RUNNING HEAD: Evaluative Conditioning

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A review of procedure knowledge and mental process theories

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Applying Pavlovian conditioning to a phenomenon in daily life always boils down to the following question: Does the phenomenon qualify as an instance of Pavlovian conditioning? As is evidenced by different chapters in this book, many phenomena have been considered as instances of Pavlovian conditioning. In the present chapter, I examine whether changes in liking can also be understood from this perspective. Before I review the evidence on this topic, I first consider in more detail the meaning of the term "Pavlovian conditioning" because this determines what phenomena can be seen as instances of Pavlovian conditioning and thus how Pavlovian conditioning can be applied.

What is Pavlovian conditioning?

In some textbooks, Pavlovian conditioning is defined in a very narrow manner as the unconscious formation of associations that results from the pairing of a conditioned stimulus (CS) and an unconditioned stimulus (US) and that leads to changes in physiological responses (e.g., salivation) (e.g., Arnould, Price, & Zinkhan, 2004; Evans, Jamal, & Foxall, 2006). Such a definition is narrow in that it limits conditioning to changes in one particular class of responses that are due to one particular type of mental process. Other researchers impose other restrictions on the definition of Pavlovian conditioning, for instance, when arguing that "true" Pavlovian conditioning always involves biologically relevant USs (e.g., Miller & Matute, 1996). In this section, I will argue that it makes more sense to define Pavlovian conditioning in broadest possible manner, that is, as a change in behavior that is due to the pairing of stimuli. Imposing restrictions on the nature of the changes, the nature of the responses, the nature of the stimuli, or the nature of the underlying mental processes is

unnecessary and can lead to deleterious effects (see De Houwer, 2007, 2009, for an in depth discussion).

Let us consider the necessity of restrictions regarding the nature of the responses. There is no *a priori* reason why only changes in one type of responses (e.g., physiological responses) should be considered as possible instances of Pavlovian conditioning. It is true that Pavlov's (1927) seminal studies focused on changes in a physiological response (salivation) but since then many studies on Pavlovian conditioning have looked at changes in other types of behavior. For example, in studies on autoshaping, food is presented to pigeons each time a key lights up. As a result of this contingency, the pigeons start pecking the key (e.g., Brown & Jenkins, 1968). There is no logical reason why a change in salivation could count as Pavlovian conditioning but a change in key pecking could not. More generally, there is no logical reason why any type of response should be excluded on an *a priori* basis from the realm of Pavlovian conditioning (Eelen, 1980).

There is also no *a priori* reason why Pavlovian conditioning should be restricted to changes in behavior that are due to a particular process like the (unconscious) formation of associations in memory. It is true that some researchers (used to) believe that conditioned changes in behavior are due to the unconscious formation of associations (e.g., Thorndike, 1911; Watson, 1913). But this was simply one possible theory about the processes that produce conditioning effects. There are also other theories of classical conditioning according to which the formation of associations does depend on awareness (e.g., Dawson & Schell, 1987) or that do not refer to the formation of associations at all. For instance, Mitchell, De Houwer, and Lovibond (2009a) have argued that Pavlovian conditioning results from the conscious formation and evaluation of propositions about CS-US relations. Why should some theories be dismissed on an *a priori* basis?

In addition to the fact that there are no good reasons to limit Pavlovian conditioning to only a subset of effects of the pairing of stimuli, doing so can have several deleterious consequences (see De Houwer, 2007). First, it could prevent researchers from acknowledging and studying the similarities and differences between different effects of stimulus pairings. The mere fact of using different labels for different effects can draw attention away from similarities in the conditions under which the effects occur. Moreover, knowledge about the similarities and differences between different effects of stimulus pairings can provide crucial information about the processes by which the pairing of stimuli influences behavior. Second, defining Pavlovian conditioning in terms of particular processes hampers the study of conditioning because a particular change in behavior can be considered as an instance of conditioning only when it can be established that it is produced by certain processes. This is problematic because it is often extremely difficult to determine whether a particular process is responsible for a certain change in behavior. The same problem arises with other criteria that are difficult to verify (e.g., whether stimuli are biologically relevant). Finally, a definition of Pavlovian conditioning in terms of mental processes holds the risk that doubts about the role of those mental *processes* lead to doubts about the existence of Pavlovian conditioning *effects* (Eelen, 1980). For instance, the downfall of behaviorist theories of conditioning led to a dramatic slowdown in research on conditioning effects because many researchers inferred that humans do not show “true” Pavlovian conditioning effects (i.e., effects that are due to unconscious association formation; e.g., Brewer, 1974). More generally, defining effects in terms of processes violates the scientific principle that theories (i.e., the explanans) need to be separated from the effects that they aim to explain (i.e., the explanandum).

Because of these reasons, I prefer to define Pavlovian conditioning as a change in

behavior that results from the pairing of stimuli. The only criterion that is left for labeling a change in behavior as an instance of Pavlovian conditioning is that the change is due to the pairing of stimuli rather than other factors such as genetic makeup (e.g., changes in behavior due to maturation), the simple repeated experience of a stimulus (e.g., habituation) or the relation between a behavior and a stimulus (e.g., operant conditioning; De Houwer, 2009). In laboratory situations, this criterion can be verified by implementing appropriate control conditions (e.g., by presenting stimuli in an unpaired manner). Although it might not always be easy to determine the environmental cause of a change in behavior, applying the minimal definition of Pavlovian conditioning will always be more straightforward than applying other definitions in which other criteria are added to the minimal definition (e.g., criteria regarding the nature of the response, the nature of the US, or the type of underlying process).

Some readers might not be willing to accept this minimal definition, perhaps because of historical reasons. All definitions are subject to matters of convention and everyone is thus free to add criteria to the minimal definition. If one chooses to do so, it should, however, be made explicit what the additional criteria are, why those criteria are thought to be crucial, and how it can be verified whether a certain effect of stimulus pairings meets those criteria. One should also be aware of and be willing to accept the limitations that such additional criteria impose on Pavlovian conditioning research. I prefer the minimal definition because it maximizes the scope of Pavlovian conditioning research, because it is logically coherent, and because it is the easiest to verify.

What is Evaluative Conditioning and How Can We Study it?

Adopting a minimal definition of Pavlovian conditioning allows one to fully engage in the question of whether certain changes in liking are instances of Pavlovian conditioning. The only criterion that needs to be satisfied in order to categorize a change in liking as an

instance of Pavlovian conditioning is that the change is due to a relation between stimuli rather than to other environmental factors such as the simple repeated presentation of a single stimulus (as is the case in mere exposure effects, see Bornstein, 1989). A change in liking that is due to the pairing of stimuli is typically referred to as an evaluative conditioning (EC) effect (Levey & Martin, 1975; De Houwer, 2007). EC effects are thus a subset of Pavlovian conditioning effects, the only distinction being that EC effects always involve changes in liking whereas Pavlovian conditioning effects can relate to a change in any type of observable response. The procedures that are used to study evaluative conditioning are also very similar to the procedures that are used to study other forms of Pavlovian conditioning: Stimuli are paired in a certain way under certain conditions. The only systematic difference between EC procedures and other Pavlovian conditioning procedures is that all EC procedures measure on changes in liking (De Houwer, 2007).

As is the case with other instances of Pavlovian conditioning (and thus all possible applications of Pavlovian conditioning), several questions can be raised regarding EC (De Houwer, 2009). A first question concerns the procedural conditions under which the pairing of stimuli results in changes in liking. These conditions refer either to the abstract nature of the relation between stimuli or to the concrete way in which the relation is implemented. The abstract nature of the relation refers to the statistical properties of the relation between stimuli (e.g., contiguity, contingency) and possible changes in those properties (e.g., extinction). Studies that examine the impact of these procedural features inform us about which aspects of the relation are crucial in establishing EC. The concrete implementation of the relation requires choices regarding the stimuli that are presented, the type of liking response that is observed, the organism that experiences the relation, the context in which the relation present, and the way in which information about the relation is communicated.

By manipulating each of these procedural elements, knowledge can be gained about those aspects of the procedure or environment that determine whether and to what extent a relation between stimuli influences the liking of those stimuli. I will refer to this knowledge as *procedure knowledge*. Note that procedure knowledge about EC goes beyond mere empirical knowledge. First, it involves more than the description of an event in that it offers hypotheses about which elements in the procedure are assumed to exert an impact on behavior. Like all hypotheses, procedure knowledge needs to be backed up by (empirical and logical) arguments. For instance, the empirical observation that the liking of a particular CS changes after it has been paired 10 times with a particular US can be explained in terms of the mere co-occurrence of the CS and US or in terms of the positive statistical contingency between the CS and US (i.e., the fact that the CS and US often co-occur *and* never occur separately). Which procedural explanation is correct, needs to be determined on the basis of additional research (e.g., by manipulating the number of CS-only and US-only trials). Second, procedure knowledge goes beyond the individual event in that hypotheses about the role of procedural elements are thought to be valid in more than one situation. For instance, the hypothesis that CS-US co-occurrences are sufficient for EC is thought to be true not only for one particular CS-US pair in one specific context. Procedure knowledge is therefore more than a collection of empirical findings (see De Houwer, 2009).

The second question that can be raised regarding EC concerns the nature of the mental processes that are responsible for EC. Theories about the mental processes that underlie EC aim to explain procedure knowledge about EC, that is, why certain aspects of the EC procedure determine the magnitude and direction of EC effects. For instance, some mental process models predict that EC will depend primarily on the number of CS-US co-occurrences whereas other mental process models predict that the statistical contingency is

important (i.e., that also the number of CS-only and US-only trials count). The merits of different mental process theories can be evaluated by examining (a) how well they can account for the available procedure knowledge (i.e., the heuristic function of process theories) and (b) the extent to which they predict novel procedure knowledge (i.e., the predictive function of process theories).

In the remainder of this chapter, I use this framework to review the literature on EC (see De Houwer, Thomas, & Baeyens, 2001, and Field, 2005, for other reviews). The first section summarizes findings regarding the effects of the abstract nature of the relation and the concrete implementation of the relation. The second section provides an overview of mental process theories of EC. The review is not intended to be exhaustive in the sense that all relevant studies will be discussed or even cited. I will, however, attempt to present a summary of what I believe to be the main findings and insights that are currently available in the literature on EC.

Procedure Knowledge

The Abstract Nature of the Relation

The statistical properties of the CS-US relation.

The presence of stimuli can be related in many different ways. Therefore, the value of the claim that a change in behavior is due to a CS-US relation depends heavily on how much is known about the exact properties of the CS-US relation that determine its effect on behavior. We will consider three statistical properties of the CS-US relation: Co-occurrence, contingency, and redundancy.

Co-occurrence. Several studies suggest that EC becomes stronger as the number of CS-US pairings increases, that is, the more often the CS and US co-occur in space and time (e.g., Baeyens, Eelen, Crombez, & Van den Bergh, 1992a; Bar-Anan, De Houwer, & Nosek,

2009). However, after more than 10 pairings, there is no further increase (Bar-Anan et al., 2009) or even a slight decrease in EC (Baeyens et al., 1992a). Although co-occurrence is important, it is not a necessary condition for EC. EC can occur even when the CS and US have never co-occurred but are related in an indirect manner through co-occurrences with a third stimulus. In a seminal study on this topic, Hammerl and Grabitz (1996) first presented pairs of neutral stimuli (e.g., A-B). Afterwards, one of the stimuli of each pair was presented together with a US (e.g., B-US). During a test phase, it was found that the latter pairings changed not only the liking of the CS that was paired with the US (e.g., B) but also the liking of the other neutral stimulus (e.g., A). This effect, which is known as sensory pre-conditioning, has been replicated and examined in more detail by Walther (2002).

Contingency. Baeyens, Hermans, and Eelen (1993) examined the impact of the statistical contingency between the CS and the US by intermixing CS-US trials with trials on which only the CS or only the US occurred. Unlike what is typically found in Pavlovian conditioning research, the magnitude of EC was not affected by the number of trials on which only the CS or only the US was presented. However, the failure of Baeyens et al. to find an impact of contingency might have been due to the low power of their statistical tests. More research on this issue is thus needed.

Redundancy. A relation between a CS and a US can also be described in terms of its redundancy, that is, the extent to which the CS-US relation overlaps with other CS-US relations. We know of only two studies that looked at the impact of the redundancy of the CS-US relation on EC. The relation between a CS A and the US can be described as redundant when CS A always co-occurs together with a second CS B that also co-occurs with the US. Dwyer, Jarratt, and Dick (2007) found that the change in liking of A was as large

after A-US pairings (i.e., A+ trials) as after AB-US pairings (i.e., AB+ trials). That is, they failed to observe an overshadowing effect. Lipp, Neumann, and Mason (2001) on the other hand, observed a bigger change in liking of A when the A-US relation was redundant (i.e., after AB+ and B+ trials) than when the A-US relation was not redundant (i.e., after AB+ and B- trials). Again, more research on this topic is needed before clear conclusions can be drawn regarding the impact of redundancy on EC.

Changes in the statistical properties of the CS-US relation.

The relation between a CS and US does not necessarily remain stable over context or time. The presence of a CS-US relation can be preceded or followed by the absence of the same relation. It can also vary according to the broader context in which the organism is placed. I will now discuss the impact of these various procedural elements.

Presentations of the CS-only and the US-only. Most research about changes in the CS-US relation focused on the impact of CS postexposure trials. These trials are presented after the CS-US trials and contain only the CS. Studies on Pavlovian conditioning typically show that a conditioned change in behavior can be reversed by presenting the CS on its own after the CS-US trials. Surprisingly, this phenomenon, which is known as extinction, has not been found in a number of EC studies (e.g., Baeyens, Crombez, Van den Bergh, & Eelen, 1988; Baeyens, Eelen, Van den Bergh, & Crombez, 1989a; De Houwer, Baeyens, Vansteenwegen, & Eelen, 2000; Diaz, Ruiz, & Baeyens, 2005) even under conditions in which extinction of Pavlovian conditioning was observed (e.g., Vansteenwegen, Francken, Vervliet, De Clercq, & Eelen, 2006). Lipp, Oughton, and Lelievre (2003; also see Lipp & Purkis, 2006, and Blechert, Michael, Vriends, Margraf, & Wilhelm, 2007), on the other hand, did find evidence for extinction in EC when they measured CS liking during the extinction phase rather than only after the extinction phase. In a more recent study, however, Blechert,

Michael, Williams, Purkis, and Wilhelm (2008) failed to find extinction even when liking of the CSs was measured during the extinction phase. In sum, the available evidence suggests that CS-only trials have little effect on conditioned changes in liking.

Only two studies have examined the effects of CS-only trials that are presented before the CS-US trials (De Houwer et al., 2000; Stuart, Shimp, & Engle, 1987). In both studies, CS-only trials seemed to interfere with EC, that is, with the effect of subsequent CS-US trials. This effect of CS preexposure trials is typically referred to as latent inhibition (e.g., Lubow & Gewirtz, 1995). Finally, there is one study that looked at the effects of US-only trials. In that study, Hammerl, Bloch, and Silverthorne (1997) found that US-only trials also delayed EC, both when presented before and after the CS-US trials.

Occasion setting. In the studies discussed until now, the change in the CS-US relation occurred over time. A CS-US relation can, however, also depend on the physical context that is present (e.g., a second stimulus or the color of a room). In that case, the physical context can function as an occasion setter that signals when the CS-US relation holds. Baeyens and colleagues (Baeyens, Crombez, De Houwer, & Eelen, 1996a; Baeyens, Hendrickx, Crombez, & Hermans, 1998) studied occasion setting in EC by using the color of drinks as a signal for when a particular fruit flavor would be followed by a bad aftertaste. For instance, a fruit flavor was followed by the bad aftertaste only in green drinks but not in blue drinks. During a test phase in which none of the drinks had the bad aftertaste, drinks with the fruit flavor that was previously paired with the bad aftertaste were liked less than drinks with other flavor, regardless of the color of the drink. Hence, the studies of Baeyens and colleagues did not provide evidence to support the conclusion that conditioned changes in liking depend on the presence of the context in which the CS-US pairings were presented. Note that Hardwick and Lipp (2000) did observe occasion setting when using modulation of the startle response as an

index of learning. However, it has been argued that modulation of the startle responses does not provide a good index of evaluative conditioning because it can also be affected by factors other than the valence of the CSs (see below, section on the nature of the responses).

The Concrete Implementation of the CS-US Relation

The nature of the stimuli.

The modality and semantic category of the CSs and USs. EC effects have been observed with a wide range of visual stimuli such as photographs of human faces as CSs and USs (e.g., Baeyens et al., 1992a), paintings as CSs and USs (Levey & Martin, 1975), outdoor sculptures as CSs and USs (e.g., Hammerl & Grabitz, 1996), nonsense words as CSs and valenced words as USs (e.g., Staats & Staats, 1957), cartoon characters as CSs and valenced words and photographs and USs (e.g., Olson & Fazio, 2001), and names of fictitious products as CSs and valenced pictures as USs (e.g., Stuart et al., 1987; Pleyers, Corneille, Luminet, & Yzerbyt, 2007).

EC effects have also been found with non-visual stimuli. For instance, gustatory (taste) stimuli have been used as CSs (e.g., artificial fruit flavors) and USs (e.g., sugar or a chemical substance that produes a bad aftertaste; e.g., Baeyens, Eelen, Van den Bergh, & Crombez, 1990a; Lamote, Baeyens, Hermans, & Eelen, 2004; Zellner, Rozin, Aron, & Kulish, 1983). Olfactory (odor) stimuli have also been used successfully as USs (e.g., Hermans, Baeyens, Lamote, Spruyt, & Eelen, 2005; Todrank, Byrnes, Wrzesniewski, & Rozin, 1995) and as CSs and USs (e.g., Stevenson, Boakes, & Wilson, 2000). Other studies demonstrated EC with somatosensory stimuli such as the touch of objects as CSs and USs (e.g., Hammerl & Grabitz, 2000) or mild electric shocks as USs (e.g., Hermans, Vansteenwegen, Crombez, Baeyens, & Eelen, 2002). Auditory stimuli such as pieces of music have also been employed successfully as USs (e.g., Bierley, McSweeney, &

Vannnieuwkerk, 1985).

The valence and identity of the US. Although EC can be characterized as a general phenomenon that can involve many different kinds of stimuli, the available evidence suggests that properties of the stimuli do determine the magnitude and direction of EC. First and foremost, the valence of the US determines the direction of the change in valence of the CS. That is, a CS that is paired with a positively valenced US tends to become more positive whereas a CS that is paired with a negatively valenced US tends to become more negative (e.g., Baeyens et al., 1992a). The importance ofUS-valence rather than the specific identity of the US is also illustrated by the fact that EC is found not only when a CS is repeatedly paired with a single (positive or negative) US but also when it is paired with different USs that all share the same valence (e.g., Olson & Fazio, 2001; Stahl & Unkelbach, 2009).

There is less certainty about the effects of the extremity of the valence of the USs. On the one hand, Baeyens et al. (1988) found equally large effects with strongly valenced USs (e.g., mutilated faces) than with mildly valenced USs (e.g., disliked photographs of intact human faces). In a more recently reported study, Jones, Fazio, and Olson (in press) selected USs on the basis of a pilot study in which the valence of each US had to be determined as quickly as possible. USs that were classified quickly (and tended to be strongly valenced) resulted in smaller EC effects than USs that were classified slowly (and tended to be mildly valenced). Although more studies are needed to examine the impact of US extremity, the available evidence gives little reason to believe that more extreme USs lead to more extreme EC. If anything, the reverse seems to be true.

There are some indications that positive USs are less effective than negative USs (e.g., Baeyens et al., 1990a). One explanation might be that positive USs tend to be less extremely valenced than negative USs. As we discussed in the previous paragraph, there is,

however, little evidence to support the idea that more extreme USs produce stronger EC. A second possible explanation is that people seem to differ more in their appreciation of potentially positive stimuli than in their liking of potentially negative stimuli (Peeters & Czapinski, 1990). This would result in more variability (and thus statistically smaller effects) when positive USs are used than when negative USs are used. Finally, organisms might be genetically prepared to learn more quickly about relations that involve negative stimuli than about relations that involve positive stimuli (Peeters & Czapinski, 1990). More research is needed before definite conclusion regarding this issue can be reached.

Changes in the valence and identity of the US. Assume that a CS is paired with a positive US, and that this results in an increase in the liking of the CS. Research showed that when the positive US is afterwards made negative (e.g., by pairing it with negative stimuli), the CS will also become more negative. This finding is known as US-revaluation and has been observed in a number of studies (e.g., Baeyens, Eelen, & Van den Bergh, 1990b; Walther, Gawronski, Blank, & Langer, 2009). It should be noted, however, that Baeyens, Vanhouche, Crombez, and Eelen (1998) failed to observe a US-revaluation effect in a study where artificial fruit flavors were used as CSs and a soap-like aftertaste was used as the US. They attributed this failure to the specific nature of their US.

In studies on US-revaluation, the identity of the US with which a CS is paired is kept stable whereas the valence of the US is changed. In studies on counterconditioning, both US identity andUS-valence are changed. For instance, after a CS has been paired with a positively valenced US, it is paired with a different US with a negative valence. Results have shown that the second pairing undoes and sometimes even reverses the change in liking that was produced (e.g., Baeyens et al., 1989a).

The intrinsic relation between CS and US. Apart from possible main effects of the

nature of the CS and the nature of the US, EC can also depend on the intrinsic relation between the CS and US, that is, the interaction of the nature of the CS and the nature of the US. For instance, Baeyens et al. (1990a) found that pairing the color of a drink with a bad aftertaste did not result in a change in liking of other drinks with that color whereas pairing the flavor of a drink with a bad aftertaste did change the liking of other drinks with that flavor. Hence, it seems that the relation between the color and the aftertaste has less effect on the liking of drinks that the relation between the flavor and the aftertaste. Likewise, Todrank et al. (1995) found that pairings of neutral photographs of human faces as CSs with odors as USs influenced the liking of the photographs only if the odors were "plausibly human" (e.g., sweat or fragrances). Such findings suggest that EC depends on the intrinsic relation between the CS and the US (see Garcia & Koelling, 1966, for similar finding in the context of other types of Pavlovian conditioning).

Researchers have also looked at the impact of the perceptual similarity between the CSs and USs. Martin and Levey (1978) found that EC was stronger for CSs that were paired with perceptually similar USs than for CSs that were paired with perceptually dissimilar USs. This effect was replicated by Field and Davey (1999) but shown to be an artifact in that it remained present even when the CS-US pairs were never presented. The artifact can arise when researchers select CSs on the basis of unreliable evaluative ratings that a participant gives at the start of the experiment. It is, for instance, possible that evaluative ratings of some CSs change simply as the result of seeing other stimuli that are used in the experiment. This is most likely to happen for CSs that resemble other positive or negative stimuli in the stimulus list (see Field & Davey, 1999, for more details). Baeyens, Eelen, Van den Bergh, and Crombez (1989b) manipulated the perceptual similarity between the CS and US independently of the evaluative ratings of participants and failed to find stronger EC for

perceptually similar CS-US pairs. In sum, there is little evidence to support the conclusion that EC depends on the perceptual similarity between the CS and US.

The manner in which the CS and US are presented. Once the stimuli have been selected, they need to be presented in a certain manner. This requires decisions about the time and location at which the stimuli occur, their size, luminance, and so on. Results suggest that EC effects become stronger the more the CS and US are presented in close temporal and spatial proximity (e.g., Jones et al., in press). Even though EC has been observed when the US always is presented before the CS (Martin & Levey, 1987; Stuart et al., 1987), effects in those situations appear to be weaker than when the presentation of the CS and US overlap or when the CS is presented briefly before the US. Finally, when using pictures as CSs and USs, Jones et al. (in press) recently found that EC effects increase in magnitude with increases in the size of the CSs.

Nature of the evaluative response.

What sets EC apart from other forms of Pavlovian conditioning is that it involves changes in evaluative responses, that is, responses that are assumed to reflect the liking of objects. Most often, changes in direct measures of liking are examined. Such direct measures require the participant to self-assess their liking of the CSs and USs, for instance, by selecting a number on a likert scale or by sorting the stimuli into separate piles for liked, neutral, or disliked pictures (e.g., Levey & Martin, 1975; Baeyens et al., 1992a). In more recent studies, indirect measures of liking have also been used, in which liking is inferred from performance during reaction time tasks (e.g., De Houwer, Hermans, & Eelen, 1998; Hermans et al., 2002; Kerkhof et al., 2009; Mitchell, Anderson, & Lovibond, 2003), from physiological responses (e.g., Vansteenwegen, Crombez, Baeyens, & Eelen, 1998), and from neurological responses (e.g., Klucken et al., 2009). One should, however, be aware of the fact that a change in a

response can be labeled as EC only if it can be argued that the response is an evaluative response, that is, if it can be argued that the response provides an index of liking. For instance, some physiological responses such as skin conductance and modulation of the startle response seem to be determined by arousal level of stimuli rather than by the evaluative properties of stimuli and therefore do not qualify as indices of liking (e.g., Vansteenwegen et al., 1998). Nevertheless, the available evidence supports the conclusion that EC has been observed in a variety of evaluative responses.

Nature of the organism that experiences the CS-US relation.

Species. Many studies on EC have been conducted with human samples (see De Houwer et al., 2001, for a review). Some studies could be described as studies on EC in non-human animals (e.g., Boakes, Albertella, & Harris, 2007; Capaldi, 1992; Delamater, Campese, LoLordo, & Sclafani, 2006). Unfortunately, the literature on human and nonhuman EC has developed independently, perhaps because it is not clear whether (the determinants of) evaluative responses in human and nonhumans are comparable.

Societal status and age. Most studies on EC involved psychology students, but some studies involved children (e.g., Baeyens, Eelen, Crombez, & De Houwer, 2001; Field, 2006; Fulcher, Mathews, & Hammerl, 2008) and community samples (e.g., Baeyens, Wrzesniewski, De Houwer, & Eelen, 1996). However, little is known about whether EC depends on the societal status or age of the participants.

Personality and mental disorders. Surprisingly few EC studies have taken into account the personality of the participants. One exception is a study by Baeyens et al. (1992a) who measured the “evaluative style” of their participants but failed to find differences in EC depending on whether participants were “feelers” or “thinkers”. We know of one study that compared EC in patients and healthy controls. In this study, Blechert et al. (2007) observed

that patients with poststraumatic stress disorder showed delayed extinction of EC compared to a healthy control group. This finding is somewhat puzzling given the fact that extinction of EC is rarely observed in groups of healthy participants (see above).

Neurological and genetic properties. Neurological research on EC is still in its infancy. There have been two studies on the role of the amygdaloid nuclear complex (ANC), a structure that is critically involved in Pavlovian conditioning of fear responses. Whereas Johnsrude, Owen, White, Zhao, and Bohbot (2000), found impaired EC in individuals with unilateral damage to the ANC, Coppens et al. (2006) did find intact EC in these individuals. More research is thus needed to clarify the involvement of this and other brain regions in EC. To the best of my knowledge, there are no studies on the effects of the genetic make up of individuals or the use of chemical substances on EC.

Nature of the context in which the relation is presented.

Other tasks. A relation between stimuli cannot be presented in a vacuum but always occurs in a broader context in which other regularities are present. For instance, a particular CS-US relation can be present in a context in which participants are asked to fulfill certain tasks. Several studies confirm that tasks that are present briefly before or during the presentation of the CS-US relation can influence EC. Corneille, Yzerbyt, Pleyers, and Mussweiler (2009) recently found that EC effects were stronger when, briefly before the presentation of the CS-US pairs, participants were asked to detect similarities between various kinds of pictures compared to when their task was to detect differences between pictures. Tasks that are present during the presentation of the CS-US pairs also seem to be able to influence EC. Whereas some researchers found that the presence of an attention-demanding task facilitates EC (e.g., Fulcher & Hammerl, 2001; Walther, 2002), others found that it reduces the size of EC (e.g., Field & Moore, 2005; Pleyers, Corneille, Yzerbyt, &

Luminet, 2009). Finally, Baeyens, Eelen, and Van den Bergh (1990b) found that instructing participants to detect which CS goes together with which US did not influence the magnitude of EC. If anything, EC effects were smaller in the condition where participants were asked to discover the CS-US pairs. In sum, although it is clear that the broader context in which CS-US pairs are presented does influence EC, it is not clear how other regularities in the environment (such as secondary tasks) affect EC.

Other effects of the CS-US relation. The context in which a CS-US relation is presented consists not only of other contingencies and their effects on the organism, but also of other effects of that CS-US relation. This consideration leads to the question of whether the effects that a CS-US relation has on the liking of the CS (i.e., EC) are somehow related to other effects of that CS-US relation (e.g., effects on physiological responses or on conscious knowledge). Research on this question has focused mainly on effects of the CS-US relation on responses that can be seen as indices of awareness of the CS-US relation. The results of this research are, however, mixed. Some studies suggest that EC is independent of awareness of the CS-US relation (see De Houwer et al., 2001, and Field, 2005, for a review). For instance, Baeyens et al. (1990a; also see Dickinson & Brown, 2007, but see Wardle, Mitchell, & Lovibond, 2007) found that a contingency between a flavor and a bad aftertaste led to a change in liking of the flavor even though participants could not indicate which flavor was paired with the bad aftertaste. When, however, there was a relation between the color of the drinks and the bad aftertaste, participants were able to indicate which color was paired with the bad aftertaste, but they did not change their liking of the drinks with that color. A similar dissociation between EC and awareness of the CS-US relation was found by Fulcher and Hammerl (2001). They found that manipulations that increased awareness of the CS-US relations (e.g., instructions to detect the contingencies, blockwise presentations of the CS-US

pairs) actually decreased the magnitude of EC. In many other studies, however, a close link between awareness of the CS-US contingencies and EC has been observed. In a particularly convincing study, Pleyers et al. (2007) calculated for each participant the EC effect for CSs for which the participants could indicate the valence of the US with which it was paired and the EC effect for CSs for which participants did not remember the valence of the associated US. Significant EC occurred only for the former set of CSs. Similar results were found in several recent studies (e.g., Dawson, Rissling, Schell, & Wilcox, 2007; Stahl & Unkelbach, 2008, Stahl, Unkelbach, & Corneille, in press; Wardle et al., 2007).

Nature of the way in which the CS-US relation is communicated.

In most EC studies, the CS and US stimuli are physically present and are thus experienced directly by the participants. However, a CS-US relation in the world can have an impact even when the organism does not experience the CS and US stimuli directly. First, EC can result also from observing other organisms that do directly experience the CS-US relation. In studies on observational EC, Baeyens et al. (1996) videotaped a child who drank little cups of water, some of which also contained a product that resulted in a bad, soap-like aftertaste. The model always displayed a negative facial expression after drinking cups of water with a bad aftertaste and a positive facial expression after drinking water that did not have the bad aftertaste. Other children watched the video while drinking cups of water simultaneously with the model. None of the drinks of the observers contained the bad aftertaste. Instead, each drink contained one of two neutral fruit flavors. The order of the drinks was arranged in such a way that the model always displayed a positive facial expression after the observers drank a cup of water with one flavor (e.g., apricot). When the observers drank water with the second flavor (e.g., lychee), the model always displayed a negative expression. Afterwards, the observers reported that they liked the first flavor better than the second one. One explanation

for this finding is that the facial expression of the model functioned as a US. From this perspective, the participants did experience the relation between the CS (flavor) and US (facial expression) directly. Another explanation is that the observers were influenced by how the model reacted to the relation between the CS (flavor) and US (bad aftertaste of the drink).

A second way of presenting information about CS-US relations indirectly is by giving verbal instructions. For instance, Gregg, Seibt, and Banaji (2006) told some participants that members of a fictitious social group called “Niffites” generally behaved in a positive manner whereas members of a different fictitious social group called “Luupites” generally behaved in a negative manner. Simply providing this information was sufficient to create a preference for Niffites compared to Luupites, regardless of whether liking was measured using rating scales or derived from performance in a reaction time task. In a related study, De Houwer (2006) told participants the names of Niffites would be paired with positive stimuli whereas names of Luupites would be paired with negative stimuli (or vice versa). Even though the stimuli were never actually presented, a reaction time measure of liking (i.e., the Implicit Association Test) showed that participants did like the Niffites names better than the Luupites names. Although there have been few studies that directly compare the effects of direct experiences of CS-US relations with the effects of verbal information about the same CS-US relations, the available evidence does allow for the conclusion that both ways of presenting information can lead to EC.

Mental Process Theories

Until now we have considered only the impact of elements of the procedure on EC. Our review shows that a lot can be learned about the determinants of EC at this level of explanation. In this section, we will try to explain this procedure knowledge by describing mental processes that might underlie EC. The aim of these process theories is to explain how

the pairing of stimuli can lead to changes in liking and why these changes depend on the nature of the procedure.

The Conceptual-Categorization Account

According to Davey (1994), the pairing of a CS and a US can result in a change in the liking of the CS because it makes salient those features of the CS that it has in common with the US. For example, assume that an evaluatively neutral face has the features of brown eyes, long shape, full lips and long hair. Also assume that this neutral face is repeatedly presented together with a liked US that has the features of blue eyes, round shape, full lips, and long hair. The CS-US pairings are assumed to increase the salience of the features that the CS has in common with the US, being, full lips and long hair. As a result, the CS is more likely to be categorized as a liked stimulus. Note that this explanation of EC does not refer to the existence of associations in memory but does attribute EC to the CS-US pairings.

The model of Davey (1994) correctly predicts that EC should depend mainly on the number of co-occurrences of the CS and US because it is on these trials that the salience of the CS features can change. Once the salience of certain CS features has been increased, these changes in salience (and thus liking) might persist even when the CS or US are subsequently presented on their own. However, the model has difficulties explaining a number of other findings. First, EC has been found even when the CS and US belong to different modalities and therefore do not have features in common. Second, the model cannot explain the fact that revaluation of a particular US after the CS-US pairings influences the liking of the CS with which it was paired but not the liking of other CSs (Baeyens et al., 1992b; Walther et al., 2009). US-revaluation might influence the nature of the features that a participant regards as typical for liked or disliked stimuli. This should, however, influence the liking of all CSs, not only the CS that was paired with that specific US. Third, the model

does not provide an explanation for how merely instructing participants about a CS-US relation can result in EC.

The Holistic Account

Martin and Levey (1978, 1994; Levey & Martin, 1975) postulated that the co-occurrence of a CS and a US automatically results in the formation of a holistic representation that encodes stimulus elements of both the CS and US, as well as the valence of the US. Once the holistic representation has been formed, the CS can activate this representation and thus the evaluation that was associated with the US.

The holistic model correctly predicts that conditioned changes in liking should depend mainly on CS-US co-occurrences because these trials result in the formation of the holistic representation. Subsequent CS-only trials should not alter the holistic representation and thus should also not influence the conditioned change in liking. Hence, the model is in line with those studies that failed to find extinction of EC. The model can explain the effect of US-revaluation if it is assumed that the US can activate the holistic representation on the US-revaluation trials and if the new valence of the US can be integrated in the holistic representation. The holistic account also predicts that EC can occur in the absence of awareness. Some argue, however, that unconscious EC has still not been demonstrated conclusively (e.g., Lovibond & Shanks, 2002; Dawson et al., 2007). The model cannot explain that, in many cases, EC does occur only when participants are aware of the CS-US contingencies (e.g., Pleyers et al., 2007). It also fails to provide an account of how EC can occur on the basis of instructions, in the absence of any CS-US pairings.

The Misattribution Account

Recently, Jones et al. (in press) proposed a misattribution theory according to which the evaluative reaction that is evoked by the US can be become associated with the CS on trials

where the CS and US co-occur. In line with early behaviorist theories of conditioning (e.g., Thorndike, 1911; Watson, 1913), it is assumed that these S-R associations can be formed in the absence of awareness of the CS-US relation. Jones et al. do postulate, however, that the formation of an S-R association depends on what they call an "implicit misattribution" of the evaluative response to the CS. That is, participants need to (incorrectly) assume that the evaluation that they experience is caused by the CS rather than by the US. This misattribution can occur implicitly in that it does not depend on a conscious evaluation of the CS or US. Nevertheless, any variable that influences the likelihood that the US-valence is misattributed to the CS should influence EC. Jones et al. indeed observed an impact of a number of these variables, including the size of the CS (feelings are more likely to be attributed to large and thus salient CSs) and spatial proximity (feelings are more likely to be attributed to CSs that are close to a US). However, such effects could be explained also without invoking the assumption that EC depends on a misattribution of the evaluation that is evoked by the US (e.g., CS size and CS-US proximity could as such influence the formation of CS-US associations).

The most striking support for the misattribution theory, however, comes from the finding that mildly valenced USs result in stronger EC effects than strongly valenced USs. Jones et al. (in press) explain this finding by assuming that the feeling evoked by strongly valenced USs is more likely to be correctly attributed to the US and thus less likely to be misattributed to the CS. However, the effect that Jones et al. observed was small (i.e., only marginally significant despite a large sample) and present only in participants who were classified as unaware. Moreover, Baeyens et al. (1988) failed to find an effect of US extremity. More research on this topic is clearly needed.

The misattribution theory cannot explain the effects of US-revaluation on EC because

the representation that is assumed to underlie EC does not contain information about the stimulus properties of the US. Because of this, the US cannot activate the CS representation during the revaluation trials. The model can also not explain EC in the absence of CS-US co-occurrences, such as with indirect CS-US relations (i.e., sensory preconditioning) or EC as the result of instructions.

The Referential Account

Baeyens et al. (1992b; Baeyens & De Houwer, 1995) postulated that there are two types of learning. The first type concerns the learning of predictive relations by which the CS becomes a signal for the upcoming presentation of the US. This type of signal learning is assumed to underlie most cases of Pavlovian conditioning, that is, most effects of the pairing of stimuli (also see Rescorla, 1988). The second type concerns the learning of referential relations by which the CS becomes a stimulus that simply refers to (i.e., makes one think of) the US without becoming a signal for the actual presentation of the US. EC is assumed to depend on the second type of learning. Whereas Baeyens et al. (1992b) seemed to assume that the two types of learning actually depend on the formation of different types of CS-US associations in memory, De Houwer (1998; De Houwer et al., 2001) suggested that signal and referential learning depend on a single learning mechanism that produces only one type of CS-US associations. According to De Houwer, signal and referential learning differ because the CS-US associations have a different effect on preparatory responses than on evaluative responses.

Because referential learning is thought to be driven by the co-occurrence of stimuli, the referential model can explain why EC seems to be resistant to extinction (i.e., impervious to the effects of CS-only trials that are presented after CS-US trials). The redundancy of the CS-US relation should also not have an effect. Moreover, the model can explain the presence

of US-revaluation effects because the change in liking of the US is assumed to be mediated by the activation of the US representation. Changing this representation during the US-revaluation trials should thus also affect the liking of the CS. Just like the holistic and the misattribution accounts, the referential account postulates that referential learning is independent of awareness of CS-US contingencies and should thus occur also in the absence of contingency awareness. However, the evidence on unaware EC is still inconclusive. Moreover, at least in certain cases, there does seem to be a close link between EC and contingency awareness (e.g., Pleyers et al., 2007). Finally, because association formation is assumed to be a gradual process that is driven by the actual presence of stimuli, it is difficult to see how the referential model can explain EC as the result of instructions.

The Propositional Account

De Houwer (2007; De Houwer, Baeyens, & Field, 2005) put forward the suggestion that EC, like all other forms of conditioning (see De Houwer, 2009; Mitchell et al., 2009a), might result from the formation of propositions about the CS-US relation. According to this propositional account, the liking of the CS will change only after participants have formed the conscious proposition that the CS is paired with a valenced US. Although the model does not always explain how this propositional knowledge results in a change in liking (see Mitchell, De Houwer, & Lovibond, 2009b), it does postulate that the formation of a proposition about the CS-US relation is a necessary mediating step. One possible way in which propositions can influence liking is that participants use propositional knowledge about the CS-US relation as a justification for determining how much they like the CS. For instance, the fact that a CS is paired with a negative US can be seen as a justification for disliking the CS (De Houwer et al., 2005).

Because the formation of propositions is a conscious and effortful process, the

propositional account predicts that EC should depend on awareness of the CS-US relation. It would thus not be able to account for convincing evidence for unaware EC. The model also predicts that other tasks that direct attention away from the CS-US pairings should hamper EC. The evidence on this issue is mixed (e.g., Hammerl & Fulcher, 2001; Pleyers et al., 2009). Although the propositional model does not make strong predictions about the statistical properties of the CS-US relation that determine EC, it is compatible with the observation that EC is driven primarily by co-occurrences of the CS and US (i.e., that contiguity rather than contingency seems to matter). Co-occurrences would be primary in those cases where EC depends not on the formation of propositions about the statistical contingency between the CS and US but on the formation of propositions about the co-occurrence of the CS and US. Because EC is assumed to depend on knowledge about the US, revaluation of the US should influence EC. Finally, because propositional knowledge can result either from experience or from instructions, the model can account for EC as the result of instructions.

Conclusions

The research on EC that we reviewed in this chapter clearly shows that the pairing of stimuli can lead to changes in liking of those stimuli. We have also learned that EC is a general phenomenon that occurs with many different stimuli, influences many types of evaluative responses, can be found in many different organisms and contexts, and can result both from experience, observation, and instruction. We have also learned that EC seems to be driven mostly by the co-occurrence of the CS and the US whereas contingency and redundancy seem to be less important. Nevertheless, there are still many uncertainties about the conditions under which EC occurs and the mental processes that underlie EC. First, although EC is a general phenomenon, there have also been genuine failures to find EC (e.g.,

Rozin, Wrzesniewski, & Byrnes, 1998). This suggests that there are subtle but important boundary conditions that need to be fulfilled before the pairing of stimuli results in a change in liking. Second, the literature on EC is characterized by many conflicting results, including on important topics such as the relation between EC and awareness of the CS-US contingencies, the impact of US-revaluation, the impact of CS postexposure trials (i.e., extinction), the impact of other tasks that direct attention toward or away from the CS-US contingencies, and the relation between EC effects that are due to experience versus instructions. Because of these conflicting results, progress regarding our understanding of the mental processes that underlie EC has been limited. Different theories make different predictions regarding the role of contingency awareness, US-revaluation, extinction, attention, and instructions, but the conflicting results interferes with the selection between or refinement of these theories.

As was suggested by De Houwer et al. (2005; De Houwer, 2007), it is possible that EC effects can be due to different mental processes. The conflicting results in the literature could thus be due to the fact that different processes underlie EC in the different studies. For instance, it is possible that when EC is caused by propositional processes, it will depend on awareness, US-revaluation, CS postexposures, attention, and instructions. In cases where EC is independent from contingency awareness, US-revaluation, CS postexposures, attention, or instructions, it might be due to more automatic processes such as the formation of holistic representations. As argued by De Houwer (2007), an important task for future research on EC should thus be to uncover the variables that determine the properties of EC, that is, whether EC depends on awareness, US-revaluation, CS postexposures, attention, or instructions. Such an approach can lead to new insights in the important phenomenon of evaluative conditioning.

References

Arnould, E., Price, L., & Zinkhan, G. (2004). *Consumers* (2nd ed.). New York, NY: McGraw-Hill/Irwin.

Bar-Anan, Y., De Houwer, J., & Nosek, B. A. (2009). The role of contingency memory, intentional processes and number of pairings in evaluative conditioning. Manuscript submitted for publication.

Bierley, C., McSweeney, F. K., & Vannieuwkerk, R. (1985). Classical conditioning of preferences for stimuli. *Journal of Consumer Research, 12,* 316-323.

Baeyens, F., Crombez, G., De Houwer, J., & Eelen, P. (1996a). No evidence for modulation of evaluative flavor-flavor associations in humans. *Learning and Motivation, 27,* 200-241.

Baeyens, F., Crombez, G., Van den Bergh, O., & Eelen, P. (1988). Once in contact, always in contact: EC is resistant to extinction. *Advances in Behaviour Research and Therapy, 10,* 179-199.

Baeyens, F., & De Houwer, J. (1995). Evaluative conditioning is a qualitatively distinct form of classical conditioning: A reply to Davey (1994). *Behaviour Research and Therapy, 33,* 825-831.

Baeyens, F., Eelen, P., Crombez, G., & De Houwer, J. (2001). On the role of beliefs in observational flavor conditioning. *Current Psychology, 20,* 183-203.

Baeyens, F., Eelen, P., Crombez, G., & Van den Bergh, O. (1992a). Human EC: Acquisition trials, presentation schedule, evaluative style and contingency awareness. *Behaviour Research and Therapy, 30,* 133-142.

Baeyens, F., Eelen, P., & Van den Bergh, O. (1990a). Contingency awareness in EC: A case for unaware affective-evaluative learning. *Cognition and Emotion, 4,* 3-18.

Baeyens, F., Eelen, P., Van den Bergh, O., & Crombez, G. (1989b). The influence of CS-UCS perceptual similarity/dissimilarity on human evaluative learning and signal learning. *Learning and Motivation, 20,* 322-333.

Baeyens, F., Eelen, P., Van den Bergh, O., & Crombez, G. (1989). Acquired affective-evaluative value: Conservative but not unchangeable. *Behaviour Research and Therapy, 27,* 279-287.

Baeyens, F., Eelen, P., Van den Bergh, O., & Crombez, G. (1990b). Flavor-flavor and color-flavor conditioning in humans. *Learning and Motivation, 21,* 434-455.

Baeyens, F., Eelen, P., Van den Bergh, O., & Crombez, G. (1992b). The content of learning in human EC: Acquired valence is sensitive to US-revaluation. *Learning and Motivation, 23,* 200-224.

Baeyens, F., Hendrickx, H., Crombez, G., & Hermans, D. (1998). Neither extended sequential nor simultaneous feature positive training result in modulation of evaluative flavor conditioning in humans. *Appetite, 31,* 185-204.

Baeyens, F., Hermans, R., & Eelen, P. (1993). The role of CS-US contingency in human evaluative conditioning. *Behaviour Research and Therapy, 31,* 731-737.

Baeyens, F., Vanhouche, W., Crombez, G., & Eelen, P . (1998). Human evaluative flavor-flavor conditioning is not sensitive to post-acquisition US-inflation. *Psychologica Belgica, 38,* 83-108.

Baeyens, F., Vansteenwegen, D., De Houwer, J., & Crombez, G. (1996). Observational conditioning of food valence in humans. *Appetite, 27,* 235-250.

Baeyens, F., Wrzesniewski, A., De Houwer, J., & Eelen, P. (1996). Toilet rooms, body massages, and smells: Two field studies on human evaluative odor conditioning. *Current Psychology, 15,* 77-96.

Blechert, J, Michael, T., Vriends? N., Margraf, J., & Wilhelm, F. H. (2007). Fear conditioning in posttraumatic stress disorder: Evidence for delayed extinction of autonomic, experiential, and behavioural responses. *Behavior Research and Therapy, 45*, 2019-2033.

Blechert, J., Michael, T., Williams, S. L., Purkis, H. M., & Wilhelm, F. H. (2008). When two paradigms meet: Does evaluative learning extinguish in differential fear conditioning? *Learning and Motivation, 39*, 58-70.

Boakes, R. A., Albertella, L., & Harris, J. A. (2007). Expression of flavor preference depends on type of test and on recent drinking history. *Journal of Experimental Psychology: Animal Behavior Processes, 33*, 327-338.

Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968-1987. *Psychological Bulletin, 106,* 265-289.

Brown, P.L., & Jenkins, H.M. (1968). Autoshaping of the pigeon's key-peck. *Journal of Experimental Analysis of Behavior, 5*, 325-337.

Capaldi, E. D. (1992). Conditioned food preferences. *The Psychology of Learning and Motivation, 28*, 1–33.

Coppens, E., Vansteenwegen, D., Baeyens, F., Vandenbulcke, M., Van Paesschen, W., & Eelen, P. (2006). Evaluative conditioning is intact after unilateral resection of the anterior temporal lobe in humans. *Neuropsychologia*, *44*, 840-843.

Corneille, O., Yzerbyt, V. Y., Pleyers, G., & Mussweiler, T. (2009). Beyond awareness and resources: Evaluative conditioning may be sensitive to processing goals. *Journal of Experimental Social Psychology, 45*, 279-282.

Davey, G. C. L. (1994). Defining the important questions to ask about evaluative conditioning: A reply to Martin and Levey (1994). *Behaviour Research and Therapy,*

32, 307-310.

Dawson, M. E., Rissling, A. J., Schell, A., & Wilcox, R. (2007). Under what conditions can human affective conditioning occur without contingency awareness? Test of the evaluative conditioning paradigm. *Emotion, 7*, 755-766.

Dawson, M. E., & Schell, A. M. (1987). Human autonomic and skeletal classical conditioning: The role of conscious cognitive factors. In G. Davey (Ed.) *Cognitive processes and Pavlovian conditioning in humans* (pp. 27-56). Chichester, UK: Wiley.

De Houwer, J. (1998). Leren is eenvoudig, doen is moeilijk: Een nieuwe visie op het onderscheid tussen evaluatieve en Pavloviaanse conditionering. [Learning is simple, performance is difficult: A new view on the distinction between evaluative and Pavlovian conditioning]. *Gedragstherapie, 31*, 49-66.

De Houwer, J. (2006). Using the implicit association test does not rule out an impact of conscious propositional knowledge on EC. *Learning and Motivation, 37*, 176-187.

De Houwer, J. (2007). A conceptual and theoretical analysis of EC. *The Spanish Journal of Psychology*.

De Houwer, J. (2009). *Leerpsychologie* [Learning Psychology]. Gent, Belgium: Academia Press.

De Houwer, J., Baeyens, F., & Field, A. P. (2005a). Associative learning of likes and dislikes: Some current controversies and possible ways forward. *Cognition and Emotion, 19*, 161-174.

De Houwer, J., Baeyens, F., Vansteenwegen, D., & Eelen, P. (2000). Evaluative conditioning in the picture-picture paradigm with random assignment of CSs to USs. *Journal of Experimental Psychology: Animal Behavior Processes, 26*, 237-242.

De Houwer, J., & Beckers, T. (2002). Higher-order retrospective revaluation in human

causal learning. *Quarterly Journal of Experimental Psychology, 55B,* 137-151.

De Houwer, J., Hermans, D., & Eelen, P. (1998). Affective and identity priming with episodically associated stimuli. *Cognition and Emotion, 12,* 145-169.

De Houwer, J., Thomas, S., & Baeyens, F. (2001) Associative learning of likes and dislikes: A review of 25 years of research on human EC. *Psychological Bulletin, 127,* 853–869.

Delamater, A. R., Campese, V., LoLordo, V. M., & Sclafani, A. (2006). Unconditioned stimulus devaluation effects in nutrient-conditioned flavor preferences. *Journal of Experimental Psychology: Animal Behavior Processes, 32,* 295–306.

Diaz, E., Ruis, G., & Baeyens, F. (2005). Resistance to extinction of human evaluative conditioning using a between-subjects design. *Cognition and Emotion, 19,* 245-268.

Dickinson, A., & Brown, K. J. (2007). Flavor evaluative conditioning is unaffected by contingency knowledge during training with color–flavor compounds. *Learning & Behavior, 35,* 36-42.

Dickinson, A., Shanks, D., & Evenden, J. (1984). Judgment of act-outcome contingency: The role of selective attribution. *Quarterly Journal of Experimental Psychology, 36A,* 29-50.

Dwyer, D. M., Jarratt, F., & Dick, K. (2007). Evaluative conditioning with foods as CSs and body shapes as USs: No evidence for sex differences, extinction, or overshadowing. *Cognition and Emotion, 21,* 281-199.

Eelen, P. (1980). Klassieke conditioning: Klassiek en toch modern [Classical conditioning: Classic but nevertheless modern]. In Liber Amicorum Prof. J.R. Nuttin, *Gedrag, dynamische relatie en betekeniswereld [Behaviour, dynamic relation, and world of meaning],* Leuven, Belgium: Universitaire Pers Leuven.

Evans, M., Jamal, A., & Foxall, G. R. (2006). *Consumer Behaviour*. Chichester, UK: Wiley.

Field, A. P. (2006). I don't like it because it eats sprouts: Conditioning preferences in children. *Behavior Research and Therapy, 44*, 439-455.

Field, A. (2005). Learning to like (or dislike): Associative learning of preferences. In A. Wills (Ed.), *New directions in human associative learning* (pp. 221-252). Mahwah, NJ: Lawrence Erlbaum.

Field, A. P. & Davey, G. C. L. (1999). Reevaluating EC: A nonassociative explanation of conditioning effects in the visual EC paradigm. *Journal of Experimental Psychology: Animal Behaviour Processes, 25,* 211-224.

Field, A. P., & Moore, A. C. (2005). Dissociating the effects of attention and contingency awareness on evaluative conditioning effects in the visualparadigm. *Cognition and Emotion, 19*, 217–243.

Fulcher, E. P., & Hammerl, M. (2001). When all is revealed: A dissociation between evaluative learning and contingency awareness. *Consciousness and Cognition, 10,* 524-549.

Fulcher, E. P., Mathews, A., & Hammerl, M. (2008). Rapid acquisition of emotional information and attentional bias in anxious children. *Journal of Behavior Therapy and Experimental Psychiatry, 39*, 321-339.

Garcia, J., & Koelling, R.A. (1966). The relation of cue to consequence in avoidance learning. *Psychonomic Science, 4*, 123-124.

Gregg, A. P., Seibt, B., & Banaji, M. R. (2006). Easier done than undone: Asymmetry in the malleability of implicit preferences. *Journal of Personality and Social Psychology, 90*, 1-20.

Hammerl, M.., Bloch, M., & Silverthorne, C. P. (1997). Effects of US-alone presentations on

human evaluative conditioning. *Learning and Motivation, 28*, 491-509.

Hammerl, M., & Grabitz, H. -J. (1996). Human evaluative conditioning without experiencing a valued event. *Learning and Motivation, 27*, 278-293.

Hammerl, M., & Grabitz, H. -J. (2000). Affective-evaluative learning in humans: A form of associative learning or only an artifact? *Learning and Motivation, 31*, 345-363.

Hardwick, S. A., & Lipp, O. V. (2000). Modulation of affective learning: An occasion for evaluative conditioning? Learning and Motivation, 31, 251-271.

Hermans, D., Baeyens, F., Lamote, S., Spruyt, A., & Eelen, P. (2005). Affective priming as an indirect measure of food preferences acquired through odor conditioning. *Experimental Psychology, 52*, 180-186.

Hermans, D., Vansteenwegen, D., Crombez, G., Baeyens, F., & Eelen, P. (2002). Expectancy- learning and evaluative learning in human classical conditioning: Affective priming as an indirect and unobtrusive measure of conditioned stimulus valence. *Behaviour Research and Therapy, 40*, 217-234.

Johnsrude, I. S., Owen, A. M., White, N. M., Zhao, W. V., & Bohbot, V. (2000). Impaired preference conditioning after anterior temporal lobe resection in humans. *Journal of Neuroscience, 20*, 2649-2656.

Jones, C. R., Fazio, R. H., & Olson, M. A. (in press). Implicit misattribution as a mechanism underlying evaluative conditioning. *Journal of Personality and Social Psychology*.

Kerkhof, I., Goesaert, E., Dirikx, T., Vansteenwegen, D., Baeyens, F., D'Hooge, R., & Hermans, D. (2009). Assessing valence indirectly and online. *Cognition and Emotion*.

Klucken, T., Kagerer, J., Schweckendiek, J., Tabbert, K., Vaitl, D., & Stark, R. (2009). Neural, electrodermal and behavioral response patterns in contingency aware and unaware subjects during a picture-picture conditioning paradigm. *Neuroscience, 158*,

721-731.

Lamote, S., Baeyens, F., Hermans, D., & Eelen, P. (2004). An exploration of affective priming as an indirect measure of food attitudes. *Appetite, 42,* 279-286.

Levey, A. B., & Martin, I. (1975). Classical conditioning of human 'evaluative' responses. *Behaviour Research and Therapy, 4,* 205-207.

Lipp, O. V., Neumann, D. L., & Mason, V. (2001). Stimulus competition in affective and relational learning. *Learning and Motivation, 32,* 306-331.

Lipp, O. V., Oughton, N., & LeLievre, J. (2003). Evaluative learning in human Pavlovian conditioning: Extinct, but still there? *Learning and Motivation, 34,* 219-239.

Lipp, O. V., & Purkis, H. M. (2006). The effects of assessment type on verbal ratings of conditional stimulus valence and contingency judgement: Implications for the extinction of evaluative learning. *Journal of Experimental Psychology: Animal Behavior Processes, 32,* 431-440.

Lovibond, P. F., & Shanks, D. R. (2002). The role of awareness in Pavlovian Conditioning: Empirical evidence and theoretical implications. *Journal of Experimental Psychology: Animal Behavior Processes, 28,* 3-26.

Lubow, R.E. & Gewirtz, J.C. (1995). Latent inhibition in humans: Data, theory, and implications for schizophrenia. Psychological Bulletin, 117, 87-103.

Martin, I. & Levey, A. B. (1978). Evaluative conditioning. *Advances in Behaviour Research and Therapy, 1,* 57-102.

Martin, I. & Levey, A. B. (1987). Learning what will happen next: conditioning, evaluation and cognitive processes. In G. Davey (Ed.), *Cognitive processes and Pavlovian conditioning in humans* (pp 57-82). New York: John Wiley.

Martin, I. & Levey, A. B. (1994). The evaluative response: Primitive but necessary.

Behaviour Research and Therapy, 32, 301-305.

Miller, R.R. & Matute, H. (1996). Biological significance in forward and backward blocking: Resolution of a discrepancy between animal conditioning and human causal judgment. *Journal of Experimental Psychology: General, 125*, 370-386.

Mitchell, C. J., Anderson, N. E., & Lovibond, P. F. (2003). Measuring EC using the implicit association test. *Learning and Motivation, 34*, 203-217.

Mitchell, C. J., De Houwer, J., & Lovibond, P. F. (2009a). The propositional nature of human associative learning. *Behavioral and Brain Sciences, 32*, 183-198.

Mitchell, C. J., De Houwer, J., & Lovibond, P. F. (2009b). Link-based learning theory creates more problems than it solves. *Behavioral and Brain Sciences, 32*, 230-246.

Olson, M., & Fazio, R. (2001). Implicit attitude formation through classical conditioning. *Psychological Science, 5*, 413-417.

Pavlov, I. (1927). Conditioned Reflexes. London, UK: Oxford University Press.

Peeters, G., & Czapinski, J. (1990). Positive-negative asymmetry in evaluations: The distinction between affective and informational negativity effects. *European Review of Social Psychology, 1*, 33-60.

Pleyers, G., Corneille, O., Luminet, O. & Yzerbyt, V. (2007). Aware and (dis)liking: Item-based analyses reveal that valence acquisition via EC emerges only when there is contingency awareness. *Journal of Experimental Psychology: Learning, Memory & Cognition, 33*, 130-144.

Pleyers, G., Corneille, O., Yzerbyt, V., & Luminet, O. (2009). Evaluative conditioning incurs attentional costs. *Journal of Experimental Psychology: Animal Behavior Processes, 35*, 279-285.

Rescorla, R.A. (1988) Pavlovian conditioning: It's not what you think it is. *American*

Psychologist, 43, 151-160.

Rozin, P., Wrzesniewski, A., & Byrnes, D. (1998). The elusiveness of EC. *Learning and Motivation, 29*, 397-415.

Staats, A. W., & Staats, C. K. (1957). Meaning established by classical conditioning. *Journal of Experimental Psychology, 54*, 74-80.

Stahl, C., & Unkelbach, C. (2009). Evaluative learning with single versus multiple USs: The role of contingency awareness. *Journal of Experimental Psychology: Animal Behavior Processes, 35*, 256-291.

Stahl, C., Unkelbach, C., & Corneille, O. (in press). On the respective contributions of awareness for US valence and US identity in valence acquisition through evaluative conditioning. *Journal of Personality and Social Psychology*.

Stevenson, R.J., Boakes, R. A., & Wilson, J. P. (2000). Resistance to extinction of conditioned odour perceptions: Evaluative conditioning is not unique. *Journal of Experimental Psychology: Learning, Memory and Cognition, 26*, 423-440.

Stuart, E. W., Shimp, T. A., & Engle, R. W. (1987). Classical conditioning of consumer attitudes: Four experiments in an advertising context. *Journal of Consumer Research, 14*, 334-351.

Todrank, J., Byrnes, D., Wrzesniewski, A., & Rozin, P. (1995). Odors can change preferences for people in photographs: A cross-modal evaluative conditioning study with olfactory USs and visual CSs. *Learning and Motivation, 26*, 116-140.

Thorndike, E. L. (1911). *Animal intelligence: Experimental studies*. New York: MacMillan.

Vansteenwegen, D., Crombez, G., Baeyens, F., & Eelen, P. (1998). Extinction in fear conditioning: Effects on startle modulation and evaluative self-reports. *Psychophysiology, 35*, 729-736.

Vansteenwegen, D., Francken, G., Vervliet, B., De Clercq, A., & Eelen, P. (2006). Resistance to extinction in evaluative conditioning. *Journal of Experimental Psychology: Animal Behavior Processes, 32*, 71-79.

Walther, E. (2002). Guilty by mere association: EC and the spreading attitude effect. *Journal of Personality and Social Psychology, 82*, 919-934.

Walther, E., Gawronski, B., Blank, H., & Langer, T. (2009). Changing likes and dislikes through the back door: The US-revaluation effect. *Cognition and Emotion, 23*, 889-917.

Wardle, S. G., Mitchell, C. J., & Lovibond, P. F. (2007) Flavor evaluative conditioning and contingency awareness. *Learning & Behavior, 35*, 233-241.

Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review, 20*, 158-177.

Zellner, D. A., Rozin, P., Aron, M., & Kulish, C. (1983). Conditioned enhancement of human's liking for flavor by pairing with sweetness. *Learning and Motivation, 14*, 338-350.

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