Evaluative Conditioning: Past, Present, and Future

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Abstract

Evaluative Conditioning (EC) research investigates changes in the evaluation of a stimulus after co-occurrence with an affective stimulus. To explain the motivation behind this research, this essay begins with an overview of the history of EC research, followed by a summary of the state of the art with respect to three key questions. How should EC procedures be used to influence evaluation? We provide a guide based on evidence concerning the functional properties of EC effects. How does the EC effect occur? We discuss the possible mediating cognitive processes and their automaticity. Are EC effects ubiquitous outside the lab? We discuss the evidence for the external validity of EC research. We conclude that the most important open questions pertain to the relevance of EC to everyday life, and to the level of control that characterizes the processes that mediate the EC effect after people notice the stimulus co-occurrence.

Keywords: Evaluative Conditioning, Attitude Formation, Associations, Propositions, External Validity

On a coat hanger at home, a woman keeps her late father's beloved cashmere sweater. It fills her with a warm feeling every time she looks at it. Why does this woman love this sweater? Perhaps because it reminds her of her dad, or the feelings she had toward him. Perhaps she had already grown to like the sweater after seeing her father wear it often when he was alive. Psychologists would tend to suspect that the mere co-occurrence of the sweater with the woman's beloved father contributed to the formation of the warm feelings she has toward it. They might suggest that the woman was conditioned to like the sweater. Can attitudes be conditioned? In other words, does the mere co-occurrence between stimuli change attitudes? In this article, we present an overview of the past, present, and future of research that has focused on the effects of spatiotemporal stimulus pairing (e.g., the sweater and the father) on judgment, which is known as evaluative conditioning (EC). We review the history of EC research (past) to explain the motivations behind EC research, the current state of the art regarding the main issues driving EC research (present), and the key open questions that should orient further research on EC (future).

THE HISTORY OF EC RESEARCH

Early Research: Staats and Staats

As an introduction to EC and the motivation behind EC research, we start with a brief historical narrative. The study of the formation of likes and dislikes did not begin with conditioning paradigms. Earlier, social psychologists studied how people judge others based on verbal information about the traits of the target individuals (Asch 1946, Bruner & Tagiuri 1954; for a review, see Schneider 1973), and how verbal messages about a range of concepts influence people's attitudes with regard to these concepts (Hovland et al. 1953). Unlike social psychologists, Behaviorist psychologists, who studied learning, found it more challenging to

utilize their typical paradigms for the study of attitude formation. For them, an “attitude” was an odd dependent variable because it was not an overt response. The authors of the article that presented the earliest well-controlled experiment on the conditioning of favorability judgment (Staats & Staats 1958) felt compelled to assure readers that an attitude is an "implicit response" (citing Doob 1947), to lay the foundation for the hypothesis that the principles of classical conditioning could apply to attitudes (earlier work used conditioning to induce attitude-related behaviors; Razran 1936).

In classical conditioning, the spatiotemporal proximity of a conditioned stimulus (CS) and an unconditioned stimulus (US) leads to changes in the response to the CS in preparation for the occurrence of the US (for a review, Domjan 2005). In the first experiment that conditioned attitudes (Staats & Staats 1958), the CSs were words denoting nationality (e.g., Dutch), and the USs were words with positive or negative meaning. Participants read the CS words from a screen while uttering the US words that were presented auditorily. A CS_{pos} co-occurred with positive USs (US_{pos}s), and a CS_{neg} co-occurred with US_{neg}s. After this acquisition phase, the participants rated the CSs on an unpleasant-pleasant continuum. The results showed that participants judged the CS_{pos} as more pleasant than the CS_{neg}. The procedure of presenting CSs in spatiotemporal proximity with evaluative USs is known as the EC procedure, and the effect of this procedure on the evaluation of the CSs is called the EC effect (De Houwer 2007).

Staats & Staats (1958) concluded that their studies demonstrated how attitudes are formed. To illustrate, they suggested that their finding explained why people would like Dutch people after being told good things about the Dutch (e.g., “Dutch people are honest”). This example however ignores the fact that verbal messages do not only pair stimuli but also provide information about the relationship between stimuli (the Dutch are honest). This omission is

emblematic of a possible blind spot that characterized the Behaviorist perspective on EC for a long time; namely, co-occurrence is a relation and people may attempt to draw inferences from it.

At that time, people's tendency to make sense of things was considered a threat to the claim that attitudes were conditioned. The danger was that the EC effect was the result of the participants' attempt to comply with the researchers' expectations (e.g., Orne 1962, Page 1969). Studies conducted in the wake of Staats and Staats' research focused on that possibility, mostly by testing whether pairing influences evaluation without awareness of the CS-US co-occurrence (i.e., without contingency awareness). Although these studies yielded inconclusive results regarding the role of contingency awareness in EC, most found evidence that the evaluation changed even when the participants did not report awareness of the research hypothesis (e.g., Cohen 1964, Insko & Oakes 1966, McGinley & Layton 1973), thus reducing the possibility that it was the product of demand characteristics.

The Second Generation: From Levey and Martin to Baeyens

Several decades after Staats and Staats' seminal research, Levey & Martin (1975) revisited the conditioning of attitudes by implementing a different paradigm and theoretical framing. Levey and Martin used photos instead of words, measured reported (dis)liking of the CSs directly rather than assessing a reported pleasantness judgment, and dubbed this form of conditioning Evaluative Conditioning (Martin & Levey 1978). Levey and Martin argued that the conditioning of evaluation is important because it is the necessary precondition for classical conditioning (Levey & Martin 1975), whereas the conditioning of overt responses is sometimes, but not always, another result of classical conditioning (Martin & Levey 1994). They reasoned that the approval or disapproval of stimuli is a basic response shared by many organisms as a

vehicle to ensure positive outcomes from the interrelations between the animal and its environment (Levey & Martin 1990). Therefore, (dis)approval is the first to be conditioned, and the conditioning of other responses is solely a possible by-product of this conditioning.

A decade after Levey and Martin coined the term EC, empirical research on EC got its first boost, thanks primarily to Frank Baeyens, who published 21 articles reporting empirical research on EC from 1988 to 2009. The main claim that motivated his research was the notion that EC is not attitude formation generated by classical conditioning. Rather, the EC effect is the product of referential learning which is different from the signal learning (learning which stimuli predict the occurrence of the US) that governs classical conditioning (Baeyens et al. 1992a). This argument was based on empirical differences between EC and classical conditioning paradigms in studies on non-evaluative responses. Unlike the conditioning of non-evaluative responses, EC effects were thought to occur without contingency awareness, and with no (or very little) sensitivity to the CS-US contingency, which was most visible in EC's resistance to changes in the CS-US contingency (e.g., presentations of CS without the US) that were supposed to lead to the extinction of the conditioned evaluative response. Referential learning was hypothesized to influence the evaluation of the CS based on an automatic averaging of the valence of the stimuli with which the CS co-occurred in the past (De Houwer et al. 2001).

Critiques of the referential learning perspective came from researchers who argued that EC is a form of classical conditioning (e.g., Davey 1994), or experimenter demand (e.g., Field 2000). The empirical research inspired by these themes was still dominated by the issue of contingency awareness, but some studies turned to other questions. If EC is distinct from classical conditioning, this means that very little is known about it. Anything that had been studied with classical conditioning paradigms now needed to be studied with EC paradigms. This

included basic parameters such as the presentation schedule and the number of acquisition trials (e.g., Baeyens et al. 1992a), as well as phenomena such as Overshadowing (effects when two CSs co-occur with the same US; e.g., Dwyer et al. 2007), and Counterconditioning (effects of new co-occurrence of the CS with a US of the opposite valence; e.g., Baeyens et al. 1989).

The current day: De Houwer's Influence

Figure 1 lists the number of papers every year since 1987 which explicitly stated that they were examining EC (prior to 1987, there were no such papers at all in most years). EC research has clearly proliferated in the past few years. Recent research has addressed many novel questions, but the question of the automaticity of EC remains the most frequent. Automatic processes can include various features (i.e., unawareness, unintentionality, uncontrollability, and efficiency) that do not necessarily overlap. Each of the separate features of automaticity of the EC effect can be investigated independently of the other automaticity features. The bar colors in Figure 1 show a rough categorization that illustrates how common the investigation of automaticity was. Of the various features of automatic processes, contingency awareness has been the most common research question. Why? Perhaps because new results have reversed the conclusions of earlier studies. In the first few decades of EC research, researchers mostly agreed that there was reasonable evidence for an EC effect without awareness. In a rough count, we found that between 1987 to 2005, 70% (16/23) of the papers that reported research that attempted to measure awareness concluded that an EC effect can occur without awareness of the CS-US co-occurrence. In contrast, in the last 15 years (i.e., since 2006), that statistic changed to 35% (21/60).

Although in previous generations, the conclusion that the EC effect requires awareness of the CS-US co-occurrence was considered a serious threat to the importance and validity of the

effect, Figure 1 clearly shows that the recent confirmation of that conclusion has not dampened interest in EC research. Two theoretical developments, both contributed by Jan De Houwer, are likely to have fueled the ongoing interest in EC research despite its loss of status as unconscious learning. First, De Houwer (2007) suggested decoupling the term EC from any specific theoretical model that explains how the CS-US co-occurrence influences evaluation. Instead, he argued that EC should be considered a procedure or the effect of that procedure. The research community has adopted this recommendation and now refers to the EC procedure and EC effect. De Houwer correctly predicted that adopting his recommendation would help avoid a drop in interest such as the one that occurred in classical conditioning after Brewer (1974) famously argued that there is no evidence for classical conditioning in humans. Brewer's claim was based on the lack of evidence for classical conditioning without contingency awareness. If the EC effect could be decoupled from the dominant theoretical assumption that it is the result of low-level processes that do not require awareness, the findings challenging that assumption would not prompt researchers to abandon EC research. Instead, this kind of finding would encourage them to consider alternative accounts.

De Houwer's second contribution that probably helped maintain interest in EC despite the conclusion that the EC effect requires contingency awareness, was a new theoretical perspective that assumed that this awareness is indeed required for the EC effect to emerge. According to the propositional perspective (De Houwer 2009, 2018), people make inferences about the valence of the CS based on the knowledge that it co-occurs with the US. When evidence started to accumulate that the EC effect actually occurs solely (or mostly) when people are aware of the CS-US co-occurrence, this evidence was considered compatible with the propositional perspective rather than with ideas that challenged the importance of EC research by

arguing that the effect was the result of demand characteristics or redundant with everything that is already known about classical conditioning.

Actually, reasoning is not the only possible account for the EC effect, even if the effect always requires awareness of the CS-US co-occurrence. The processes that follow the conscious detection of the co-occurrence might still be non-inferential, unconscious, or uncontrolled. Later in this essay, we suggest that this possibility is one of the key open questions for future EC research. We also argue that it is time for EC research to pay more attention to external validity. To delve further into these proposals, however, we first need to review the state of the art on EC.

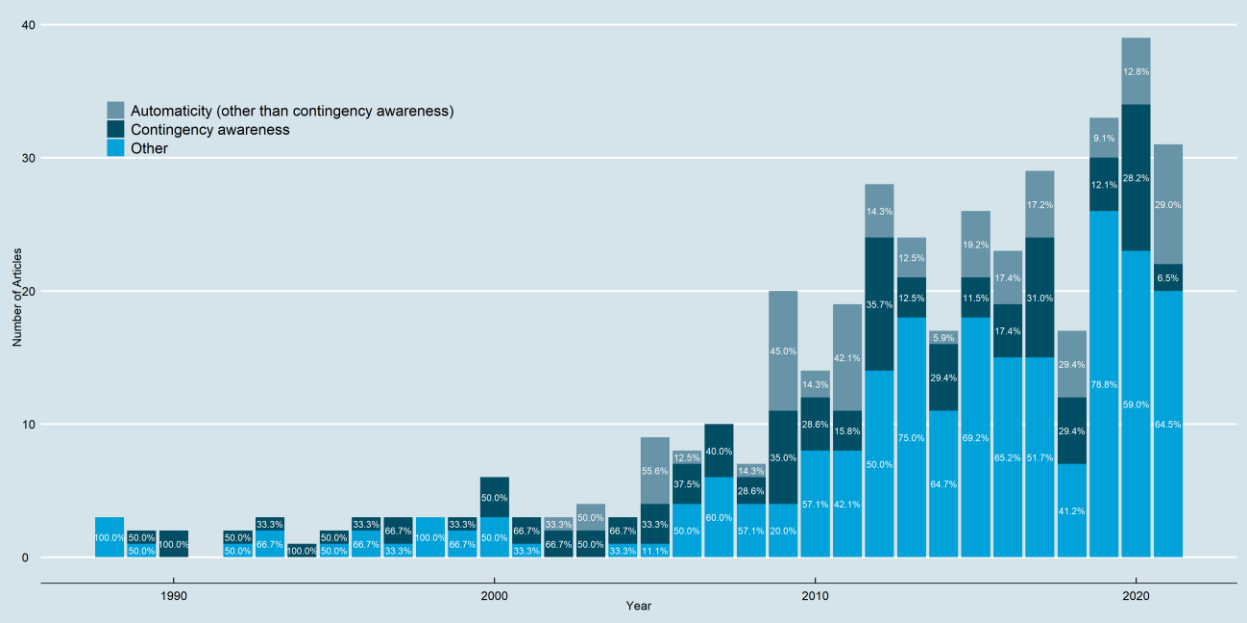

Figure 1. Number of EC papers, by year. We searched peer-reviewed papers in English that included the term "Evaluative Conditioning" in their title or abstract when searching in PubMed and PsycINFO, or in the title or topic, when searching in Web of Science. We included in our count only empirical papers that used an EC procedure to test an EC effect. We categorized papers based on the research questions presented by the authors of each paper. If one of the questions pertained to contingency awareness, we categorized the paper under 'contingency awareness'. We categorized papers under 'automaticity' if the paper did not include a research question pertaining to contingency awareness, but included a question pertaining to (un)intentionality, (un)controllability, (un)awareness, or (in)efficiency of the processes that underlie EC. All other papers were categorized as 'other'.

THE PROCEDURAL LEVEL: FUNCTIONAL PROPERTIES

To present the state of the art on EC and the open questions for future EC research, we start at the procedural level. What are the functional characteristics of evaluative conditioning; i.e., how do elements in the environment influence the EC effect? Answering these questions can help provide a practical guide to harnessing EC procedures to change evaluation.

Figure 2 illustrates some basic EC procedures. The two basic mandatory components are the acquisition phase and the evaluation phase. In the acquisition phase, a (conditioned) stimulus (CS) is repeatedly paired with a positive or negative (unconditioned) stimulus (US). Most EC designs (e.g., Gast & Rothermund 2011a) pair (one or more) CS with positive stimuli (CS_{pos}) and (one or more) CS with negative stimuli (CS_{neg}) in the acquisition phase. However, there are other options. For example, some studies use CSs that are paired with neutral stimuli, no stimuli, or with an equal number of positive and negative stimuli (CS_{neu}). This CS_{neu} can be used in addition to the CS_{pos} and CS_{neg} (e.g., Walther 2002), or together with only CS_{pos} or CS_{neg} (e.g., Vansteenwegen et al. 2006).

The CSs and USs can be in different modalities including visual (e.g., images of faces; Walther 2002), verbal (e.g., words; Balas & Gawronski 2012), auditory (e.g., music; Moran & Bar-Anan 2013), olfactory (odors; Baeyens et al. 1996), and flavors (e.g., Kerkhof et al. 2011), although the most common are images and words. The CSs and the USs can be in the same (e.g., Balas & Gawronski 2012) or different (e.g., Kerkhof et al. 2011) modalities.

In the evaluation phase, the CSs is measured either directly (e.g., “how much do you like the CS”?), or indirectly by using cognitive tasks or physiological measures (e.g., the blink startle response). Because EC procedures can vary, an EC effect can be calculated in different ways, depending on the specific CSs used in the procedure and the study design (within/between

participants). The different possibilities are illustrated in Figure 2. The mere CS-US co-occurrence usually results in an assimilative effect: the CS acquires valence that is similar to the valence of the paired US. This effect holds across the different types of stimuli and procedures described above.

Whereas all EC procedures include an acquisition phase followed by an evaluation phase, some may include additional phases before or after the acquisition phase that change the nature of the CS-US relationship (e.g., presenting the CS alone). Researchers manipulate different factors before, during, and after the acquisition phase. Next, we present several main questions about these factors and the current state of the art (for earlier reviews, see De Houwer et al. 2001; Hoffman et al. 2010; Walther et al. 2011b).

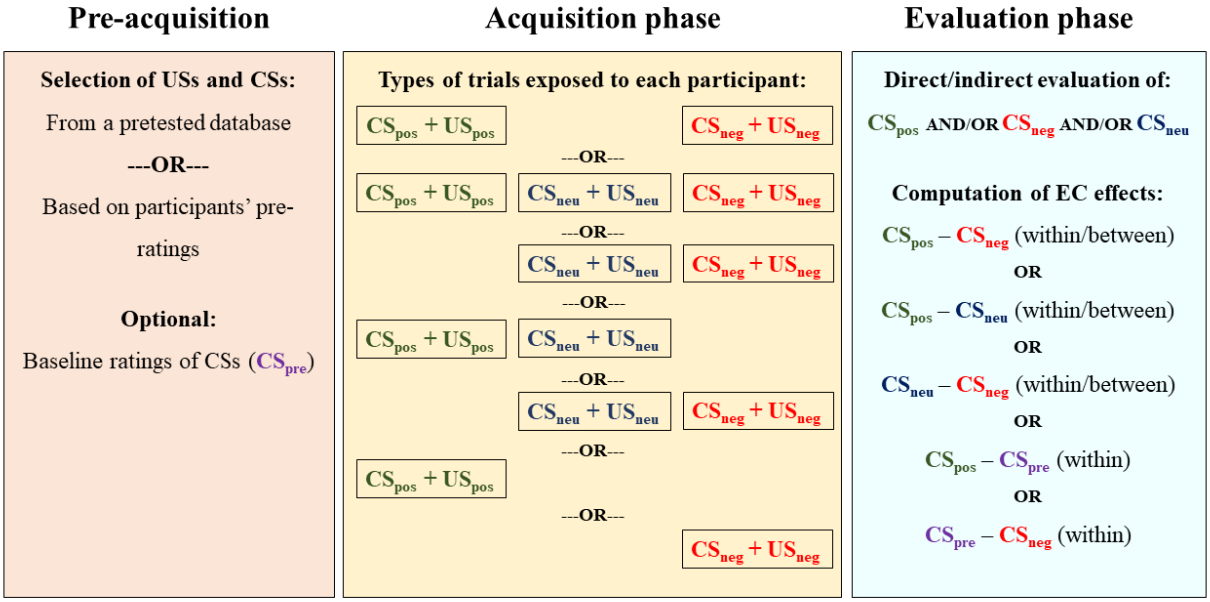

Figure 2. An illustration of basic EC procedures. CS = conditioned stimulus, US = unconditioned stimulus, pos = positive, neg = negative, neu = neutral, pre = pre-ratings, within = within-participants design, between = between-participants design.

Factors Manipulated Before or During the Acquisition Phase

Does the CS-US sequence matter? CS-US co-occurrences can differ in terms of sequence; i.e., the CS can precede the US (forward conditioning), follow the US (backward conditioning), or appear simultaneously with the US (simultaneous conditioning). In terms of effect size, a meta-analysis found no significant differences in the magnitude of the effect generated by different sequences (Hofmann et al. 2010). Confirmation comes from more recent studies that have compared simultaneous and sequential conditioning directly (e.g., Hütter & Sweldens 2013, Kattner et al. 2012; for exceptions see Stahl & Heycke 2016, Zerhouni et al. 2018) as well as for forward versus backward conditioning (e.g., Gast et al. 2016, Kim et al. 2016, Mallan et al. 2008). For forward and backward conditioning, a shorter interval between the CS and the US was reported to lead to stronger effects (Gast et al. 2016).

Research suggests that sequential EC effects are more memory-dependent than simultaneous EC effects. Hütter & Sweldens (2013) found that only simultaneous conditioning but not sequential conditioning led to an EC effect without contingency memory. Stahl & Heycke (2016) found that although an EC effect from simultaneous pairings did not depend on remembering which US the CS co-occurred with, an EC effect from sequential pairings only emerged with accurate US identity memory. Finally, research suggests that under some conditions (i.e., using intense USs, predictable US onset, and self-reported evaluation measures), backward conditioning can lead to a reversed (contrast) EC effect (i.e., a preference for CS_{neg} over CS_{pos}; e.g., Andreatta et al. 2013, Green et al. 2020, Luck & Lipp 2017).

Does the number of repetitions matter? There is no consistent evidence as to how many CS-US co-occurrences are needed for an EC effect, or the relationship between the number of co-occurrences and the magnitude of the EC effect. Some studies have only found an EC effect with

10 (Baeyens et al. 1992a) or 12 (Bar-Anan et al. 2010) co-occurrences, whereas others have obtained an EC effect with four (Experiment 1b; Kurdi & Banaji 2019), two (Kattner 2014, Experiment 2a), or even a single co-occurrence (e.g., Stuart et al. 1987), if the evaluation is measured right after the co-occurrence. No study has found a steady increase in the EC effect with the number of co-occurrences, but some have found an increase that peaked at the 10 (Baeyens et al. 1992a) or 15 co-occurrences (Bar-Anan et al. 2010) mark, sometimes followed by a decline in the effect size with additional co-occurrences (Baeyens et al. 1992a). Studies using an indirect evaluation measure have failed to find an effect for the number of co-occurrences (Hu et al. 2017: 8 vs. 12; Kurdi & Banaji 2019: 4-24). Hofmann et al.'s (2010) meta-analysis did not find a significant correlation between the number of trials and the magnitude of the EC effect (across measures).

Does it matter whether the CS co-occur with single or multiple USs? EC effects can be induced by pairing a single CS with a single US or with different USs of the same valence. There is no consistent evidence as to which method induces stronger EC effects. Different studies have reported stronger effects for single-US (Stahl & Unkelbach 2009, Sweldens et al. 2009), multiple-US (Gawronski et al. 2015a), or no difference at all (Fortier-St-Pierre et al. 2019). Although some results (Sweldens et al. 2010) suggested that multiple-US produces an EC effect that is more resistant to CS-only presentations and is less susceptible to changes in US valence as compared to an EC effect produced by single-US procedures, evidence from further research has not confirmed these differences (Fortier-St-Pierre et al. 2019, Gawronski et al. 2015a, Stahl & Unkelbach 2009).

Does it matter whether the US co-occur with single or multiple CSs? Cue-competition refers to cases where the pairing schedule of one CS influences the conditioning of another CS (Kattner

& Green 2015). One line of research on cue-competition has tested whether the co-occurrence of two CSs with the same US diminished the EC effect (i.e., Overshadowing; Mackintosh 1975). Dwyer et al. (2007) found no evidence of cue-competition in a procedure that presented each CS separately with the same US, as compared to presenting each CS with a different US. However, presenting two CSs at the same time with the US resulted in a smaller EC effect on each CS than presenting only one CS with the US (Kattner & Green 2015, Walther et al. 2011a).

A second line of cue-competition research has tested EC effects when a phase of CS_1-US co-occurrence is followed by a phase of CS_1-CS_2-US co-occurrence. In classical conditioning, this setup was reported to reduce the conditioned response to the CS_2 (Blocking; Kamin 1969). Most studies have failed to find blocking effects in EC (Dickinson & Brown 2007, Kattner & Green 2015, Laane et al. 2010; but see Tobler et al. 2006), and some have even found slightly augmented effects in the blocking group compared to the control condition that did not include a CS_1-US co-occurrence phase (Beckers et al. 2009, Walther et al. 2011a). However, blocking has been reported on an indirectly measured evaluation (Kattner & Green 2015), and in an unusual EC procedure in which each CS co-occurred with both US_{neg} and US_{pos} (Alves et al. 2020).

Factors Manipulated after the Acquisition Phase

Does a presentation of the CS without the US after the acquisition phase eliminate the EC effect? Early studies indicated that contrary to classical conditioning, presentations of CS without the US after the acquisition phase did not extinguish its previously acquired valence. In other words, the EC effect appears to be resistant to extinction (e.g., Baeyens et al. 1988, 2005; Blechert et al. 2008; Dwyer et al. 2007; Vansteenwegen et al. 2006). However, more recent studies have found boundary conditions for this finding: extinction has been observed on self-report measures (but not on indirect evaluation measures) if the participants report their

evaluation of the CSs not only after the extinction phase, but also before the extinction phase, right after or during the acquisition phase (e.g., Gawronski et al. 2015a, Luck & Lipp 2020a, Moran et al. 2020, Nishiyama 2020).

Does changing the valence of the US after the acquisition phase also change the EC effect? Research has found US reevaluation EC effects. Specifically, the evaluation of the CS changed if the evaluation of the US that previously co-occurred with the CS changed (Baeyens et al. 1992b, Du Juan et al. 2015, Walther et al. 2009). For example, the evaluation of a CS that co-occurred with a US_{pos} changed to negative if new information revealed that the US was actually negative. The CS evaluation did not change, however, if the acquisition phase included an explicit evaluative response to the US (Gast & Rothermund 2011b) or if the US tended to spontaneously trigger evaluative responses (i.e., flavor; Baeyens et al. 1998), possibly because these conditions link the CS to an evaluative response rather than solely to the specific US.

Does a new CS-US co-occurrence reverse the effect of a previous CS-US co-occurrence? Liking of a CS that previously co-occurred with a US_{pos} can disappear or reverse to disliking if the CS later co-occurs with a US_{neg}. The opposite was observed when the CS first co-occurred with a US_{neg} and then with a US_{pos}. This counterconditioning effect has been abundantly demonstrated (Baeyens et al. 1989, Engelhard et al. 2014, Jozefowiez et al. 2020, Kerkhof et al. 2011, Schweckendiek et al. 2013, Van Dis et al. 2019, but see Kang et al. 2018, Meulders et al. 2015). However, the evidence as to the persistence over time of counterconditioning effects is still mixed (Kerkhof et al. 2011, Van Dis et al. 2019).

Does the EC effect generalize from the CS to stimuli similar to the CS? Ample evidence suggests that the EC effect can be generalized to other components of the CS (e.g., the same stimulus from a different angle; Hütter & Tigges 2019), stimulus exemplars from the CS

category (e.g., a different stimulus of the same color; Bierley et al. 1985), attributes associated with the CS (e.g., attributions of hostile intent of the CS; Olson & Fazio 2006), and the category to which the CS belongs (e.g., the social group to which the CS belongs; Glaser & Kuchenbrandt 2017). The EC effect can be generalized based on perceptual similarities such as color (Boddez et al. 2017), shape (Glaser & Kuchenbrandt 2017), or common features (Hütter et al. 2014, Kocsor & Bereczkei 2017). The EC effect can also be generalized from more abstract rules such as derived relationships or shared group membership (e.g., Bui & Fazio 2016, Dack et al. 2012, Glaser & Kuchenbrandt 2017, Spruyt et al. 2014, Zanon et al. 2012). Research examining whether generalization effects follow similarity or rule-based categorizations has found that when the two are contrasted, similarity-based generalization was more dominant (Halbeisen et al. 2021, Högden et al. 2020, but see Zanon et al. 2012).

THE THEORETICAL LEVEL: MEDIATING COGNITIVE PROCESSES

How does the EC effect occur? What are the cognitive processes that mediate the effect of stimulus co-occurrence on evaluation? Is this effect automatic? These perennial questions remain the core of EC research. However, most previous works have focused on one facet: the awareness of the CS-US co-occurrence. In this section, we detail the dominant theoretical perspectives on EC, briefly describe research on the awareness of CS-US co-occurrence and expand on research on other questions related to automaticity.

Theoretical Perspectives on EC Effect

The EC effect did not need a theoretical account when it was considered a form of classical conditioning. The referential account (Baeyens et al. 1992a, Baeyens & De Houwer 1995, De Houwer et al. 2001) was the main early explanation that posited that the effect of CS-US co-

occurrence on evaluation (EC) was mediated by a form of learning that differed from learning that mediates the effect of CS-US co-occurrence on appetitive and defensive preparatory responses to the CS (classical conditioning). However, the publicly available articles that describe this account lack detail and are not always coherent. The referential account is rarely tested today or supported by any active EC researcher.

In the past several decades, two theoretical perspectives have inspired EC research. One perspective continues to explain the EC effect in terms of processes that can (or must) occur unintentionally and do not require awareness of the co-occurrence. This perspective is represented by two models: the implicit misattribution model (IMM; Jones et al. 2009, March et al. 2018), and the associative-propositional evaluation (APE) model (Gawornski & Bodenhausen 2006, 2011, 2018). According to the IMM, participants sometimes misattribute to the CS the affective reaction that was elicited by the US. However, this model has had little impact because it was proposed as an account for the EC effect in a specific EC procedure; namely, the surveillance paradigm (e.g., Olson & Fazio 2001, see Moran et al. 2021 for a discussion).

The APE model draws on the reflective-impulsive model, a general theory of social cognition and behavior (Strack & Deutsch 2004). The basic tenet of this model is the distinction between mental processes that rely on associative links and mental processes that rely on propositions. Associative links are linked pairs of mental concepts that form as the result of exposure to spatiotemporal proximal stimuli under the Hebbian principle (neurons that fire together, wire together). The link causes the activation of one concept after the other concept has been activated. For example, the link between the mental representation of the nonword “OTIR” and the mental representation of the concept “pleasant” is expected to lead to the activation of “pleasant” after OTIR is perceived or remembered. Propositions are a more complex form of

representation because they include relations (specifying how concepts are related one to another), and therefore can be evaluated as being true or false. Propositions allow for inference. For example, the proposition “OTIR and pleasant stimuli were randomly paired” can lead to the inference that there is no need to change one's evaluation of OTIR.

According to the APE model (Gawornski & Bodenhausen 2006, 2011), the EC effect is the prototypical case of external stimulation that leads to the formation of associations and influences evaluation without the involvement of higher-order propositional processes. The CS-US co-occurrence wires the mental representation of the CS with the mental representation of the US or with the (evaluative) response to the US. The EC effect is hence the result of the automatic activation of the US or the evaluative response to the US when encountering the CS. According to the APE model, the activation of the US (or its valence) automatically leads to an evaluation compatible with the evaluation of the US. Upon non-automatic evaluation, people may reject their automatic evaluation if it is inconsistent with other propositions that come to mind.

Arguments against the notion that the EC effect is the result of low-order automatic processes derive from the propositional perspective on the EC effect (De Houwer 2007, 2009, 2018). The main idea is that the EC effect is mediated by the formation of propositional knowledge in memory. This general perspective does not specify what propositions are formed after exposure to the CS-US co-occurrence, or how the propositions lead to a change in the evaluation of the CS. Because propositions, by definition, are required for making inferences (i.e., forming new propositions or modifying old propositions, based on previous propositions), the propositional perspective entails that inference plays a key role in the effect of stimulus co-occurrence on evaluation.

The Integrated Propositional Model (IPM; De Houwer 2018) of EC was proposed as one possible propositional model that could translate the basic tenets of the propositional perspective into a more specific account of the EC effect. According to the IPM, when people observe CS-US co-occurrence, they sometimes form a proposition about the CS-US relation (e.g., "the CS and the US co-occur"). This proposition is then harnessed to infer an evaluative proposition (e.g., "because similar stimuli co-occur, the CS is similar to the US in valence"). The inferred proposition can influence the evaluative response, thus constituting the EC effect. The IPM does not commit to one specific inference. It leaves the door open for more research on which specific inferences constitute the main drivers of the EC effect.

De Houwer (2018) proposed that under the propositional perspective, the EC effect can be thought of as a case of problem-solving based on the information provided about the CS, including the CS-US co-occurrence, and other CS-US relationships. Note that in many EC experiments, one important piece of information that may influence participants' sense-making is the fact that they know they are taking part in an experiment, and that the researchers programmed the presentation of the stimuli. This information is key to a propositional account we dub the Communication Account. According to this account, participants may interpret the CS-US co-occurrence as a message from the person who created that co-occurrence, informing them that the CS is similar to the US. This explanation restricts the relevance of EC research to cases in which people perceive stimulus co-occurrence as a message. It applies to most EC studies, but only to some cases of stimulus co-occurrence in real life.

Is the EC Effect Automatic?

The main theoretical question in EC research remains the automaticity of the EC effect. The EC effect would be considered automatic if it occurs under one or more of the automaticity

conditions (i.e., unintentionally, without control, with no need for cognitive recourses, and with no need for awareness). For many years, the prevalent assumption was that EC research is the study of attitude formation through low-level processes that can occur automatically (e.g., Martin & Levey 1994). In recent decades, papers that reported testing the automaticity assumptions have often attributed these assumptions to the APE (e.g., Stahl et al. 2016), or the IMM (e.g., Verwijmeren et al. 2012). These assumptions have been contrasted with the assumption that non-automatic processes underlie the encoding of mental representations that later influence evaluation; an assumption attributed to the propositional perspective.

The disagreement between the models about automaticity, however, pertains mostly to the automaticity of the encoding of the CS-US co-occurrence. Even the propositional model allows the involvement of automatic processes, after the contingency has been consciously noticed. The EC effect could be the result of automatic inference processes that occur after the (conscious) encoding of the proposition that the CS and the US co-occur. Even more in line with "low-level" models, the propositional perspective allows for the automatic activation of the US valence when encountering the CS, as a result of partial retrieval of the proposition "the CS and the US co-occur" (De Houwer 2018).

Most studies on automaticity and EC have examined whether EC effects can occur without contingency awareness; that is, without the participants' awareness of the co-occurrence of the CS with the US or the US valence. This question does not only distinguish between theoretical perspectives. It is an important question because if the EC effect does not require this awareness, it is probably more ubiquitous in everyday life than if awareness were required. Further, an EC effect without contingency awareness would suggest that the mental processes that underlie the EC effect do not require awareness, are unintentional, and are not easily controlled because

people cannot intentionally cause or prevent the effect of CS-US co-occurrence if they are not aware of that co-occurrence. Recent reviews on the automaticity of the EC effect have concluded that there is no robust evidence for unawareness and uncontrollability of the encoding of the CS-US co-occurrence (Corneille & Mertens 2020, Corneille & Stahl 2019). Therefore, we center here on evidence for (un)awareness and (un)controllability at the later stages of the processes that lead to EC effects.

Effect and Process Awareness

It may be the case that people need to notice the CS-US co-occurrence for an EC effect to occur, but that the mental processes which lead from noticing the co-occurrence to a change in evaluation are unconscious. Experiments implementing open-ended tests to measure experimenter demand influences have usually reported very little awareness of the EC effect (e.g., Jones et al. 2009). On the other hand, evidence compatible with a conscious effect comes from the finding that participants who reported that they had intentionally relied on the CS-US co-occurrences when they evaluated the CSs exhibited a much stronger EC effect than participants who reported not relying on the co-occurrences (Bar-Anan et al. 2010). Nevertheless, both findings are limited by factors such as confabulation and forgetting that might bias retrospective self-reports.

Perhaps the best evidence for (un)awareness of the effect of stimulus co-occurrence on evaluation comes from research that instructed participants to avoid evaluating the CSs if they thought that exposure to the CS-US co-occurrence influenced their evaluation of the CSs. Participants who received these instructions did not show a smaller EC effect than participants who did not receive such instructions (Sava et al. 2020). To summarize, although there is scant

evidence, the reported data suggest that the EC effect can occur without people's awareness that their evaluation was altered by the CS-US co-occurrence. Further research is sorely needed.

Goal-Dependency (Intentionality and Controllability)

The effect of processing goals. Can people resist (i.e., control) the EC effect when they are exposed to CS-US co-occurrence? Do they need to have specific intentions for the EC effect to occur? One type of research designed to answer these questions tests whether having specific processing goals influences the EC effect. The less such goals exert an influence, the more uncontrollable the EC effect is likely to be. Research has found that processing goals induced before the acquisition phase moderated EC effects (e.g., Corneille et al. 2009, Gast & Rothermund 2011a, Stahl et al. 2016). For example, Corneille et al. (2009) found a larger EC effect (on self-reported evaluations) when participants completed a task before the acquisition phase that elicited the goal of processing perceptual similarities between stimuli, than when participants completed a task that elicited the goal of processing perceptual differences between stimuli.

A few studies have demonstrated that manipulating processing goals can eliminate or reverse the EC effect. Specifically, EC effects were eliminated (on both direct and indirect evaluation measures) when participants were asked to process the CS-US pairs on a non-evaluative dimension (i.e., to indicate whether a pair of CS and US faces came from a specific geographic location) compared to when participants were asked to process the CS-US pairs on an evaluative dimension (i.e., to indicate whether a pair of CS and US faces was positive or negative; Gast & Rothermund 2011a). The EC effects were reversed (i.e., a preference for CS_{neg} over CS_{pos}) when participants were asked to compare the CS and the US (e.g., on likability)

during the acquisition phase, compared to when participants were asked to judge the CS and the US together (Unkelbach & Fiedler 2016).

Explicit intentions to prevent the EC effect. Some studies have directly tested the influence of goals to prevent the EC effect. It is clear that people can control their self-reported evaluation and hide an EC effect if they are motivated to do so. Nevertheless, this may not reflect people's real evaluation of the CSs. Further, when self-report measures of evaluation still show an EC effect despite these instructions, this could be the result of people's failure to understand the instructions, or a lack of awareness of the CS-US co-occurrence that prevents them from modifying their self-reported evaluation. In line with this rationale, it is unsurprising that instructions to prevent or reverse the effect of CS-US co-occurrence on self-reported evaluation of the CSs were easily followed, but only when people remembered the co-occurrence (Balas & Gawronski 2012).

One method to study people's ability to prevent (i.e., control) the EC effect despite their obvious ability to modify their self-reported evaluation is to use indirect measures of evaluation; namely, measures that are less easily controlled than direct self-report measures, such as the evaluative priming task (EPT; Fazio et al. 1995). Gawronski et al. (2014) instructed participants before the acquisition phase to prevent (or promote) the influence of the CS-US co-occurrences on their feelings. These instructions reduced (but did not eliminate) the EC effect on self-reported evaluations, but did not influence the EC effect on indirect evaluation measures. Similarly, Gawronski et al. (2015b) found that three instructed emotion-regulation strategies (suppression, reappraisal, and facial blocking of emotional responses) when provided before the acquisition phase were effective in reducing (but not eliminating) the EC effect on self-reported evaluations, but were ineffective in reducing the EC effect on indirect evaluation measures.

The interpretation of an EC effect on indirect evaluation measures, despite instructions to control for that effect, depends on what construct is captured with these measures. Although research is still ongoing, it is likely these measures sometimes capture the unintentional and cognitively efficient activation of evaluative memories; i.e., any association in memory between an object (e.g., the CS) and valence. However, it is not clear whether an EC effect on an indirect measure is much different than this type of effect on a memory test. For example, if people remember that the CS_{pos} co-occurred with US_{pos}, this might be enough for an EC effect in the EPT. The same memory trace that influenced performance in the indirect measure might possibly also influence behavior in other contexts, thus reflecting an automatic activation of an evaluative response when encountering the CS. For that reason, effects of CS-US co-occurrence on an indirectly measured evaluation, despite intentions to prevent the EC effect, might suggest an uncontrolled effect of co-occurrence on an unintentional evaluation. However, there is not enough current evidence to draw this conclusion. One line of research that could provide relevant evidence would consist of examining whether despite instructions to avoid the EC effect, the CS-US co-occurrence could still influence behavior related to the evaluation of the CSs under conditions that favor automatic cognition (e.g., choosing between a CS_{pos} and a CS_{neg} under cognitive load). This would validate the EC effects on indirect measures as effects on automatic evaluation.

Further evidence as to the controllability of the EC effect comes from studies that have used a process-dissociation (PD) procedure (e.g., Hutter & Sweldens 2018). To dissociate controllable and uncontrollable processes contributing to the EC effect, these studies employed standard versus reversal instructions before the acquisition phase. In the standard condition, participants were told that the US valence was informative about the CS. In this condition, both

controllable and uncontrollable processes were expected to lead to a regular EC effect. In the reversal condition, participants were told that US valence should be the opposite from what was presented. In this condition, controllable and uncontrollable processes were expected to have opposite effects on CS evaluations. The PD procedure estimates the contribution of these controllable and uncontrollable processes from participants' evaluative responses to the CS on a later evaluation task. These studies found evidence for the contribution of both controlled and uncontrolled processes. However, the validity of this specific PD procedure to accurately measures controllable and uncontrollable processes has been challenged (Corneille et al. 2019).

Relational information. Closely related to the question of controllability is the issue of whether an EC effect occurs even when participants know that the CS-US co-occurrence does not mean that the CS and the US are similar in valence. Consider, for example, studies that informed participants before the acquisition phase that the co-occurrence was non-diagnostic for evaluation (e.g., Kurdi & Banaji 2019, Moran et al. 2022). Participants were told explicitly whether the CS-US co-occurrence reflected a relation of similarity in valence or not. Indeed, in real life, the co-occurrence between stimuli does not always imply a similarity in valence. Some co-occurrences are the result of mere chance, such as the case of two co-workers who happen to share the same office only because they both joined the company at the same time. Further, stimuli may even co-occur because they are opposites in valence, as is the case for objects that are used to prevent or reduce the negative effects of other objects. For example, a child might notice that undergoing a painful medical procedure increases the likelihood of receiving a cookie.

When information about the CS-US relation is available, the crucial question is whether, despite knowledge of that the CS and US co-occurred for reasons other than similarity in

valence, the mere fact of CS-US co-occurrence will have a residual assimilative effect (Gawronski & Bodenhausen 2018) on evaluation, beyond (or even counter to) the effect of relational information. For example, would children like the kind of cookie that was routinely given to them after a painful medical procedure less than a cookie that was routinely given to them after visiting the zoo? The attenuation in liking the cookies that were given after medical procedures may reflect an assimilative effect of the mere co-occurrence of the cookie with a negative object (vs. a positive object). In such cases, the assimilative effect of the mere co-occurrence may reflect processes that are not mediated by intentional, conscious, controlled inference from the information about the CS-US relation. Processing the CS may activate the valence of the US in memory and automatically trigger a compatible evaluative response, through spread of activation. Whether such an effect occurs and what factors moderate its strength are of considerable importance for determining the influence of the co-occurrence between stimuli on evaluation. In other words, is the EC effect limited solely to cases in which it is reasonable to assume that the CS-US co-occurrence reflects a similarity relation? Or, does EC occur even when people know that the co-occurrence does not reflect similarity, or might even reflect an opposition between the CS and the US?

Many studies have found evidence compatible with an assimilative effect of the CS-US co-occurrence, above and beyond the effect of the relational information about whether co-occurrence reflects a similarity in valence. For example, people's self-reported preference for creatures that helped them by ending negative events over creatures that harmed them by ending positive events was weaker than their self-reported preference for creatures that helped by starting positive negative events over creatures that harmed them by starting negative events (Bading et al. 2020, Moran & Bar-Anan 2013, Moran et al. 2016). The preference for the helpers

over the harmers may possibly have been attenuated when they helped or harmed by ending events because the helpers co-occurred with negative events, and the harmers co-occurred with positive events. A similar attenuation has been found in a large number of studies (for a summary, see Moran et al. 2016). For example, the EC effect was attenuated but not eliminated even when participants were explicitly told that the co-occurrence did not reflect a similarity relation (Kurdi & Banaji 2019, Moran et al. 2022).

Interestingly, an effect of mere CS-US co-occurrence on self-reported (i.e., controlled) evaluation of the CS, despite the knowledge that the CS and the US had opposite valences, is compatible with the propositional perspective (because it allows for automatic activation of part of the stored proposition) but is incompatible with the APE model. According to the APE model, the mere co-occurrence would form a CS-US association that would influence automatic evaluation but would be rejected by controlled evaluation because of its inconsistency with other knowledge about the CS (i.e., the knowledge inferred from the specific CS-US relationship). Bar-Anan & Moran (2018) proposed that memory links between an object and valence (formed by a CS-US co-occurrence, or by other forms of information) lead to quick and efficient activation of the valence when evaluating the object. Because people usually consider activated valence as valid evidence for the evaluation of the object, the quickly activated valence serves as an anchor that is only adjusted by the result of slower processes, such as the inference from the specific CS-US relation. If so, the EC effect is prevalent and highly uncontrollable.

Although many results are compatible with an assimilative effect of CS-US co-occurrence on the CS evaluation, even when relational information suggests a CS-US opposition, there are alternative accounts to all these results, based on other possible distinctions between opposition and similarity relations. For example, opposition relations might have a reduced impact on

evaluation because the inference process is more difficult for these relations than for similarity relations (Bading 2021, Moran et al. 2016). Simulation studies (Bading 2021) have suggested that this criticism also applies to studies that have found evidence for an assimilative EC effect despite knowledge about the CS-US opposition relation using PD procedures (e.g., Heycke & Gawronski 2020). So far, the best evidence that we know of that counters this alternative account comes from two studies that manipulated participants' focus while they were exposed to the CS-US co-occurrence and to information about the CS-US relation. Focus on the mere co-occurrence increased the assimilative effect of the co-occurrence on self-reported evaluation (Moran et al. 2016). Importantly, there was no evidence that the focus manipulation influenced the ability to process the relational information because, at the end of the study, all participants demonstrated perfect memory for the CS-US relations. However, it could still be the case that remembering the relations is easier than processing them and that a focus on the co-occurrence reduced participants' ability for deep processing of the opposition relations and therefore reduced the effect of inference on the eventually controlled evaluation.

Summary of the Automaticity of the EC Effect

There is ample evidence compatible with the possibility that the EC effect occurs even when participants are motivated to control it, even when participants know that the stimulus co-occurrence does not suggest a similarity between the CS and the US, and even when they know that the reason for the co-occurrence implies a contrast in valence between the CS and US. Further, there is also some evidence that the EC effect occurs even when people are unaware of the effect of the co-occurrence on their evaluation. All this evidence suggests that EC may be a ubiquitous effect that occurs even when people have no reason to assume that the co-occurrence reflects a CS-US similarity. When people process clear information that suggests that the CS and

the US are similar (e.g., when a person routinely makes us feel happy), uncontrolled processes that cause the EC effect may contribute to the formation of the evaluation of the CS, above and beyond the effect of other controlled processes. Importantly, however, much of the evidence in favor of automatic processes in the EC effect is still vulnerable to alternative accounts, and needs further validation.

EXTERNAL VALIDITY: THE RELATIONSHIP BETWEEN EC RESEARCH AND THE REAL WORLD

The intuition of many EC researchers is that EC research is important because EC effects play a crucial role in shaping attitudes in people's everyday lives. This intuition is explicitly expressed in many EC articles (e.g., Gast & Rothermund 2011a, Gawronski et al. 2015b). But is this intuition valid? How relevant is what we study about EC in the lab to real-life situations? Mundane realism concerns the extent to which what happens in the research setting is likely to occur in the normal course of everyday lives; that is, in the 'real world' (Aronson & Carlsmith 1969). This issue is highly pertinent to EC research because there is a clear gap between the intuition that the EC effect plays a crucial role in everyday lives and the fact that the vast majority of EC studies are conducted in the lab, under highly controlled conditions that are unlikely to exist in the real world. For example, the CSs are novel rare objects such as non-words or abstract shapes, only the CS and US appear on a computer screen, and the CS-US co-occurrence only occurs a few times in a short period of time.

Currently, there are only a handful of field studies that have examined EC effects "in the wild," and tested whether evaluations change as a result of stimulus co-occurrence outside the lab. In one study, participants were instructed to consume a neutral stimulus while they were engaged in daily positive or negative events. For example, participants were asked to sniff a

neutral odor in a bottle (CS) while they were involved in a daily activity they pre-defined as positive or negative for them (US). The findings found no evidence for an EC effect (Rozin et al. 1998). In contrast, two other field studies found evidence for EC effects in real-life contexts (Baeyens et al. 1996, Hoffmann et al. 2012). For example, Baeyens et al. (1996) implemented a real-life co-occurrence between a neutral odor (CS) and rest room activities (US). Participants were exposed for several days to a lavender scent in their office rest rooms. After the exposure participants rated how much they liked the lavender scent (and another non-exposed control scent) and how much they liked to go to the rest room in general. An EC effect was found. Participants who evaluated going-to-the-toilet negatively (US_{neg}) rated the lavender scent as more negative than the control scent, whereas participants who evaluated going-to-the-toilet positively (US_{pos}) showed the reverse preference.

As with many other effects in psychology, the paucity of field studies clearly curtails what is known about the relevance of EC research to evaluative learning in everyday life. However, there are two lines of research within the EC literature that can help shed some light on the mundane realism question: EC studies in the marketing domain and studies that test the EC procedure as an intervention to change existing problematic (or to promote existing desirable) evaluations and behaviors.

EC in the Marketing Domain

In marketing, novel stimuli (e.g., a product or a brand) are presented with affective stimuli (e.g., a celebrity or cute puppies) to potential consumers, and the designers of the presentation (e.g., in an ad) control it quite similarly to EC researchers in the lab. One difference is that the CSs in EC research are usually neutral in valence, whereas marketing use novel stimuli that are not necessarily neutral. However, previous studies that compared the influence of

the EC procedure on novel versus neutral CSs found similar EC effects (e.g., Dedonder et al. 2010). Therefore, lab studies that examine the effect of stimulus co-occurrence on consumer attitudes, despite using CSs that are not necessarily neutral, are highly relevant to the question of the external validity of EC research.

Starting from Gorn's (1982) pioneering work on the effects of pairing music with products, several studies have investigated EC effects in the marketing domain. The early studies established that EC procedures can change attitudes toward products and brands (e.g., Bierley et al. 1985, Gorn 1982). Later studies used products/brands as CSs but investigated the same procedural and theoretical questions about EC as studies outside the marketing domain, such as presentation schedule (e.g., Stuart et al. 1987) and contingency awareness (e.g., Allen & Janiszewski 1989).

Other studies have tested moderators in the lab that are relevant to marketing in the real world. For example, studies have found persistence of EC effects over time (e.g., Loebnitz & Grunert 2015), and generalization to other similar products (e.g., Till & Priluck 2000). Others found that the fit between the CS and the US matters (e.g., pairing a sports drink [CS] with Michael Jordan [US] leads to stronger effects than pairing it with Pierce Brosnan [US]; Till et al. 2008). Stimulus co-occurrence influence product evaluations even in the presence of conflicting attribute information (Dempsey & Mitchell 2010). EC procedures can be used to modify attitudes toward existing ("mature") brands (e.g., Gibson 2008). Furthermore, EC effects are largely unaffected by warnings of persuasion attempts (Sweldens et al. 2010). Surprisingly, although the main driver of marketing research is to explain customer behavior and choices (and not only evaluations), only a few studies have included a behavioral measure and demonstrated that EC procedures can affect the actual choice between products (e.g., Gibson 2008, Groenland

& Schoormas 1994). These studies found that participants preferred to consume the product that was the CS_{pos} rather than the CS_{neg}.

We are not aware of any EC marketing studies that were conducted outside the lab. Such studies could attempt to manipulate or measure co-occurrences between products and affective stimuli and test their effect on customers' evaluations and behaviors. In addition, more lab studies (see Schemer et al. 2008 for a rare example) could try to use contexts that more closely resemble real-life marketing (such as implanting pairings in a display that simulates browsing in online social media). Such studies would enhance what is known about the external validity of EC research.

EC based Interventions

Another type of lab experiment that is relatively similar to procedures that could be used outside the lab are studies that test interventions to change problematic evaluations and behaviors. The hope is that EC procedures can be effective in fighting problematic evaluations and behaviors or promoting desirable ones. Some of the most frequently investigated topics are alcohol (e.g., Houben et al. 2010), unhealthy food (e.g., Hollands et al. 2011), vegetable intake among young children (e.g., Hausner et al. 2012), body dissatisfaction (e.g., Aspen et al. 2015), exercise (e.g., Antoniewicz & Brand 2016), self-esteem (e.g., Grumm et al. 2009), and prejudice (e.g., Olson & Fazio 2006).

Are EC procedures an effective intervention? The current evidence is inconclusive. Whereas some studies have found significant effects on evaluation and behavioral measures (e.g., Houben et al. 2010), others have reported no evidence for evaluative or behavioral changes (e.g., Glashouwer et al. 2018). Some studies only found effects on evaluation but not on behavior (e.g., Geng et al. 2013). Others found effects on behavior but not on evaluation (e.g., Ellis et al.

2015). Yet others found effects solely on a subset of the evaluation measures used (Grumm et al. 2009), or found that the effect depends on moderators such as the specific stimuli used or individual differences (e.g., Choi & Lee 2015), or effectiveness only in the short but not in the long term (e.g., Lai et al. 2016). Hence, the effectiveness of EC procedures in this context is inconsistent and depends on various moderators, but the absence of a meta-analysis on this type of studies prevents drawing clear conclusions.

Most intervention studies have been conducted in the lab and used measures without a clear relationship to real life, such as indirect evaluation measures (e.g., Antoniewicz & Brand 2016), behavior in the lab (e.g., Geng et al. 2013), and self-reported behavioral intentions (e.g., Zerhouni et al. 2018). However, unlike EC research in the marketing domain, research on EC-based interventions includes field studies which further strengthens their external validity. Some studies (mainly on vegetable intake among young children) have been conducted in the natural environment (e.g., where children normally eat; Hausner et al. 2012). Other studies have tested whether using a game-like smartphone application based on EC principles, outside the lab, can reduce problematic (non-suicidal and suicidal self-injury, Franklin et al. 2016; body dissatisfaction, Kosinski 2019) or promote desirable (physical activity, Conroy & Kim 2021) cognitions and behavior. Finally, some studies have conducted the EC procedure in the lab but measured the effect of that procedure on behavior in real life, such as (self-reported) alcohol consumption during the week subsequent to the EC intervention (Houben et al. 2010).

The results of intervention studies are mixed, especially those that had real-life aspects (e.g., field studies). For example, the findings from studies on game-like smartphone applications based on EC principles are inconsistent, with one study showing promising results (Conroy & Kim 2021), one showing no effect of the intervention (Kosinski 2019), and one showing an

effect that was limited to the short-term (Franklin et al. 2016). This underscores the need for more research to establish the relevance of EC procedures to real-life behaviors and evaluation change.

CONCLUSIONS: OPEN QUESTIONS AND FUTURE RESEARCH DIRECTIONS

After compiling this review, we debated whether EC research tends to find consistent answers to central questions. Our response was that although some results tend to repeat (e.g., the extinction of the EC effect, under well-defined conditions), and some results have recently become highly consistent (e.g., the lack of evidence for an EC effect without contingency awareness), other findings are inconsistent, and many important questions have not been sufficiently tested. Below, we propose some key future research directions based on our conclusions.

On the functional level, the influence of certain procedural factors on the EC effect is still unknown. For example, what is the minimum number of co-occurrence trials that will lead to an EC effect? Does using single-US versus multiple-US procedures lead to different (quantitative and qualitative) EC effects? Clearly, more empirical research is needed, but so are new systematic reviews and meta-analyses that would help determine the moderators responsible for the inconsistent evidence.

On the theoretical level, the APE model and the propositional perspective have emerged as fruitful in inspiring novel research that has led to informative discoveries. However, we purposely did not include a detailed examination of the accuracy of these models, when compared with actual results. The propositional perspective and the APE model can be adjusted in a post-hoc manner to explain most findings (De Houwer et al. 2020), and both are complex enough to allow for the refutation of some predictions without toppling the whole theory.

Therefore, we recommend focusing future research on specific questions rather than theoretical models.

What are the most important open questions? First, research inspired by the propositional perspective has clearly demonstrated that inferences can contribute to the EC effect. However, it still remains unclear what specific inferences are the most influential. This question can be investigated by explicitly asking participants about their inferences, and by manipulating factors related to assumed inferences and testing whether they moderate the EC effect (see Moran et al. 2022, for an example).

The second important question pertains to automaticity. We reviewed evidence that suggests that the EC effect occurs (1) even when participants are unaware of the influence of the co-occurrence on their evaluation, (2) even when participants try to control that influence, and (3) even when participants have no reason to assume that the CS-US co-occurrence reflects a valence similarity. These findings suggest that EC might be a ubiquitous effect because it may not require intentions and awareness other than consciously noticing the CS-US co-occurrence. However, the evidence for influence unawareness is preliminary. Further, there are alternative accounts for the effect of mere co-occurrence above and beyond the effect of the CS-US relation. Future research should attempt to find strong convincing evidence for (or against) unintentional, uncontrollable, and influence-unaware EC effects.

Finally, another pressing question is the extent to which EC research is relevant to human judgment outside the lab. Is it commonplace for people to notice stimulus co-occurrence? This condition is currently considered necessary for the effect. Does noticing a stimulus co-occurrence in everyday life lead to an EC effect? Is it limited to cases in which people know that the co-occurrence was arranged by another person, possibly to convey stimulus similarity (the

communication account)? As with many other effects in psychology, field studies are critical, especially if lab studies determine that an EC effect does not occur automatically and always relies on controlled inferences that might consider motivations and contexts that are unique to lab settings. Some of these field studies could focus on marketing and interventions to promote healthy (over unhealthy) behaviors, two lines of research that have contributed to strengthening the external validity of EC research. These lines of research would also benefit from meta-analyses and systematic reviews that could help integrate the findings and put forward conclusions as to the evidence for external validity available today.

In this essay, we discussed the past, present, and future of EC research. We hope the reader has acquired a better grasp of this research, realizes its potential importance, and is inspired to contribute to the study of the intriguing open questions that will doubtless shape the future of EC research.

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