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## Attitudes as Propositional Representations

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### Abstract

Attitudes are mental representations that help explain why stimuli evoke positive or negative responses. Until recently, attitudes were often thought of as associations in memory. This idea inspired extensive research on evaluative conditioning (EC) and implicit evaluation. However, attitudes can also be seen as propositional representations which, unlike associations, specify relational information and have a truth value. We review research on EC and implicit evaluation that tested the basic tenets of the propositional perspective on attitudes. In line with this perspective, studies show that both phenomena are moderated by relational and truth information. We discuss implications for predicting and influencing seemingly irrational behavior such as excessive alcohol intake and implicit racial bias.

## 22 **Attitudes: A Brief History**

23 From a cognitive perspective, **attitudes** (see Glossary) can be conceptualized as mental  
24 representations that determine how we evaluate stimuli, that is, whether we respond in  
25 positive or negative ways to stimuli in our environment (**evaluation**). As such, attitudes are  
26 assumed to be a crucial driving force behind much of what we do, think, and feel [1]. It is  
27 therefore unsurprising that cognitive researchers spent considerable effort in trying to  
28 understand the nature of attitudinal representations, the way they are acquired, and the  
29 manner in which they influence our evaluative responses [2,3].

30 As mental representations, attitudes are often considered to be **associations** between  
31 representations in memory [4]. This associative perspective on the nature of attitudinal  
32 representations provided a bridge between attitude research and the age-old tradition of  
33 associationistic thinking in philosophy and psychology (see [5] for a historical overview). Via  
34 this bridge, two important ideas entered attitude research: (1) the idea that associations can be  
35 formed on the basis of mere spatio-temporal contiguity and (2) the idea that – if associations  
36 are sufficiently strong - activation can spread **automatically** from one representation to the  
37 other. These ideas can easily be applied within the attitude domain. For instance, after  
38 repeatedly seeing a popular actor in advertisements for a particular brand of coffee, an  
39 association would be formed between, on the one hand, the representation of the coffee brand  
40 and, on the other hand, the representation of the actor or the representation of positive  
41 valence [6]. Once the association is sufficiently strong, seeing that coffee brand in the  
42 supermarket would activate not only the representation of the coffee brand but via spreading  
43 of activation also the positive valence attached to the representation of the actor. This would  
44 then result in positive responses to the coffee brand such as buying coffee of that brand.

45 The associative perspective on attitudes has been highly generative. First, because  
46 activation can spread between representations automatically, the associative perspective

47 highlights that stimulus evaluation can occur automatically, that is, under suboptimal  
48 conditions (e.g., when there is little time to process stimuli). We refer to these automatic  
49 instances of stimulus evaluation as **implicit evaluation**, whereas the term **explicit evaluation**  
50 is used to refer to stimulus evaluation that occurs under optimal conditions. The prediction  
51 that stimulus evaluation can occur automatically (i.e., under suboptimal conditions) has now  
52 been verified empirically in numerous studies (see [7] for a review). This research provided  
53 an important impetus for the development of so-called **implicit measures** such as the  
54 **Evaluative Priming Task** (EPT) [8] and the **Implicit Association Task** (IAT) [9] that are  
55 now used throughout and beyond psychology (see [10] for a review).

56       Second, the idea that associations can be formed as the result of mere spatio-temporal  
57 contiguity inspired a wealth of research on **evaluative conditioning** (EC; see [11] for a  
58 review). In a typical EC study, a neutral stimulus (i.e., the conditional stimulus or CS) and a  
59 valenced stimulus (i.e., the unconditional stimulus or US) are presented together on each trial  
60 (e.g., a novel brand name and a positive image are presented together on a computer screen)  
61 [12]. Afterwards, participants typically respond more positively to CSs that were previously  
62 paired with positive USs compared to CSs that were previously paired with negative USs.  
63 Such changes have been observed both when participants have ample time and opportunity to  
64 determine whether they like the CS (i.e., explicit evaluations) and when stimulus evaluations  
65 are assessed under suboptimal conditions (i.e., implicit evaluations). From an associative  
66 perspective, evaluative responses to the CS change as the result of the formation of  
67 associations via which the presentation of the CS can trigger the positive or negative  
68 responses that were initially triggered by the US (Box 1, Box 2).

### 69 **A Propositional Perspective on Attitudes**

70       Rather than thinking of attitudinal representations as associations, they also can be  
71 conceived of as **propositional representations**. For instance, a positive attitude toward a

72 particular brand of coffee (e.g., Brand X) could be seen as a representation that specifies the  
73 information “Brand X is good” (Figure 1, Key Figure). In contrast to (simple) associative  
74 representations, propositional representations can **specify information about how concepts**  
75 **are related**. For instance, unlike an association between the concepts “I” and “good”,  
76 propositional representations can capture the difference between the belief “I *am* good” and  
77 the belief “I *want to be* good” by specifying information about the nature of the relation (i.e.,  
78 “am” vs. “want to be”) and the roles within each relation (i.e., that it is I who is good or wants  
79 to be good) [13,14]. Moreover, because propositional representations specify relational  
80 information, they also **have a truth value** in a philosophical sense: it is possible to at least  
81 entertain the question whether the information they specify is true or false.

82 Cognitive psychologists have long emphasized the important role of propositional  
83 representations in human behavior and cognition [5,15] and highlighted the limitations of  
84 associative representations in accounting for many aspects of human behavior and cognition  
85 [16,17]. Also in attitude research, there is a large consensus that attitudinal phenomena such  
86 as persuasion require propositional representations, for instance, to encode the meaning of  
87 persuasive arguments and to allow for inferences on the basis of those arguments.  
88 Nevertheless, the idea that attitudinal representations themselves are associative in nature has  
89 remained popular in attitude research, at least in part because of the evidence supporting the  
90 existence of EC and implicit evaluation, two phenomena that were predicted on the basis of  
91 the associative perspective.

92 More recently, however, it has been argued that propositional representations also  
93 mediate seemingly associative phenomena such as EC [18,19] and implicit evaluation [20,21]  
94 (Figure 1, Key Figure). From a propositional perspective, EC (and other types of  
95 conditioning) require(s) the formation of propositional representations about the relation  
96 between the CS and US [18,19,22]. For instance, advertisements in which a popular actor is

97 seen together with a particular brand of coffee might lead to the belief that “Brand X co-  
98 occurs with Actor Y” or that “Actor Y likes Brand X” from which the belief “Brand X is  
99 good” is inferred (see [23]). Even when these inferences are not rational or normatively  
100 correct (e.g., the inference that “Brand X is good” cannot logically be derived from the belief  
101 that “Actor X likes Brand X”), people might under certain conditions (e.g., when there is  
102 little time to reflect or little else to go on) still make such inferences and act upon them.  
103 Furthermore, a propositional perspective allows for implicit evaluation if one assumes that  
104 also under suboptimal conditions, propositional representations can be activated and  
105 inferences can be drawn.

106       The main aim of this paper is to highlight that the propositional perspective on attitudes  
107 provides a viable and useful alternative to the associative perspective on attitudes. The  
108 proposal that also EC and implicit evaluation might be mediated by propositional  
109 representations strengthens the viability of the propositional perspective by undermining the  
110 idea that those phenomena provide unique support for an associative perspective on attitudes.  
111 As such, it questions the need to postulate the existence of attitudes as associations. Even  
112 though it is difficult to exclude the possibility that attitudes as associations do exist (see Box  
113 3), the propositional perspective has been useful in that it inspired a host of studies that, in  
114 our opinion, generated important new insights and would otherwise not have been conducted.  
115 In the next sections, we review a subset of these studies, more specifically those that  
116 examined whether EC and implicit evaluation are sensitive to relational information and truth  
117 information. We focus on EC and implicit evaluation because research on these phenomena  
118 pretty much originated from an associative perspective. Hence, they provide an ideal testing  
119 ground for the propositional perspective on attitudes. The picture that is emerging from this  
120 research highlights the complexities of EC and implicit evaluation and reveals new pathways  
121 for predicting and changing behavior.

## 122 **Evaluative Conditioning**

### 123 *Relational information moderates EC*

124 If EC occurs because beliefs about stimulus valence (e.g., “Brand X is good”) are  
125 inferred from beliefs about the relation between stimuli (e.g., “Brand X co-occurs with Actor  
126 Y”; “Actor Y likes Brand X”), then information about the specific relation between stimuli  
127 could influence beliefs about stimulus valence and thus the strength and direction of EC  
128 effects. In line with this reasoning, EC has been found to depend heavily on information  
129 about how a CS and US are related (see [24,25] for reviews). In one study [26], participants  
130 learned about pharmaceutical products (CSs) that co-occurred with positive and negative  
131 health-related conditions (USs). On each trial, a relational qualifier was presented between  
132 the CS and the US which indicated whether the product *causes* or *prevents* the health-related  
133 condition. When products were said to cause conditions, a standard EC effect emerged (i.e.,  
134 participants liked products that cause positive conditions more than products that cause  
135 negative conditions). However, when products were said to prevent conditions, a reversed EC  
136 effect emerged (i.e., participants liked products that prevent negative conditions more than  
137 products that prevent positive conditions). Similarly, EC was found to be stronger when CSs  
138 were said to be causes of USs rather than mere predictors [27]. Effects like these have been  
139 found not only when EC was assessed using explicit evaluations but also using implicit  
140 evaluations [26,28] and multinomial modelling techniques [29-31].

141 Although the effects of relational information on EC are widespread, their magnitude  
142 depends on several factors. First, effects are usually stronger and found more consistently  
143 when EC is assessed using explicit evaluations than when using implicit evaluations [32-36].  
144 Second, relational information seems to have a stronger effect on EC when it is made salient  
145 [35,37]. In line with this conclusion, relational information has a bigger impact when it is  
146 presented simultaneously with rather than before or after the CS-US pairs [33,38], when it is

147 manipulated within rather than between participants [26,39-41], and when it is provided via  
148 verbal instructions rather than non-verbal cues [26,27,42].

149 *Truth information moderates EC*

150         From a propositional perspective, EC depends less on actual CS-US pairings than on  
151 what people believe to be true about the CS-US pairings. In-line with this idea, participants  
152 who report incorrect beliefs about CS-US pairings (e.g., a stimulus is incorrectly remembered  
153 to be paired with positive rather than negative stimuli) often exhibit reversed EC effects on  
154 implicit and explicit evaluations [43,44]. Furthermore, when misinformation is used to induce  
155 false memories about CS-US pairings, EC effects typically are in line with the false  
156 memories rather than the actual pairings [45].

157         Changes in liking also occur when beliefs are induced via instructions about CS-US  
158 pairings in the absence of actual CS-US pairings. These instructions have been found to  
159 influence not only explicit evaluations but also implicit evaluations [46-51]. In some cases,  
160 instructions influence implicit evaluations even when there is no effect on explicit  
161 evaluations, which argues against the idea that the former effects are necessarily mediated by  
162 the latter [51-53]. CS-US instructions can reverse not only novel but also pre-existing  
163 evaluations [54] and sometimes produce effects that are stronger than those of actual CS-US  
164 pairings [48,55]. Finally, the effects of instructed CS-US pairings and actual CS-US pairings  
165 seem to depend on the same moderators [50,52] (but see [56] for a dissociation), which is to  
166 be expected if both types of effects reflect similar beliefs about CS-US relations.

167         Because propositional representations have a truth value, they also allow for inferential  
168 reasoning (i.e., the construction of new propositional representations on the basis of their  
169 compatibility with the content of other propositional representations). As a result, people who  
170 encode information about the contingency between stimuli (via instructions or actual  
171 pairings) can use this to infer information about stimulus valence [23]. The impact of

172 contingency information on evaluation might, however, depend on the extent to which this  
173 information is considered diagnostic for inferring stimulus valence. In-line with this idea,  
174 research suggests that perceived diagnosticity of stimulus pairings moderates EC [38,57]. For  
175 instance, when participants viewed pairings of social groups with valenced adjectives, they  
176 reported a preference for social groups paired with positive adjectives when these pairings  
177 were described as diagnostic (e.g., the adjectives were said to accurately describe the groups)  
178 but not when the pairings were described as random [49,58]. On the other hand, (instructions  
179 about) CS-US pairings have been shown to influence CS evaluations even when the  
180 assignment of CSs to USs was said to be random and thus uninformative about the CSs [59].

#### 181 *Conclusions*

182 Before the emergence of the propositional perspective on attitudes, EC was considered  
183 to be a “primitive means of changing attitudes” [60, p. 287]. The research that we reviewed  
184 paints a drastically different picture. Based on this evidence, we have argued that EC can be  
185 thought of as a very subtle type of persuasion in which information about the pairing of  
186 stimuli functions as a persuasive argument. For instance, based on the fact that a novel brand  
187 name is presented together with a positive picture, people might sometimes (e.g., when there  
188 is little time or little other information available) infer that the novel brand is probably good.  
189 Although the spatio-temporal pairing might be a weak argument for inferring whether  
190 something is good or bad, unlike many other persuasive arguments (e.g., another person  
191 telling you that the novel product is good), it is a very subtle argument that is unlikely to  
192 evoke reactance (see [61] for more details).

193 This propositional perspective on EC remains, however, controversial. Some of the  
194 findings that support a propositional perspective (e.g., the impact of instructions about CS-US  
195 pairings on stimulus evaluations) could also be accounted for from an associative perspective  
196 (e.g., when allowing instructions about CS-US pairings to strengthen CS-US associations)



197 [4,62]. Other findings seem to challenge a propositional perspective (e.g., the fact that  
198 relational information has a bigger impact on explicit evaluations than on implicit evaluations  
199 and the fact that EC occurs even when the assignment of CSs to USs was said to be random),  
200 although post-hoc explanations of those findings are often possible (e.g., by assuming that  
201 explicit and implicit evaluations are influenced by different propositional representations: see  
202 below and [19]).

### 203 **Implicit Evaluation**

#### 204 *Relational information moderates implicit evaluation*

205 From a propositional perspective, pre-existing propositional representations in memory  
206 can be activated under suboptimal conditions and novel propositional representations can be  
207 formed as the result of inferences that are made under suboptimal conditions. Both processes  
208 can give rise to implicit evaluation [20,21]. For instance, if the belief “Brand X is good” has  
209 been entertained in the past, it is represented in memory and can thus be retrieved from  
210 memory, also under suboptimal conditions. Even when the belief “Brand X is good” has not  
211 been considered in the past, it could be inferred on the spot based on the belief that “Actor Y  
212 likes Brand X”, also when conditions are suboptimal for making inferences. When this  
213 happens, the implicit evaluation of Brand X will be positive, that is, it will evoke positive  
214 responses under suboptimal conditions [20,21,23]. It has also been argued that any  
215 propositional representation that encodes evaluative information (e.g., “Actor Y likes Brand  
216 X”) can produce implicit evaluations (e.g., positive responses to Brand X) even in the  
217 absence of inferences about stimulus valence (e.g., “Brand X is good”) [19, p. 9].

218 Because propositional representations encode relational information, this perspective  
219 predicts that implicit evaluation can depend on relational information. Studies showing that  
220 the nature of the CS-US relation moderates implicit evaluations in the context of EC (see  
221 previous section) already support the conclusion that implicit evaluation is sensitive to

222 relational information.

223         The propositional perspective also gave rise to the development of a new type of  
224 implicit measures. Most of the popular implicit measures were not designed to capture  
225 relational information, probably because their development was inspired by the associative  
226 perspective on attitudes. For example, an IAT designed to measure implicit self-esteem [63]  
227 cannot distinguish between actual self-esteem (I AM good) and ideal self-esteem (I WANT  
228 TO BE good) [13,14]. Recently, several implicit tasks were designed that can capture  
229 relational information, such as the Relational Responding Task (RRT) [64] (see Figure 2 for  
230 an illustration of the difference between the RRT and a classic IAT), the Implicit Relational  
231 Assessment Procedure (IRAP) [65], the Truth Misattribution Procedure (TMP) [66], and the  
232 Propositional Evaluation Paradigm (PEP) [67,68]. The utility of these measures has now been  
233 demonstrated for assessing and predicting depression [13,14,69], sex-related pain [70],  
234 alcohol consumption [71], body dissatisfaction [64,72], and smoking [73].

235 *Truth information moderates implicit evaluation*

236         The idea that implicit evaluation is mediated by propositional representations implies  
237 that even under suboptimal conditions, stimulus evaluation might depend on what people  
238 believe to be true. Studies testing this idea often used impression formation procedures in  
239 which participants first read valenced statements about a target person (e.g., ‘Bob helped an  
240 old lady’) and were then informed about whether those statements were true or false.  
241 Whereas some initial studies found that **validity** information influences explicit but not  
242 implicit evaluations [74,75], more recent (replication) studies using this procedure typically  
243 found strong validity effects also on implicit evaluations [76-78]. Other studies extended  
244 these findings by showing that effects of validity information depend on specific moderators  
245 such as whether participants have sufficient opportunity and motivation to elaborate on the  
246 validity information [35,79-82].

247           Also the **believability** of information moderates implicit evaluation. For instance,  
248 implicit evaluation has been shown to depend on the credibility of the source who provides  
249 information [83]. Likewise, information that discredits earlier information can result in a  
250 marked shift in implicit evaluations [57] provided that participants find the discrediting  
251 information believable [84,85].

252           Finally, the impact of information on implicit evaluation depends not only on whether  
253 the information is considered to be true, but also on the extent to which it considered to be  
254 **diagnostic** [86-88]. For instance, when forming an impression about an unfamiliar person  
255 named Bob, only pieces of information that allow one to draw conclusions about Bob's  
256 character seem to have a robust effect on implicit (and explicit) evaluation [89]. Even a single  
257 piece of highly diagnostic information (e.g., that someone is a child molester) can lead to  
258 dramatic shifts in pre-existing implicit evaluations [86]. Such shifts can occur even for deep-  
259 rooted implicit evaluations of well-known persons [84,90] and can remain stable over long  
260 periods of time [85].

### 261 *Conclusion*

262           Whereas from an associative perspective, implicit evaluation is fundamentally  
263 different from explicit evaluation, the research that we reviewed above reveals striking  
264 parallels between both phenomena. Most crucially in the context of the present paper, just  
265 like explicit evaluation, implicit evaluation is moderated by relational information and truth  
266 information. Although this fits well with the idea that both phenomena are mediated by  
267 propositional representations, a propositional perspective does not imply that implicit and  
268 explicit evaluation are functionally identical. As we noted above (also see Box 2), explicit  
269 evaluation can be thought of as evaluation under optimal conditions (i.e., when there is ample  
270 opportunity and motivation to reflect upon the various pieces of information for intentionally  
271 deciding whether something is good or bad), whereas implicit evaluation can be thought of as

272 evaluation under conditions that are suboptimal in one or more respects (e.g., when someone  
273 has little time or needs to engage in other tasks). From this perspective, both explicit and  
274 implicit evaluation thus depend on the use of propositional information but they can differ  
275 with regard to what information is taken into account and the manner in which it is taken into  
276 account.

277         So when would these differences between explicit and implicit evaluation arise?

278 Generally speaking, to the extent that a particular type of information processing requires  
279 optimal conditions (e.g., effort), its impact on explicit evaluation will be bigger and less error  
280 prone than its impact on implicit evaluation. For instance, because ignoring salient  
281 information is an effortful process, attempts to ignore such information are likely to have a  
282 bigger impact on explicit than on implicit evaluation (i.e., to-be-ignored information is less  
283 likely to influence explicit than implicit evaluation; see [52]). Note that this could also  
284 explain why in EC studies, relational information typically has a bigger impact on explicit  
285 than on implicit evaluation [32-36]. In many cases, the correct use of relational information  
286 (e.g., X stops bad things) requires ignoring co-occurrence information (e.g., X co-occurs with  
287 bad thing), which is more likely to be successful when using explicit rather than implicit  
288 evaluation measures. Nevertheless, from a propositional perspective, we can also envisage  
289 situations in which relational information has a bigger impact on implicit than on explicit  
290 evaluation. Imagine that participants are instructed to dismiss relational information after  
291 having processed this information. Such an instruction is likely to have a bigger impact on  
292 explicit than on implicit evaluation, which implies that the relational information will more  
293 strongly influence implicit than explicit evaluation. This example illustrates the more general  
294 point that, from a propositional perspective, explicit and implicit evaluation cannot be  
295 differentiated in terms of the type of information that they depend on (e.g., relational vs. non-  
296 relational). Likewise, unlike to what is sometimes assumed from an associative perspective

297 [75], they can also not be differentiated in terms of the way in which information has been  
298 acquired (e.g., via instructions or via experiencing events). Hence, provided that the content  
299 of the information is kept constant, also dissociations between explicit and implicit evaluation  
300 should not depend on how information is communicated. From a propositional perspective,  
301 dissociations between explicit and implicit evaluation are always related to differences in  
302 processing conditions.

303         In response to the evidence that implicit evaluation is moderated by relational  
304 information and truth information, some might argue that “real” instances of implicit  
305 evaluation are based on associations that do not encode relational information and do not  
306 have a truth value [4]. This position is difficult to refute without a clear specification of the  
307 criteria for establishing whether instances of evaluation are “truly implicit” (also see Box 2).  
308 We can point out that the moderating impact of relational and truth information has been  
309 demonstrated using all currently available procedures for capturing implicit evaluation (e.g.,  
310 EPT, IAT, multinomial modelling). Rather than engaging in ontological debates about what  
311 “real” implicit evaluation might look like, we see merit in the fact that research that was  
312 inspired by a propositional perspective on attitudes provided important new information  
313 about the nature of stimulus evaluation under suboptimal conditions.

#### 314 **Concluding Remarks**

315         We hope to have shown that the propositional perspective on attitudes provides a  
316 viable and useful alternative to the associative perspective on attitudes. It not only offers a  
317 potential explanation for phenomena like EC and implicit evaluation but also inspired many  
318 new studies on these phenomena. The results of these studies have drastically changed the  
319 way we think about EC and implicit evaluation: rather than being simple phenomena based  
320 on an primitive associative mechanism, EC and implicit evaluation seem to have much in  
321 common with complex phenomena such as persuasion and explicit evaluation. We must

322 acknowledge, however, that there is still no consensus about whether attitudes are best  
323 conceived of as associations or as propositional representations. In hindsight, this lack of  
324 consensus is unsurprising. Also other areas of cognitive psychology (e.g., research on  
325 category learning) have struggled with reaching consensus about the nature of mental  
326 representations (Box 3).

327         Nevertheless, the debate between associative and propositional perspectives on  
328 attitudes has generated new insights in the moderators of phenomena such as EC and implicit  
329 evaluation. This not only adds to the knowledge about these phenomena but also points at  
330 new ways of predicting and influencing how people evaluate stimuli in their environment.  
331 For instance, whereas an associative perspective puts forward extensive training as the  
332 preferred tool to change implicit evaluation [91], a propositional perspective highlights the  
333 potential of belief updating, which can be achieved not only by providing verbal messages  
334 but also by providing non-verbal experiences such as the pairing of stimuli. Future research  
335 should aim to identify the beliefs that drive evaluation under specific (suboptimal) conditions  
336 and to find ways to challenge those beliefs or to empower individuals with ways to counteract  
337 the effects of those beliefs (see Outstanding Questions). For instance, excessive consumption  
338 of alcohol might have its origin not in associations between alcohol and positive concepts but  
339 in beliefs about possible benefits of alcohol consumption that people might not endorse under  
340 optimal conditions but that might still guide behavior under suboptimal conditions (e.g.,  
341 when under stress; [92]). Based on this idea, new types of training are currently being  
342 developed that help excessive drinkers to take into account more adaptive beliefs also under  
343 suboptimal conditions [93]. These ideas can be extended to other topics such as implicit  
344 racial bias (Box 4). In ways like these, the theoretical debate about the nature of attitudinal  
345 representations is already having important practical implications.

346 **Text Boxes**

347 **Box 1. Separating evaluation (effect) from attitude (mental representation)**

348 In psychology, effects refer to the impact of elements in the environment on behavior.  
349 For instance, the negative priming effect refers to the observation that responding to a target  
350 is slowed down when this stimulus was a distractor on a previous trial [94]. From a cognitive  
351 perspective, effects are mediated by mental processes. For instance, negative priming could  
352 be due to the inhibition of the mental representation of a stimulus when it is a distractor [95].  
353 Because there are typically multiple mental process explanations of a particular effect (e.g.,  
354 negative priming effects have been explained also in terms of the retrieval of memory traces:  
355 [96]), it is advisable to clearly distinguish effects from mental processes [97-99].

356 In line with these considerations, we think of stimulus evaluation as an effect (i.e., the  
357 impact of stimuli on evaluative behavior) and attitudes as mental representations that mediate  
358 evaluation (see [2] for more details). Many of the phenomena examined in attitude research  
359 deal with specific moderators of evaluation, such as the conditions under which a stimulus  
360 evokes an evaluative response (as in research on implicit evaluation) or the events that  
361 determine whether a stimulus evokes positive or negative responses (as in research on EC).  
362 Hence, we can define also these phenomena as effects without referring to specific mental  
363 processes. Doing so allows us to consider a range of ideas about the mental processes that  
364 mediate these phenomena and to exploit these ideas in order to make new predictions about  
365 the moderators of stimulus evaluation.

366 Also implicit measures such as scores on the EPT or IAT can be thought of in terms of  
367 stimulus evaluation (see [100] for more details). For instance, a racial IAT [9] provides a  
368 well-controlled setting for registering evaluative responses to Black and White faces under  
369 suboptimal conditions. To the extent that implicit measurement tasks mimic the conditions  
370 under which people evaluate racial stimuli in the real world, responses in those tasks could

371 predict behavior in real-life situations.

372 **Box 2. What is “implicit” stimulus evaluation?**

373 We use the term “implicit evaluation” to refer to situations in which stimuli  
374 automatically evoke evaluative responses. Automaticity refers to various automaticity  
375 features (e.g., unintentional, unaware, efficient, fast) that do not necessarily co-occur (for  
376 detailed discussions, see [101,102]). These automaticity features can be thought of as  
377 conditions that are suboptimal for cognitive processing (e.g., lack of time, lack of resources,  
378 the goal to engage in a process is weak or absent, awareness of the presented stimuli is  
379 reduced or absent; see [103] for a discussion of the variables that promote or hinder cognitive  
380 processing). Hence, implicit evaluation can be defined as stimulus evaluation under  
381 suboptimal conditions. This definition implies that the distinction between implicit and  
382 explicit evaluation is not all-or-none but multifaceted and gradual in nature.

383 In our opinion, this definition overcomes many of the problems associated with other  
384 definitions (see [104,105] for detailed discussions of other definitions and their downsides).  
385 Nevertheless, one possible objection against our definition is that conditions are rarely  
386 optimal in all possible respects, meaning that virtually all instances of evaluation qualify as  
387 implicit in some sense. In our opinion, the term “implicit evaluation” still has merit when  
388 used in relative terms (i.e., some conditions are less optimal than others) and when specifying  
389 in what way conditions are suboptimal (e.g., lack of time or resources). For instance, when  
390 referring to a score on a racial IAT [9] as an instance of implicit evaluation, one could specify  
391 that the score reflects evaluative responses to the skin color of Black and White faces under  
392 conditions that (1) provide relatively little time for responding, (2) allow for relatively little  
393 conscious control over responding, and (3) do not promote the intention to evaluate faces on  
394 the basis of skin color [106]. When conceived of in this way, performance on tasks like the  
395 IAT provides information about the boundary conditions of stimulus evaluation (e.g., whether



396 and when stimuli can be evaluated in the absence of the intention to evaluate [8,107]) and  
397 allow us to examine whether stimuli are evaluated differently under different conditions (e.g.,  
398 whether a Black person is evaluated more positively when there is ample time).

399 Some prefer the term “automatic evaluation” over the term “implicit evaluation”, in  
400 part because “implicit” is often treated as referring only to (un)awareness and evidence  
401 regarding the prevalence of unaware evaluation is mixed [104]. Regardless of one’s  
402 terminological preference, we believe an overarching concept is needed to refer to evaluation  
403 under suboptimal conditions. The fact that conditions can be suboptimal in many different  
404 ways should not stop but encourage us to explore how evaluation varies as a function of the  
405 degree to and way in which processing conditions are suboptimal. To use an analogy, there is  
406 merit in documenting not only the peak performance of a system but also how it performs  
407 under pressure.

### 408 **Box 3. Distinguishing the associative and propositional perspective on attitudes**

409 The debate between associative and propositional perspectives on attitudes has been  
410 muddled by the fact that associations and propositional representations are situated at slightly  
411 different levels of explanation [19,108,109]. Whereas associations are structures in memory  
412 that encode information, propositional representations are defined in terms of the content of  
413 information. More specifically, associations are links via which activation can spread  
414 between nodes ([110], p. 228) whereas propositional representations specify relational  
415 information that has a truth value [17]. At least in principle, (networks of) associations could  
416 qualify as propositional representations if they encode relational information that has a truth  
417 value. One might thus argue that the debate between associative and propositional  
418 perspectives on attitudes is without substance (e.g., [62], p. 5). This conclusion, however,  
419 misses the fact that in attitude research (and other areas of research such as learning research  
420 [111]), proponents of the associative perspective have until now said little on whether or how

421 associative structures could encode relational information that has a truth value, probably  
422 because associations are limited in their capacity to encode such information [17]. This also  
423 explains why a systematic investigation of the role of relational and truth information in  
424 seemingly associative phenomena such as EC and implicit evaluation had to await the  
425 development of the propositional perspective on attitudes.

426         One could also argue that the debate between associative and propositional perspectives  
427 on attitudes is pointless because it is impossible to adjudicate between such broad theoretical  
428 perspectives. Each perspective encompasses a class of models that share assumptions about  
429 the nature of representations but differ in what they postulate about the formation and  
430 retrieval of representations (see [112,113] for similar arguments in other areas of research).  
431 Different (instantiations of) models within the same class often make contradictory  
432 assumptions and predictions, which allows proponents of a particular perspective to switch  
433 between models (or model instantiations) in a post-hoc manner. It is also difficult to  
434 empirically differentiate propositional models from certain models that postulate both  
435 propositional and associative representations. Consider a model in which propositional  
436 beliefs can determine the strength of associations (e.g., [4]). Although many questions can be  
437 raised about such a model (e.g., about how beliefs would influence associations, about when  
438 and which type of representation would influence behavior, about the added value of  
439 allowing associative representations), it would be virtually impossible to empirically  
440 differentiate it from propositional models because any variable that influences beliefs (e.g.,  
441 relational or truth information) could then also influence associations [97,114] (but see [52,  
442 53] for evidence arguing against such a model).

443         Nevertheless, ideas about mental processes, whether broad or specific, can also be seen  
444 as mere tools for generating predictions about the moderators of psychological effects [2].  
445 Even if confirmation or falsification of a specific prediction does not allow one to reject (a

446 class of) models, it does add to our knowledge about the moderators of psychological  
447 phenomena. Adopting a propositional perspective on EC and implicit evaluation has been  
448 highly generative in the latter way. As we discuss in the closing section of our paper, this new  
449 knowledge in turn generates new ideas about how to better predict and influence real-life  
450 behavior [97,99,114].

#### 451 **Box 4. Defusing and advancing debate on implicit racial bias**

452         The concept of implicit racial bias originated from an associative perspective on  
453 attitudes, more specifically the idea that many people, unbeknownst to them, have in memory  
454 associations between representations of Black persons and negative concepts (e.g.,  
455 untrustworthy, dangerous) that bias their behavior toward Black people. It has been argued  
456 that implicit measures such as the racial IAT can reveal these hidden associations and that  
457 training programs must be set up to counteract the effect of these biased associations [115].  
458 Few ideas in modern psychology have instigated such widespread and heated societal debate  
459 as this notion of implicit racial bias [116]. Most importantly, questions have been raised  
460 about whether racial IAT scores reveal unconscious associations [117] and whether these  
461 associations produce behavior that is actually discriminatory [118].

462         In our opinion, much of this debate can be defused by defining implicit racial bias as  
463 an effect [100]. According to this definition, implicit racial bias simply refers to the fact that  
464 (evaluative) behavior can be influenced automatically (i.e., under suboptimal conditions) by  
465 racial features such as skin color (also see Boxes 1 and 2). Accepting this important fact does  
466 not require that one also accepts the idea of hidden associations that direct behavior in  
467 unethical ways beyond our control. It also does not require that one accepts the racial IAT as  
468 a valid index of these hidden associations (see [119], for a similar conclusion based on  
469 different arguments). As such, much of the debate surrounding the literature on implicit racial  
470 bias can be avoided without losing the core insight that behavior can be influenced by racial

471 features automatically (i.e., under suboptimal conditions).

472           Treating implicit racial bias as an effect also allows one to adopt a propositional  
473 perspective on implicit racial bias. From this perspective, when conditions are suboptimal for  
474 cognitive processing, people's behavior might be influenced by beliefs or inferences that they  
475 might not endorse under more optimal conditions (e.g., the belief that Black people are  
476 dangerous). Just like the propositional perspective is starting to inspire research on the  
477 prediction and treatment of alcohol abuse, it points at new opportunities for predicting and  
478 influencing implicit racial bias. More specifically, relational implicit measures such as the  
479 Relational Responding Task [120] could be used to uncover the beliefs that guide racial  
480 behavior under suboptimal conditions. Once identified, techniques for belief revision can be  
481 used to target those beliefs and to help people counteract these beliefs in real-life situations.

482

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774

**Glossary**

775

**Association:** A link between nodes in memory via which activation can spread.

776

**Attitude:** A mental representation that mediates stimulus evaluation, that is, that allows

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stimuli to evoke evaluative responses.

778

**Automatic:** An umbrella concept that can refer to different ways in which conditions are

779

suboptimal for cognitive processing (synonym of implicit).

780

**Believability:** The extent to which information is considered to be true or false.

781

**Diagnosticity:** The extent to which information allows for conclusions.

782

**Evaluation:** The impact of stimuli on evaluative responses.

783

**Evaluative conditioning (EC):** Changes in evaluations that are due to pairings between

784

stimuli.

785

**Evaluative Priming Task:** A task in which participants respond to valenced targets that are

786

preceded by evaluatively congruent or incongruent prime stimuli.

787

**Explicit (attitude) measure:** Scores that reflect evaluation under optimal conditions

788

**Explicit evaluation :** Stimulus evaluation under optimal conditions.

789

**Implicit:** An umbrella concept that can refer to different ways in which conditions are

790

suboptimal for cognitive processing (synonym of automatic). Is used by some to refer only to

791

conditions that are suboptimal in terms of awareness.

792

**Implicit Association Test:** A task in which participant categorize target stimuli using

793

responses also used to categorize attribute (e.g., valenced) stimuli.

794

**Implicit (attitude) measure:** Scores that reflect evaluation under suboptimal conditions

795

**Implicit evaluation:** Stimulus evaluation under suboptimal conditions.

796

**Propositional representation:** A representation that specifies relational information and has

797

a truth value.

798

**Relational information:** Information about how stimuli are related. It allows organisms to

799 respond not only on the basis of individual stimuli but also on the basis of how one stimulus

800 relates to another [121, pp. 159-163, 185-191].

801 **Truth information:** Information about whether other information is true or false.

802 **Validity:** The extent to which information is true or false.

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### **Outstanding questions**

- What beliefs and inferences underlie EC?
- Why do stimulus pairings influence stimulus evaluations even when people are informed that the stimulus pairings do not provide valid information about the valence of the stimuli that are paired?
- What beliefs and inferences underlie implicit evaluation?
- Why are effects of relational information sometimes stronger on explicit evaluations than on implicit evaluations?
- What is the best way to measure beliefs and inferences under suboptimal conditions?
- Can seemingly irrational behavior be influenced using techniques of belief revision?
- Does belief revision involve changes in representations that are already in memory or adding new representations to memory?
- What is the best way to influence beliefs that determine behavior under suboptimal conditions?
- Can associative networks represent relational information (relations and relational roles)?
- Are attitudes also propositional in non-verbal organisms such as non-human animals and human infants?

823

**Highlights**

824

1. Attitude research was for a long time dominated by an associative perspective that views attitudes as associations between representations in memory.

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2. New theories have argued that attitudes constitute propositional representations

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which, in contrast to associations, specify relational information and have a truth

828

value.

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3. Recent research on evaluative conditioning and implicit evaluation, two phenomena

830

that were originally thought to be underpinned by associations, supports the

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propositional perspective on attitudes.

832

4. The propositional perspective on attitudes has inspired new ways to measure, predict,

833

and influence (evaluative) behavior.

834

835 **Figure Legends**

836 **Figure 1. The Associative and Propositional Perspectives on Attitudes.** From an  
837 associative perspective, attitudes are associations that can result for spatio-temporal  
838 contiguity and that allow for automatic spreading of activation. Hence, stimulus evaluation  
839 can emerge from mere spatio-temporal contiguity and can occur automatically. To illustrate,  
840 pairing Brand X with positive pictures in an advertisement can result in an association  
841 between the representation of Brand X and the representation of positive valence. Afterwards,  
842 the presence of Brand X activates its representation in memory, which, via automatic  
843 spreading of activation, activates the representation of positive valence, which in turn leads to  
844 a positive response. From a propositional perspective, attitudes are representations that  
845 encode relational information and have a truth value. Spatio-temporal contiguity can give rise  
846 to stimulus evaluations because it can result in beliefs about stimuli (e.g., “Brand X is paired  
847 with positive stimuli”; “Brand X promotes health”) from which beliefs about stimulus  
848 valence are inferred (e.g., “Brand X is good”). Stimulus evaluation can be automatic because  
849 propositional representations can be activated automatically or inferences can be drawn  
850 automatically. Hence, both evaluative conditioning (EC) and implicit evaluation can be  
851 moderated by relational and truth information.

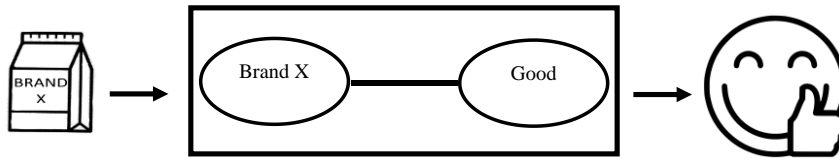
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853 **Figure 2. Non-Relational (IAT) versus Relational Implicit (RRT) Measures.** Illustration  
854 of the difference between the classic IAT measuring self-esteem, an RRT measuring actual  
855 self-esteem, and an RRT measuring ideal self-esteem. In the IAT, participants are asked to  
856 categorize items using two computer keys. In the RRT, participants are asked to respond as if  
857 items are true or false. Scores in all tasks are computed to reflect the difference in response  
858 times in the two types of blocks (block type A, block type

859

**Key Figure**

**Attitudes as associations**



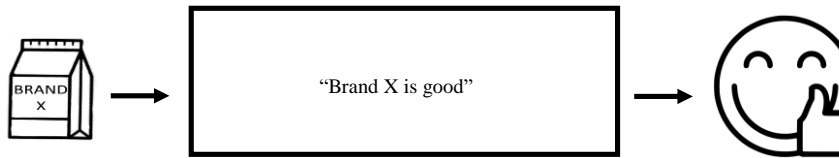
*Key Properties*

Associations can result from spatio-temporal contiguity  
 Associations allow for automatic spreading of activation

*Key Predictions*

Stimulus evaluation can emerge from mere spatio-temporal contiguity  
 Stimulus evaluation can occur automatically

**Attitudes as propositional representations**



*Key Properties*

Propositions encode relations  
 Propositions have a truth value

*Key Predictions*

Relational info moderates EC and implicit evaluation  
 Truth info moderates EC and implicit evaluation

	<b>IAT (self-esteem)</b>	<b>RRT (actual self-esteem)</b>	<b>RRT (ideal self-esteem)</b>												
<b>Block type A</b>															
<b>Instructions:</b>	Categorize the stimuli	Respond as if you are good	Respond as if you want to be good												
<b>Trial example:</b>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">Me or Good</td> <td style="width: 50%;">Not me or Bad</td> </tr> <tr> <td colspan="2">Competent</td> </tr> </table> </div>	Me or Good	Not me or Bad	Competent		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">True</td> <td style="width: 50%;">False</td> </tr> <tr> <td colspan="2">I am competent</td> </tr> </table> </div>	True	False	I am competent		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">True</td> <td style="width: 50%;">False</td> </tr> <tr> <td colspan="2">I want to be competent</td> </tr> </table> </div>	True	False	I want to be competent	
Me or Good	Not me or Bad														
Competent															
True	False														
I am competent															
True	False														
I want to be competent															
<b>Correct response:</b>	Left key	Left key	Left key												
<b>Block type B</b>															
<b>Instructions:</b>	Categorize the stimuli	Respond as if you are not good	Respond as if you do not want to be good												
<b>Trial example:</b>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">Me or Bad</td> <td style="width: 50%;">Not me or Good</td> </tr> <tr> <td colspan="2">Competent</td> </tr> </table> </div>	Me or Bad	Not me or Good	Competent		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">True</td> <td style="width: 50%;">False</td> </tr> <tr> <td colspan="2">I am competent</td> </tr> </table> </div>	True	False	I am competent		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">True</td> <td style="width: 50%;">False</td> </tr> <tr> <td colspan="2">I want to be competent</td> </tr> </table> </div>	True	False	I want to be competent	
Me or Bad	Not me or Good														
Competent															
True	False														
I am competent															
True	False														
I want to be competent															
<b>Correct response:</b>	Right key	Right key	Right key												
<b>Logic of the task:</b>	Faster responses when two mentally associated concepts are mapped onto the same response key	Faster responses in blocks that reflect a belief the participants endorse than in blocks that reflect a belief the participants do not endorse													