not in the control condition, $t(53) = -.91$, $p = .37$.

Recognition Task

Following Olson and Fazio (2001), the covariation estimation data were analyzed by first calculating the mean of participants' responses to each CS and the three US of a given valence. A summary measure of awareness was computed as the difference between the mean of participants' covariation estimates for the CS-US pairs that were actually presented ($M = 2.7$) and the mean for the CS-US pairs with the opposite-valenced US ($M = 2.6$). Using this index, a marginal effect emerged such that participants may have been slightly more certain that the CS appeared with images of the correct valence than the incorrect one, $t(106) = 1.6$, $p = .12$. However, explicit memory for CS-US pairings did not differ between conditions, $t < 1$. Further, this index did not correlate with conditioning score in the whole sample ($r = .01$, $p = .93$) or in either the flash ($r = .08$, $p = .57$) or control condition ($r = -.08$, $p = .56$). Adding recognition task performance as a covariate into the focal ANOVA on conditioning score did not lessen the effect of the flash manipulation on conditioning, $F(1, 106) = 4.36$, $p < .05$. Other effects in this analysis including that of CS-US recognition failed to attain statistical significance, F's < 1.[4]

Discussion

By manipulating attention shifting, Study 2 provided further evidence that EC is increased under conditions of source confusability, here because the CS and US are processed in immediate temporal continuity. The inclusion of an explicit CS-US recognition task provided additional evidence that EC is not always dependent upon conscious awareness of CS-US contingencies. By manipulating rather than measuring attention shifting, Study 2 warrants a firm causal conclusion that such attention shifting can foster EC.

Study 3

Study 3 sought to provide converging evidence for an implicit misattribution mechanism by manipulating a different property of the CS-US presentation that would promote or inhibit source confusion. It would seem reasonable to expect that such source confusion is more likely when the actual source and another object that might also be a target of attribution appear close together spatially rather than far apart. In Study 3, participants were randomly assigned to one of two conditions: the CS and US were presented either such that they nearly overlapped or appeared at opposite ends of the computer display. The eye tracking data from Study 1 confirmed that the surveillance task demands lead participants to survey the items on the screen for the presence of the targets. Thus, we could be confident that CS-US contiguity was created even in the condition in which the stimuli were positioned distantly. However, we expected source confusability to be greater when the CS and US were presented in close proximity to one another. The spatial proximity of the CS and US should increase source confusion for at least three reasons. First, spatial proximity may increase the likelihood that the CS and US are processed in close temporal continuity. We expect misattribution to be more likely when an evaluation evoked by the US and a representation of the CS are active simultaneously. Second, and relatedly, it is easier to shift eye gaze between two objects close in spatial proximity, and the previous two studies found increased conditioning when participants frequently shifted between CS and US. Finally, there is reason to relate spatial proximity to source confusability above and beyond the logic of processing continuity that underlies Studies 1 and 2. When CS and US are spatially separated, the true source of the evaluation is likely to be relatively evident as opposed to when the actual source and another object co-occur spatially. One line of research consistent with this notion suggests that individuals form mental representations that capture relationships between hedonically relevant stimuli and spatial locations (Crawford & Cacioppo, 2002). Pertinently, it was found that individuals do so through incidental learning and can detect even weak ($r = \pm.3$) correlations. Such findings suggest that individuals spontaneously localize the spatial origin of hedonic experiences. Source confusability should thus generally be reduced when the US and CS are remote from one another because any such localization promotes accurate attribution.

Participants

One-hundred forty-five undergraduate males ($n = 57$) and females ($n = 88$) participated in exchange for partial course credit.

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[4]Though the 107 participants categorized as unaware of CS-US contingencies on the basis of the post experimental questionnaire did not exhibit evidence of explicit memory for CS-US pairs, this was not the case for the 23 excluded participants whose questionnaire responses resulted in their being categorized as aware of CS-US contingencies. These participants scored higher on the explicit memory index ($M = 1.20$) than those categorized as unaware ($M = .12$), $t(128) = 5.96$, $p < .001$. The same is true of Study 3, which is to be presented momentarily. The 17 participants excluded from other analyses due to awareness by the post-experimental questionnaire also scored higher on the explicit recognition index ($M = 1.17$) than those categorized as unaware ($M = .13$), $t(134) = 5.48$, $p < .001$. The correspondence between these measures provides some evidence of their validity.

Procedure

The procedure followed Study 2 closely. The most important difference is that rather than manipulating attention shifting, the proximity of CS and US pairs was manipulated (as, of course, was CS counterbalancing). In all cases, the pairs were centered vertically in the computer display. In the close proximity condition, the CS and US were positioned in horizontal contiguity such they nearly touched, with approximately a 1 cm space between the two stimuli. In the far proximity condition, the CS and US were separated maximally horizontally such that each was adjacent to the outer border of the visual display, a separation of approximately 20 cm. The explicit CS-US recognition memory test utilized in Study 2 was also included.

Results

Seventeen participants were excluded from analyses for reporting contingency or demand awareness on the post-experimental questionnaire (of these exclusions, 9 were from the CS-US close proximity condition and 8 were from the distant condition). An additional 8 participants were excluded from analyses after they were identified as “Pokemon fans” for reporting both high liking for and strong familiarity with Pokemon cartoons[5]. Data from 120 participants remained.

Conditioning

Conditioning score was examined by a 2 (CS counterbalancing: which cartoon was CS+ and which CS−) × 2 (CS proximity: close or far) between-subjects ANOVA. A significant main effect of CS proximity showed that conditioning scores were higher when the CS and US were close together ($M = 1.24$) than when they were far apart ($M = -.64$), $F(1, 116) = 4.05$, $p < .05$. No other main effect or interaction was significant, though a weak effect of counterbalancing condition was observed, indicating only that one CS was liked slightly more than the other overall: $F(1, 116) = 1.65$, $p = .20$. Thus, CS-US co-occurrence had a greater effect on evaluations of the CS when they appeared close together. Conditioning scores, controlling for CS counterbalancing condition, in the close proximity condition were significantly greater than zero, $t(56) = 2.06$, $p < .05$, but did not differ from zero in the far proximity condition, $t < 1$.

Recognition Task

Participants were no more confident that a given CS had appeared with a US of a given valence when the CS and US had indeed appeared together ($M = 2.69$) than they were that the CS had appeared with a US of the opposite valence ($M= 2.63$). The mean difference score, .06, was again marginally different from zero: $t(119)= 1.55$, $p=.12$.

The major purpose of the recognition task was to examine whether contingency awareness might have been enhanced by CS-US proximity. An independent samples *t*-test indicated that recognition task performance was no different when the CS and US were close together (difference score $M= .08$) than when the CS and US were far apart ($M= .04$): $t < 1$. Again, recognition task performance did not correlate significantly with conditioning score across conditions ($r = .12$, $p = .24$) or within the close proximity($r = .17$, $p = .25$) or distant proximity

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[5]The a priori decision to exclude Pokemon fans was based on the reasoning that they are likely to have well-established attitudes towards the Pokemon CS, rendering them relatively insensitive to conditioning (Cacioppo et al., 1992; Shimp, Stuart, & Engle, 1991). Pokemon fans were identified formally after initial data analyses revealed that more participants reported high liking for or high familiarity with Pokemon cartoons than in previous usages of the paradigm. Pokemon cartoons experienced an apex of popularity several years ago, and the cohort of the cartoon’s peak popularity are beginning to reach undergraduate age. No more than two participants would have been categorized as Pokemon fans in any study conducted before this one. This study marked the final usage of Pokemon CS, which were replaced with stylistically similar but more obscure cartoons. The post-experimental questionnaire was subsequently adjusted accordingly but measurement of CS familiarity was conceptually unchanged.

condition (*r* = .05, *p* = .70). When recognition performance is included in the 2 (CS Counterbalancing) × 2 (CS proximity) ANOVA as a covariate, the results remain the same: a significant main effect of CS proximity: $F(1, 116) = 4.24$, $p<.05$. No other significant main effect or interaction was observed.

Discussion

In sum, Study 3 provided evidence that EC is increased when the CS and US appear close in spatial proximity. Importantly, the manipulation of CS-US proximity did not influence participants' awareness of CS-US contingency and the effect was observed after excluding any participant able to report the rule governing CS-US covariation. Therefore, it appears that the proximity manipulation influenced participants' evaluations of the CS in a manner independent of their explicit memory for CS-US pairings. This effect was predicted from the implicit misattribution account on multiple rationales, namely that close CS-US spatial proximity increases the likelihood that the CS and US will be processed in close temporal continuity, that CS-US proximity relates to the likelihood of CS-US shifting, and that the spatial localization of hedonically relevant but distant stimuli can attenuate source confusability. The CS-US contiguity that necessarily occurred in the far proximity condition, as a consequence of participants' compliance with the surveillance task demands, was not sufficient to promote EC. However, greater EC was apparent when CS-US contiguity occurred under conditions that were more likely to promote source confusion and implicit misattribution.

Study 4

Study 4 aimed to provide further converging evidence for a misattribution account by again altering parameters of CS-US presentation in the Olson and Fazio (2001) procedure, this time by varying the relative size of the CS and US. In previous instantiations of this paradigm, the CS and US were of approximately equal size. Here, the relative salience of the CS and US were manipulated by altering their size. In one condition, the CS was large and the US was small, and in another this relationship was reversed. If an implicit misattribution mechanism is at work, individuals should be more likely to misattribute the evaluation activated by the US to the CS when that CS is relatively salient. A well-documented finding in attribution research is that as the salience of a plausible causal source increases, so does the likelihood that individuals will make attributions to that source (Heider, 1958; Jones & Nisbett, 1971; Pryor & Kriss, 1977; Taylor & Fiske, 1978). Therefore, source confusion is likely when the actual source of the evaluation is low in salience while another appropriate object is highly salient. When the CS is comparatively salient because of its greater size, individuals are likely to misattribute evaluations to it. In contrast, individuals will more likely correctly attribute the evaluation evoked by the US to the US when it is salient. This reasoning led to the prediction that a larger EC effect would be obtained when the CS was relatively salient than when the US was relatively salient.

This introduction of a size differential does introduce a possible confound. It could be expected that when the US is small, a less intense affective reaction could result, either because smaller objects evoke less affect or because the smaller, less salient US receives relatively less attention in this condition. If the US does induce weaker affective reactions in the small-US condition, however, this confound would clearly work against the hypothesis of Study 4 rather than in its favor.

Participants

One-hundred thirteen undergraduate males (*n* = 61) and females (*n* = 52) participated in exchange for partial course credit.

Procedure

Study 4 was methodologically similar to Studies 2 and 3. Large images were approximately four times the standard size of 128 × 160 pixels. These large images occupied slightly less than half of the computer display. The small images were of the standard size, ensuring that they were large enough to be easily perceived. Filler and target stimuli also varied in size, mimicking the critical trials. Due to the conclusive results of Studies 2 and 3, explicit recognition of the CS-US pairings was not subsequently assessed.

Results

Data from 2 participants were excluded because they clearly did not take the surveillance task seriously or failed to comprehend its instructions. These participants made a high number of errors during the surveillance task, more than three standard deviations from the mean number of errors, which was 2.7. Seventeen participants were excluded due to contingency or demand awareness (of these exclusions, 7 were from the CS-salient condition and 10 were from the US-salient condition). Data from 94 participants remained.

The primary analysis of interest concerns the dependent variable conditioning score and the manipulation of relative CS/US salience. A 2 (CS counterbalancing) × 2 (CS salience: high or low) between-subjects ANOVA was conducted to test whether differences in conditioning score were evident between experimental conditions. A main effect emerged for both CS counterbalancing condition and the CS salience manipulation, CS counterbalancing: $F(1, 90) = 7.30$, $p <.01$, CS salience: $F(1, 90) = 3.9$, $p =.05$. The former indicates a relative preference for one of the two CS used regardless of the valence of the US that appeared with it. More importantly, a main effect of CS salience consistent with an implicit misattribution account was observed. When the CS was highly salient due to its relatively large size, higher conditioning scores were observed ($M = .90$) than when the CS was low in salience ($M = -.70$). Controlling for the CS counterbalancing effect, conditioning score in the CS high salience condition differed marginally from zero, $t(49) = 1.8$, $p = .08$, while no conditioning effect was evident in the US high salience condition, $t(43) = -1.1$, $p = .30$. The counterbalancing by salience interaction was not significant ($F < 1$).

Discussion

Study 4 tested the implicit misattribution hypothesis by manipulating the relative salience of the CS to the US. Consistent with expectations, greater evidence for EC was obtained when the CS was large and the US was small, relative to when this relationship was reversed. These results are consistent with the proposed model in which evaluations automatically activated by the US were misattributed to the CS, a process facilitated by its perceptual salience. This result is especially difficult to explain from any other theoretical explanation of EC of which we are aware, which do not have any apparent reason to predict that EC should be facilitated when the CS is more salient than the US.

Study 5

The last three experiments manipulated elements of CS-US presentation to test the implicit misattribution model. When CS-US pairings were arranged in such a way as to promote source confusion (flashing, close spatial proximity, CS salience), stronger EC was observed, even in the absence of contingency awareness. The present experiment took a different approach to testing the role of source confusability in EC in order to provide convergent evidence for the proposed mechanism. The experiment focuses on the nature of the US and, in particular, the extent to which the evaluations they automatically evoke are open to source confusion.

Any model of EC requires that the US be valenced stimuli. Given its emphasis on implicit processes, our proposed model requires that the attitudes toward the US be associated sufficiently strongly that those attitudes will be automatically activated upon presentation of the US. Such automatic activation is an initial first step. There is no evaluation to be implicitly misattributed to the CS if the US does not evoke one. But, given that the accessibility of attitudes toward the US meets this minimal criterion, might increasingly greater attitude accessibility actually interfere with implicit misattribution? In other words, might strongly evocative US produce less EC than more mildly evocative US? As counterintuitive as this possibility may seem, we reasoned that the answer might very well be yes. For strongly evocative US, the automatically-activated evaluation may be relatively “bound” to its actual source and, hence, insusceptible to misattribution. The source of the evoked evaluation should be relatively obvious, more so than when the US is less evocative. More subtle evaluative reactions may be more open to implicit misattribution, thus producing relatively greater EC.

This reasoning led to the expectation that when US provoked relatively powerful reactions, participants would be less likely to misattribute that reaction to the CS than when the US were more mildly evocative. To operationalize evocativeness, we selected US words and images characterized by very strong or more moderate attitude accessibility, on the basis of the latency with which a sample of participants could categorize the stimulus as positive or negative. Consistent with past research on attitude accessibility (Fazio, 1995), faster latencies were assumed to be indicative of stimuli that were more strongly evocative. A considerable body of literature indicates that such faster responding is associated with many indices of attitude strength, including attitude accessibility, attitude extremity, and attitude certainty (e.g., Fazio et al., 1986; Holland, Verplanken, & van Knippenberg, 2003; Powell & Fazio, 1984). We expected more mildly evocative stimuli to serve as more effective US than strongly evocative stimuli.

Participants

One-hundred twenty-nine undergraduate males (n = 68) and females (n = 61) participated for partial course credit.

Procedure

Participants were randomly assigned to one of four conditions representing US type (strongly or mildly evocative) and CS counterbalancing The procedure closely followed the previous studies, especially Study 2, insofar as the version of the surveillance EC procedure used included a variant of the “flashing” CS-US presentation in all experimental conditions. The flashing differed in that the timing parameters were altered with the intent of making the stimulus flashing less predictable and more attention-grabbing. Instead of occurring in a regular and invariant fashion, one of four flashing parameters was randomly assigned to each critical and filler trial during which flashing occurred. Each was only a minor alteration of the parameters reported in Study 2 and affected the lags between flashes but not their frequency. Following the conditioning procedure, participants completed the post-experimental questionnaire, were debriefed, and then were dismissed.

Two sets of US stimuli were identified through pre-testing (stimuli are listed in the Appendix). US words were selected from an evaluative lexicon established from data from 27 participants. The two sets of US words were selected primarily on the basis of accessibility. Highly evocative US words were identified as positive or negative more quickly (M = 690 ms) than mildly evocative US words, M = 849 ms, $t(38) = 10.90$, $p < .001$. However, within both sets of stimuli, words were recognized as unequivocally positive or negative as demonstrated by the highly accurate proportion of participants who correctly categorized the valence of the adjectives (mildly evocative M = .93, strongly evocative M = .95), despite the instructions to respond as quickly as possible.

US images were selected on the basis of attitude accessibility data gathered in a separate pretest in which 48 participants made positive/negative categorizations of a set of 80 image stimuli composed of a combination of IAPS images and valenced image stimuli obtained from internet postings. Forty images were retained (27 from the IAPS). Ten positive and ten negative US were identified for each US stimulus set. They were selected according to mean latency to identify the valence of the image (strong M = 920 ms, mild M = 1307 ms, $t(38) = 10.42$, $p < .001$). Again, only unambiguously positive or negative US were selected for inclusion as shown by the high proportion of accuracy in evaluative categorization (strong M = .98, mild M = .98).

Typically, more extremely valenced attitude objects are associated with higher attitude accessibility than less extremely valenced objects. No actions were taken to equate the extremity of the two stimulus groups of attitude objects because we make the same predictions for attitude extremity as we do for attitude accessibility. One should be relatively unlikely to mistake a strongly valenced attitude as having arisen from a neutral object compared to a more weakly valenced attitude[6]. Therefore, though attitude accessibility was the primary criterion used for stimulus set determination (for both images and words, the two distributions of latency data were non-overlapping), the ultimate goal was to construct two sets of US, one of which was strongly evocative and thus less prone to misattribution and another which was milder and more susceptible to misattribution.

Results

Two participants were excluded from analyses as a consequence of having made a high number of errors during the conditioning procedure (more than three standard deviations beyond the mean, which was 2.2). Data from 127 participants remained.

Contingency Awareness

In the previous studies reported, a relatively small and statistically equivalent proportion of participants in each source confusability condition were eliminated. However, in Study 5 the nature of the US stimulus set had a strong impact on contingency and demand awareness, $\chi^2(1, N = 127) = 15.62$, $p < .001$. In the mildly evocative condition (n = 62), only three participants displayed contingency or demand awareness (4.8%). In the highly evocative condition (n = 65), 21 participants displayed contingency or demand awareness (32%). Following previous procedure, and to provide evidence consistent with the posited model which argues that EC can occur in the absence of awareness under conditions of high source confusability, the three aware participants were excluded from further analyses involving the mildly evocative group. In the strongly evocative group, data from aware and unaware participants were examined separately.

Conditioning

Examination of conditioning scores revealed an EC effect in the mildly evocative US condition: M = .85, $t(58) = 2.01$, p = .049. No evidence of EC was observed, on the other hand, among the contingency unaware participants in the strongly evocative US condition for: $M = -.31$, $t(43) = -.60$, p = .55. For contingency aware participants in the strongly evocative US condition,

[6]Analysis of US word valence ratings (deviation from scale midpoint) confirmed that the strongly evocative list (M = 3.29) was judged to be more extreme than the mildly evocative list (M = 2.47, $t(38) = 5.30$, $p < .001$). Extremity data was not collected for all image stimuli, but the IAPS normative were examined for the 27 IAPS photos selected for use. The strongly evocative US were similarly extreme (M = 2.1) to the mildly evocative US (M = 2.0, $t < 1$). These strongly evocative US images were rated as somewhat more arousing (M = 5.3 vs. M = 4.9), though this difference did not reach a conventional significance level: $t(25) = 1.6$, p = .12.

however, a robust EC effect emerged: $M = 3.62$, $t(19) = 4.07$, $p = .001$. Thus, EC was observed in the absence of contingency awareness, but only in the mildly evocative US condition. Direct comparison of the mildly evocative US condition unaware and strongly evocative US unaware groups was conducted as in previous studies with a 2 (US stimulus set) × 2 (CS counterbalancing) between-subjects ANOVA. It revealed an effect of the US variable that nearly achieved a conventional two-tailed level of significance, $F(1, 102) = 3.62$, $p = .06$.

Discussion

Consistent with predictions, mildly evocative US were more effective than highly evocative US at producing EC, but only among participants who did not become aware of CS-US contingencies. Results revealed that the two US stimulus sets both produced EC, but through very different means. Interestingly, in the mildly evocative condition, participants rarely noticed CS-US contingencies, but in the highly evocative condition they did so with unusual frequency. Further, those participants who could report the rule governing CS-US covariation in the highly evocative condition demonstrated a strong EC effect. It seems that the properties of the highly evocative US set were especially conducive to some mechanism of EC involving contingency or demand awareness[7].

Further research using a purer manipulation will be necessary to determine whether accessibility of US attitudes per se can moderate EC. Other evaluative dimensions were allowed to co-vary with accessibility, so it may be that extremity or another of its natural confounds contributed to the results. The implicit misattribution model posits that US attitude accessibility or any other variable that pertains to the likelihood of source confusion will have such a function. Also, in the present study we dichotomized US attitude accessibility, and thus it may be tempting to think of the two sets as high and low in attitude accessibility. However, the US sets are more appropriately described as high and moderate in attitude accessibility. We selected only familiar and unambiguously positive or negative stimuli. In addition, we would expect EC to be attenuated given US characterized by extremely low attitude accessibility were employed, because no attitude would be activated by the US to misattribute. Future research might then test for curvilinear relationships between US attitude accessibility and EC.

General Discussion

According to our theoretical model, EC occurs through implicit misattribution when an evaluation evoked by a US is incorrectly attributed to a CS, forming or changing an attitude towards that CS. Five studies provided empirical support for an implicit misattribution mechanism by showing that EC is moderated by source confusability, the potential for the misattribution of an evaluation. Such misattribution is likely when the specific cause of an evaluation is ambiguous and when another object is present to which a plausible but incorrect attribution could be made. We reasoned that ambiguity with respect to the source of an evaluation should be especially high when that source and another appropriate object are processed in immediate temporal continuity. This ambiguity should be further enhanced when the processing of the two objects is not only immediate but also alternates repeatedly, as when attention is directed back and forth between the two objects. Attention shifting between the CS and US was measured (Study 1) and manipulated (Study 2). Greater EC effects were observed when participants repeatedly shifted their attention between the CS and US. Due to attentional

[7]Analyses of the contingency/demand aware participants excluded from Studies 1–4 do indeed suggest that this large effect of awareness was promoted by the strongly evocative US employed in Study 5. Pooling all aware participants from Studies 1–4 into a single sample, a t-test on conditioning scores showed a comparatively weak effect of conditioning (difference from zero) despite the quite greater degrees of freedom, $M = 1.33$, $t(59) = 1.9$, $p = .063$. This pooled conditioning score of contingency aware participants for Studies 1–4 was smaller ($M = 1.32$) than the conditioning score of Study 5 contingency aware participants in the highly evocative US condition ($M = 3.67$), $t(55) = -2.16$, $p = .035$.

factors and the integration of spatial and evaluative information, the spatial proximity of the CS and US also impacts the likelihood that an evaluation of the US could feasibly be misattributed to the CS. In Study 3, EC was observed when the CS and US were presented close together but not when they were presented far apart. If two objects are available to which an evaluation might be attributed, attribution theory suggests that whichever is more salient possesses an advantage. In Study 4, the relative salience of the CS and US was manipulated by altering their relative size. EC was observed when the CS was larger than the US but not when the US was larger than the CS. Study 5 provided additional support by confirming the hypothesis derived from the model that for contingency unaware participants, the extent to which the evaluation was "bound" to the US would moderate EC. Provided participants remained unaware of the pairings, more strongly evocative US actually produced less EC.

It is important to note that in all conditions of all of our experiments, a relatively high degree of CS-US contiguity was present. After all, our least contiguous condition, the distant proximity condition of Study 3, involved the CS and US simultaneously appearing on a computer screen in a task context that necessitated surveillance of the presented items. It seems, however, that contiguity alone is not sufficient for EC to occur, at least in the absence of contingency awareness. The more that contiguity promotes source confusion and is conducive to implicit misattribution, the greater the EC.

The Implicit Misattribution Mechanism

The implicit misattribution model is conceptually consistent with the major characteristics of EC that have notably distinguished it from Pavlovian classical conditioning (PC). Baeyens and colleagues (1993), for example, found that EC was not sensitive to the degree of statistical contingency between the CS and US. In order to form attitudes via misattribution, a US need not consistently appear with a CS, but EC should increase with the absolute number of pairings because each provides an opportunity for misattribution and such misattributions could act cumulatively. EC has also been distinguished from PC by its resistance to extinction when the CS is presented without the US (Baeyens et al., 1988). This is consistent with an implicit misattribution model. Once an attitude has formed through implicit misattribution, there is no reason to hypothesize that this attitude will not persist when the CS later appears repeatedly without the US. It is not the CS's value in signaling the upcoming occurrence of a positive or negative US that is of consequence, but the very valence that has been transferred from the US to the CS that forms the basis of the attitude.

The implicit misattribution mechanism also is consistent with a moderator of EC that has received fairly little attention to date. At least one study has also found that EC can be moderated by *feature matching* between the CS and US. Todrank, Byrnes, Wrzesniewski, and Rozin (1995) found that US odors influenced attitudes towards CS images of human faces, but only when those odors were "plausibly human." A misattribution mechanism requires that the evaluation evoked by the US could feasibly have arisen from the CS, so some minimal degree of feature matching is a necessary condition. Without it, source confusion is unlikely to occur.

Conceptually, when EC occurs through implicit misattribution individuals need not notice or remember that the CS and US co-occur (i.e., exhibit contingency awareness). The results of Studies 1–5 and previous research using this experimental paradigm are consistent with this idea. The implicit misattribution mechanism merely requires that the US evoke a particular evaluation and that this evaluation be misattributed to the CS, and there is no reason to presume that individuals must be aware that the CS and US reliably co-occur for this to happen. Indeed, if participants notice that a CS is occurring with a positive or negative object, such awareness could make salient the US and its evaluative aspects, possibly discouraging misattributions to the CS.

A question that rises from this research is whether EC produced through implicit misattribution should properly be considered *conditioning*. Conditioning theorists Lovibond and Shanks (2002) have, for example, dismissed evidence that EC can occur without contingency awareness as artifactual because the observed attitude formation could have been produced through a "nonassociative" mechanism. We view the implicit misattribution mechanism as inherently associative insofar as it involves an evaluative response to the US becoming associated with the CS. We also view the implicit misattribution mechanism as associative in that it produces an evaluative reaction to the CS as a consequence of spatio-temporal contiguity with consistently-valenced US. This sort of *mere association* leading to attitude change is one way to define EC. If EC is considered an *effect* of the pairing of two stimuli rather than a specific process, we view it appropriate to consider attitude formation caused by implicit misattribution as a genuine instance of evaluative conditioning, albeit not the only form thereof (see also De Houwer, 2007). However, the implicit misattribution account differs from previous associative accounts of EC (e.g. Gawronski & Bodenhausen, 2006; Walther, Gawronski, Blank, & Langer, in press) in that it is the evaluative character of multiple US, rather than a representation of a single US per se, that becomes associated with a representation of the CS. Although CS-US associations of the latter sort undoubtedly underlie many demonstrations of EC (see, e.g., Walther et al., in press, for evidence of US-revaluation, a phenomenon especially consistent with the development of an association between a CS and a specific US) it is unlikely that they explain EC in the present research. A CS-US associative account posits that changes in liking emerge following conditioning procedures when exposure to the CS directly activates a representation of the US and that this activation then influences evaluation of the CS. Given such a mechanism, it is difficult to imagine EC in absence of contingency awareness, especially if awareness is assessed via a recognition test involving co-presentation of CS and US as was done in some of the present studies and in previous research using the surveillance procedure (Olson & Fazio, 2001). Direct CS-US association is also far more likely to explain EC effects when the same US is repeatedly paired with a given CS, which is not the case in for the present surveillance procedure, in which no US appears with a CS more than once.

Other Mechanisms of EC

The implicit misattribution model of EC is complementary to existing models (for a review, see De Houwer, Thomas, & Baeyens, 2001) and does not call them into question. Here we selectively review various ways in which the co-occurrence with a US could influence attitudes about the CS, i.e., various mechanisms by which EC might be produced. As just referenced, multiple accounts of EC, though differing in their details, involve the formation of a stimulus-stimulus association between the CS and US (e.g. Martin & Levey, 1994; Baeyens, Eelen, Crombez, & Van den Bergh, 1992; Gawronski & Bodenhausen, 2006; Walther et al., in press). In such models, EC occurs because subsequent encounters with the CS produce evaluations consistent with the US by virtue of this association between the two. That is, the CS evokes the specific US with which it was earlier associated.

CS-US pairings could also produce EC by causing individuals to form particular beliefs about the CS (Fishbein & Middlestadt, 1995). After repeatedly pairing "Brand L" pizza boxes with an image of a race car, one group of researchers found that participants rated the pizza brand as more likely to be delivered hot and quickly, and that these beliefs mediated positive attitude change towards the pizza brand (Kim, Allen, & Kardes, 1996).

Davey (1994) noted that neutral CS typically have both positive and negative features and theorized that the pairing of a US with a CS may highlight those features of the CS that are evaluatively congruent with the US. The increased salience of positive or negative features provokes the conceptual recategorization of the CS, which has persisting evaluative consequences. We certainly do not doubt that a priming mechanism of this sort can produce

EC (see Niedenthal, 1990). However, it is important to note that such a mechanism cannot account for the effects of source confusion that have been demonstrated in the current research.

Finally, as mentioned earlier, pairing a CS and US could produce conditioning effects as a consequence of Pavlovian conditioning (signal learning), as the CS comes to be liked or disliked because it signals the pending occurrence of a wanted or unwanted event. In a very similar mechanism, one that could apply to the contingency aware participants in the present studies, one might come to (dis)like the CS because he or she knows that it will always be accompanied by a valenced object. This knowledge alone might be viewed as a reasonably diagnostic basis for evaluating the CS.

These mechanisms have been offered with varying degrees of empirical support and theoretical elaboration. An extensive evaluation of each is beyond the scope of this paper. It seems worth noting, though, that if a multiple mechanisms perspective is accepted, then various inconsistencies in the literature are to be expected simply as a function of the heterogeneity of mechanisms. For example, the issue of contingency awareness' role in EC has been especially contentious. PC theorists have argued that contingency awareness is a necessary condition for the occurrence of PC and have extended this claim to EC (Lovibond & Shanks, 2002). Empirically, however, various relationships between the two have been observed. EC has been found only when participants are contingency aware (e.g. Pleyers et al. 2007), only when participants are *not* contingency aware (e.g. Fulcher & Hammerl, 2001), and has also been found to be uncorrelated with EC (e.g. Baeyens et al., 1988, 1993). This is not surprising if EC can occur in different ways. Both the implicit misattribution mechanism and the conceptual recategorization model would not conceptually seem to require contingency awareness. On the other hand, stimulus-stimulus, signal learning, and belief formation mechanisms would all be expected to occur more readily if not exclusively when individuals elaborate upon the CS-US relationship.

Future Directions

EC has proven to be a phenomenon of interest to multiple disciplines, and existing theory reflects this diversity. However, EC has received comparatively little attention from attitude researchers. How the phenomenon and existing literature is best integrated with social psychological theory of attitudes remains an open problem.

A major goal for EC research should be to develop distinct models of EC. Doing so will require more closely tying methodology to theory. Multiple mechanisms of EC might operate in a single procedure (see Kim, Lim, & Bhargava, 1998, Experiment 2, for evidence of dual mediation). For most purposes, experimental procedures should be designed to facilitate one particular mechanism of EC. The procedure used here was not created specifically to isolate an implicit misattribution mechanism, but there are reasons why it is particularly suited to it and why it is particularly unsuited to creating EC through other major mechanisms. The basic surveillance procedure is conducive to an implicit misattribution mechanism due to the nature of the CS and US stimuli selected, the simultaneous presentation of stimuli (which we view as critical element of the surveillance procedure and especially relevant to source confusability), the use of a cover story and distracter task, and the infrequency with which participants demonstrate contingency or demand awareness. Also, in our paradigm, no single US is ever repeated, rendering EC mechanisms involving stimulus-stimulus association or belief formation unlikely because they would have to occur by one-trial learning.

The perspective that EC can occur through multiple mechanisms will be useful to resolve inconsistencies in the EC literature and can clarify the generalizability of empirical findings. The first step in this direction involves speculating about what particular mechanism or mechanisms is likely to have operated in previous EC work by examining the compatibility of a given mechanism with the specific research procedures. For example, it is unclear whether an implicit misattribution mechanism has operated in previous EC work, though some procedures such as that of Staats and Staats (1958) are conceptually and operationally similar to the Olson and Fazio (2001) procedure. These two procedures have in common the brief, subtle, and simultaneous pairings of CS and moderately positive or negative US. In other EC studies, it is very unlikely that implicit misattribution was at work. For example, in some studies the response to a US could not have conceivably come from the CS, such as when electric shocks are used as US and words or pictures are used as CS (e.g. Cacioppo et al., 1992; Zanna et al., 1970). In these studies, feature matching between CS and US is low; participants could not have misattributed their responses to the US (physical pain) to the CS (a photograph or word). In these particular studies, observed attitude change with respect to the CS is likely to have been a consequence of Pavlovian conditioning. These electric shock procedures were modeled on PC experiments, and their focus was on signal value, the prediction of shock. Contingency awareness is to be expected, and it is likely that these conditioning effects were mediated by such awareness rather than a misattribution mechanism.[8]

Seemingly minor procedural characteristics could have important ramifications for the feasibility of a particular mechanism of EC. For example, Pleyers and colleagues (2007) found evidence for EC only when participants were aware of CS-US contingencies. In their procedure, they presented CS-US pairings in which the CS images were small, novel consumer brands that were embedded in larger, valenced US images. Regardless of the particular mechanism operating in this work, such stimulus presentation should discourage implicit misattribution due to the high relative salience of the US. Study 4 suggests that had a small US instead been embedded in a large CS, EC would have been more likely to occur through misattribution, and consequently different results concerning the role of contingency awareness in EC might have been obtained.

In closing, having isolated source confusion and implicit misattribution as a mechanism by which EC has occurred, we hope it would lose some of its elusiveness. Some procedural instantiations promote the mechanism. Others do not, and it is in these latter cases that EC may prove less than robust. One of the exciting aspects of the model is that it leads one to think about procedural variations that can enhance EC by their heightening source confusability. It is doubtful that we, or any other researchers, would have thought to manipulate eye-gaze shifting, CS-US proximity, CS-US relative size, or the extent to which US were attitudinally evocative, were it not for consideration of the implications of our postulated model.

Acknowledgments

This research was supported by Grant MH38832 from the National Institute of Mental Health. The authors thank Allison Blodgett and Ping Bai for invaluable assistance conducting Study 1 and preparing the data. We also extend thanks to Chris Loersch and Kate Darwent for comments on earlier drafts of the manuscript.

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[8]Though contingency awareness is to be expected, this should not be taken to mean that the results are artifactual and stem from demand awareness, that participants inferred they were *supposed to* express a particular evaluation. Indeed, the contribution of Zanna and colleagues (1970) is precisely its demonstration of attitude conditioning in an experimental setting that separated collection of the dependent variable from the conditioning phase, which purportedly composed separate experiments.

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Table 1

Conditioning score as a simultaneous regression function of CS counterbalancing and number of critical trials on which one, two, or three or more eye gaze shifts between CS and US occurred.

Variable	β coefficient	*t*-value	*p*-value
CS counterbalancing	.440	2.50	.020
# of 1 shift trials	.491	1.74	.096
# of 2 shift trials	.167	.91	.371
# of 3+ shift trials	.960	3.28	.003

Appendix

Unconditioned stimuli (US) used in Study 5

	Mildly Evocative		Strongly Evocative	
	Word	**Image**	**Word**	**Image**
Positive	Useful	Waterfall	Great	Kittens
	Calming	Sailboat	Joyful	Hot air balloons
	Desirable	Campsite	Excellent	Sundae
	Appealing	Diploma	Perfect	Diamond
	Relaxing	Happy couple	Awesome	Baby seal
	Beneficial	Astronaut	Fantastic	Sports car
	Worthwhile	Woman w/baby	Enjoyable	Party balloons
	Valuable	Mountain peak	Amazing	Puppies
	Terrific	Boy w/ice cream	Loveable	Milk & Cookies
	Commendable	Chipmunk	Wonderful	JetSki
Negative	Inferior	Hazmat suit man	Horrible	Pile of skulls
	Harmful	Bees	Disgusting	Cigarette butts
	Offensive	Worms	Hateful	Man with knife
	Troublesome	Trash on street	Sorrowful	Snake
	Upsetting	Man kneeling by toilet	Awful	Flat tire
	Terrifying	Smokestacks	Terrible	Crying boy
	Unhealthy	Dirty water pipe	Depressing	Car exhaust
	Useless	Trash in sand	Dreadful	Shark
	Undesirable	Wrecked cars	Bad	Cockroach
	Dislikable	Dirty dishes	Foolish	Snarling dog