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What do memory data tell us about the role of contingency awareness in evaluative conditioning? ☆

Bertram Gawronski [a,*], Eva Walther [b]

[a] Department of Psychology, The University of Western Ontario, Social Science Centre, London, Ontario, Canada N6A 5C2
[b] Department of Psychology, University of Trier, Germany

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ABSTRACT

Evaluative conditioning (EC) refers to the effect that pairings of a conditioned stimulus (CS) with a valenced unconditioned stimulus (US) lead to changes in the evaluation of the CS. There have been recurring debates about whether EC requires awareness of the contingency between CSs and USs during learning. We argue that the memory performance data obtained in the standard paradigm remain ambiguous about the role of contingency awareness during the encoding of CS–US pairings. First, memory performance data are unable to distinguish between encoding-related versus retrieval-related effects. Second, the relation between memory performance and evaluation is correlational, which limits conclusions about causal relations between memory performance and EC effects. These ambiguities imply that any possible data pattern can be interpreted in at least two different ways. It is concluded that a resolution of the current debate requires alternative approaches in which contingency awareness is experimentally manipulated during the encoding of CS–US pairings.

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Introduction

Some people like spinach; others detest it. Some prefer Coke over Pepsi; others like Pepsi better than Coke. Some are attracted to ambitious people; others prefer a mate with family values. In general, our evaluations of objects and individuals play a significant role in everyday life, because they influence decisions which products we are going to buy or who we are going to date or marry. Even though automatic evaluative reactions can help us navigate through a world of complex decisions (Ferguson & Zayas, 2009), they can also have undesired effects when they promote behaviors that are dysfunctional for our health and well-being, such as addictive behaviors or phobic reactions. Not surprisingly, one of the most important questions in psychology is where these evaluations come from and what factors lead to changes in evaluative responses.

Over the past three decades, social psychologists have become increasingly interested in the role of conditioning mechanisms as a source of people's likes and dislikes (for reviews, see De Houwer, Thomas, & Baeyens, 2001; Jones, Olson, & Fazio, 2010; Walther, Weil, & Düsing, 2011). In a typical evaluative conditioning (EC) paradigm, a neutral conditioned stimulus (CS) is repeatedly paired with either a positive or a negative unconditioned stimulus (US). The common result is that the CS acquires the valence of the US, such that CSs that have been paired with positive USs acquire a positive valence and CSs that have been paired with negative USs acquire a negative valence (for a meta-analysis, see Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010). Even though EC paradigms have originally been used to study the formation of attitudes toward novel objects, there is accumulating evidence that EC paradigms are also effective in changing existing attitudes toward familiar objects, including attitudes toward social groups (e.g., Karpinski & Hilton, 2001; Olson & Fazio, 2006), the self (e.g., Baccus, Baldwin, & Packer, 2004; Dijksterhuis, 2004; Grumm, Nestler, & von Collani, 2009), continents (e.g., Gawronski & LeBel, 2008), and consumer products (e.g., Gibson, 2008).

One of the reasons why the EC paradigm has attracted so much attention is that EC effects have been claimed to occur in the absence of conscious awareness of the contingency between the CS and the US (e.g., Baeyens, Eelen, & van den Bergh, 1990; Field & Moore, 2005; Fulcher & Hammerl, 2001; Jones, Fazio, & Olson, 2009; Olson & Fazio, 2001, 2002; Walther & Nagengast, 2006). The presumed independence of contingency awareness is not only theoretically important, in that it may distinguish EC from other variants of conditioning, such as Pavlovian signal learning (see De Houwer et al., 2001; Walther, Nagengast, & Trasselli, 2005); it also raises some interesting questions about whether people are consciously aware of the sources of their preferences (see Gawronski, Hofmann, & Wilbur, 2006; Wilson, Dunn, Kraft, & Lisle, 1989). On the one hand, one could argue that the ability to learn object-valence contingencies

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* Corresponding author.
E-mail address: bgawrons@uwo.ca (B. Gawronski).

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outside of conscious awareness is a highly functional capacity that facilitates context-appropriate action. On the other hand, it also implies the disturbing possibility that we might be helpless to resist the influence of those who try to manipulate us outside of our awareness (e.g., Dijksterhuis, Smith, van Baaren, & Wigboldus, 2005; Karremans, Stroebe, & Claus, 2006).

In addition to these questions, the role of contingency awareness in EC has become a central issue in the ongoing debate between the proponents of dual-process and single-process theories (for a review, see Gawronski & Creighton, in press). Drawing on the distinction between associative and propositional processes, some dual-process theorists have proposed two distinct mechanisms by which attitudes can be formed and changed: (a) an associative mechanism in which objects and events become automatically linked by virtue of their mere co-occurrence and (b) a propositional mechanism that involves a conscious validity assessment of propositionally represented statements (e.g., Gawronski & Bodenhausen, 2006; Rydell & McConnell, 2006). This distinction has been challenged by single-process theorists who argued that the acquisition of new information is generally mediated by propositional processes, and that there is no empirical evidence for the existence of a distinct associative process of automatic link formation (e.g., Kruglanski & Gigerenzer, 2011; Mitchell, De Houwer, & Lovibond, 2009). Because EC is often treated as a prototypical example of associative learning, the question of whether EC effects can occur in the absence of contingency awareness has important implications for the debate about dual-process and single-process theories.[1]

Although the assumption that EC does not require contingency awareness is rather widespread in the social psychological literature, its validity has been challenged by several studies that found EC effects only when participants were able to report the contingency between the CS and the US (e.g., Bar-Anan, De Houwer, & Nosek, 2010; Dawson, Rissling, Schell, & Wilcox, 2007; Dedonder, Corneille, Yzerbyt, & Kuppens, 2010; Pleyers, Corneille, Luminet, & Yzerbyt, 2007; Stahl & Unkelbach, 2009; Stahl, Unkelbach, & Corneille, 2009). These findings not only fueled controversies about the learning mechanisms that underlie EC effects (e.g., De Houwer, 2009; Gawronski & Bodenhausen, 2006, 2009; Hofmann et al., 2010; Jones et al., 2010; Kruglanski & Gigerenzer, 2011; Mitchell et al., 2009); they also sparked disputes about the proper way of measuring contingency awareness in EC studies (e.g., Jones et al., 2009; Pleyers et al., 2007).

In the present article, we argue that the currently dominant approach of studying contingency awareness in EC remains ambiguous as to whether contingency awareness during the encoding of CS–US pairings is or is not required for EC effects to occur (see also De Houwer, 2001; Field, 2000). This argument is based on three methodological observations. First, the standard paradigm to study contingency awareness assesses subsequent memory performance in correctly identifying CS–US pairings rather than contingency awareness during the encoding of CS–US pairings. Second, the relation between memory performance and evaluation data in this paradigm is correlational rather than experimental, which implies that the causal direction of the obtained relations remains ambiguous. Third, these characteristics entail that any data pattern can be interpreted in at least two different ways, one implying that contingency awareness is necessary and the other one implying that contingency awareness is not necessary for EC effects to occur. To overcome these ambiguities, we endorse the development and use of experimental approaches in which contingency awareness is manipulated during the encoding of CS–US pairings.

Ambiguities in the standard paradigm

Memory versus awareness

To investigate the role of contingency awareness in EC, researchers typically include a free recall or recognition task in which participants are asked to identify the US with which a given CS has been paired in the preceding learning task. In some studies, researchers distinguished between participants who did versus did not show evidence for contingency memory (e.g., Fulcher & Hammerl, 2001). Other researchers argued that this participant-based approach is suboptimal and that contingency awareness should be studied on an item basis for each individual CS (e.g., Pleyers et al., 2007). Irrespective of how contingency awareness is determined for a given data set, it is important to note that both data analytic strategies are based on memory performance data that are assessed after the presentation of CS–US pairings. That is, researchers tend to assess participants' subsequent performance in correctly identifying the CS–US pairings of the learning task. These data are typically interpreted as reflecting participants' awareness of CS–US contingencies during encoding of the relevant pairings. If EC effects are found in the absence of accurate memory for the CS–US contingencies, it is inferred that attitudes can be influenced by CS–US pairings outside of conscious awareness (e.g., Baeyens et al., 1990; Field & Moore, 2005; Fulcher & Hammerl, 2001; Jones et al., 2009; Walther & Nagengast, 2006). If, however, EC effects are found only when participants show accurate memory for the CS–US contingencies, it is assumed that attitudes remain unaffected by CS–US pairings unless participants are consciously aware of these pairings during encoding (e.g., Dawson et al., 2007; Dedonder et al., 2010; Pleyers et al., 2007; Stahl & Unkelbach, 2009; Stahl et al., 2009).

In a critical analysis of the literature on unconscious learning, Shanks and St. John (1994) argued that awareness checks of this kind have to meet two criteria to reliably distinguish between conscious and unconscious learning. First, it is important to establish that the obtained effects on the primary criterion measure (i.e., evaluation) are indeed driven by the same information that the experimenter aims to assess with the awareness measure (*information criterion*). Second, the awareness measure must have the same sensitivity to the learned information as the primary criterion measure (*sensitivity criterion*). According to Shanks and St. John, learning effects on the primary criterion measure in the absence of effects on the awareness measure provide valid evidence for unconscious learning only when both conditions are met. With regard to the use of memory measures in EC research, Shanks and St. John further noted that “the information criterion does not raise particular problems, because there is little doubt that the information the subjects learn (the contingency between CS and US) corresponds to what the awareness test asks them to report” (p. 377).[2] Thus, granted that the employed measures of contingency memory are sufficiently sensitive, Shanks and St. John's analysis would suggest that the standard paradigm is well-suited to establish whether EC effects do or do not require awareness of CS–US contingencies.

Counter to this conclusion, we argue that performance on subsequently administered memory tasks remains ambiguous as to the whether the obtained effects reflect encoding-related or retrieval-related processes. For example, memory for CS–US contingencies in an EC paradigm could be low because participants did not recognize the relevant contingencies during encoding. Alternatively, memory

[1] It is important to note that not all dual-process theories of attitudes propose two conceptually distinct learning mechanisms. For example, Fazio's (2007) MODE model distinguishes between automatic and controlled processes in the *expression* of attitudes, but it remains agnostic about whether the *formation* of attitudes occurs through a single process or two distinct processes.

[2] According to Shanks and St. John (1994), the information criterion is more relevant for other variants of learning that have been claimed to occur outside of conscious awareness, such as artificial grammar learning.

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performance could be low because participants failed to recollect specific details of the learning episode, although they had consciously recognized the contingency between the CS and the US during encoding. The latter case resembles the dissociation commonly found in research on source memory, in which participants are usually able to recall the content of a message while being unable to recall its source (for a review, see Johnson, Hashtroudi, & Lindsay, 1993). Applied to EC, one could argue that the conditioned response to the CS is functionally equivalent to the representation of the “message” which remains unqualified even if participants fail to recollect the specific CS–US contingencies as the “source” of their response. From this perspective, it would be premature to interpret EC effects in the absence of accurate memory for CS–US contingencies as evidence for the hypothesis that EC effects do not require contingency awareness during encoding, because dissociations between “source memory” and “message memory” are due to retrieval-related processes, not encoding-related processes (Johnson et al., 1993). The bottom-line is that contingency awareness is hardly ever assessed *concurrently* during the encoding of CS–US pairings (for a notable exception, see Baeyens et al., 1990), which in fact seems difficult without increasing participants' attention to the relevant pairings (Shanks & St. John, 1994). Rather, measures of contingency memory are generally administered *after* the encoding of CS–US contingencies, and performance on these tasks is influenced by multiple factors over and above participants' awareness of CS–US contingencies during encoding. Although the conceptual difference between contingency memory and contingency awareness has been acknowledged by some researchers (e.g., Bar-Anan et al., 2010; Pleyers et al., 2007; Stahl et al., 2009), its methodological implications are rarely considered in the ongoing debate about the role of contingency awareness in EC.

Correlation versus causation

In addition to the role of encoding-related versus retrieval-related processes, there is a second ambiguity that is rather difficult to resolve: the causal relation between memory performance and evaluation data. In a standard EC paradigm, researchers manipulate the valence of the US that is paired with a given CS, and then assess evaluations of the CS. To investigate the role of contingency awareness, researchers typically include a measure of contingency memory in addition to the evaluation measure (Shanks & St. John, 1994). In other words, the experimental manipulation involves pairings of CSs and USs and participants' evaluations and memory performance serve as two distinct dependent measures (see Fig. 1). Importantly, both evaluation and memory performance are measured variables in such a design, which implies that any relation between the two is merely correlational. Thus, conclusions about causal relations between the two variables remain inherently ambiguous, as it is generally the case for correlational designs. Of course, any effects of the experimental manipulation on the two dependent measures can be unambiguously attributed to the causal influence of that manipulation. However, this does not imply that the memory and evaluation measures are causally related in a particular way. It may well be that the obtained evaluation effects depend on memory, but it is also possible that the obtained memory effects depend on participants' evaluations (e.g., Bar-Anan et al., 2010).

Antecedent versus effect

In technical terms, the debate about whether EC effects depend on contingency awareness during encoding is one about the *causal antecedents* of learning, in particular about the factors that *moderate* the acquisition of evaluative knowledge (cf. Baron & Kenny, 1986). The claim that EC effects occur only when participants are aware of the contingency between the CS and the US implies that evaluative knowledge about the CS is acquired only when contingency

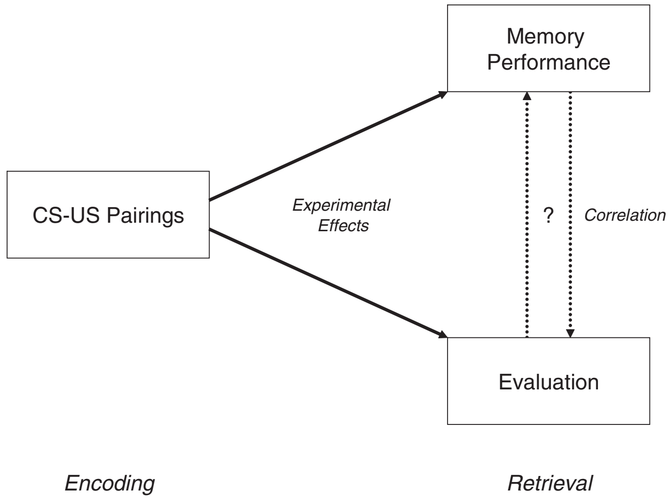

Fig. 1. Schematic depiction of the standard paradigm used to study the role of contingency awareness in evaluative conditioning. The encoding stage involves an experimental manipulation of CS–US pairings. The effects of these pairings are assessed at the retrieval stage with measures of evaluation and memory performance. Although effects on the memory performance and evaluation measures can be unambiguously attributed to the experimental manipulation, the relation between evaluation and memory performance is merely correlational.

awareness is present, but not when it is absent. Conversely, the claim that EC effects do not require contingency awareness implies that evaluative knowledge about the CS is acquired regardless of whether contingency awareness is present or absent. However, the correlational nature of the relation between memory performance and evaluation data in the standard paradigm is also consistent with a different interpretation according to which contingency memory represents a *causal effect* that *mediates* EC effects during retrieval (cf. Baron & Kenny, 1986). According to this view, accurate memory performance is the product of learning, not a causal antecedent. Put differently, whereas the moderating-antecedent interpretation refers to the *formation* of a new mental representation during the encoding of CS–US pairings, the mediating-effect interpretation refers to the *retrieval* of a previously formed mental representation during the evaluation of the CS.[3] As we will outline below, the latter interpretation is consistent with either of the two data patterns that have been used to support the conflicting claims regarding the role of contingency awareness during the encoding of CS–US pairings.

For the sake of conceptual clarity, it is worth noting that the two interpretations are not mutually exclusive. It is certainly possible that contingency awareness during the encoding of CS–US pairings is a moderating antecedent of the formation of new mental representations, which in turn may influence the retrieval of these representations in measures of memory performance. In fact, this interpretation represents the basis for the dominant use of memory performance measures in research on EC. As we will outline below, however, a simultaneous operation of encoding-related and retrieval-related influences is not guaranteed, because either one of them can operate without the other. On the one hand, it is possible that contingency awareness during encoding of CS–US pairings is a necessary precondition for subsequent influences on CS evaluations, and these effects may occur even when participants are unable to recall specific details of the learning episode. On the other hand, variations in memory performance remain silent about the role of contingency awareness during encoding, because any dissociation between memory

[3] Note that we use the term *retrieval* in a broad sense to subsume intentional processes (e.g., intentional retrieval in direct measures of evaluation, such as self-reported evaluative judgments) as well as unintentional processes (e.g., unintentional activation in indirect measures of evaluation, such as evaluative priming).

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performance and evaluation data can be interpreted in at least two different ways.

Standard interpretations and their alternatives

Lack of EC effects in the absence of US identity memory

One potential pattern in the standard paradigm is that EC effects emerge only when there is accurate memory for the specific US a given CS had been paired with. This pattern is typically interpreted as evidence that EC effects require conscious awareness of CS–US contingencies during encoding (e.g., Dawson et al., 2007; Dedonder et al., 2010; Pleyers et al., 2007; Stahl & Unkelbach, 2009; Stahl et al., 2009). In this interpretation, the covariation between evaluation and memory performance is assumed to reflect the impact of contingency awareness as a moderating antecedent of EC effects.

From the perspective of the mediating-effect account, however, covariations between EC effects and memory performance may reflect the operation of retrieval-related rather than encoding-related processes. Specifically, one could argue that EC effects depend on the strength of the mental link between the CS and the US. If the link is strong enough, activation of the CS may spread to the US, which in turn activates the evaluative response associated with the US (cf. Baeyens, Eelen, Van den Bergh, & Crombez, 1992; Sweldens, Van Osselaer, & Janiszewski, 2010; Walther, Gawronski, Blank, & Langer, 2009). If, however, the mental link between the CS and the US is too weak, activation of the CS may be insufficient to simultaneously activate the US, and thereby the evaluative response associated with the US. This conceptualization implies that performance on measures of contingency memory represents a causal effect of learning that mediates EC effects during retrieval, rather than a causal antecedent that moderates evaluative learning during encoding. Hence, it remains ambiguous if the failure to obtain EC effects in the absence of contingency memory reflects (a) the presumed necessity of contingency awareness during the encoding of CS–US pairings, or (b) the absence of a strong mental link between the CS and the US as a precondition for evaluative transfers from the US to the CS during retrieval. In other words, the lack of EC effects in the absence of contingency memory is consistent with at least two interpretations, one implying that awareness of CS–US contingencies during encoding is necessary and the other one implying that contingency awareness is not necessary for EC effects to occur.

EC effects in the absence of US identity memory

Along the same lines, there are also two alternative explanations for the opposite case, namely EC effects in the absence of contingency memory. Such data patterns are typically interpreted as evidence that EC effects do not require awareness of CS–US contingencies during encoding. However, because memory performance data are ambiguous about the contribution of encoding-related versus retrieval-related processes, it is also possible to explain such data from the opposite point of view. Research in social and cognitive psychology has shown that people can experience positive or negative reactions toward a given object even when they fail to accurately identify the relevant events that gave rise to these reactions (e.g., Gawronski et al., 2006; Lieberman, Ochsner, Gilbert, & Schacter, 2001; Wilson et al., 1989; Zajonc, 1968). However, the fact that people sometimes fail to remember the past events that are responsible for an evaluative response does not imply that they were unaware of these events at the time they occurred (Mitchell et al., 2009).

This logic can also be applied to the role of contingency memory in EC. In line with the claim that EC effects presuppose contingency awareness during the encoding of CS–US pairings, one could argue that participants are most often aware of these pairings, which creates a mental link between the CS and the US. This mental link may be strong enough to elicit an evaluative response to the CS in a subsequent evaluation task. However, participants may not have introspective access to the semantic link between the CS and the US that is responsible for the positive or negative feeling on which they base their evaluation. In line with this contention, there is evidence showing that participants show chance-level performance when they are asked to guess the semantic meaning of subliminally presented words, but above-chance performance when they are asked to guess the valence of the same subliminally presented words (e.g., Bargh, Litt, Pratto, & Spielman, 1989; Dijksterhuis & Aarts, 2003; Greenwald, 1992). Applied to measures of contingency memory in EC paradigms, this *lexical-affective dissociation* implies that participants may be experientially aware of the affective responses that are resulting from CS–US links, even when they have no conscious access to the CS–US link that gave rise to the affective response (e.g., Lewicki, 1985). Hence, it remains unclear whether EC effects in the absence of contingency memory reflect (a) the presumed irrelevance of contingency awareness during the encoding of CS–US pairings, or (b) an example of lexical-affective dissociations during retrieval.

Lack of EC effects in the absence of US valence memory

Many studies in the EC literature are concerned with participants' memory for pairings of the CS with a particular US. Sometimes, however, participants may be unable to identify the particular US a given CS had been paired with, but they may still remember the valence of the US. For example, in a study by Stahl et al. (2009) EC effects emerged only for those CS–US pairings for which participants correctly remembered the valence of the US, and memory for the US's identity did not further contribute to EC effects. Based on this finding, the authors concluded that contingency awareness plays a critical role in EC, "albeit valence awareness, not identity awareness" (p. 404).

Stahl et al.'s (2009) distinction between valence and identity awareness is helpful to provide deeper insights into the relation between contingency memory and EC effects. Yet, it is important to note that the critical role of US valence memory does not necessarily reflect encoding-related processes. On the one hand, it seems possible that participants have to be consciously aware of the valence of the US during the encoding of CS–US pairings. On the other hand, it is also possible that US valence memory is the *result* of evaluative learning, in that participants may guess the valence of the US on the basis of the evaluative response evoked by the CS (e.g., Bar-Anan et al., 2010). In other words, if EC effects occur only in the presence of US valence memory, this pattern may indicate either (a) the necessity of CS–US valence contingency awareness during the encoding of CS–US pairings, or (b) participants' use of the evaluative response to the CS as a cue in guessing the valence of the US during retrieval.[4]

EC effects in the absence of US valence memory

Even though Stahl et al.'s (2009) data suggest that EC effects are limited to conditions when participants can remember the valence of the US, it is important to note that a similar ambiguity applies to the opposite outcome, namely EC effects in the absence of US valence memory. On the one hand, one could argue that such effects indicate that awareness of CS–US valence contingencies during the encoding

[4] According to Stahl et al. (2009), guessing of US valence on the basis of evaluative responses to the CS should occur irrespective of whether participants' evaluative responses are consistent or inconsistent with the valence of the US a given CS has been paired with. Yet, in their study, reverse EC effects were not associated with particular response patterns in the memory task, suggesting that valence-based guessing processes may not play a role in paradigms to assess contingency memory. Counter to the null effect in Stahl et al.'s study, however, other research did find systematic relations between EC effects and EC-congruent responses in the memory task that were independent of the actual US valence (e.g., Bar-Anan et al., 2010). Hence, guessing of US valence on the basis of evaluative responses to the CS cannot be ruled out a priori.

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of CS–US pairings is not required for the emergence of EC effects. On the other hand, such a data pattern is also consistent with the claim that awareness of CS–US valence contingencies is indeed required during encoding, and that participants may not be able to recollect the valence of the US in the subsequent memory task. Under some conditions, they may also refrain from using their evaluative response to the CS as a cue to guess the valence of the US (e.g., Stahl et al., 2009). Such flexible use of cues in memory tasks is consistent with evidence showing that the impact of evaluative responses on recognition judgments depends on various factors, including analytic versus holistic processing styles (e.g., Whittlesea & Price, 2001). Thus, EC effects in the absence of US valence memory also remain ambiguous as to whether participants have to be consciously aware of the relevant contingencies during the encoding of CS–US pairings.

Single versus multiple USs

So far, our discussion focused primarily on cases where a given CS has been repeatedly paired with the same US. Even though the use of single USs is rather common, there are several EC studies in which the same CS was paired with multiple different USs of the same valence (e.g., Jones et al., 2009; Olson & Fazio, 2001; Sweldens et al., 2010). These studies raise the question of what type of memory data one could reasonably ask for in studies using multiple USs: memory for US valence or memory for US identity? Intuitively, one could argue that data on US valence memory seem more appropriate, because participants may recall that a particular CS had been consistently paired with positive or negative USs, even when they fail to remember the identity of the USs. As outlined above, such memory data remain ambiguous about the role of contingency awareness during encoding. Following the logic outlined above, this ambiguity remains regardless of whether EC effects emerge only in the presence or even in the absence of US valence memory.

Alternatively, one could point to the advantage of collecting memory data on US identity over and above US valence, because such data may provide additional insights that cannot be gained from US valence memory (e.g., Stahl & Unkelbach, 2009). In this case, it is again useful to consider each of the two possible outcomes and their respective interpretations. First, if EC effects emerge in the absence of US identity memory, one could argue that contingency awareness is not required during the encoding of CS–US pairings. However, one could also argue that, in cases of multiple USs, memory for US identity is actually the wrong measure, because awareness of CS–US valence contingencies is the critical determinant of EC effects (Stahl et al., 2009). Second, if EC effects emerge only in the presence of US identity memory, one might conclude that contingency awareness is indeed required during the encoding of CS–US pairings. However, one could also argue that such data reflect the necessity of sufficiently strong CS–US links to produce evaluation effects during retrieval. Hence, memory data on US identity in paradigms with multiple USs remain equally ambiguous about the role of contingency awareness during the encoding of CS–US pairings.

Implications

The current analysis has several implications for research on the role of contingency awareness in EC. First, it seems desirable to describe the measures employed in EC research as measures of contingency memory rather than contingency awareness (see also Bar-Anan et al., 2010). The common use of the term *contingency awareness* is rooted in the desire to study boundary conditions during the encoding of CS–US pairings (e.g., De Houwer, 2009; Mitchell et al., 2009). Even though there is no doubt that encoding-related processes can influence performance on memory tasks, the reverse conclusion that performance on memory tasks exclusively reflects encoding-related processes is a prime example of the logical fallacy of *affirming the consequent*. After all, memory performance reflects the joint product of multiple factors, including encoding-related and retrieval-related processes. Thus, for the sake of conceptual precision, it would be useful to describe the memory tasks commonly employed in EC research as measures of contingency memory, which may or may not reflect contingency awareness during encoding.

Second, it seems important to take the correlational nature of the relation between memory performance and evaluation data into account (see Fig. 1). In the standard paradigm, both memory performance and evaluation data can be unambiguously related to a causal effect of the experimental manipulation of CS–US pairings in the preceding learning task. However, this does not imply a particular causal relation between the two outcome measures. For example, it is possible that a failure to obtain EC effects in the absence of contingency memory reflects the *moderating* function of contingency awareness during encoding. Alternatively, one could interpret the same findings as reflecting the *mediating* role of CS–US links for the emergence of EC effects. Because any possible outcome can be explained in at least two different ways (see Table 1), it seems premature to draw strong conclusions about the role of contingency awareness during encoding, regardless of whether the EC effects do or do not occur in the absence of contingency memory.

Third, the current analysis encourages the development of alternative approaches to study the boundary conditions of EC effects. Specifically, the ambiguous nature of the relation between memory performance and evaluation data implies the quest for experimental approaches to manipulate contingency awareness during encoding instead of studying correlations between EC effects and memory performance. Even though correlational approaches are rather common to study the boundary conditions of EC effects, recent research has started to use experimental designs to investigate the moderating roles of cognitive resources (Pleyers, Corneille, Yzerbyt, & Luminet, 2009) and processing goals (Corneille, Yzerbyt, Pleyers, & Mussweiler, 2009; Fiedler & Unkelbach, 2011; Gast & Rothermund, 2011). Of course, designing experimental manipulations of contingency awareness might be more difficult compared with manipulations of other markers of automaticity (see Bargh, 1994). However, in the absence of experimental evidence the exact relation between EC effects and contingency memory will remain ambiguous,

Table 1
Standard and alternative interpretations of different patterns of EC effects and contingency memory.

	Standard interpretation	Alternative interpretation
Lack of EC effects in the absence of US identity memory	Awareness of CS–US contingencies during encoding is required for EC effects to occur.	Memory data reflect sufficiently strong CS–US link that mediates evaluation effects during retrieval.
EC effects in the absence of US identity memory	Awareness of CS–US contingencies during encoding is not required for EC effects to occur.	Lexical-affective dissociation during retrieval produces conscious affective experiences in the absence of introspective access to the semantic CS–US link that is responsible for these experiences.
Lack of EC effects in the absence of US valence memory	Awareness of CS–US valence contingencies during encoding is required for EC effects to occur.	Evaluative response evoked by the CS is used as a cue to guess the valence of the US during retrieval.
EC effects in the absence of US valence memory	Awareness of CS–US valence contingencies during encoding is not required for EC effects to occur.	Failed recollection of US valence and evaluative response evoked by the CS is not used as a cue to guess the valence of the US during retrieval.

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regardless of whether EC effects do or do not occur in the absence of contingency memory.

Toward an experimental analysis of contingency awareness in EC

To our knowledge, there are at least two sets of experimental studies that provide preliminary evidence regarding the role of contingency awareness during the encoding of CS–US pairings. A first study by Schultz and Helmstetter (2010) experimentally manipulated contingency awareness during the encoding of CS–US pairings in a fear conditioning paradigm by varying the discriminability of the CSs (for similar approach, see Knight, Nguyen, & Bandettini, 2003). As dependent measures, the researchers assessed galvanic skin responses and self-reported US expectancies concurrently during the presentations of the CSs in the learning phase. Supporting the usefulness of the manipulation of contingency awareness, results showed accurate US expectancies only when CS discriminability was high, but not when it was low. Yet, differential skin conductance responses to the CSs emerged regardless of whether CS discriminability was high or low. These results are consistent with the hypothesis that EC effects can occur in the absence of contingency awareness. However, they do not provide compelling evidence for this hypothesis, given that the measure of galvanic skin responses may reflect arousal rather than evaluative responses. To the extent that the transfer of US valence is guided by different learning principles than the transfer of US arousal (Gawronski & Mitchell, submitted for publication), future research using similar manipulations would benefit from including measures that unambiguously reflect evaluative responses.

Two other studies that provide preliminary evidence for the role of contingency awareness during the encoding of CS–US pairings were conducted by Dedonder et al. (2010) and Pleyers et al. (2009). In their experiments, participants' cognitive resources were manipulated by means of a secondary task (auditory 2-back task) during the presentation of CS–US pairings. As dependent measures, the researchers assessed self-reported CS evaluations and contingency memory after the presentation of CS–US pairings. The results showed that both EC effects and contingency memory were significantly lower when participants had to perform a secondary task during the encoding of CS–US pairings than when their cognitive resources were untaxed. These results are consistent with the hypothesis that EC effects depend on people's awareness of CS–US contingencies during encoding. However, they do not provide compelling evidence for this hypothesis, given that the contingency memory measure suffers from the same weaknesses that have been outlined for correlational designs. A concurrent assessment of US-expectancies during the encoding of CS–US pairings, such as the one used by Schultz and Helmstetter (2010), would provide more compelling evidence (see also Baeyens et al., 1990). More importantly, the manipulation employed by Dedonder et al. (2010) and Pleyers et al. (2009) is technically a manipulation of cognitive resources, not conscious awareness. Because different features of automaticity (e.g., unintentionality, unawareness, efficiency, uncontrollability) do not necessarily covary (see Bargh, 1994; Moors & De Houwer, 2006), a manipulation that is closer to the concept of awareness would provide more compelling evidence.

Notwithstanding the interpretational ambiguities in these studies, we believe that the experimental approach employed by Schultz and Helmstetter (2010), Dedonder et al. (2010), and Pleyers et al. (2009) is superior compared with the traditional correlational approach. To be sure, awareness is a state of the individual rather than a feature of the environment. Hence, any manipulation of awareness will be indirect in the sense that it will vary aspects of the environment that are assumed to influence the state of the individual. However, the fact that subjective states can be manipulated only indirectly does not mean that any manipulation is equally distal to the concept of awareness. For example, whereas manipulations of CS discriminability are closer to the concept of awareness compared with other features of automaticity, manipulations using secondary tasks are closer to the concept of resource-dependency (see Bargh, 1994; Moors & De Houwer, 2006). Thus, the most compelling evidence would be provided by studies that include (a) experimental manipulations that are close to the concept of awareness rather than other features of automaticity (e.g., Schultz & Helmstetter, 2010), and (b) a manipulation check of contingency awareness that is administered concurrently during the presentation of CS–US contingencies (e.g., Baeyens et al., 1990).

Conclusion

In the title of this article, we asked the question: “What do memory data tell us about the role of contingency awareness in evaluative conditioning?” The short answer to this question is: “not much,” at least when the question refers to contingency awareness during the encoding of CS–US contingencies. As we outlined in this article, the memory performance data of the traditional correlational paradigm (see Fig. 1) remain ambiguous about the exact role of contingency awareness during the encoding of CS–US pairings. These ambiguities imply that any data pattern can be interpreted in at least two different ways, one implying that contingency awareness is necessary and the other one implying that contingency awareness is not necessary for EC effects to occur (see Table 1). To overcome these limitations, we suggested that researchers move beyond the traditional correlational paradigm, which remains inherently ambiguous about the causal relation between memory performance and evaluation. We hope that the current analysis will inspire the development of experimental approaches to study the role of contingency awareness in EC, which may help to provide deeper insights into this notoriously recurring, but fascinating question.

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