Putting Operating Principles (What) Before Conditions (How and When) to Improve Theorizing:

S – S versus S – R Learning in Evaluative Conditioning

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Abstract:

I argue that theorizing in evaluative conditioning has paid insufficient attention to distinguishing what is learned (operating principles) from how and when the learning takes place (operating conditions). In terms of its operating principles, EC effects can be established both via stimulus – stimulus (S – S) and via stimulus – evaluative response (S – R) associations. Operating conditions of EC that have received a lot of attention are the famous features of automaticity (awareness, intentionality, controllability, resource efficiency). A lot of research in our field has focused on investigating operating conditions, without specifying operating principles, which limits the interpretability of previous work, especially if conflicting findings arise. I call for putting the principles before the conditions, and to approach EC theorizing in a more piecemeal manner, from the ground up. I believe for now we should treat the operating principles and operating conditions as orthogonal, and do not assume that only certain processes can lead to certain representations. Evidently, this calls for a lot of future research, and theorizing that is more focused and precise. By specifying and testing clearly both operating principles and conditions, our theories will be (initially) smaller in scope, but likely more verifiable.

Introduction: Theoretical Accounts of Evaluative Conditioning

People come to like stimuli that co-occur with other stimuli they already like, and they start disliking those stimuli that co-occur with other stimuli they already dislike. In scientific contexts, researchers in psychology and marketing have studied this fundamental effect termed “evaluative conditioning.” In more than 30 years of research, it has become well-established that evaluative conditioning has strong and lasting effects on people’s attitudes in many domains. Whether it concerns our preferences for brands, faces, races, tastes, odors, words or even abstract patterns, in countless domains researchers observed that people come to like better (vs. worse) those stimuli that co-occurred with other stimuli they already liked (vs. disliked). The fact that EC commands such a sustained and increasing interest is caused by the fact that it is both theoretically and practically highly important. As a result, both researchers with a fundamental interest in human learning and social influence processes, as well as researchers in applied fields (e.g., marketing and consumer behavior) have taken a keen interest in this phenomenon.

Much of their research has focused on identifying the psychological process(es) underlying EC. Since EC was clearly defined as an ‘effect’ (De Houwer, 2007), it has been broadly recognized that it is likely to be multiply determined, and several possible process accounts for EC have been proposed in the past (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010; Jones, Olson, & Fazio, 2010). The most prominent of these accounts are the “referential account,” the “holistic account,” the “implicit misattribution account,” the “conceptual categorization account,” and the “propositional account.” For a summary of each account’s core features and predictions, see Hofmann et al. (2010).

The Problems with Universal Process Accounts

These process accounts have undoubtedly played a crucial role in generating rigorous, high-quality theory-testing research programs that have become so emblematic of EC research. Nevertheless, I see three fundamental problems inherent in the field's reliance on these types of accounts, which lead me to question their sustained usefulness. The first problem is that even though these accounts often propose different types of psychological processes generating the EC effect, they can be *empirically indistinguishable*. Take, for example, the referential versus the holistic accounts. The referential account proposes that EC entails the automatic formation of associations between conditioned (CS) and unconditioned stimulus (US) representations by which the CS becomes a stimulus that simply refers to the US, without becoming a signal for it (Baeyens, Eelen, Vandenberg, & Crombez, 1992). The holistic account, on the other hand, proposes that EC entails the automatic formation of holistic CS-US representations. Despite these different process assumptions, the primary predictions of both accounts *converge* in that EC should increase with the number of CS-US occurrences, that EC can be independent of contingency awareness, and that EC is resistant to extinction, while it is unclear where the accounts make diverging predictions (Hofmann et al., 2010, p. 392).

The second problem is that, while these accounts often propose an interesting core idea of how EC effects might be generated, they are often *insufficiently precise to be empirically falsifiable*. For example, several accounts (e.g., the referential, holistic and misattribution accounts) propose an EC process that would be automatic in nature, but fail to specify precisely which features of automaticity they expect the process to display (i.e., its operating conditions). As was already argued by Bargh (Bargh, 1994), the famous horsemen of automaticity (awareness, intentionality, controllability and efficiency) do not necessarily co-occur. Similarly, accounts which propose 'non-automatic' accounts of EC, like the propositional account, might still allow for the presence of some automaticity features. For example, they might claim that people 'cannot help' forming propositions about CS – US relations when they

perceive them, to explain evidence that EC has uncontrollable effects on CS evaluations (Gawronski, Balas, & Creighton, 2014; Hütter & Sweldens, 2018).

The accounts' vagueness in the specification of their operating conditions, combined with the fact that most researchers agree that the EC effect is likely multiply determined (i.e., several of these accounts could be operating at the same time), renders their empirical verification, let alone falsification, very troublesome.

The third problem is that these accounts all too readily draw a direct line from *what* is being learned (content; operating principles) to *how and when* learning takes place (operating conditions; Corneille & Stahl, 2018; Gawronski & Bodenhausen, 2014). As I will argue below, the operating principles refer to the fact that at the most basic level, EC effects can be caused by people learning two types of associations: between a conditioned and unconditioned stimulus (S – S), or between a conditioned stimulus and an evaluative response (S – R). One should avoid jumping to inferences, however, from the principles (what) to the conditions (how and when) of learning. I will refer to accounts that blend operating principles and conditions as 'universal' accounts. I believe that despite the 30+ years of research that has been conducted on EC, we are simply not at the stage yet where universal accounts are viable. There are at least two reasons for this:

- One reason is that we are still at a stage where research efforts are needed to develop and improve our knowledge and measurement of the operating principles and conditions themselves. For example, as a field, we have struggled for decades to improve our measurement of even the most basic of operating conditions – contingency awareness – and we have still not settled on an ideal method that yields consistently reliable measurements (Gawronski & Walther, 2012; Sweldens, Corneille, & Yzerbyt, 2014). While research is still at the stage where major improvements in our ability to measure the basic operating conditions of EC

are necessary, I believe it would be overly ambitious to develop theories that hold predictions about both principles and multiple operating conditions simultaneously. As long as EC's operating conditions, and perhaps even its operating principles (see below), cannot be clearly measured, manipulated or distinguished, such theories cannot be properly tested anyway.

- The second reason is that at this stage we should be open to the possibilities that (i) operating principles are orthogonal to operating conditions, and (ii) operating conditions can vary independently from each other. With the current set of universal process accounts, that is not the case. For example, the 'referential account' proposes the automatic formation of associations through which the CS starts to refer to the US. It is unclear ex ante, however, why a similar process could not cause the CS to start referring to the ER instead. Conversely, there is currently only one account – implicit misattribution – which explains the formation of S – R associations. It is unclear, however, why the formation of S – R associations should be limited to one possible process. In principle, we should be open to the possibility that S – R associations can be formed through 'referential' or even 'propositional' kind of learning processes as well.

Instead of aiming to establish universal theories on EC 'off the bat,' I believe we should opt for a more piecemeal, gradual approach to theorizing. Start by obtaining more clarity on 'what' is learned in EC, and only then start filling in the blanks regarding how and when.

On Operating Principles: S – S versus S – R Learning in EC

EC effects are defined as a change in liking towards a CS, resulting from its repeated pairing with a US which already generates an evaluative response (ER; liking or disliking). As illustrated in figure 1, there are two elementary ways in which this change in liking towards the CS can come about.

FIGURE 1

DURING EVALUATIVE CONDITIONING, ASSOCIATIONS CAN BE FORMED BETWEEN CONDITIONED AND UNCONDITIONED STIMULI (S-S LEARNING) OR BETWEEN A CONDITIONED STIMULUS AND AN EVALUATIVE RESPONSE (S-R LEARNING).

The first possibility is that over the course of an EC procedure, the repeated CS – US presentations result in the establishment of a mental association between the two stimuli (CS – US). As a result, when the CS is encountered later, the corresponding US representation will be automatically activated as well – and with it, the evaluative response generated by the US. In other words, the evaluative response remains a

property of the US, and is only 'extended' to the CS on the condition that it keeps its association to the US. Due to the continued dependency on the US, I referred to this type of EC effect as an 'indirect transfer of valence' in previous work (Sweldens, van Osselaer, & Janiszewski, 2010). Alternatively, this type of learning has been referred to as 'referential learning' (Baeyens et al., 1992).

The second possibility is that over the course of the EC procedure, the repeated CS – US presentations result in the establishment of a mental association between the CS and the evaluative response generated by the US (CS – UR). As a result, when the CS is encountered later, the evaluative response will be activated directly as it has become the property of the CS, without the need for an ongoing (or even original) association to the US itself. Due to its relative independence on intermediating US associations, I referred to this type of EC effect as a 'direct transfer of valence' before (Sweldens et al., 2010). Alternatively, this type of learning has been referred to as 'intrinsic learning' (Baeyens et al., 1992).

Note that this conceptualization of operating principles and operating conditions in EC diverges from the "Operating Principles and Conditions in Evaluation" proposed by Gawronski and Bodenhausen (2014), but is in line with other scholars' ideas with regard to this distinction (Corneille & Stahl, 2018). In their conceptualization, Gawronski and Bodenhausen similarly argue that one should distinguish between what is learned (principles) versus the how and when (conditions), but rather than highlighting the difference between S – S and S – R associations, they propose that people can learn both "associative" and "propositional representations," which can be distinguished based on their operating conditions. I prefer the current conceptualization, as in my humble opinion, in Gawronski and Bodenhausen's model, the operating principles are distinguished based on *how* they are established and activated (i.e., based on operating conditions), rather than on *what* exactly is learned. As a result, the operating principles and conditions are not truly orthogonal and the operating principles can only be distinguished from each other by referring to their operating conditions. For example, associative learning is the "formation of

mental representations on the basis of observed spatiotemporal contiguities,” while propositional learning is the “formation of mental representations on the basis of propositional information that is regarded as valid.” Furthermore, associative learning in this model is assumed to be independent of conscious awareness, while propositional learning is dependent on conscious awareness (Gawronski & Bodenhausen, 2014, pp., p. 193). In sum, the proposed distinctions apply rather to how the mental representations are formed or activated (i.e., operating conditions), rather than how they really differ in their content (i.e., the ‘what’ question that is supposed to govern the principles).

How to Distinguish S – S from S – R Learning?

There is one ‘classic’ way of distinguishing S – S from S – R learning in conditioning effects, and that is by investigating what happens to CS responses when the US valence is changed post-conditioning – the so-called US-revaluation paradigm (Mackintosh, 1983; Rescorla, 1974, 1988). The reasoning is clear-cut. If the change in feelings towards the CS occurred through the S – S route, then any change in the evaluative response towards the US will yield corresponding changes in the evaluative response towards the CS. However, if the conditioning procedure established a direct transfer of valence from the US to the CS (S – R), without the need for mediation by CS-US associations, then later changes in the valence of the US should not affect evaluative responses towards the CS anymore.

In the realm of EC, to my knowledge only five articles (i.e., a mere 1% of the total) have examined the impact of US revaluation, painting a mixed picture. Two of these articles concluded that EC effects are likely exclusively based on S – S associations (Baeyens et al., 1992; Walther, Gawronski, Blank, & Langer, 2009). Three other articles claimed there are at least some circumstances in which EC effects can be S – R in nature (Baeyens, Vanhouche, Crombez, & Eelen, 1998; Gast & Rothermund, 2011; Sweldens et al., 2010).

Establishing more ways in which S – S learning can be distinguished from S – R learning would be one important area for future EC research. One possible directions of development might entail a return to item-based US valence versus US identity measures of contingency memory (Stahl, Unkelbach, & Corneille, 2009; Sweldens et al., 2014). Those measures have (rightly) fallen in disuse for their original purpose – examining whether contingency memory is a necessary condition for EC effects to appear. The reason for this was twofold. First, the identity-based measures did not tap into all possible sources of awareness that could underlie an EC effect (Stahl et al., 2009). Indeed, if the EC effect is based on S – R associations, contingency memory would be revealed in awareness of the CS – US *valence* association, which is not captured by CS – US identity measures. Second, the valence-based measures overestimate contingency memory when people rely on their (conditioned) attitudes in answering the memory question, which interferes with the detection of contingency-unaware EC effects (Hütter, Sweldens, Stahl, Unkelbach, & Klauer, 2012). However, perhaps these measures could be more valuably used to determine whether the EC effect in a particular setup is based rather on S – S than on S – R associations.

If S – S learning underlies EC, the performance on US identity-based measures should closely mirror performance on US valence-based measures. To the extent that the EC effect is based more on S – R associations, performance on US-valence based measures should start dominating performance on US-identity based measures.

I would also like to draw attention to a mediation-based approach developed in Sweldens et al. (2010, experiment 1). In that approach, we measured post-conditioning CS attitudes, US attitudes and item-based US-identity memory. What we found was that in a context where we assumed EC would be based on S – R associations, the EC effect was fully mediated by participants' attitudes towards the USs *that were actually paired with the CS* (while EC was only partially mediated by participants' attitudes towards the USs they *thought* were paired with the CS as indicated in the US-identity memory test). The corollary is that in that context, CS attitudes are fully determined by the US valence as it was transferred during

the learning (conditioning) phase (S – R), rather than by the valence of stimuli participants think have been paired with the CS (S – S) in the post-conditioning memory test. The reverse pattern was observed in contexts where we assumed EC would be based on S – S associations: there the EC effect was fully mediated by participants' attitudes towards the US they *thought* had been paired with the CS (S – S), and only partially mediated by their attitudes towards the USs that had *actually* been paired with the CS.

Other approaches to distinguish S – S versus S – R based EC could be developed. One potential avenue could be based on speeded response-time measures as employed in indirect measures of evaluation. Since the ER becomes directly attached to the CS in S – R learning, while only indirectly in S – S learning, one could hypothesize that classifying a CS as positive or negative (as in an Implicit Association Test; Greenwald, McGhee, & Schwartz, 1998) could be done *faster* in S – R compared with S – S conditions.

On the Need to Put Principles Before Conditions

I believe it is fair to say that *in the vast majority of research we have conducted, we simply do not know whether the generated EC effects are established via the S – S or the S – R route, or even through a mix of both*. I also believe this state of affairs is highly undesirable, since it is theoretically possible that the operating conditions characterizing S – S versus S – R learning might be different from each other. I believe that if we are to truly understand EC effects, we need to start by doubling down our efforts at understanding *what* is learned (principles) *before* we can get more reliable insights into the operating conditions (e.g., features of automaticity) of EC. Again, there are at least two reasons for this.

First, how are we even to interpret conflicting pieces of evidence regarding the operating conditions of EC, if we do not know whether they were obtained on the same operating principles? For example, a researcher might find that in one type of procedure, or among a certain class of participants, or with a certain kind of stimuli, EC can be established by means of subliminal presentations, while it cannot with

other procedures, participants or stimuli (Heycke, Aust, & Stahl, 2017). As long as we have no further information on EC's operating principles in each setting, these findings, while interesting, would remain puzzling pieces of conflicting information. Imagine, however, how much more valuable the same observations would be if they would be paired with insight into whether EC is based on different representational structures (S – S versus S – R). In other words, putting operating principles first might, in principle, allow us to achieve more clarity in the interpretation of research findings centering on operating conditions.

Second, putting the principles first will also allow to *improve* the research we do on operating conditions. Take, for example, the perennial question regarding the necessity of contingency awareness for EC effects to emerge, which has played an important role in nearly 50% of the research efforts devoted to EC (Sweldens et al., 2014). Among the many complications that have plagued this extensive stream of research, a central problem is that researchers are often insufficiently precise regarding the level of awareness they are intending to study (see the Lens Model proposed by Newell & Shanks, 2014; Sweldens, Tuk, & Hütter, 2017). This is obviously related to the discussion of US identity- versus US valence-based measures of awareness in the previous section. The point is that we need clear theorizing regarding the representational structure we assume is underlying EC (S – S or S – R), to properly define our measurement of key operating conditions such as awareness or memory.

How to Create S – S versus S – R associations

So far, I have argued that we should focus on operating principles first, before research on operating conditions can be sensibly conducted. However, at the same time, we will need to establish a few initial operating conditions that will reliably influence whether EC is more likely to be based on S – S or S – R representations. In my doctoral dissertation research, I focused on two procedural conditions that

influence this likelihood (Sweldens, 2009; Sweldens et al., 2010). The first is relatively straightforward, and concerns whether a CS is consistently paired with the *same US* or always with *different USs* of the same valence. The reasoning here is clear-cut, as increasing the number of times a CS will be perceived in combination with the same US, should increase the likelihood that a memory association between those two stimuli (S – S) is developed. Whether S – R associations co-develop at the same time is an open question, but there should little doubt that repeated presentations of the *same CS-US combination* will reliably increase the likelihood that S – S associations are formed and will play a role in the eventual EC effect. Conversely, EC procedures in which CSs are always presented with *different US*, will result in a much smaller likelihood that strong S – S associations will be developed (note that this likelihood is not zero; people can learn an association between two stimuli based on a single presentation if sufficiently attentive or motivated). At the same time, as long as those USs share a particular valence, the possibility that S – R connections between the CS and the evaluative response are formed should remain intact.

The second procedural condition I proposed might be less intuitive: I argued that S – R learning is enhanced when CS and US are perceived *simultaneously*. The reasoning here was based on the idea that affective responses might exist in a diffuse, uninterpreted state for a very short period (Murphy, Monahan, & Zajonc, 1995; Zajonc, 1980) and reinforced by the argument by Jones, Fazio and Olson (2009) that affective responses can be implicitly misattributed under the right circumstances. In their ensuing review article, Jones and colleagues (2010) concurred that “simultaneous presentations are the most crucial methodological key to producing implicit misattribution.” Furthermore, Jones et al. (2009) identified several other procedural characteristics that would enhance the likelihood that implicit misattribution takes place: more eye-movements between CS and US, a smaller relative salience of the US, and less evocative US would all lead to a greater likelihood that affective responses can be implicitly misattributed.

The former might lead one to assume that simultaneous presentations are essential to create S – R associations. However, as argued in the introduction to this article, I believe one should avoid (at least at this stage) such direct leaps from operating principles to operating conditions. I believe implicit misattribution is *one possible way* in which S – R associations could be created, and for it to occur, simultaneous presentations are likely crucial. As corroborating evidence, there are now several studies which have demonstrated with different methodologies the superiority of simultaneous CS – US presentations in generating EC effects in the absence of contingency awareness (Hütter & Sweldens, 2013; Stahl & Heycke, 2016). Yet, I also believe S – R representations can be formed by psychological processes that are very different from implicit misattribution. An article by Gast and Rothermund (2011) already points to one S – R generating process that is likely to be much more deliberate and propositional in nature. Gast and Rothermund found that when people explicitly express their like or dislike of a stimulus combination *during* the conditioning procedure, the resulting EC effect is resistant to post-conditioning US-revaluation and, hence, is S – R in nature. Hence, encouraging people to *express* their evaluative response (ER) during the conditioning procedure, increases the likelihood that they will learn an association to this ER.

More generally, I believe that any manipulation that increases the likelihood that people *attend* to the ER, rather than the US identity itself, will increase the likelihood that S – R representations are established instead of S – S associations. Note that manipulating the heterogeneity of the CS – US pairings is one possible way of doing this. Participants in a *different US pairings condition*, to make sense of the information presented to them (the conditioning procedure), will have difficulty distinguishing consistent CS – US identity pairings, but might instead note that some CS are consistently paired with positively valenced US, whereas others are consistently paired with negatively valenced US. Hence, they might process this *gist* information explicitly, leading to an S – R representation underlying the EC effect in this condition.

On the Link Between Operating Principles and Operating Conditions

I have argued in the previous sections that, at this stage, it would be premature to assume that only one type of psychological process (e.g., implicit misattribution) could generate a particular type of EC representation (e.g., S – R). More generally, given the limited amount of EC research that has so far been conducted on the operating principles, we should treat operating principles and operating conditions as orthogonal. That is, we should not assume *ex ante* that establishing S – S associations will be more (or less) effortful, intentional, controlled or conscious than establishing S – R associations. At this point, I would like to refer to the excellent working paper by Corneille and Stahl (2018) that assesses the evidence in EC for each of these operating conditions, and how these are related to the operating principles. For now, I believe the most promising direction for future research in this field is to theorize about the possible links between operating conditions and operating principles, and develop the experiments, methods and protocols to test those theories. Such theories will likely be smaller in scope than the ‘universal’ theories that have come before. Hopefully, they will also be more verifiable.

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